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Exploring the Role of Vernacular Architectural Criteria in Providing Urban Resiliency: A Focus on Graduate Architecture Education

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Abstract

Architecture is a platform that embraces environmentally friendly design principles and fosters collaboration. Future architecture students and graduates require new skills to address changing environmental conditions and climate changes. Buildings play a crucial role in environmental conditions, urban development, and the well-being of users. Architects have a responsibility to design safe and resilient buildings for sustainable cities. This study discusses the importance of sustainability awareness in architectural education and shares the results of the graduate course "Sustainability and Materials in Architecture." It emphasizes the role of buildings in addressing natural and urban challenges. The course outcomes showed that sustainable development goals can be achieved by drawing insights from vernacular architecture. Through such curricula, young architects can enhance their ability to design buildings and settlements that withstand natural disasters like earthquakes, floods, and landslides.

Keywords: *Architectural education, sustainable development, urban resilience, sustainable design, vernacular architecture.*

Kentsel Dayanıklılığı Sağlamak için Yöresel Mimarlığı Keşfetmek: Mimarlık Eğitiminde bir Deneme

Öz

Mimarlık, sürdürülebilir tasarım ilkelerini benimseyen ve iş birliği içinde çalışabilen bir platformdur. Gelecekteki mimarlık öğrencileri ve mezunları, değişen çevresel koşullar, iklim değişiklikleriyle yüzleşerek yeni beceri ve perspektiflere ihtiyaç duyacaktır. Binalar, sadece çevresel koşullar ve kentsel gelişim açısından değil, aynı zamanda kullanıcıların sağlık, refah, güvenlik, konfor ve yaşam kalitesi üzerinde de önemli bir rol oynamaktadır. Bunlarla birlikte dayanımlı kentler yaratmaya yönelik güvenli binalar tasarlamak da mimarların sorumluluğundadır. Bu çalışmada, mimarlık eğitiminde sürdürülebilirlik farkındalığının önemi ele alınmış ve "Mimarlıkta Sürdürülebilirlik ve Malzemeler" adlı lisansüstü dersinin sonuçları paylaşılmış, binaların doğal ve kentsel zorluklarla başa çıkma sürecindeki rolü üzerinde durulmuştur. Ders kapsamında hazırlanan öğrenci çalışmalarından elde edilen sonuçlar karşılaştırılarak dersin beklenen kazanımları değerlendirilmiştir. Sonuç olarak sürdürülebilir kalkınma hedeflerine yönelik mimari katkıların yöresel mimarlık kriterlerinden çıkarımlar yapılarak elde edilebileceği belirlenmiştir. Bu tür müfredatlar sayesinde, genç mimarlar deprem, sel, toprak kayması gibi doğal afetlere dayanıklı yapılar ve yerleşimler tasarlamada yetkinliklerini geliştirebilirler.

Anahtar Kelimeler: *Mimarlık eğitimi, sürdürülebilir gelişme, kentsel dayanım, sürdürülebilir tasarım, yöresel mimari.*

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1. Introduction

Architecture is in a favorable position to embrace and uphold fundamental principles of environmentally friendly design while also promoting collaboration and coordination across various fields of study. Over the next decades, architecture students and graduates will encounter a transformed climate during their professional peak. The changing environmental conditions will introduce novel codes and practices, some of which are unforeseeable. As a result, these future professionals will require fresh skills and perspectives to adjust and innovate in conjunction with other subject areas and disciplines. Yet, it cannot be denied that buildings play a substantial role not only in sustainable urban development and changing environmental conditions, but also in impacting the health, well-being, comfort, and quality of life of their occupants or users. Consequently, there is a compelling case for meticulously designing curricula that prioritize tackling these critical challenges.

On the other hand, due to the constraints posed by an undergraduate architecture degree program, many undergraduates might embrace the opportunity to engage in graduate studies focused on sustainability. It is widely agreed that the current four-year undergraduate Bachelor of Architecture programs in Türkiye do not offer sufficient time for a thorough exploration of sustainability and the concepts it involves, such as resiliency, livability, inclusiveness, etc. Consequently, there is a recognized desire, both nationally and internationally, for specialized graduate programs in sustainability and graduate program curricula enriched with sustainability-themed courses which would also open up advanced research prospects for faculty members in this field (NAAB 2009; MIAK 2023; RIBA 2011; UNESCO-UIA 2017).

In a country where a significant portion of its lands are located in a high earthquake risk zone and frequently facing the impacts of the climate crisis, such as flooding caused by heavy rainfall, and especially in a country dealing with rapid and uncontrolled urbanization, the ways of building structures that harmonize with both humans and nature should be strictly taken into consideration. Emekci (2021), presented her findings regarding how sustainability can be applied in this environment-friendly building process and emphasized the significance of architectural design in this context. Considering our country's environmental conditions, the threats it faces and the necessity of taking sustainability criteria into account in the construction process, it is understood that addressing the concepts of sustainable urban development and urban resilience in architectural programs is inevitable.

Being aware of all these, within the scope of this study, the outcomes of the graduate course named "Sustainability and Materials in Architecture" will be shared and evaluated. The fundamental aim of this course is to support students in developing themselves as environmentally conscious architects via assessing the sustainability of architectural designs and their implementation, with a particular focus on the role of building materials in ensuring amid many natural and urban challenges like earthquakes, global warming, and climate change challenges. To achieve this goal, each term, students are expected to engage in discussions related to sustainability, livability, and resilience in architectural and urban terms within different scenarios. They are expected to offer some solution proposals for the given urban and environmental problems.

This study's material consists of the outputs from two different group projects conducted during the 2022-23 fall semester within the graduate course mentioned above. As a starting point, the challenges presented to the students during that specific term and the reasons for selecting them are explained. Subsequently, the conceptual tools the students were briefed, and they should employ in their quest for solutions are described. Finally, the proposed solutions developed by the groups for the selected case studies are presented, followed by a comparative analysis to evaluate the extent to which the students utilized the provided tools and the maturity of their proposed solutions.

In the results and discussion section of the study, a comparative assessment is made between the covered course and student works and a brief discussion about the outcomes are made. The conclusion of the study offers suggestions for how curricula in architecture programs can be developed to increase awareness about essential topics such as sustainable development, urban challenges, natural hazards, and urban resiliency, all of which hold significant positions on the global agenda.

2. Materials and Methods

This study uses proceedings from a graduate course mentioned above held at Bursa Uludag University, Institute of Science and Technology, Architectural Program. During the 2022-23 fall semester, the aim of the course was to develop proposals from an architectural perspective for enhancing the urban resilience capacity of a vulnerable residential area against natural disasters. The selection of the specific vulnerable residential area and the type of natural disaster was left to the students, and they were expected to explain their choices along with the reasons behind them. To guide the students in the process of developing their proposals and to support them in establishing a theoretical background, they were asked to conduct research on the topics of SDG 2030 and vernacular architecture for sustainability. The idea was for them to benefit from the information they gathered during this research to come up with suitable recommendations.

Before proceeding to examine the students' studies, it would be appropriate to briefly explain the reasons for choosing these research topics. The Sustainable Development Goals (SDGs) represent a global initiative aimed at eliminating poverty, safeguarding the environment, and fostering peaceful and prosperous lives for everyone. These goals proposed by UNDP, serve as a framework to identify challenges, and devise appropriate solutions. The objectives and stages of the process are interconnected and should be pursued collectively. The 17 Sustainable Development Goals (SDGs), which encompass ecological, economic, and social aspects of sustainability, have been implemented worldwide.

In Türkiye, these objectives, which are sought to be achieved in various theoretical and applied studies across different fields, are increasingly taken into consideration in academic research and architectural education. In this context, the content, meaning, and examples of implementations have been examined within the scope of the mentioned course. Initially, students were asked to explore the relationship between these objectives and the discipline of architecture. Furthermore, they were expected to develop proposals that were capable of realizing these objectives within the context of the built and natural environment. In this way, it is believed that young architects' awareness of both sustainable development discourse and the multidimensional nature of architecture is enhanced.

On the other hand, vernacular resources and building systems encompass a variety of accessible materials and techniques utilized in traditional buildings worldwide. Familiarizing students with these resources allow them to gain insights into the technical, cultural, and environmental aspects shaping the building practices. Latter & Oliver (1997-2004) state that, having an understanding of how space is utilized in particular cultural settings and recognizing the connection between vernacular architectural traditions and the preservation of regional identity will contribute to promoting sensitive and sustainable development amid the rise of globalization.

The instructors who share the same perspective consistently include references to the vernacular architecture literature in the course. Within the scope of this paper, the semester when the evaluated studies were conducted, the VerSus (Vernacular Heritage Sustainable Architecture) project was mentioned. It is a European research project developed from 2012 to 2014, in the framework of the Culture 2007-2013 programme. VerSus, led by ESG/Escola Superior Gallaecia in Portugal, focuses on the concept of local sustainability.

The primary objective of the project is to explore innovative ways of implementing these findings into modern sustainable architecture, drawing inspiration from fundamental principles of vernacular architecture. By aligning with the defined principles (Figure 2) of the project, various research and studies were analyzed and supplemented with relevant examples. The impact of these principles on sustainable architecture was thoroughly investigated (Versus, 2017).

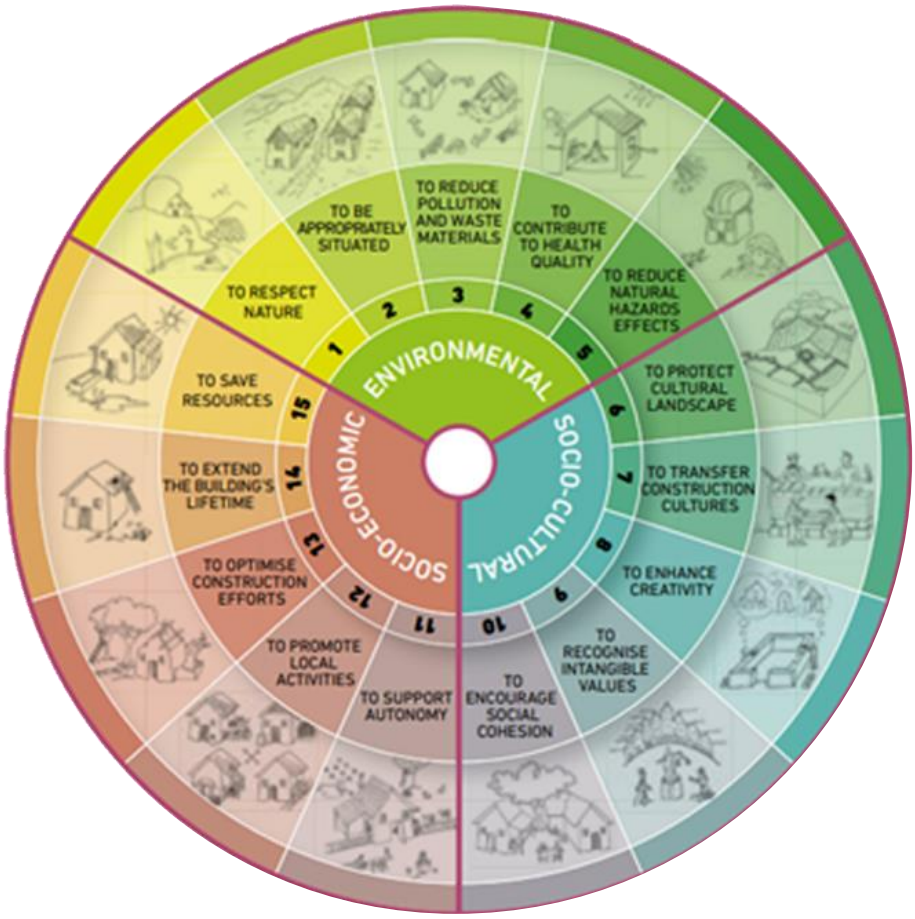


Figure 1. Environmental, socio-cultural, and socio-economic sustainable principles (Correia, Dipasquale & Mecca, 2014)

The VerSus Principles are classified as environmental, socio-cultural, and socio-economic. It consists of a total of 15 principles (Figure 1).

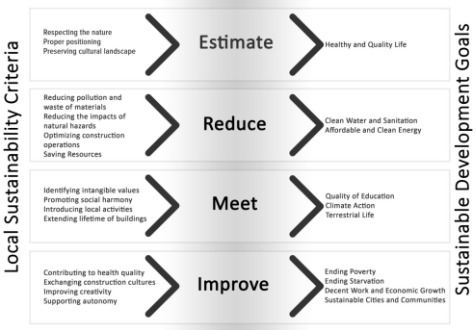
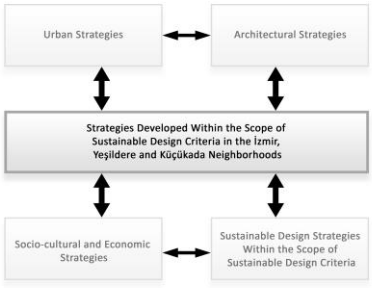
Environmental sustainability principles: Respect for nature, appropriate location, reducing pollution and waste materials, contributing to the quality of health, and reducing the effects of natural hazards.

Socio-cultural sustainable principles: Protecting the cultural landscape, transferring construction cultures, increasing creativity, recognizing spiritual values, and promoting social cohesion.

Socio-economic sustainable principles: Supporting autonomy, supporting local activities, optimizing construction work, prolonging the life of the building, and conserving resources.

Following their research on these two topics, the students identified the vulnerable residential areas in which they carried out their studies and the environmental threats faced by these areas. Both teams decided to focus their studies on informal settlements (squatter areas) located near city centers of big cities in our country. Their reasons for choosing squatter areas are as follows: Nowadays, a considerable number of people, particularly in low- and middle-income countries, reside in urban areas and mostly in informal settlements. Informal settlements refer to substandard housing constructed outside of official regulations and laws. These settlements often lack access to mains water, adequate infrastructure for sanitation, drainage, and utilities. Another characteristic of these areas is that they are located in regions of the city that are vulnerable to natural hazards, such as being close to riverbeds, on steep slopes, or in soft-soil wetlands with low earthquake resistance. Such areas are constantly at risk of natural disasters, including floods, landslides, and earthquakes. Here, we provide a comparative summary and analysis of studies conducted by two distinct groups, Team A and Team B (Table 1).

Table 1. Comparison of the main points in case studies of Team A and Team B

	TEAM A	TEAM B
Case study Area Preference and its visual presentation	Alacahırka Neighborhood in Bursa 	Yeşildere and Küçükada Neighborhoods in İzmir 
The main characteristic of the preferred city	4th most populated city in Turkey. rapid and unplanned urbanization, migration, an industry city	3rd most populated city in Turkey. rapid and unplanned urbanization, migration, a port city
Type of the Residential area	Squatter settlement located near the city center	Squatter settlement located near the city center
Natural Characteristics of the area	Steep terrain, around riverbeds, low earthquake resistance	Steep terrain, around riverbeds, low earthquake resistance
Socio-cultural characteristics of the area	An area experiencing internal migration	An area experiencing internal migration
Natural threads	Earthquake, flood, landslide	Earthquake, flood, landslide
Analysis techniques	Archival, literature, on-site observations	Archival, literature
Synthesis Presentation	SWOT Analysis table, layout, and section graphics of the area	SWOT Analysis table, layout, and section graphics of the area
Theoretical Framework	Estimate, Reduce, Meet, and Improve are four main headings determined through the correlation of SDGs and sustainability criteria included in the VerSus project. The proposals were developed under these headings.	Sustainability criteria included in the Ver Sus project are evaluated and the proposals were developed in four headings, two of which are urban scale and architectural scale, the other two of which are socio-cultural and socio-economic context, and sustainable design context
Theoretical Framework Scheme		

Team A case study, Phase I: Alacahırka Neighborhood, Bursa Current Situation Analysis

Team A chose to undertake research on a squatter settlement in Bursa. Bursa, being the fourth largest city in Turkey in terms of population, has been experiencing rapid industrialization and urbanization for many years, leading to numerous unplanned settlements. Due to this aspect, Bursa, which hosts vulnerable living areas and residents, has been considered a suitable choice for the brief of the course being presented in this study.

The preferred squatter settlement in Bursa is Alacahırka Neighborhood. This settlement is established at the foothills of Uludağ and is bounded by the Cilimboz stream, which is one of the city's two natural

thresholds in the south-north direction. Over time, it has spread towards the Hisar region, which is one of the city's first settlement areas and has developed a close relationship with the city center.

Alacahırka, one of the unplanned settlements that began to surround the outskirts of the city due to the rapid growth of the textile industry and later the automotive industry and increasing migration in Bursa, forms a settlement line on the slopes of Uludağ together with other neighboring squatter neighborhoods.

While evaluating the urban and environmental problems faced by the selected area, the team conducted a comprehensive literature and archive analysis (Çalışkan & Akbulak, 2010; Kaplanoğlu, 2014), as well as held a meeting with the neighborhood headman. Interpreting the data they gathered through a SWOT analysis, the team members prioritized utilizing vernacular architecture features to improve identified weaknesses and mitigate threats, and based on this, they developed recommendations.

In their report, Team A stated that the residential properties in Alacahırka exhibit similarities to the housing construction culture of the migrant residents' places of origin. Although they didn't provide a reference directly confirming this observation, it is believed that some clues were obtained from the meeting with the neighborhood headman and the synthesis of the students' observations based on their knowledge about traditional Turkish house construction and material characteristics.

During the investigation of the natural threats faced by the study area, Team A, who utilized the works of Bursa Metropolitan Municipality and relevant literature, has determined that Alacahırka and its surroundings, like a significant part of Bursa, are at risk in terms of seismicity. Although a major earthquake has not occurred in Bursa in recent years, it is known from historical sources that the city center and its surroundings have experienced devastating earthquakes causing significant destruction and loss of life. Another threat faced by the area is flash floods caused by the increasing heavy rainfall due to climate change in recent years. The proximity of the area to Cilimboz Stream plays a significant role in these flash floods, and the most severe one occurred in October 2010. The neighborhood has faced significant economic, social, and environmental challenges because of this disaster. Unplanned and irregular settlements, the presence of excessive rainwater and surface runoff, the lack of a proper rainwater collection system, the prevalence of extensive concrete surfaces without permeable soil, and the inadequacy of existing rainwater management systems were the reasons. From the report titled "Sustainable Energy and Climate Change Adaptation" prepared by Bursa Metropolitan Municipality, the team learned that the slopes of Uludag have been experiencing severe climatic impacts. Over the past two decades, the air temperature has risen by 0.5 degrees due to factors such as uncontrolled urbanization, reduction in green spaces, expansion of industrial activities, excessive development, increased construction projects, and a growing population due to migration (BUSECAP, 2017).

Team B case study, phase i: Yesildere/ Kucukada Neighborhoods, Izmir Current Situation Analysis

Team B chose to undertake research on a squatter settlement in İzmir. İzmir, being the third largest city in Turkey in terms of population, has been experiencing rapid urbanization for many years, due to its being an important port and coastal city opening to the Aegean Sea, and offering numerous opportunities. Since the early years of the Republic, Izmir has been subjected to the second highest migration rate after Istanbul for many years, resulting in the presence of unplanned and unhealthy residential areas. Due to this aspect, İzmir, which hosts vulnerable living areas and residents, has been considered a suitable choice for the brief of the course being presented in this study.

The preferred squatter settlement in İzmir is spread across two different neighborhoods which are located on each side of Meles Stream. These neighborhoods are Yeşildere and Küçükada, which are only 2 kilometers from the city center. Due to the leather factories and other industrial establishments established around the Meles Stream, Yeşildere became a region where the workers set up their squatters (Kaya, 2020).

The team conducted a comprehensive literature and archive analysis while evaluating the urban and environmental problems faced by the selected area. They could not make interviews since they didn’t

go to İzmir. Interpreting the data they gathered through a SWOT analysis, the team members prioritized utilizing vernacular architecture features to improve identified weaknesses and mitigate threats, and based on this, they developed recommendations in four different scales they determined.

In their report, Team B stated that the geographical structure of Izmir is shaped by the alluvial deposits surrounding the inner gulf, and as a result of the settlement pattern established on slopes, the city experiences natural disasters such as landslides and floods in various parts (Egetelgraf, 2021). In 2014, a considerable number of houses were destroyed in a landslide in case study areas. They used both literature and media news as sources (Versus, 2017; Aslan,1978). On the other hand, the region, being one of the earthquake-prone areas in Izmir, is constantly under the threat of earthquakes. They also put stress on the security problems caused by vacant industrial facilities.

The students have emphasized that the settlements are located in a very steep and unplanned area, and they have also highlighted that the residences do not provide a safe and healthy living environment. However, they have not made any comments related to vernacular architecture. However, unlike Team A, they have not made any comments related to vernacular architecture. It is believed that this is due to the fact that the residential fabric in the case study areas is not characterized by local features of vernacular architecture but rather consists of hastily and inexpensively constructed, unhealthy housing structures.

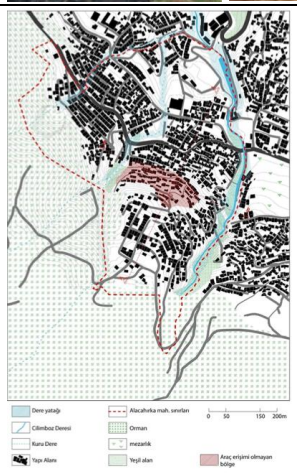
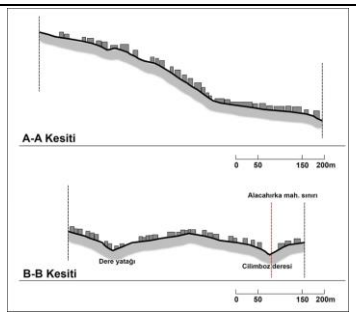
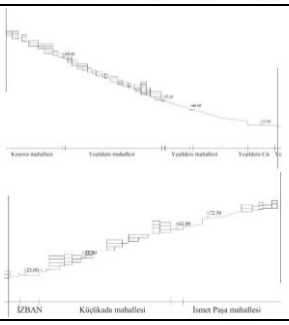
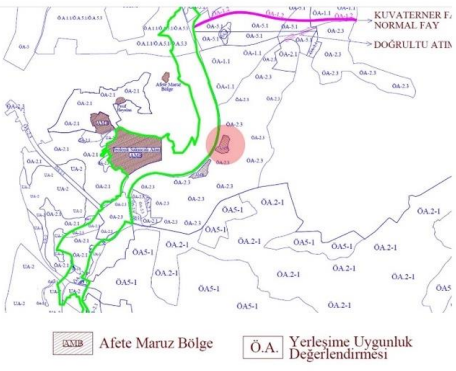
Team A and Team B have supported their findings expressed in their reports with visual representations provided in the table below (Table 2).

Both teams expressed their results with a SWOT Analysis, although it was not an obligation. They presented their proposals under some sub-headings they developed during their literature studies about the vernacular architecture and SDG2030 topics. While Team A presented a parallel evaluation with the VerSus criteria, Team B created a different set of criteria for sustainability and resilience and developed their proposals accordingly. The findings and proposals put forth by both teams are summarized below.

Team A indicated that the unplanned settlement's progress has led to numerous issues, particularly evident in areas with steep slopes. Certain zones lack vehicle access due to narrow streets and stairways, further exacerbating infrastructure shortcomings. The team thought that this lack of vehicle access could potentially hinder emergency responses during disasters such as earthquakes, fires, and floods. They also indicated that the lack of green areas is another important in terms of not only environmental but also social issues (Nevzat, 2013).

The most significant result highlighted by Team B's analyses was that the chosen area is an unhealthy and insecure region. The main reasons for these problems were identified as the major highway dividing the region, abandoned industrial structures, and the Meles Stream acting as a boundary within the area. In addition to the infrastructure inadequacy, the absence of open public spaces was considered a notable deficiency in a region dominated by a strong neighborhood culture.

Table 2. Visual representations of the findings of Team A and Team B

	TEAM A: Alacahırka, Bursa	TEAM B: Yeşildere and Küçükada, İzmir
Photos for introducing the area		
Photos for explaining the threads	 	 
Environmental Analysis Sheets		
		
		

According to the evaluation results of team B, who work in the neighborhoods of İzmir, Yeşildere, and Küçükada, the strongest aspect of these squatter settlements is their proximity to the city center, similar to Alacahırka in Bursa. The weakest aspects are identified as the poor quality of housing and inadequate infrastructure. Additionally, the lack of efforts in rehabilitating the stream and leaving abandoned industrial structures untouched are mentioned as the most significant threats. It is stated

that the greatest opportunity that can be considered for the region is the location of the area along the İZBAN railway line and the main road that connects to Izmir Airport, providing connectivity to the city.

Team A Case study, Phase II: Proposals for Natural Hazard Resiliency of Alacahırka Neighborhood, Bursa

Team A offered their proposals for improving the resiliency of the squatter settlement they examined by using their theoretical framework (see Table 1). They integrated the sustainability criteria indicated in the VerSus Project (see Figure 1) and SDGs (SDG 2022-2023). Their proposals are grouped under four main actions that they indicated as *Estimate, Reduce, Meet, and Improve.* According to them, these are the main actions we can derive from vernacular architecture culture to meet the SDGs. Thus, they developed their proposals to improve the resiliency of their case study area against natural hazards it is threatened by, mostly earthquakes, floods, and landslides. The proposals can be summarized as follows in Table 3.

Table 3. The proposals of the Team A

ESTIMATE	REDUCE	MEET	IMPROVE
Respect nature and rehabilitate the riverside, develop a greenbelt alongside the river	Reduce pollution and waste; optimize the construction Works of the old building stock, improve the social services of the local municipality.	Meet the social needs; provide some meeting points for social activities, enable the residents to work for improving the environment, provide local support for social needs	Improve the houses; shield the buildings from the cold dry wind integrate the walls facing that direction into the slope or establishing buffer areas to obstruct the wind. Opt for a compact and clustered architectural layout, construct thick stone or earthen walls Mitigate the impact of summer heat by installing sun-shielding units on the western front. Design a green-filled patio or courtyard to counter the intensity of summer heat and drought. Incorporate a wind and snow-resistant roof. Implement systems that harness environmental resources
Respect topography and replan the urban texture of the area suitable for the landscape, offering a proper Street layout	Reduce the effects of natural hazards; design public open spaces via rehabilitating unused registered buildings. Demolish the residential buildings with landslide risk. Take control of the water resources	Meet the physical needs; develop the insufficient infrastructure and housing conditions considering local capabilities. Improve the organic texture of the settlement increasing its accessibility	Improve the Construction Culture; identify the buildings that are not resistant to earthquakes and are about to collapse, increase the use of local wooden construction systems for contributing to energy saving, ecological balance, and earthquake resistance
Respect the cultural landscape and let equal access for the residents for self-gardening	Save the resources; take control of the Cilimboz stream against floods, reinforce the buildings against earthquakes, use solar panels for heating and hot water, provide natural ventilation	Meet the economic needs; maintenance/ rehabilitation of the houses with local knowledge and local materials, improve the settlements shopping alternatives in walking distance, provide some local job opportunities	Improve the autonomy; utilize local opportunities to reduce socio-economic inequality, support local production, encourage the use of local resources, create employment in the region, establish collective production centers

Team B Case study, Phase II: Proposals for Natural Hazard Resiliency of Yesildere/ Kucukada Neighborhoods, Izmir

Team B offered their proposals for improving the resiliency of the squatter settlement they examined by using their theoretical framework (see Table 1). They used the VerSus Principles, which are classified as environmental, socio-cultural, and socio-economic (see Figure 1). They have approached the environmental context in two different scales, architectural and urban. They have considered the socio-economic and socio-cultural context together and have also developed recommendations for sustainable architectural design. They attempted to relate this final context to the SDGs. However, it can be said that Team B's conceptual framework is not fully matured at this point. Their proposals are grouped under four main sub-titles as *Urban Strategies, Architectural Strategies, Socio-cultural and Economic Strategies, and Sustainable Design Strategies.* Their objective is to improve the resilience of their case study area against natural hazards it is threatened by, mostly earthquakes, flood, and landslides via their strategy proposals. The proposals can be summarized as follows in Table 4.

Table 4 The proposals of the Team B

URBAN STRATEGIES	ARCHITECTURAL STRATEGIES	SOCIO-CULTURAL AND ECONOMIC STRATEGIES	SUSTAINABLE DESIGN STRATEGIES
- Demolish the already low-quality housing in the vicinity and relocate them away from the stream, -construct new houses in areas least affected by landslides and floods, - rehabilitate the stream and organize its surroundings as a green area by afforestation, -provide adaptive re-use of abandoned industrial structures for social and cultural activities.	- construct new houses using local materials and traditional building systems, -incorporate measures for minimal resource use in their designs, - ensure high earthquake resistance in the design and construction of the houses, - provide natural ventilation and lighting, - implement climate control using local methods, - design the silhouette of the Yeşildere avenue considering the strategic location of it, which passes through the settlement and connects the Airport to the city center, along with its impact on the city's image.	-rehabilitate the stream and organize its surroundings as an open public space, thus, it will not only become an attraction point for this area but also for the entire city and the residents, - organize activities in this public space to bring the locals together and foster a sense of community, - Transforme the abandoned industrial facilities in the area into cultural centers to encourage the public to engage in social and cultural activities, -plan walking and cycling routes within the area to enhance its accessibility and recreational opportunities.	-minimize environmental impact through the use of renewable energy sources, especially solar panels for heating and hot water - to develop various canal systems and collection ponds to utilize the slope of the terrain for rainwater storage. The collected water will be treated and planned to meet various irrigation needs in residential areas.

3. Findings and Discussion

A comparative analysis of the student work carried out within the scope of the graduate course "Sustainability and Materials in Architecture" 2022-23 Autumn Semester, which has content developed to raise awareness of sustainability, is presented in the upper section. Both evaluated studies are group work products. One of the groups (Team B) consists of students who started working immediately after four years of undergraduate architectural education and continued to work during their graduate studies. The other group (Team A) consists of students who have not started working yet. When the works of both groups are analyzed, there are two distinct differences. One of them is that Team A is more successful in creating the theoretical framework of their studies, and the second is that Team B is more successful in developing proposals.

Team A, by better analyzing the theoretical sources they examined within the scope of the course, successfully developed the theoretical framework they were expected to develop to be used in the report they prepared. In this framework, the concepts in the two main sources expected to be used were analyzed and integrated with sufficient maturity. As a result of this integration, the group identified four different analysis components, analyzed the case study area under these headings and presented their recommendations for the area to be more resilient against natural disasters by categorizing them under these headings. This success of Team A was attributed to the fact that the students started their master's degree right after their undergraduate education and that they adapted more easily to the theory-oriented structure of the master's degree while the knowledge and skills they acquired in the theoretical part of their undergraduate education were still fresh.

Although Team B did not develop a theoretical framework of sufficient maturity to be used in the analysis of their chosen case study, they conducted and presented their analyses using techniques similar to those of Team A. Although Team B examined the concepts in the two main sources they were expected to utilize in this study, they were not mature enough at this stage because they could not integrate them, synthesize them and develop a unique conceptual framework. On the other hand, the suggestions they developed for the sample area to be more resilient against natural disasters were developed by taking into consideration the location and environmental context of the sample area within the city and its unique characteristics. This careful approach of Team B in developing unique proposals was found successful. The fact that Team B members are involved in professional practice is thought to have increased their awareness of professional dynamics. Regardless of the scale, it is inevitable that studies conducted by sufficiently internalizing the site context will achieve more original and successful results.

Team A's recommendations draw a more general framework that can be evaluated in any squatter settlement. Team B's proposals offer more original solutions by taking into account the characteristics of the case study area they have chosen. However, both teams failed to demonstrate the expected maturity in their ability to use vernacular architecture criteria, which was expected of them within the scope of the study, to produce solutions to improve and make squatter settlements more resilient, which continue to show some similar characteristics today.

These outcomes highlight the need to provide students in a particular program with a variety of courses that promote sustainability awareness and can mutually enhance each other. In this way, students will have the opportunity to work on the subject for a longer period of time and evaluate different perspectives and develop their analysis and synthesis skills. One group of these courses should be related to vernacular architecture, while the other group should question the relationships between sustainable development and the discipline of architecture. As Ozorhon & Ozorhon (2020) point out, it is crucial to emphasize the significance of vernacular architecture in architectural education to foster awareness among students, as it plays a pivotal role in shaping future architectural environments. The researchers indicate that, contemporary and future architecture draws its foundation from historical origins and past knowledge. The evolution of the architectural profession, which has evolved alongside human development, is exemplified by its successful achievements. The primary challenge lies in comprehending the approaches and principles that have emerged through years of experience and integrating them into the present while aligning them with the realities of the current century (Ozorhon & Ozorhon, 2020). Correlating the principles of vernacular architecture with

the facts of the century may be possible via understanding the requirements of sustainable development. In envisioning a sustainable future, higher education plays a distinct role in fostering awareness of sustainability and simultaneously equipping future professionals for it. Sustainability encompasses matters that are central to architecture, and therefore, imparting sustainability awareness in architectural education is an extremely important necessity. Çalıkuşu (2019), in her detailed study about the sustainability awareness in architectural education, found out that sustainability should be more involved in architectural education both in undergraduate and graduate programs.

4. Conclusion and Suggestions

The need for raising sustainability awareness in architectural education is accepted by architecture schools in different parts of the world (Brogden, 2020; Salama, 2005; Stupar et al., 2018; Han & Kwon, 2019; Nyka, 2019) and by institutions evaluating and accrediting architectural education (NAAB, 2009; MIAK, 2023; RIBA, 2011; UNESCO-UIA, 2017). There are different opinions on whether the courses should be within the scope of undergraduate or graduate programs (Venkataraman, 2009; Altomonte et al., 2014; Lulo et al., 2012).

In this study, a course given within the scope of a graduate program and its outcomes are discussed. Sustainability awareness is addressed in the context of SDGs and its expansions, especially with the emphasis on "Natural hazard Resilience". Sustainable design is discussed in the context of vernacular architecture, which is at the core of architectural design and should continue to be. When the student works were evaluated, it was seen that a perspective that takes inspiration from vernacular architecture in the development of proposals to provide natural hazard resilience and associates them with sustainable development goals, which have a great place and importance in today's architectural discourse, encourages students to think critically in both subject areas and can support the development of analysis and synthesis skills.

Especially in a country like Türkiye, a large part of which is a first-degree earthquake zone, which faces risks such as landslides due to its rugged geography, and which is under the threat of disasters caused by unexpected climatic changes caused by the climate crisis as in many parts of the world, all relevant disciplines need to update and improve their education on sustainable development and its requirements. If the studies on developing resilient settlements against disasters such as earthquakes, floods, and landslides, which are discussed in this study, are addressed with sufficient weight within the discipline of architecture, more conscious architects can be trained.

In the study, inferences were made by evaluating the final products of only one course in one academic semester. In future studies, the final products of this course in different academic semesters can be evaluated, as well as the final products of different courses on the subject can be evaluated comparatively. In this way, steps can be taken to develop effective curricula to increase sustainability awareness in architectural education and to receive architectural contributions towards achieving the SDGs. With the gains to be obtained from these curricula, young architects will also improve themselves in designing structures and settlements that are resistant to earthquakes, floods, landslides, and similar natural disasters.

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All authors contributed equally to the article There is no conflict of interest.

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A Software and Hardware Supported System Suggestion for Obtaining Potable Water from Air with Solar Energy

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Abstract

Fresh water is one of the most important resources consumed. However, droughts due to global climate change, rapid population growth increasing construction sector activities and the lack of importance to protect freshwater resources during these activities increase the problems related to water. This study aims to raise awareness among people about the protection of freshwater resources. For this purpose, a software and hardware-supported system has been developed to obtain fresh water by cooling and condensing the humidity in the air with the help of thermoelectric modules and fans. The developed system can automatically become active or passive according to the weather conditions and uses less energy than its counterparts. The system, which can also operate independently of the grid with solar energy, can also purify the water obtained by producing ozone gas with the effect of static electricity on the surface where water droplets form and make it drinkable.

***Keywords**: Water cycle, potable water, condensation, dew point, solar energy, thermoelectric cooling.*

Güneş Enerjisiyle Havadan İçilebilir Su Elde Edebilen Yazılım ve Donanım Destekli bir Sistem Önerisi

Öz

Tatlı su, Yeryüzünde tüketilen kaynaklar arasında en önemlilerinden bir tanesidir. Ancak küresel iklim değişikliğine bağlı kuraklıklar, hızlı nüfus artışı ve artan inşaat sektörü faaliyetleri ve bu faaliyetler sırasında tatlı su kaynaklarının korunmasına gereken önemin verilmemesi su ile ilgili sorunları giderek arttırmaktadır. Bu çalışma ile insanların tatlı su kaynaklarının korunmasına yönelik bilinçlendirilmesi amaçlanmıştır. Bu amaç doğrultusunda, havadaki nemi termoelektrik modül ve fanlar yardımıyla soğutup yoğuşturarak tatlı su elde edebilen yazılım ve donanım destekli bir sistem geliştirilmiştir. Geliştirilen sistem, hava şartlarına göre otomatik olarak aktif veya pasif hale geçebilmekte ve emsallerinden daha az enerji kullanmaktadır. Güneş enerjisi ile şebekeden bağımsız olarak da çalışabilen sistem, aynı zamanda su damlacıklarının oluştuğu yüzeyde statik elektrik etkisiyle ozon gazı üreterek elde edilen suyu arıtmakta ve içilebilir hale getirebilmektedir.

***Anahtar kelimeler:** Su döngüsü, içilebilir su, yoğuşma, çiğ noktası, güneş enerjisi, termoelektrik soğutma.*

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1. Introduction

The World Commission on Environment and Development defines sustainability as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The sustainability–architecture relationship rests on three basic pillars. These are minimizing energy consumption, minimizing negative environmental effects, and efficient use of resources. The concept of sustainable architecture, shortly, means creating healthy living environments that aim to minimize negative environmental effects, and energy and resource consumption. Water, which is at the centre of sustainable development, is the most important among natural resources.

1.1. Defining the Problem

The construction Sector in Turkey started with railway lines and large water projects in the first years of the Republic. Later, with the subsequent public sub-investments, urban transformation projects, the increase in the rate of urbanization with the increase in population, and the increase in the infrastructure needs related to this, the construction activities gradually gained speed and became one of the basic sectors. However, the damage to the environment, the consumption of natural resources, and the deterioration of ecosystems during these construction activities have become a threat to future generations. Two of the most important resources consumed during the activities of the construction sector are energy and water. Although the construction sector is not in the first place in the ranking of the sectors that consume the most water, there is an increase in water use with the increasing rates of housing and urbanization (Pamuk & Kuruoğlu, 2016).

When viewed from space, our Earth may appear as a water planet, with ¾ of it being covered with seas and oceans. However, the distribution of water on the Earth's surface is uneven. Only 3% of the world's water is freshwater, a large amount of which is frozen in the polar ice cap. Unfortunately, due to global warming, the glaciers melt into the sea day by day. Fresh water in lakes and rivers constitutes less than 1% of the total water in the world. Most of the underground waters are located very deep from the surface as brackish water and those close to the surface are constantly drawn as drinking and utility water (Shiklomanov, 2009).

Although it is true that the freshwater used returns with a water cycle consisting of phenomena such as absorption, infiltration, evaporation, and precipitation, rapid industrialization and the spread of urbanization to the basins where water cycles take place causes this cycle to be disrupted. Especially, horizontal settlements located on permeable soils make it difficult for rainwater to percolate and reach groundwater (Booth, 1991).

Following the international agreements on watershed protection, Turkey has initiated fundamental modifications in the watershed management and planning process. However, sustainable management of water resources involves various economic, social, and ecological dimensions, and it is not a straightforward process (Pouya et al., 2020).

Freshwater resources are distributed unevenly on the earth's surface in proportion to population density. Just by looking at the precipitation maps, it can be understood how unequal the distribution of water on Earth is. The water use demands that have arisen with the increasing urbanization have reached the amounts that the water resource capacity in the areas where the city plan is made cannot handle. Today, approximately 1/5 of the world's population lives in areas with high water sensitivity and this ratio is expected to increase further in the coming years (Heidari et al., 2021).

Considering the increasing needs, it can be said that water resources are regionally finite resources according to place and time. All signs point to a growing shortage of clean and fresh water in many parts of the world in the future. In 2022, more than 4 trillion m3 of fresh water was consumed worldwide. It is expected that the world population will reach 10 billion by 2050, and the amount of water consumed will increase by 50% (Wada et al., 2013).

1.2. Literature Review

Water, which can be found in the form of solid, liquid, or water vapor on Earth, is in a constant state of change. Water interacts with the weather as it passes from one state to another with the change of environmental conditions. The atmosphere contains a large amount of moisture in the form of water vapor. The dew point is the temperature at which air must be cooled to become saturated with water vapor. Fog and mist form when the water vapor concentration in the atmosphere reaches saturation. These airborne structures are visible aerosols of tiny water droplets suspended in the air near the earth's surface on cold nights. When the air gets colder, the water vapor in it condenses to form water droplets or dew. This situation occurs especially as a result of the contact of air layers close to the ground level with cold surfaces.

Various organisms in nature have special adaptations to capture dew and meet their water needs. These include cactus, grass, moss, shrubs, desert beetles, lizards, rattlesnakes, and spider webs. Collecting fog water is a simple and sustainable way to obtain drinking water for agriculture or humans and animals. It is known that the techniques of condensing water in the air have been used by humans since ancient times. The Incas were able to sustain their civilization by collecting dew on the rainline and then changing it into cisterns for distribution to their living spaces. One of the first methods used to obtain water from the atmosphere is the passive mesh-based fog or dew collection method. It is known that this method has been used in Central and South America and South Africa since the middle of the 20th century, and in Europe and Asia since the beginning of the 21st century (Bhushan, 2020).

“Warka Water”, one of the new projects using a passive mesh-based fog or dew collection method, was developed in 2014 by the Italians for the mountainous regions of Ethiopia. The tower-type structure, consisting of a bamboo mesh frame, obtains water by condensing atmospheric water vapor on the surface of the mesh (Verbrugghe & Khan, 2023).

A system that produces drinking water by collecting water vapor from the atmosphere using metal-organic cages composed of metals and organic molecules and has a very large surface area with hollow structures has also been developed at the University of California, Berkeley. Prof. Dr. Omar Yaghi and his team, during their tests in the Mojave Desert with the prototype device they produced in 2019 managed to obtain 0.2 litres of water in a day with 1 kg of the metal-organic cage at an air temperature of over 25^{o}C and a humidity of around 7% (Yang, Clark & Yaghi, 2021).

Today, it is possible to obtain water almost anywhere in the world from atmospheric water vapor constituting a large part of greenhouse gases with water generators. Atmospheric water generators are clean and safe water sources in arid or unsanitary areas. Water generators draw in moist air and transform it into water by cooling it in a condensation chamber. However, electrical energy is used in such systems producing water from the air. Most modern plants, especially those designed to produce large volumes of water, are powered by compressors and connected to the electricity grid, which replaces one problem with another (Maleki, Eslamian & Hamouda, 2021).

In general, thermoelectric chillers work best in small spaces where there is not enough room for a compressor-based chiller. In a small-sized chiller, these systems are highly efficient and consume less energy than a compressor-based unit of the same size which is also portable.

Thermoelectric coolers work with the thermoelectric effect which is also called the Peltier effect. With the thermoelectric effect, the temperature difference and the electrical potential difference can be converted into each other. When thermoelectric modules are connected to a direct current generator, a temperature difference begins to occur between their faces. If there is a temperature difference between the faces with any heat exchange, this time it works like a direct current generator. The main application area of the Peltier effect is cooling. However, it can also be used for heating or temperature control (Balkrishan et al., 2016).

Some of the studies carried out to obtain water from the atmosphere by using a thermoelectric cooler are as follows:

Avhad et al., (2021) and their team simulated the thermoelectric cooler device using TEC-12706 Peltier modules they developed at Savitribai Phule Pune University in India using Ansys Fluent software by entering the data of four cities in India. In the simulation, the largest amount of water, with 44 mL/hr, was obtained from the city of Mumbai with an average relative humidity of 87%, followed by the cities of Bangalore, Agra, and Cherrapunji (Avhad et al., 2021).

Alenezi et al., (2023) and their team obtained 405 mL of water in 8 hours under 40°C temperature and 85% relative humidity in the climate chamber with a prototype device with a 24 W thermoelectric cooler. In the experiments they carried out in the open air, the amount of water they obtained varied according to the relative humidity. While the device was able to produce 22.5 mL/hr of water at 52% RH, it produced 42.5 mL/hr at 94% RH. (Alenezi et al., 2023).

Eslami et al. (2018) and team produced 26 mL of water in 1 hour from air at 75% relative humidity and 45°C with a 20 W thermoelectric cooler device in their experimental study in Iran (Eslami et al., 2018).

Liu et al. (2017) and his team, in their experimental study in China, conducted experiments at different relative humidity levels with a 52 W thermoelectric cooler device. The device they developed produced 11 mL/hour of water in 68% relative humidity air and 25 mL/hour in 93% relative humidity air (Liu et al., 2017).

Kadhim (2020) and his team conducted experiments in different relative humidity levels with a 70 W thermoelectric cooler device in their experimental study in Iraq. The device they developed produced 10 mL/hour of water in 65% relative humidity and 20 mL/hour in 75% relative humidity air (Kadhim, Abbas & Kadhim, 2020).

In a study conducted in Turkey by Özcan et al. (2022), a smart irrigation system with a 240 W thermoelectric cooler charged with solar energy was developed and tested to irrigate houseplants or hobby gardens by utilizing the water vapor in the atmosphere (Özcan et al., 2022).

When we look at the studies carried out to obtain water from the atmosphere, it is seen that the amount of water obtained varies significantly according to the air temperature and relative humidity. In addition, the power drawn by the system and the used cooler and fan capacities also affect the results. However, it can be said that the amount of water obtained in experimental studies with thermoelectric coolers in the literature is generally below 100 mL/hour.

Among the systems developed and patented for obtaining water from the atmosphere, the studies in the US 6,945,063 B2 patent document, the US 7,337,615 B2 patent document, and the US 6,868,690 B2 patent document can be counted.

The device, which is included in the US 6,945,063 B2 patent document, produces water by condensing metal surfaces with the photoelectric effect and works with the principle of obtaining water from the relative humidity in the air by using only the Peltier effect (Max, 2005). Although the basis of the device in the US 7,337,615 B2 patent document which produces drinking water with the thermoelectric effect is similar, this device is different in shape (Reidy, 2008). The device in the US 6,868,690 B2 patent document, which can obtain drinking water through gas cooling obtains water through gaseous systems used in refrigerators (Faqih, 2005).

2. Materials and Methods

The literature can be consulted for the precautionary measures to be taken or to be taken in the face of the problem mentioned above. In this study, a portable device was designed and tested to help meet the drinking water needs of an ordinary house. The feature that distinguishes this developed device from systems that produce water from atmospheric humidity by working with active energy 24 hours a day is that it can automatically become active or passive with software support, which makes energy optimization. The device will first condense the gaseous water in the atmosphere, then purify it to make it usable for drinking purposes. Thus, a step is taken to contribute to the protection of freshwater resources, use renewable energy, and raise awareness about protecting natural resources.

The method of this paper is based on experimental work and theoretical analysis. In the study, to

contribute to the protection of freshwater resources, a system producing water from atmospheric humidity supported by software and hardware consisting of mechanical and electronic parts has been developed and the usability and performance of the system has been demonstrated by experiments and theoretical calculations. With the developed system, the water vapor in the air is cooled to the dew point on the surface of the thermoelectric cooler module and condensed by controlling it with the energy-optimizing "C" software.

2.1. Experimental Design

The system developed and tested in this study obtains water from the humidity of the air by performing dew point analysis with the psychrometric diagram algorithm. The dew point temperature can be calculated using the psychrometric diagram, which is a graph of the thermodynamic properties of moist air used in energy physics calculations (Figure 1).

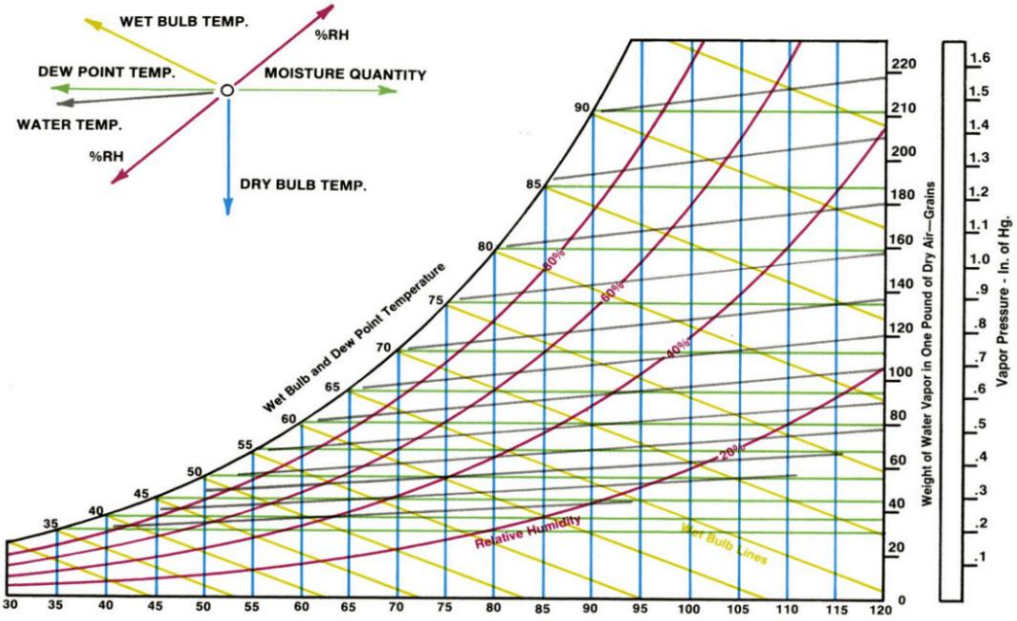

Figure 1. Psychrometric chart (Parameter Generation & Control, 2019)

The amount of moisture the air can absorb varies depending on the temperature. For example, a 1 m^3 air mass is capable of carrying about 2 g of moisture at –10°C while it can carry about 80 g of moisture when the temperature rises to 50° C (Figure 2).

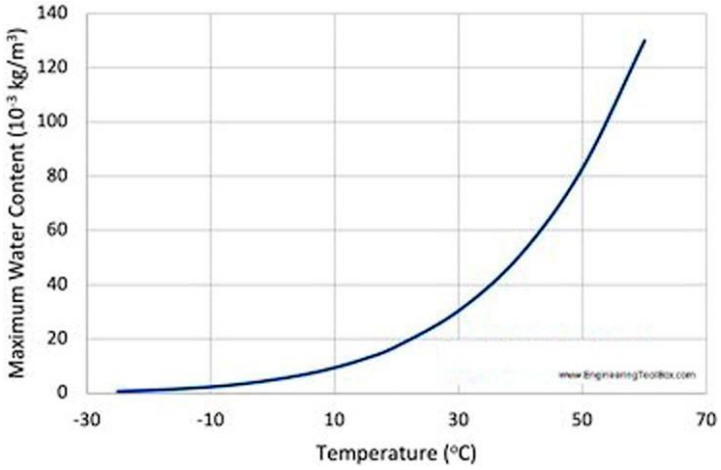

Figure 2. Maximum moisture carrying capacity vs. temperature (The Engineering Tool Box, 2023)

Some terms related to air pressure, temperature and humidity are explained below;

Absolute humidity	The mass of water vapor in a unit volume of air.
Specific humidity	The mass of water vapor contained in the air per unit mass.
Saturation point	1 m^3 of air can hold at a certain temperature.
Relative humidity	The ratio indicates what percentage of the maximum amount of moisture that the air *(at a certain temperature)* can carry.
Dew point	The temperature at which moisture in the air begins to condense depends on air pressure and humidity.
Dry bulb temperature	The temperature of the air at any degree of humidity.
wet bulb temperature	The lowest temperature that can be achieved by evaporative cooling in an area of the air.
Enthalpy	The total internal energy of a thermodynamic system depends on pressure and temperature.

The difference between absolute humidity and maximum humidity is called the humidity gap of the air. When the absolute humidity reaches the maximum humidity, the relative humidity becomes 100% and the air reaches the saturation point. There is an inverse relationship between temperature and relative humidity. When the air temperature increases, the relative humidity decreases and the air moves away from the saturation point, even if the absolute humidity does not change. Relative humidity is low in deserts and inland. The relative humidity is high on the sea, in the equatorial region, at the poles.

Weather data in the atmosphere constantly changes according to the hours. Therefore, in systems that produce water from atmospheric humidity by working with active energy for 24 hours, it is necessary to make heating-cooling adjustments according to changing weather conditions or to make it passive so that the system does not run in vain when it cannot produce water, and there are difficulties in doing this manually.

In this study, electronic hardware and software are integrated into the system to eliminate these difficulties and to make the operation of the mechanical part more efficient. The added software enables the system to operate economically by analysing the instantaneous temperature and humidity values of the environment according to the psychrometric diagram.

2.2. Experimental Setup

The system used in the experiment; consists of mechanical and electronic parts. The mechanical part consists of a thermoelectric heat exchange unit and an air circulation tower. The air circulation tower was printed with a 3D printer. In this part, ambient air is sent to the thermoelectric cooler by means of fans. When the dew point is reached under the current ambient conditions, the thermoelectric cooler converts the water vapor molecules in contact with the metal surface into water droplets.

In the electronic control part of the system, Xiaomi (II) temperature and humidity sensor, ESP32, and a tablet are used. ESP32 is a low-cost and low-power microcontroller. In this study, software with "C" language is loaded on ESP32, and the operation of thermoelectric modules is controlled through this software. Temperature and humidity values, cooling, heating, and waiting times can be observed via the Phyton software installed on the tablet. At the same time, the system can be turned on or off via the tablet.

ESP32 connects to the temperature and humidity sensor via bluetooth and to the tablet via wi-fi. When the system is turned on, ESP32 starts to communicate continuously with the temperature and humidity sensor via bluetooth and at the same time sends the data to the tablet (Figure 3).

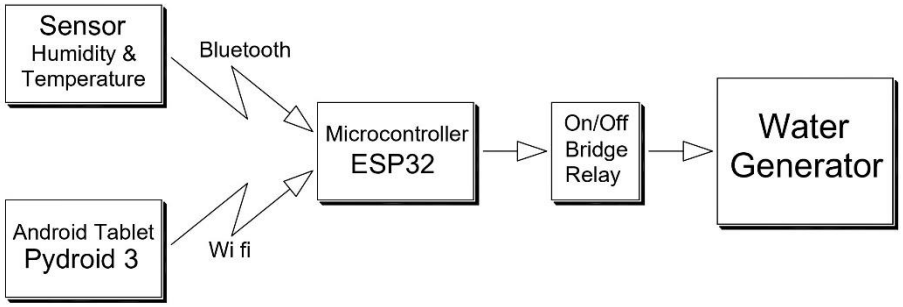

Figure 3. Connection diagram of the system elements

The main function of the ESP32, a micro-computer, is to determine the enthalpy of the air according to the data coming from the temperature and humidity sensors. Accordingly, it cools or heats the surface of the thermoelectric module or goes into inactive standby mode. The situation regarding the operation of the system is shown in Figure 4 of the Psychrometric diagram.

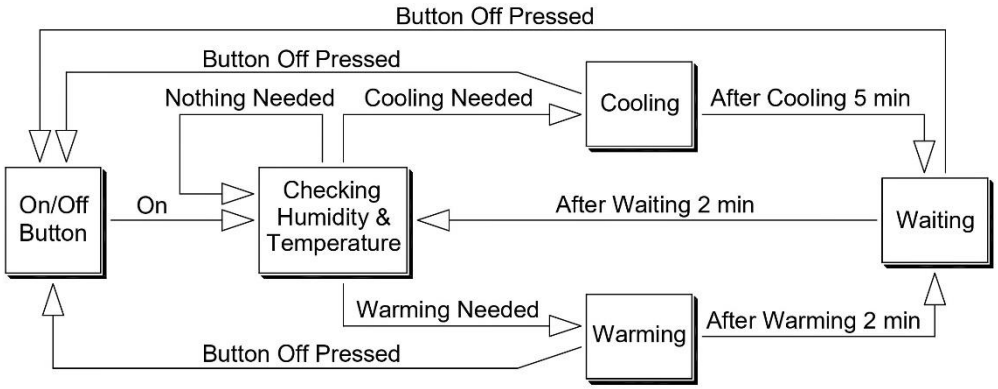

Figure 4. State diagram

The system is designed to work with solar energy in order to use energy efficiently. It can work either connected to the grid *(on grid)* or independent of the grid *(off grid)*.

The system is shown in Figure 5. The technical features and cost prices of the parts used in the system are shown in Table 1.

Figure 5. Cyclic water generator system view

Table 1. Material-price list

Material	Price ($)
Monocrystalline solar panel (75 watts, 18.5 volts max)	65
Thermoelectric heat sink module block with aluminum/copper heatsink, fan circulation, (2 x TEC 12715, 12 volt 240 W)	36
External surface airflow fan, (8 cm case fan 12 volts)	2.5
Battery, (12 volt 24Ah Gel)	34
Solar charge control module, 12 volt 30 A	4.5
ESP 32 bluetooth-wifi circuit	20
Negative ion Generator	5
Temperature - humidity sensor II (Xiaomi)	10
3D printing air circulation tower and water tank	2.5
Carrying case	25
Connectors cable-terminal	1.5
Total	206

Another function of the system is making the water it produces drinkable. For this, ozone is produced with the effect of static electricity on the metal surface where the water condenses. The condensation water is purified from viruses and bacteria. The chemical and biological properties of the water collected in the tank after condensation have been tested and shown to be drinkable.

The ozone generator in the system is used for the disinfection of living ambient air and removal of harmful substances from water as well as in swimming pools, wastewater treatment, the food industry, cold storage, and removal of colour and odour. Ozone is a gas with a very high oxidation power and the strongest disinfectant known. The disinfection effect of ozone gas is 3125 times more than chlorine under the same conditions, so it is more effective than chlorine against spores, cysts, and viruses (Seydim, Greene & Seydim, 2004).

In addition, since ozone is obtained through the breakdown of oxygen in the air, it always turns into oxygen, which is its raw material, after completing its disinfection task due to its unstable structure. The fact that ozone gas is the only disinfectant that does not leave any residue after disinfection makes its use especially in the food and livestock industry advantageous compared to other disinfectants. It is not harmful to human health as it leaves no residue (Seydim, Greene & Seydim, 2004).

3. Findings and Discussion

In the experimental study, 12 experiments were carried out in different weather conditions, and frost, ice, or water formation was observed on the metal cooler surface according to the air temperature and relative humidity values. In the experiments, the ambient temperature and relative humidity were placed on the Psychrometric Diagram, and the corresponding H [kcal/kg air] enthalpy values were found. The Psychrometric Diagram of this study is shown in Figure 6.

A table was created by ordering the enthalpy values corresponding to the air data during the experiments, from smallest to largest, and the results were recorded in Table 2. In this table, the H = 10.6 [kcal/kg air] value, in which the water on the cooling surface passes from the ice/snow phase to the liquid phase, is determined as the limit value. The enthalpy values in Table 2 are the experimental values obtained according to the capacities of the fan and cooling units in this study. The values obtained differ according to the cooler and fan capacities in different systems.

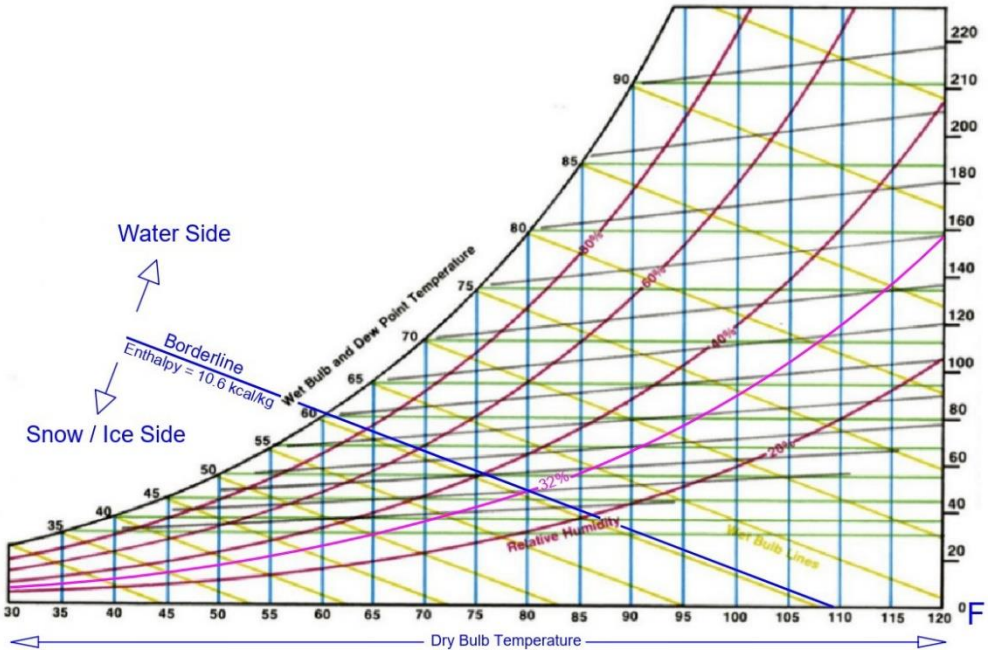

Figure 6. Psychrometric diagram of experiments

Table 2. Ambient temperature and humidity were measured during the experiments and enthalpy values

No.	Temperature [°C]	Relative humidity [%]	Enthalpy [kcal/kg air]	Conclusion
06	18.7	50	8.7	Snow
02	16.4	69	9.0	Snow
01	16.7	74	9.4	Snow
03	17.9	70	9.5	Snow
08	18.5	63	9.5	Snow
10	23.4	41	9.5	Snow
09	14.6	99	9.8	Ice
07	20.6	53	10.6	Snow / Water
11	27.2	32	10.6	Snow / Water
04	21.0	63	11.0	Water
05	25.9	42	12.1	Water
12	28.3	62	12.4	Water

According to the results obtained from the experiments, it is noted that when the enthalpy value is greater than 10.6 kcal/kg for this tested system, water formation will be observed on the cooling surface and the system is set to continue operating with a cooling function in this case *(the case of H>10.6 kcal/kg air).*

When the enthalpy value is H<10.6 kcal/kg of air, since frost or ice will form on the cooler surface, the system will then cut off the cooling and become passive and wait for the ice on the cooler to melt. However, in cases where the ambient temperature is below +4°C *(as this temperature cannot melt the ice on the surface)*, the system will switch to heating mode. It is the critical temperature range where the solid-liquid phase change of water occurs between 0°C and +4°C under 1 atm pressure.

The chemical and bacterial analysis of the water obtained as a result of the experiments was carried out in the laboratories of the Ministry of Health. The results obtained are given in Table 3 and Table 4. In addition, TDS (hardness degree) value was found as 25 mg/L in the hardness measurement. This shows that the mineral balance is suitable for drinking. Some images from the test are shown in Figure 7 (World Health Organization, 2017).

Figure 7. Views from the experiments

Table 3. Chemical analysis of produced water

Contents	Amount [mg/L]/Availability
pH	7.8
Organic matter	Suitable
Chloride	0.89
Ammonium	0.03
Sodium	1.48
Sulfate	6
Aluminum	0.003
Iron	<0.001
Chromium	<0.001
Bullet	<0.001
Manganese	<0.001
Turbidity rate	Suitable

Table 4. Bacterial analysis of the produced water

Content/Feature	Quantity/Status	Analysis method
Enterococcus	0 cfu/100ml	TS EN ISO 7899-2
Escherichia coli	0 cfu/100ml	TS EN ISO 9308-1
Coliform	0 cfu/100ml	TS EN ISO 9308-1
Foreign matter	None	Organoleptic
Smell	Idiosyncratic	Organoleptic

4. Conclusion and Recommendations

In this study, an advanced system that can economically obtain potable water from the humidity of the air and can be controlled by software has been designed, and the usability and efficiency of the system have been tested in different weather conditions. The system also can work on sunny days without the need for mains.

When similar studies are examined in the literature, it is seen that the results obtained vary not only according to the air temperature and relative humidity rates but also depending on the power of the cooler used and the amount of air passing through the unit surface.

The results obtained in the experiments within the scope of this study varied according to the air temperature and humidity. The amount of moisture that the air can absorb at certain temperatures is constant. However, there are different climate types in Turkey just like in any area in the world, and the air temperatures vary according to the climate. For this study to be used throughout the world, +4 ^{o}C, the temperature at which water is in the most density, has been determined as the heating temperature limit. This system developed in the study can operate efficiently in regions with high relative humidity and produce water.

The energy efficiency of the system developed in this study has been increased with software support. Unlike similar examples, the system performs psychrometric diagram analysis with the help of

software installed on the control unit, which automatically switches to heating or cooling conditions when necessary and shuts itself off when it does not need to work, thus saving energy.

Another purpose of this study is to test the quality of the water produced. The method used is water purification by condensation. While the water is purified physically and chemically, ozone gas is produced with the effect of static electricity on the surface where water droplets are formed, and the water obtained is purified from viruses and bacteria.

In addition, in the hardness measurement, it was seen that the mineral balance was suitable for drinking. As a result of the chemical and bacterial analysis, it was observed that the water generator system is supported by software and hardware, that can obtain drinkable water from the air with solar energy which can reach the drinking water values accepted at world standards.

Based on the results obtained in the experiments, it is suggested that in future studies, the production of large-capacity water generators with the aforementioned method and their use in humid climates are suggested as an alternative solution to water scarcity.

Acknowledgments and Information Note

The article complies with national and international research and publication ethics. Ethics committee approval was not required for the study.

Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to the article. There is no conflict of interest.

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Stakeholder Opinions on Urban Agriculture: The Case of Iğdır

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Abstract

Urban agriculture encompasses all agricultural activities within or near urban areas. Due to its complex interactions within environmental, social, and economic contexts, urban agriculture faces various challenges. Therefore, various stakeholders are involved in the process of developing urban agriculture. This study aims to determine the place and importance of urban agriculture in the eyes of stakeholders in Iğdır City and its surrounding areas. This will provide an understanding of what can be done in the region within the scope of urban agriculture. Semi-structured interview forms were used in the study. Five questions were asked to the stakeholders, and descriptive analysis, one of the qualitative data analysis methods, was used to analyze the data. According to the findings, it was concluded that Iğdır city holds significant potential in terms of urban agricultural activities. Based on the stakeholder opinions, opportunities for urban agriculture in Iğdır City were discussed.

Keywords: *Agricultural activities, local authorities, stakeholders, urban, urban agriculture.*

Kent Tarımına İlişkin Paydaş Görüşleri: Iğdır Örneği

Öz

Kentsel tarım, kentsel alanların içinde ve çeperinde gerçekleşen tüm tarımsal faaliyetleri kapsamaktadır. Çevresel, sosyal ve ekonomik bağlamlardaki karmaşık etkileşimleri nedeniyle, kentsel tarım çeşitli zorluklarla karşı karşıyadır. Bu nedenle, kentsel tarımın geliştirilmesi sürecinde çeşitli paydaşlar yer almaktadır. Bu çalışma, kentsel tarımın Iğdır ili ve çevresinde paydaşların görüşlerini belirlemeyi amaçlamaktadır. Bu da kentsel tarım kapsamında bölgede neler yapılabileceğinin anlaşılmasını sağlayacaktır. Araştırmada yarı yapılandırılmış görüşme formları kullanılmıştır. Paydaşlara beş soru sorulmuş ve verilerin analizinde nitel veri analiz yöntemlerinden biri olan betimsel analiz kullanılmıştır. Elde edilen bulgulara göre, Iğdır ilinin kentsel tarımsal faaliyetler açısından önemli bir potansiyele sahip olduğu sonucuna varılmıştır. Paydaş görüşlerinden yola çıkılarak Iğdır ilinde kentsel tarım olanakları tartışılmıştır.

Anahtar Kelimeler: *Tarımsal faaliyetler, yerel yönetim, paydaşlar, kent, kentsel tarım.*

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1. Introduction

The population of cities is increasing day by day, and cities are constantly changing and developing in line with the needs of the growing population. Due to the intensity of urban life, people are confined to limited time frames and spaces during the day. Therefore, cities are becoming critical areas in ecological, economic, social, and cultural contexts. In this regard, incorporating agricultural activities within cities can provide opportunities for solving or reducing overcrowded cities' food and environmental problems. Urban agriculture is defined as a systematic sector that produces, prepares, and sells food within and near in the city by applying production methods on natural resources, to obtain products and significantly meet the daily consumption needs of urban dwellers (UNDP, 1996; Orsini et al., 2013; Türker & Akten, 2020; Türker & Anaç, 2022; Gül, 2022). Urban agriculture can be classified in various ways depending on its diversity, actors involved, objectives, land use, scale, location, characteristics, technology, and production systems (Lohrberg et al., 2015; Türker & Akten, 2023). It can be easily adapted to different types of built environments through various typologies, scales, orientations, and goals (Hodgson et al., 2011; Nadal Fuentes, 2015). Urban agriculture is a critical key to ensuring urban sustainability and creating healthier green environments (Türker & Akten, 2020; Türker, 2021; Türker et al., 2021). For example, urban agriculture can be integrated into the rooftops of buildings such as youth centers, shopping malls, or throughout the various sections of a building or site (Philips, 2013). According to a study conducted by Clinton et al. (2018), it is estimated that there is a total of 1-7 million hectares of land, equivalent to approximately 1.4% to 11% of urban areas, with the potential for urban agriculture worldwide. Urban agriculture faces various challenges due to its complex environmental, social, and economic interactions. Therefore, various stakeholders are involved developing urban agriculture to address these challenges. The literature suggests that urban agriculture activities are primarily managed through the interaction of stakeholders belonging to three main groups (Prové et al., 2016). These groups are classified as follows:

1. *Government:* This group includes institutions, organizations, institutes, agencies, and government-led bodies at the local, national, and international levels.
2. *Civil Society:* This group comprises individuals, volunteers, NGOs, and environmental education associations directly involved in urban agriculture.
3. *Market:* This group involves distributors, entrepreneurs, and consumers related to profit-oriented urban agriculture activities.

These three groups interact and play significant roles in the management and development of urban agriculture. Therefore, understanding the perception and development potential of urban agriculture among stakeholders, as well as gaining insight into how stakeholders influence the development of urban agriculture, can provide essential guidance to decision-makers and planners in developing strategies to address food and environmental issues in cities.

This study aims to find out stakeholders' perspectives regarding current and future urban agriculture developments in the city of Iğdır and its surrounding areas. Firstly, different stakeholders representing and having the potential to be involved in urban agriculture developments in Iğdır are identified. Subsequently, a semi-structured interview technique, a quantitative research method, is conducted with the identified stakeholders. In the conclusion section, recommendations based on urban agriculture are developed for the city of Iğdır within the scope of the evaluation.

2. Material and Method

2.1. Study Area

Iğdır is in the easternmost part of the Anatolia Region, within the Erzurum-Kars Section, at a latitude of 39.9193 and a longitude of 44.0455. It is situated along the Aras River, forming the border with the neighboring Armenian province. Nakhichevan and Iran also border Iğdır to the southeast and east, Ağrı to the south, and Kars province to the northwest (Figure 1). It has a total area of 3,588 km^2 (Aksoy, 2012). Due to its economic, social, and geographical conditions, Iğdır became the 76^{th} province of Turkey, separated from the Kars province, through Law Decree No. 3806 on May 27,

1992 (Şimşek, 2018). According to the data from the Turkish Statistical Institute (TÜİK, 2022), the population of Iğdır City is recorded as 203,159.

Figure 1. The location of the study area

Extinct volcanic mountains surround Iğdır city and have a basin-like topography, which gives it a microclimate type. The average annual temperature is 11.6°C. The total annual precipitation is 258.6 mm. The plain area, where semi-arid climate conditions are observed, is characterized by steppe vegetation, while the higher elevations have Alpine vegetation (Türkoğlu & Şekercioğlu, 2017). In Iğdır city, it has been determined that of the 482 bird species found in Turkey, 321 either reside in this region or use it as a migration route. The recorded 321 bird species represent 66% of the bird species in the country and 60% in Europe (Türkoğlu, 2018). According to the land use status data, Iğdır City has 96,949 hectares of Class I and IV lands. Agricultural activities are carried out in 53,183 hectares, of which 25,706 hectares are Class I agricultural lands, covering 7% of the city's total area (Provincial Directorate of Agriculture and Forestry, 2019). Due to these characteristics, Iğdır and its surroundings are known as a region where agricultural production activities are carried out intensively.

2.2. Method

In studies related to stakeholder perspectives on urban agriculture, it can be observed that qualitative, quantitative, and mixed research methods are employed (Rogerson, 2011; Cohen & Reynolds, 2014; Sanyé-Mengual et al., 2018; Gianluca et al., 2021). The methodological approach of this study is given in Figure 2.

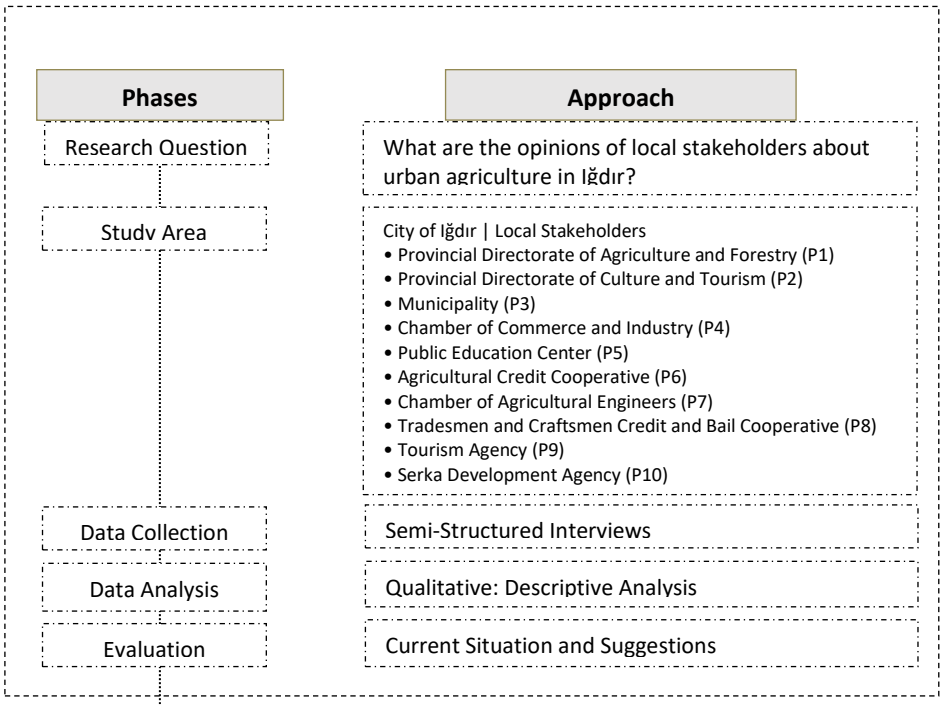

Figure 2. Methodological approach

The necessary ethical approval document for data collection in this study was approved by the Iğdır University Scientific Research and Publication Ethics Board on 24th March 2022. This study aims to evaluate urban agriculture in the city of Iğdır and its surrounding areas, gather stakeholders' perspectives in this context, and provide recommendations on how urban agriculture can be developed in the region.

Taking into account the primary stakeholder grouping of the state, civil society, and the market, the stakeholders that are influential in the decision-making mechanisms regarding the use of urban agriculture in the region are determined as follows: Iğdır Provincial Directorate of Agriculture and Forestry, Iğdır Provincial Directorate of Culture and Tourism, Iğdır Municipality, Iğdır Chamber of Commerce and Industry, Serka Development Agency, Public Education Center, Iğdır Agricultural Credit Cooperative, Iğdır Tradesmen and Craftsmen Credit and Guarantee Cooperative, Iğdır Chamber of Agricultural Engineers, and Iğdır Tourism Agency (Figure 1). Face-to-face interviews were conducted with administrators or administrative personnel representing the identified stakeholders. The study employed a qualitative research method, and semi-structured interviews were conducted with the stakeholders using a predetermined form. Qualitative research focuses on generating knowledge about how individuals perceive their potential, the world, and their lived experiences, aiming to conduct in-depth exploration (Merriam, 2018). The data analysis method used in this study is descriptive analysis. In descriptive analysis, data collected through observations, interviews, etc., are classified, summarized, and interpreted. In this type of analysis, quoting data from data sources can benefit the study's credibility (Altunışık et al., 2012). The interview form was developed with the input of landscape architecture department academics. In this context, the following questions were asked to the participants identified as urban agriculture stakeholders in Iğdır:

Q1. Do you have any knowledge about urban agriculture gardens? If so, what do you think urban agriculture gardens include?

Q2. What other contributions can urban agriculture gardens make to the city/region beyond agricultural production?

Q3. In terms of professional significance, are the potential and characteristics of Iğdır suitable and sufficient for establishing urban agriculture gardens?

Q4. What are the major risks and hazards in establishing urban agriculture gardens?

Q5. What is the value of urban agriculture gardens for this city in terms of agricultural production, urban health, and economic and social values?

The interviews were conducted at the designated dates and times determined by the stakeholders and lasted 30-45 minutes each. With the permission of the stakeholders, the interviewer took notes. During the interview, these notes were read back to the stakeholders to ensure an accurate understanding of the information they provided and to confirm its accuracy. Subsequently, the statements were adjusted to fit the academic language without altering their content. The obtained data were classified and interpreted. This process aimed to identify the current situation regarding urban agriculture in Iğdır and its surrounding areas and provide recommendations for its development and potential planning.

3. Findings and Discussion

In this section, the findings obtained from the descriptive analysis of the interview texts are presented. During the interviews with the stakeholders, the questions were coded as Q1, Q2...Q5, and the participants were coded as P1, P2, P3…....P10. The quotations are presented accordingly. The prominent findings from the responses can be summarized as follows:

Q1: Do you have any knowledge about urban agriculture gardens? If so, what do you think urban agriculture gardens include?

"Urban agriculture includes all areas where agricultural activities are conducted, including hobby gardens and community gardens etc."(P1)

"Hobby gardens, healing gardens, greenhouses, and flower gardens can be considered within the scope of urban agriculture areas."(P2)

"It can be associated with agriculture conducted within the city. This may include greenhouses, hobby gardens, and existing agricultural areas."(P4)

"It can involve cultivation and agricultural activities done for visual purposes."(P7)

"I have no knowledge about this concept."(P10)

Q2. What other contributions can urban agriculture gardens make to the city/region beyond agricultural production?

"Urban agriculture gardens can make significant contributions to creating awareness about green spaces, facilitating the establishment of sustainable green corridors within the city, and promoting mental and physical well-being."(P2)

"They provide social benefits to the community. The older generation in the region is already engaged in agriculture, and this can increase the participation of the younger population. Engaging in farming activities in their own gardens not only provides agricultural benefits but also serves as a social space for relaxation and entertainment."(P6)

"They provide employment opportunities for the city. They contribute to the local economy and have impacts on the regional and even national economies."(P8)

"These spaces can contribute positively to the local community by reducing daily stress and providing recreational areas for city residents. Thematic gardens such as hobby gardens or healing gardens can have positive effects on the community's mental well-being."(P10)

Q3. ***In terms of professional significance, are the potential and characteristics of Iğdır suitable and sufficient for establishing urban agriculture gardens?***

"Iğdır has fertile agricultural lands due to its soil structure and climate. These favorable characteristics allow the formation of hobby gardens, medicinal gardens, and flower gardens, as well as the development of greenhouse farming economically."(P2)

"Iğdır has significant agricultural potential, but it is not adequately utilized."(P5)

"Iğdır's villages and nearby neighborhoods already have agriculture, and the local population meets their needs from these areas. Due to its climate and geopolitical location, Iğdır is suitable and sufficient." (P7)

"Iğdır is already an agricultural city, and it is suitable and sufficient."(P9)

Q4. What are the major risks and hazards in establishing urban agriculture gardens?

"Areas with high agricultural potential might be at risk."(P1)

"If irrigation lines are not drawn from drinking water, it does not pose a problem."(P3)

"There is no risk."(P4)

"There is no risk. However, plant diseases can increase, and uninformed agricultural activities can have negative effects on crops."(P7)

"I don't think there is any risk."(P9)

"Establishing the infrastructure poses a significant risk."(P10)

Q5. What is the value of urban agriculture gardens for this city in terms of agricultural production, urban health, and economic and social values?

"I don't think it will contribute economically. However, it can increase interaction and solidarity among the community. Additionally, it certainly has benefits in terms of urban health, such as the contribution of green spaces, heat balance, and employment opportunities."(P1)

"Even if the products obtained from these areas are not commercial, they promote interaction through local exchanges. For example, if apricot cultivation is not carried out on a commercial scale, the local community distributes the harvest to their surroundings and sends gifts to other cities during the harvest season, which activates and stimulates courier services. Besides, it helps create a green space texture for the city."(P3)

"First and foremost, it can contribute to establishing a culture of agricultural activities within the community. If the society reaches a point where they can produce their own products, it can lead to a transition to a culture where the community can meet their own needs, solving many economic and social problems and contributing to urban health."(P5)

"In terms of culture, it strengthens the connection between the local community and agriculture, enhancing their ties with the past. In addition to the economic dimension, it strengthens both the cultural and social bonds among the people."(P8)

The answers obtained after the questions directed to the stakeholders are summarized as follows:

According to the results of the interview with the *Iğdır Provincial Directorate of Agriculture and Forestry*, it is stated that Iğdır City has sufficient infrastructure in terms of natural values for urban agriculture areas. However, it is mentioned that there is a lack of legal basis for the protection, operation, and utilization of the generated income from urban agriculture gardens. Additionally, it is noted that urbanization and existing regulations do not support the development of urban agriculture gardens on agricultural lands.

Iğdır Provincial Directorate of Culture and Tourism stated that agricultural areas are not only a food production sector but also have the potential for wide-ranging activities in collaboration with the local community. These activities can raise awareness and promote green space consciousness among the urban population. They can also support the creation of new recreational and sustainable areas in the city, play a significant role in ensuring food security for the city and the country, and make substantial contributions to tourism and the local economy.

Iğdır Municipality emphasized that agriculture has been a longstanding tradition in the Iğdır Plain and a significant portion of the population is engaged in agricultural activities. The city has a high concentration of agricultural activities, and in the past, the region was able to meet the needs of the local population with its agricultural products. However, it was noted that in recent times, most of these products are imported from other regions. This decrease in the city's external trade dimension is believed to be related to urbanization and the degradation of agricultural lands. It was also suggested that the agricultural lands of the city have sufficient productivity for crop cultivation, and even on an individual level, there is extensive utilization of agricultural practices. Residents also use agricultural production areas for recreational and hobby purposes.

Iğdır Chamber of Commerce and Industry mentioned that activities aimed at improving agriculture within the scope of urban agriculture gardens are an effective method for protecting and developing agricultural areas. Furthermore, urban agriculture areas can contribute to the continuity of local food production and the preservation of the city's culture. They can also catalyze for existing and potential recreational activities, significantly contributing to the city's economy and adding various new functions to the industrial sector.

Public Education Center expressed that urban agriculture activities can introduce the local community to a new culture of crop cultivation. This can lead to reduced food costs and shorter distances for transportation, thereby ensuring food security. In addition, urban agriculture can provide positive contributions in economic and social aspects.

Serka Development Agency pointed out that agricultural activities in rural areas can positively effect on human psychology and mental health. The increase in the quantity and diversity of products resulting from agricultural activities can provide employment opportunities for the local community in various service sectors such as processing and marketing of these products. However, it is considered that the lack of sufficient infrastructure work and the establishment of a system could pose significant challenges for the city if urban agriculture gardens are not properly implemented.

Iğdır Agricultural Credit Cooperative stated that the spaces and areas created within the scope of urban agriculture gardens would contribute to the cityscape by adding green areas and providing a healthier living environment. It was also believed that they would play an essential role in strengthening the connection between the younger generation and the soil. These agricultural gardens could be utilized as research or experimental areas for individuals and communities seeking different methods and techniques in cultivation.

Iğdır Craftsmen and Artisans Credit and Guarantee Cooperative emphasized that reviving and expanding agricultural areas in these lands where agriculture has been practiced since ancient times can play a significant role in strengthening the cultural ties of the local community. It was also stated that it could contribute to strengthening national will and enhancing social and cultural bonds.

Iğdır Chamber of Agricultural Engineers stated that urban agriculture gardens contribute to production and increase the number of green spaces, positively impacting on urban health and climate. It is believed that the local community can have a significant influence in ensuring their own and the city's food supply by engaging in agricultural activities. Establishing thematic gardens such as healing and hobby gardens, taking advantage of the positive effects of agricultural activities such as meditation, can have overall positive effects on the city's local population. To create a city that is closely intertwined with nature and agriculture, it is considered necessary for local government and public institutions to work in a coordinated manner and raise awareness accordingly.

Iğdır Tourism Agency mentioned that events or festivals organized under the agriculture theme can contribute to the city commercially and socially. These events are believed to play a significant role in promoting the city's unique cultural values and even contributing to tourism growth.

There are studies in the literature that evaluate stakeholder perspectives on urban agriculture. These studies show that evaluations are made based on different stakeholder groups. For example, it is demonstrated that the group representing urban farmers has an influence on food production in urban areas (Hara et al., 2013; Cook et al., 2015; Sanyé-Mengual et al., 2016; Specht et al., 2016; Delgado 2018; Nadal et al., 2018; Diehl 2020). Non-governmental organizations (NGOs) and restaurants are important stakeholders in ensuring access to urban agriculture products to urban markets (Sanyé-Mengual et al., 2016; Specht et al., 2016; Pollard et al., 2017). It is also shown that the local community can either promote or hinder the implementation of urban agriculture activities as stakeholders (Specht et al., 2016; Sanyé-Mengual et al., 2018; Ramaloo et al., 2018; Nadal et al., 2018; Türker & Akten, 2021). These studies emphasize that urban agriculture can be successfully carried out with the contributions of different stakeholders and highlight the importance of considering stakeholders' perspectives.

It has been revealed that local and national governments, as another stakeholder group, can directly or indirectly influence the effectiveness of urban agriculture initiatives (Vásquez et al. 2002; Rogerson, 2011; Cohen & Reynolds 2014; Sanyé-Mengual et al., 2016; Specht et al., 2016; Paddeu 2017; Specht & Sanyé-Mengual 2017; Delgado, 2018; Nadal et al., 2018).

The potential of urban agriculture gardens was investigated within the scope of this research in Iğdır City and its surrounding areas. Qualitative research techniques, specifically semi-structured interviews, were employed to evaluate the views and recommendations of public institutions, private sector, and civil initiatives. Within this scope, interviews were conducted with various stakeholders, including Iğdır Provincial Directorate of Agriculture and Forestry, Iğdır Municipality, Iğdır Chamber of Commerce and Industry, Public Education Center, Serka Development Agency, Iğdır Agricultural Credit Cooperative, Iğdır Craftsmen and Artisans Credit and Guarantee Cooperative, Iğdır Chamber of Agricultural Engineers, and Iğdır Tourism Agencies. Each stakeholder was asked questions related to urban agriculture, and their views and recommendations regarding urban agriculture gardens in Iğdır City were obtained based on their areas of interest.

According to the interviews conducted within the scope of the study, it has been identified that the preservation, management, and establishment of the legal framework for urban agriculture gardens is an important issue. It has been recognized that the agricultural land productivity in Iğdır City can serve as an adequate source of food stock for the city and its surroundings. In addition to the

economic contributions of urban agriculture activities to the city and the industrial sector, it has been emphasized that they can also play a significant role in preserving the city's cultural fabric and ensuring its sustainability. Urban agriculture gardens have been acknowledged for their role in ensuring access to safe food. Besides their economic benefits, it has been highlighted that urban agriculture gardens can have positive physical and mental effects on human health. These gardens also play an essential role in strengthening the connection between the younger generation and the land and providing healthy living conditions. They have the potential to enhance cultural ties and strengthen national identity within society. It has been suggested that themed healing gardens can be established within urban agriculture gardens to benefit from the meditative effects. Recreational activities organized within the scope of urban agriculture can contribute positively to the city's recognition and its tourism potential at the regional and national levels. Furthermore, urban agriculture gardens can serve as research or experimental areas for individuals and communities seeking alternative methods and techniques in cultivation.

Apart from meeting the community's food needs at the local level, urban agriculture has various dimensions of impact, such as environmental sustainability, health, nutrition, and social interaction. Additionally, it provides job opportunities related to local food production activities, supporting economic development, social participation, integration, and empowerment (Rasouli, 2012). With increasing implementation examples worldwide and in our country, it has become a field that addresses various agricultural practices.

4. Conclusion and Suggestions

Turkey has a rich agricultural potential and biological diversity in terms of agricultural product variety and patterns based on different climates and ecological regions. From traditional agricultural techniques to technology, a wide range of agricultural practices have been implemented in our country, becoming part of our social, cultural, and economic life. It is necessary to ensure the continuation of all these agricultural practices in a blended form with the social and cultural dimensions of the region, preserve them, and pass them on to future generations to ensure their sustainability.

When it comes to the multifaceted benefits of promoting urban farming gardens in the region and city, they go beyond increasing food stock in urban areas. They also contribute to improving the urban climate and providing additional benefits in terms of healing, therapy, social renewal, and cultural enrichment for the urban population (Metin & Türker, 2023). Therefore, these areas within the city should not be converted into built-up spaces, and efforts should be made to preserve and maintain the aforementioned benefits;

- Establishing apricot orchards as a focal point and urban emphasis within the city.
- Allocating agricultural areas to support local producers near the city to cultivate specific crops.
- Creating small-scale agricultural production and vegetable gardens in limited spaces such as apartment complexes, residential areas with gardens, rooftops, public buildings, and private sector premises.
- Developing programs for growing vegetable and fruit gardens in city parks, supported by various products throughout the year, in collaboration with park and garden authorities.
- Prioritizing research focused on supporting local products by research institutes, universities, and other research institutions, including establishing an apricot museum and research institute.
- Organizing fairs, exhibitions, and festivals to promote and market local products, along with various activities (poetry, painting, music, composition, etc.) and competitions involving primary, middle, and high school students.
- Planning to establish sales and promotional outlets serving local and international tourists, contributing to the local economy.

• Incorporating fruit tree plantations instead of forest trees as part of agricultural forestry activities in reforestation efforts conducted by the General Directorate of Forestry.

• Implementing artistic projects (sculptures, murals, flooring elements, etc.) throughout all residential areas of the city to represent the language and characteristics of agricultural products.

• Establishing an agricultural, industrial zone, and fruit/vegetable wholesale market to facilitate integration between the agricultural and industrial sectors and enable processing of plant-based and animal-based products.

The critical steps to be taken in the agricultural-focused enrichment of Iğdır City are considered as follows according to stakeholders' opinions.

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Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to the article. There is no conflict of interest.

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A Studio Study on "Reuse" in Architectural Design

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Abstract

As a result of the rapid depletion of resources and the damage caused by excessive consumption to the environment, resource management, and material reuse in the construction sector are a necessity for sustainability. This study aims to emphasize the importance of reuse. For this purpose, a workshop was conducted to transform the volumes provided by the out-of-use or ready-made materials into re-use spaces with a different function. The first stage of the study, which is carried out in three stages, is the preparatory stage, where the students do preliminary research on the subject; the second stage is the stage where the students do design studies, and the third stage is the stage where the evaluations regarding the design decisions and learning outcomes are made. At the end of the study, fourteen products were designed by the students, and eight of them were handled within the scope of the study. The direction of the advantages and disadvantages created by the properties of the materials in the design has been evaluated in terms of functionality, technique, and aesthetics. Then, the awareness and development of the students about reuse were evaluated. As a result of the study, it has been revealed that the materials that are out of use and/or produced for different purposes can have creative or guiding effects on the design, and while doing this, they can exhibit a beneficial and sustainable approach to the environment.

Keywords: *Reuse, sustainable design, architectural design.*

Mimari Tasarımda "Yeniden Kullanım" Üzerine Bir Stüdyo Çalışması

Öz

Kaynakların hızla tükenmesi sonucu değişen ihtiyaçlar ve aşırı tüketimin çevreye verdiği zararlar yapı sektöründe kaynak yönetimi ve malzemeler yeniden kullanımı sürdürülebilirliğin bir gerekliliği olarak karşımıza çıkmaktadır. Bu çalışma yeniden kullanımın önemini vurgulamayı amaçlanmaktadır. Bu amaçla kullanım dışı olan veya hazır üretimdeki materyallerin sağladığı hacimlerin farklı bir işlev ile yeniden kullanım mekanlarına dönüştürülmesine yönelik bir stüdyo çalışması gerçekleştirilmiştir. Üç aşamada gerçekleştirilen çalışmanın ilk aşaması öğrencilerin konuya ilişkin ön araştırma yaptığı hazırlık aşaması, ikinci aşama öğrencilerin tasarım çalışmaları yaptığı aşama, üçüncü aşama ise tasarım kararlarına ve öğrenim çıktılarına yönelik değerlendirmelerin yapıldığı aşamadır. Çalışma sonunda öğrenciler tarafından on dört adet ürün tasarlanmış olup sekiz adedi çalışma kapsamında ele alınmıştır. Materyallerin sahip olduğu özelliklerin yarattığı avantaj ve dezavantajların tasarıma verdiği yön işlevsel, teknik ve estetik açıdan değerlendirilmiştir. Ardından öğrencinin yeniden kullanım konusundaki farkındalıklarını ve gelişimi değerlendirilmiştir. Çalışmanın sonucunda kullanım dışı kalan ve/veya farklı amaçlar için üretilen materyallerin, aslında tasarıma yaratıcı veya yönlendirici etkilerde bulunabileceği, bunu yaparken de çevreye faydalı ve sürdürülebilir bir yaklaşım sergileyebileceği ortaya konmuştur.

Anahtar kelimeler: *Yeniden kullanım, sürdürülebilir tasarım, mimari tasarım.*

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1. Introduction

The rapid depletion of resources, changing needs, and damage caused by excessive consumption of the environment have increased the importance of the concepts of sustainability and ecology in the construction sector. One of the most basic requirements for achieving a sustainable and ecological structure is to ensure the use of natural resources without consuming or polluting the environment (Türkeri, 2021). Waste management has become an important criterion, as has the construction of energy-efficient structures, to be affected by the consequences of environmental pollution at a minimum level (Mutdoğan & Wong, 2011). The amount of solid waste is increasing due to population growth, technological developments, industry, and urbanization. This increase, which occurs with the unconscious consumption of raw materials, also increases the burden on the environment (Elibol, Bezci, Dündar Türkkan & Varol, 2018).

Implementing a sustainable approach is possible through the conservation and efficient use of resources. The fact that the material can be reused or easily disposed of is at the heart of creating a sustainable product. Therefore, in cases of both prevention of environmental pollution and irresponsible use of resources and nature, materials should be reused and turned into a resource that benefits the economy (Curi, 1992). At this point, the importance of reusing out-of-use materials to minimize the resource use caused during the construction and demolition phases emerges once again (Ringdon & Kim, 1998). Various methods are being developed to study the use value of out-of-use materials and to reuse them. One of the accepted approaches to the management of waste materials is the 3R principle, which focuses on "reduce, reuse, and recycle". This principle is an approach that encourages the use of waste materials in new products to be produced, and today it has taken its place at various scales, from urban spaces to architecture, from interior applications to industrial designs (Bekar & Nayeb, 2022). The 3R principle supports the creation of a responsive environment for obsolete materials to be viewed as a resource, not a loss, and to be reused. The use of waste materials and resource management, which have the potential to be utilized in many areas of design, is considered a sustainable design strategy. Celadyn (2019) considered resource management among sustainable design strategies with the principle of "reduce, reuse, recycle". In its most general sense, 'reduce' includes measures to reduce waste generation. 'Reuse' is expressed as the repair and functionalization of existing objects by applying simple operations. 'Recycle' is the evaluation of the material to serve a different use by converting it into raw material. Reuse is an approach that should be preferred over recycling because less energy is consumed in production (Kendir Beraha, 2019). For this reason, within the scope of the study, the focus is on the evaluation of the material through "reuse".

In order for a material to be accepted as a reuse input, it must meet conditions such as allowing multiple uses, being functional, long-lasting, and durable, being easy to dispose of, being easy to disassemble and reassemble, reducing energy consumption, and containing no toxic materials (Mercan, 2016). Reusing is not only a sustainable approach but also brings various benefits. Brass & McIntosh (1999) list the benefits of reuse as energy savings, material recovery, labor recovery, recovery of added value in manufactured parts, reduction of solid waste, reduction in the prices of goods, increase in the profit rate of remanufacturing companies, low capital requirements as a result of providing competitive opportunities through low prices, recovering a larger share of added value compared to recycling, and decreasing the machinery investments required for the production of product components.

There are also some prejudices or barriers to products being designed through reuse. One of the most important of these obstacles is the design of the product that will emerge from reused materials (Elibol et al., 2018). Each of the materials has some limitations due to its characteristics. These boundaries, arising from both technical and visual characteristics, play a decisive role in the interaction of architectural design and materials. The chain of choices that starts with the designer's reaction to the limits of the material determines the direction of the design (Kurşuncu, 2018). The attitude process when all these boundaries are defined and in contact with them is undefined, but it is the time when creativity is used the most (Kurşuncu, 2018; Bekar, 2023). When Rollo May (1975) talks about the

relationship between borders and design, he says, "Human consciousness is the distinguishing aspect of our existence; we would never have developed it without limitations. Consciousness is an awareness that arises from the dialectical tension between possibilities and limitations. The creative act arises with and against what limits man." He draws attention to the fact that boundaries that seem like a disadvantage can be turned into an advantage with a properly managed process and offer new and creative solutions. Another limitation in designing products through reuse is the difficulty of collecting and combining reused products.

Reuse practice, with both its benefits and prejudices, is preferred by different designers in various design fields. Especially in the fields of architectural design and product design, the concept of reuse is frequently encountered. Reuse, which is read from the perspective of the function factor in architectural structures, is also closely related to the economic value of the building (Kutlu, Bekar & Şimşek, 2022; Elibol et al., 2018).

This study deals with the reuse approach through architectural design products. In this direction, a studio study was held to transform the volumes provided by the out-of-use or ready-made materials into re-use spaces with a different function. It is aimed to reveal the direction that the advantages and disadvantages created by the features of the materials give to the design. In this context, the study was carried out in three stages. The first stage is the preparation stage where students do preliminary research on the subject. In the second stage, students determined a material and function for the volume they would design and then started their design line with a scenario they produced. At the end of the second stage, fourteen products were designed by the students based on reuse principles. Eight of these designs were considered within the scope of the study. The third stage is the stage where evaluations are made regarding design decisions and learning outcomes. At this stage, the direction that the advantages and disadvantages created by the properties of the materials gave to the design was evaluated from a functional, technical, and aesthetic perspective. Thus, it is emphasized that the materials that are out of use and/or produced for different purposes can have creative or guiding effects on the design while exhibiting a beneficial and sustainable approach to the environment. The study is important because it covers a studio experience process for students to organize existing volumes with a new function and evaluates the spatial and design solutions caused by the advantages and disadvantages of the spaces presented in the resulting products. At the same time, it is thought that the study will raise awareness among students, researchers, and designers about reuse and pave the way for another research to be done.

2. Material and Method

This study was carried out with the 4th-grade students of the Department of Interior Architecture, Faculty of Architecture, Karadeniz Technical University, within the scope of the Interior Architecture Project 7 course to raise awareness about reuse in design. In this direction, the students were given the subject of "converting the volumes provided by the out-of-use or ready-made materials into re-use spaces with a different function". In this study, a studio study was carried out during the project course, which included a total of thirteen weeks. In this direction, fourteen students participated in the course. At the end of the course, a total of fourteen projects were delivered, and eight projects were examined within the scope of the article. While selecting the projects, care was taken to ensure that there were no projects working with the same or similar materials in order to create diversity and examine different materials. The method of the study carried out within this framework was designed in three stages (Figure 1).

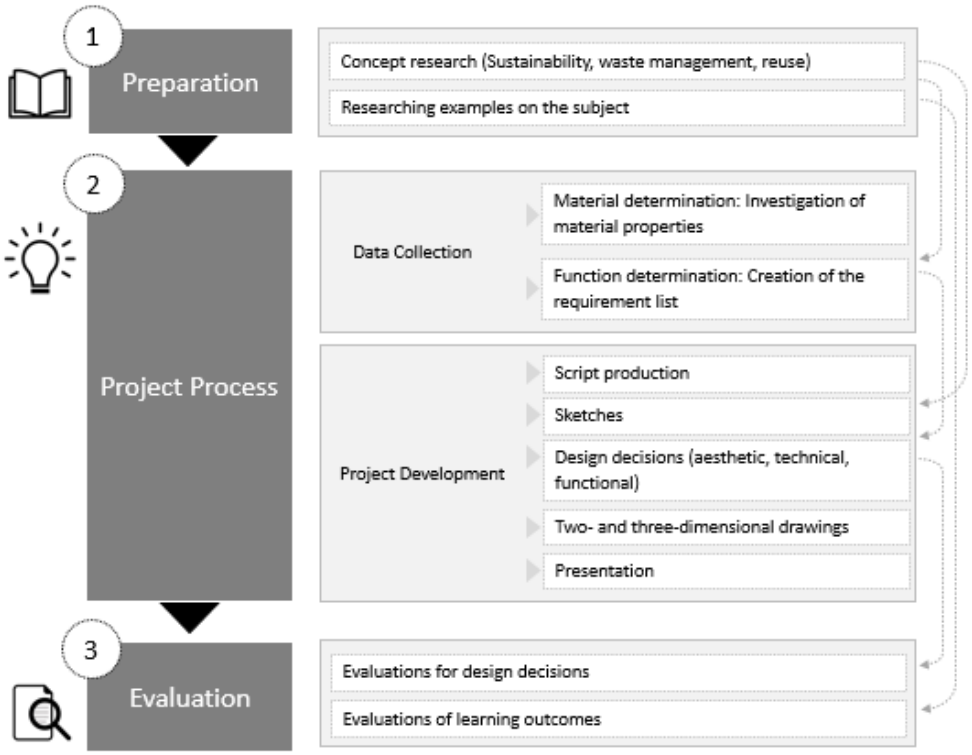


Figure 1. Representation showing the stages of the study

Phase 1: Preparation

The first stage is the preparatory stage, in which concept research, an introduction of the subject, and sample research are carried out. The purpose of concept research is to provide students with knowledge about the project subject. In this direction, students were asked to research sustainability, waste management, and reuse. Then, as a project topic, the subject of "conversion of the volumes provided by the out-of-use or ready-made materials into re-use spaces with a different function" was explained to the students. The material to be selected for reuse in the project and the function to use this material are left to the student's choice. It is expected that the outputs of the project will be used with a function that can meet today's needs. In this context, students were asked to construct their projects to include factors such as spatial organization, equipment design, lighting, air conditioning, material selection, and detailing. In this direction, first of all, the students were asked to investigate the examples related to the subject. Thus, it was ensured that the students had an idea about the current studies on the subject and adapted to it.

Phase 2: Project process

The second phase of the study consists of the project process, which includes the collection of data and the project development phases. At the stage of data collection, the students determined the materials they would study and the functions they would use to construct this material. In this context, the students researched the properties of the materials and created a list of needs for the function they chose. During the project development phase, the participants created their scenarios in light of the information they obtained from the data collection step. In other words, the participants created a space setup that could meet the needs of the material and function they chose. Then, for eleven weeks, the space designs foreseen by the scenario were carried out. At this stage, students were expected to make aesthetic, functional, and technical design decisions for the development of the project, taking into account the properties, advantages, and disadvantages of the material they chose. In this direction, various design sketches were made. When the project reaches a certain functional, technical, and visual saturation, the maturation process is completed with two-dimensional and three-dimensional drawings. At the end of the project, the students were asked to prepare a presentation sheet expressing the character of the project, the design process, and the functional, technical, and visual aspects of the design.

Phase 3: Evaluation

The third stage of the study is the stage in which the design decisions and the learning outcomes of the course are evaluated in the final product. At this stage, the students were first asked about the advantages and disadvantages of the material they chose during the project development process. In this context, questions regarding design decisions were asked: What were the advantages and disadvantages of the material you chose? How did these advantages and disadvantages direct your design? Students were asked to group their answers in terms of functional, technical, and aesthetic aspects. Accordingly, the letter 'T' is placed next to each relevant item if it is functional, 'T' if it is technical, and 'E' if it is aesthetic. Another question asked during the evaluation phase is aimed at understanding the gains of the project process for the student. For this purpose, the question "What were the contributions of your project to you regarding the gains obtained from the course?" was asked. This question is aimed to reveal the learning outcomes of the course and the student's awareness and development about reuse.

3. Findings

The project process was carried out with the participation of fourteen students. When the same or similar materials were eliminated among the fourteen projects put forward, eight different student projects were considered within the scope of the study, including Bus Cabin, Polypropylene Tank, FGRP Fiberstrong Pipe, Concrete Water Pipe, Truck Trailer, Train Wagon, Generator Cabin and Water Tank. Information about the examined projects (project number, student name, material, and function) is given in Table 1.

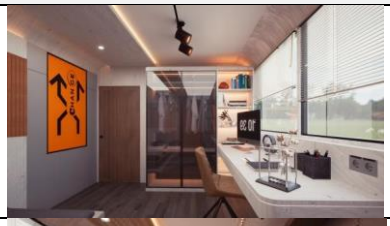
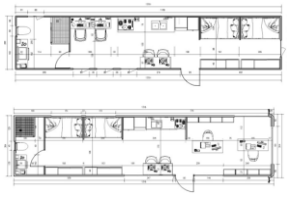
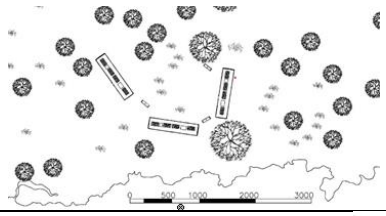
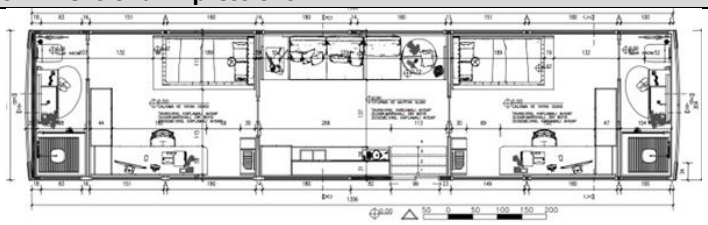
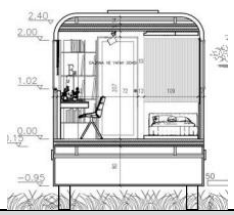
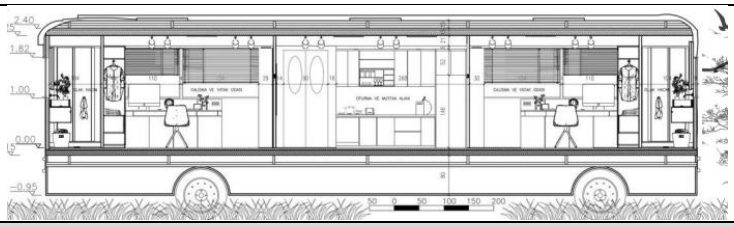
Table 1. Information about the projects

Project Number	Material	Function	Student
1	Bus cabin	Home office	Mustafa Kaptan
2	Polypropylene tank	Trade center	Elif Zehra Yıldırım
3	FGRP fiberstrong pipe	Accommodation and camping area	Özge Sabak
4	Concrete water pipe	Art village	Aleyna Çam
5	Truck trailer	Painting and ceramics workshop	Rümeysa Karagülle
6	Train wagon	Medical center	Şeymanur Taşçı
7	Generator cabin	Newsgathering center	İrem Çıbıklı
8	Water tank	Social work center	Şule Tombalak

In this part of the study, the projects carried out within the scope of the course are summarized with tables containing the project information. The table consists of three parts. The first part contains the name of the project and the material used. In the second part, there are two-dimensional and three-dimensional drawings of the projects. In the two-dimensional expressions, there are sketches of the projects, site plans of the projects, floor plans, and sections. In the three-dimensional expressions, the exterior and interior visuals of the projects are included. In the third part of the table, there are questions and answers for the students regarding the design decisions of the projects and the achievements obtained from the course.

A home office design was made using the bus cabin. Within the scope of the project, a home office was designed with the functions of a kitchen, WC, working area, sleeping area, and resting area (Table 2). Bus cabins were chosen as the material due to reasons such as the presence of a large number of unused bus cabins, their easy accessibility, ease of transportation, being economically suitable, and being easily convertible in terms of volume.

Table 2. Project no 1: Functioning of the bus cabin as a home office

Project name: Change Bus	**Three-Dimensional Expressions**	
Material: Bus Cabin	Outdoor	Interior
Material	 	
Process/Sketches	 	
Two-Dimensional Expressions		
Plans	 	
Sections	 	

Design Decisions

1. What were the advantages and disadvantages of the material you chose? How did these advantages and disadvantages guide your design?

Advantages
- Using the existing windows of the bus (F)
- Providing convenience in space organization and planning thanks to the rectangular form of the bus (F)
- Availability of luggage space for installation (F, T)
- Being portable (T)

Disadvantages
- Difficulty in placement due to the narrowness of the bus (F)
- The curved surfaces of the bus force the interior surface design (A)
- Obligation to use singular due to not being able to be connected (F, T)

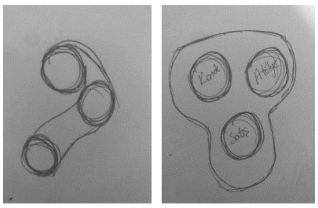
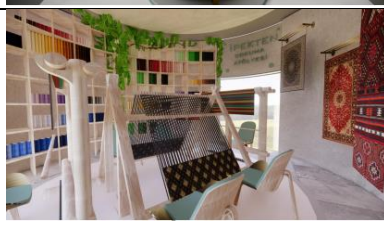
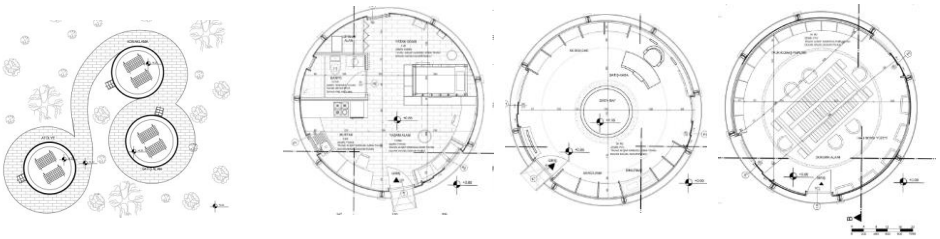
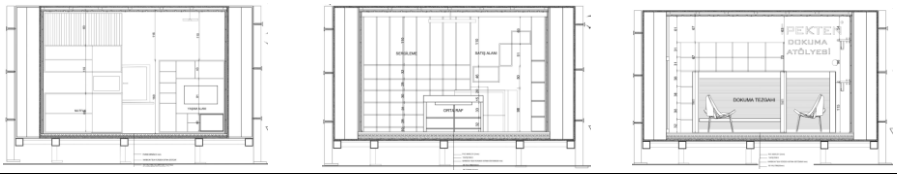
2. What were the contributions of your project to you?

- I understood the relationship between reuse and sustainability.
- I realized that I could produce economical solutions with reuse.
- I gained knowledge of waste management and resource management.
- I witnessed how out-of-use materials can meet the needs of daily life through reuse.
- I gained knowledge about space organization and equipment design in small and narrow spaces.

A trade center design was made using a polypropylene tank. Polypropylene tanks serve purposes such as storing, mixing, heating, and cooling large volumes of materials without deterioration or wear and tear for many years. Polypropylene tanks can be produced in desired sizes and shapes. Polypropylene tank was preferred as a material because it can create flexible solutions, is easy to produce, is recyclable, is resistant to heat, moisture, chemicals and other corrosive substances, is lightweight, is easily portable, is easily repaired and is easily intervened.

Within the scope of the project, a trade center with an accommodation area, a workshop area, and a sales area was designed (Table 3).

Table 3. Project no 2: Functioning of polypropylene tanks as trade centers

Project name: İpekten	**Three-Dimensional Expressions**	
Material: Polypropylene Tank	Outdoor	Interior
Material	 	
Process/Sketches	 	
Two-Dimensional Expressions		
Plans		
Sections		

Design Decisions

1. What were the advantages and disadvantages of the material you chose? How did these advantages and disadvantages guide your design?

Advantages

- Being high above ground (T)
- Resistance of the outer mass to factors such as rain, chemicals, etc. (T)
- Water resistance of the material (T)
- Easy application of window and door openings (F, T)
- Good thermal insulation (T)
- The ability to use the exterior image of the bus as a design element (A)

Disadvantages

- Requirement of an additional inward material for glass and window openings (T, F)
- Since the form is circular, it is necessary to design furniture suitable for the form (f)

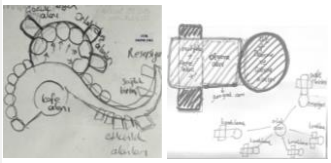
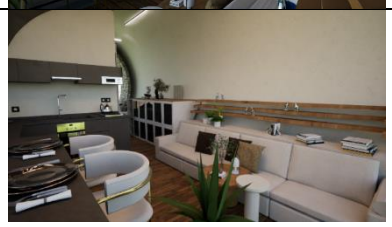
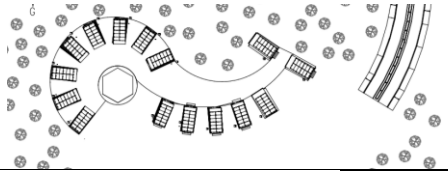
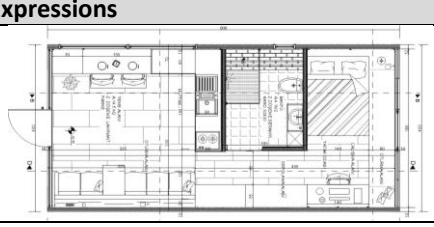
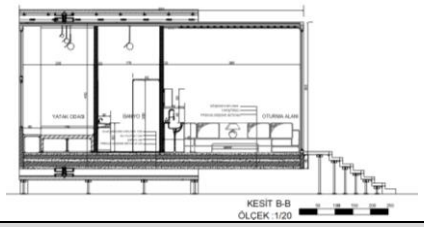
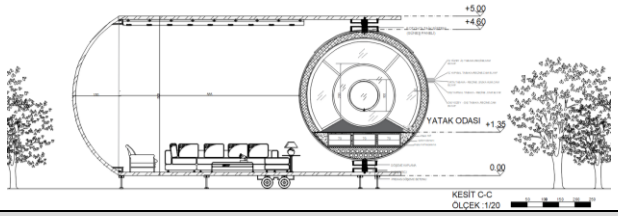
2. What were the contributions of your project to you?

- I saw how I could construct spaces that were designed with different functions before, with different function.
- The process improved my creativity in concept and detail.
- I learned different material combination details.
- I saw how fast and economical solutions can be produced for fast installation and disassembly.
- I experienced the process of reusing unused materials.
- I learned about the concept of reuse and its relationship with sustainability.

An accommodation and camping area were designed using FGRP fiberstrong pipe. Fiberstrong pipe is used as a material due to reasons such as high corrosion resistance, light and elastic structure, superior hydraulic properties, environmental friendliness, long service life, high strength structure, low

operating and maintenance costs, fast and easy laying, compatibility with ground movements, economical transportation and cost. the pipe has been selected. In the project scope, an accommodation and camping area was designed with accommodation capsules, wet areas, and socializing areas (Table 4).

Table 4. Project no 3: Functioning of FGRP fiber strong pipe as accommodation and camping area

Project name: Hand of Nature	**Three-Dimensional Expressions**	
Material: FGRP Fiberstrong Pipe	Outdoor	Indoor
Material		 
Process/Sketches		 
Two-Dimensional Expressions		
Plans		
Sections		

Design Decisions

1. What were the advantages and disadvantages of the material you chose? How did these advantages and disadvantages guide your design?

Advantages

Being strong (T)
Being light (T)
Having smooth interior surfaces (A)
Not causing any water leakage thanks to its hydraulic properties (T)
Easy connection thanks to its modular structure (T, F)

Disadvantages

Designing site-specific furniture instead of ready-made furniture in the interior due to its circular structure (T, F)
Need for support in fixing due to its circular structure (T, F)

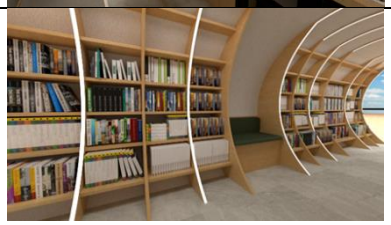
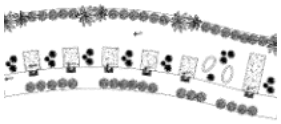
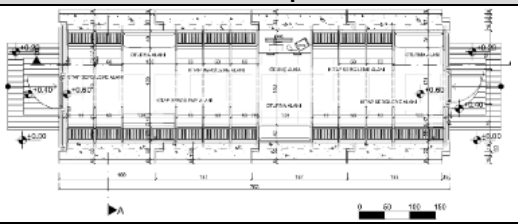
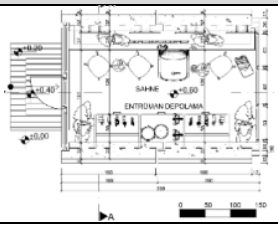
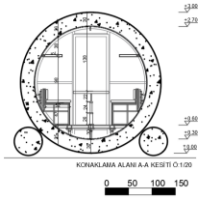
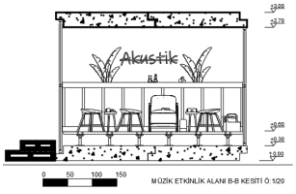
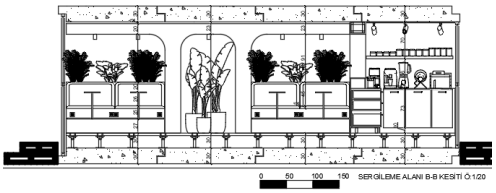
2. What were the contributions of your project to you?

- I understood the concept of reuse.
- It was a project that made me think about how to evaluate a material, and in this sense, different ideas allowed me to come up with different solutions.
- I understood the importance of reuse for sustainable design.
- I developed myself in terms of producing space-specific details.

An art village design was made using a concrete water pipe. Concrete water pipe was chosen as the material because it is a very easy-to-access material, environmentally friendly, durable, low production cost, easy to maintain and repair, compatible with climatic conditions, and non-flammable. Within the scope of the project, an art village with accommodation, a library, an exhibition, a cafeteria, and

activity areas were designed (Table 5). Concrete pipes were sometimes singular and sometimes joined to each other to design spaces.

Table 5. Project no 4: Functioning of the concrete water pipe as an art village

Project name: Art Village	**Three-Dimensional Expressions**	
Material: Concrete Water Pipe	Outdoor	Indoor
Material		 
Process/Sketches		 
Two-Dimensional Expressions		
Plans	  	
Sections	  	

Design Decisions

1. What were the advantages and disadvantages of the material you chose? How did these advantages and disadvantages guide your design?

Advantages

- Being modular (F, T)
- Creating wider spaces by being connected (F, T)
- The curvilinear surfaces supported the shelf design while designing the library section (A)
- Relief of the circulation space by making use of the inclined surfaces in the exhibition area (F)

Disadvantages

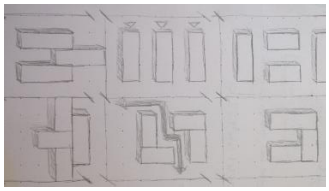
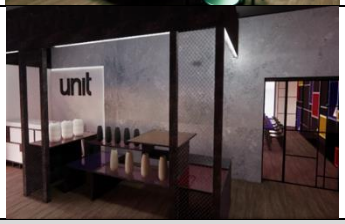
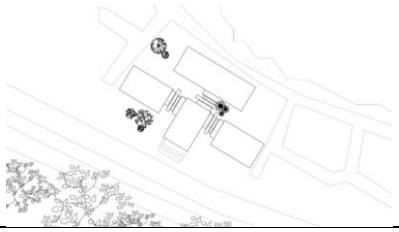
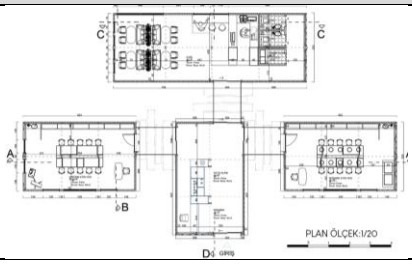
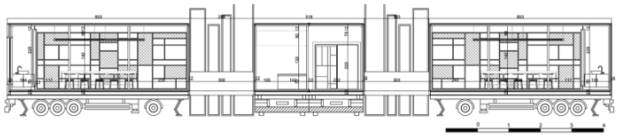
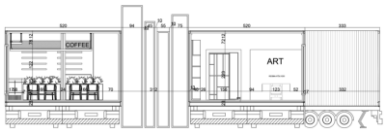
- Ability to produce flexible solutions despite the narrow interior space (F, A)
- Being able to design space-specific furniture despite not being able to use ready-made furniture (T)
- Preventing the breathing of the concrete by insulating the concrete pipe against the asbestos problem (T)
- Being able to use the spaces formed when inclined surfaces are smoothed for areas such as storage, installation, etc. (T, F)

2. What were the contributions of your project to you?

- I developed my skills in the organization of small spaces and furniture design.
- The problem of how I could make what I wanted inside the concrete pipe triggered my creativity.
- The subject of the project supported and triggered my intellectual process.
- I improved myself on details.
- The subject of the project made me look at the materials around me from a different perspective.
- I realized the importance of a sustainable approach with the evaluation of the materials that we ignored.

A painting and ceramics workshop was designed using truck trailers. Truck trailers were preferred as a material due to their features such as being volumetrically recyclable, being durable, allowing flexible use, easy access, being lightweight and portable. Within the scope of the project, a workshop design was made, which includes a painting workshop, a ceramic workshop, a cafe, sales areas, an exhibition, a wet area, and storage units (Table 6).

Table 6. Project no. 5: Functioning of truck trailers as a painting and ceramics workshop

Project name: Unit	**Three-Dimensional Expressions**	
Material: Painting-Ceramic Workshops	Outdoor	Outdoor
Material	 	
Process/Sketch	 	
Two-Dimensional Expressions		
Plans	 	
Sections	 	
Design Decisions		

1. What were the advantages and disadvantages of the material you chose? How did these advantages and disadvantages guide your design?

Advantages

- Durability of the material (T)
- Formal features facilitate the organization of space (T, F)
- Being modular and combining units easily (T, F)
- Ability to create different combinations when units come together and separate (T)

Disadvantages

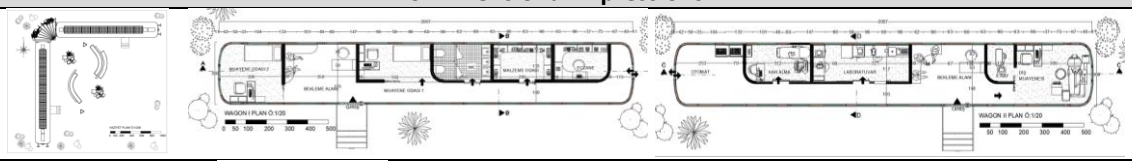
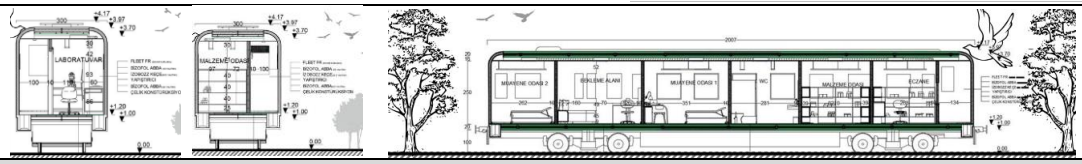
- Although the unit volume is small, it can be used by combining units (T)
- Difficulty applying design ideas to materials (A)
- Insulation requirement (T)

2. What were the contributions of your project to you?

- I got to know new materials.
- I had the opportunity to create modular design alternatives.
- I had an idea about reuse and resource management.
- I had the opportunity to see different approaches to reuse in the workshop environment.
- I had the opportunity to redesign the materials used for different purposes.

A medical center was designed using a train wagon. Train wagon was preferred as a material because many train wagons are out of use, it is resistant to corrosion, has an aesthetic appearance, can be combined, is easy to transport, and has volumetric advantages and climatic advantages. Within the scope of the project, there are examination rooms, reception, waiting areas, material rooms, pharmacies, laboratories, etc. A medical center was designed to accommodate space (Table 7).

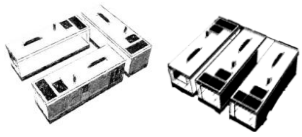
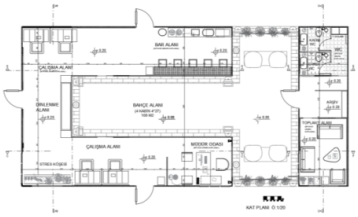
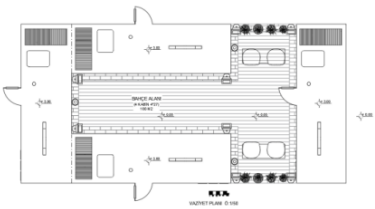
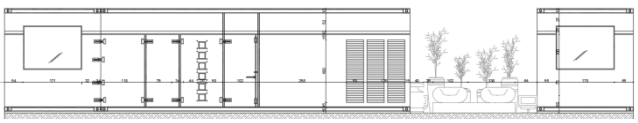
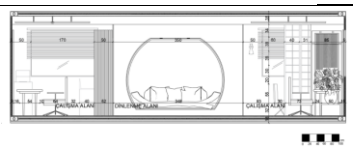
Table 7. Project no 6: Functioning of the train wagon as a medical center

Project name: Heacen	**Three-Dimensional Expressions**	
Material: Train Wagon	Outdoor	Interior
Material		 
Process/Sketch		 
Two-Dimensional Expressions		
Plans		
Sections		
Design Decisions		
1. What were the advantages and disadvantages of the material you chose? How did these advantages and disadvantages guide your design?		
Advantages	Ability to visually benefit from the characteristic features of the wagon (A) Ability to use existing window and door openings (F) Being able to be protected from the effects of water, etc. by the fact that the wagon is high from the ground (T) Being portable (T) Being modular (F)	
Disadvantages	Use of sliding doors due to the narrow and long shape of the wagon (F) Difficulty in spatial organization due to narrow and long-form (T) Designing multifunctional furniture because it does not have enough width (F, A) Insulation requirement (T)	
2. What were the contributions of your project to you?		
• I learned the importance of reuse in terms of recycling and environmental pollution. • I realized that materials that we are not aware of, that we do not see, and that we ignore can be reused. • I realized that materials that seem like waste can be sustainable with the right use. • I realized that I could design flexible and multifunctional furniture for narrow spaces. • Finding solutions to the limitations created by the material triggered my creativity.		

A news gathering center was designed using generator cabins. Generator cabins were preferred as materials due to their features such as being easily accessible, easy to maintain and repair, being light and portable, being easily convertible due to their volume characteristics, being able to create flexible solutions, and being affordable. The news-gathering center is conceived as a venue used for rapid and

effective collection of news at emergency events and small living centers. Within the scope of the project, a design including working areas, a meeting area, a bar, a wet area, an executive room, and resting areas was made (Table 8).

Table 8. Project no 7: Functioning of generator cabins as news gathering center

Project name: Streaming	**Three-Dimensional Expressions**	
Material: Generator Cabin	Outdoor	Interior
Material		 
Process/Sketches		 
Two-Dimensional Expressions		
Plans		
Sections		

Design Decisions

1. What were the advantages and disadvantages of the material you chose? How did these advantages and disadvantages guide your design?

Advantages

- Easy to attach and remove parts (T)
- Having its own sound and heat insulation (T)
- Ensuring air flow with its ventilation sections (T)
- Lightweight and easy to carry (T)
- Easy to color (A)
- Easy assembly of cabins to each other (T, F)

Disadvantages

- Negative effect of glass and steel jointing for glasses (T)
- Color mismatch (A)
- Difficulty associating ventilations on vertical surfaces with the space (T)

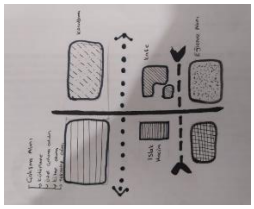
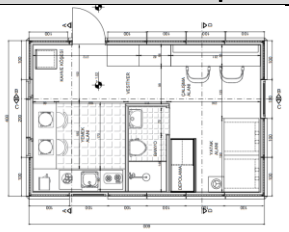
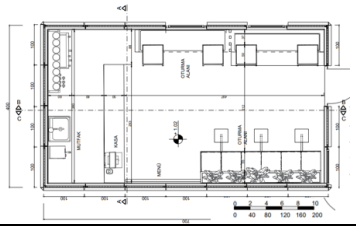
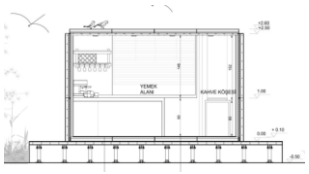
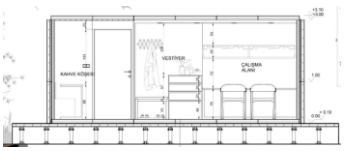
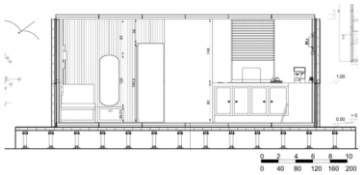
2. What were the contributions of your project to you?

- I learned about the concept of reuse in architecture.
- I realized that unused materials can be used for different functions, and we can add various needs to our lives at a low cost.
- I learned to find solutions to the limitations created by the materials we choose.
- The process triggered my creative thinking.
- I developed myself by producing details specific to the place and material.

A social work center was designed using modular water tanks. In the project, a social center where people can socialize together and at the same time retreat to nature has been considered. Water tank was preferred as a material because it is long-lasting, healthy and hygienic, easy to transport and transport to the installation site because it is produced in pieces, does not burn, is resistant to climate

changes, easy and practical installation, easy to transport and provides flexible use due to its modularity. Within the scope of the project, a design including accommodation, a working and reading area, a cafe, and an entertainment area was designed (Table 9).

Table 9. Project no 8: Functioning of generator cabins as a news gathering center

Project name: Clubby-ED	**Three-Dimensional Expressions**	
Material: Water Tank	Outdoor	Interior
Material		 
Process/Sketches		 
Two-Dimensional Expressions		
Plans		 
Sections		 

Design Decisions

1. What were the advantages and disadvantages of the material you chose? How did these advantages and disadvantages guide your design?

Advantages

- Ability to produce flexible plan solutions by being modular (F)
- Being resistant to external factors (F)
- Easy application of door and window openings (F, T)
- Being light and portable (T)
- The fact that the material is curved inward provides convenience in insulation (T)

Disadvantages

- The requirement to raise the ground against the factors coming from the ground (T)
- Curves on the surface create visual boundaries (A)
- Insulation requirement (T)

2. What were the contributions of your project to you?

- I learned about fast installation and production.
- I gained experience in producing solutions for small spaces, space organization, and equipment design.
- I developed myself by producing project-specific details.
- I have increased my awareness of ensuring sustainability by evaluating previously unconsidered spaces with different functions.

4. Evaluation

Within the scope of the study, each project was redesigned by evaluating the materials produced to serve different functions. It is seen that the materials chosen in the realization of the designs are effective in directing the design. The results obtained when an evaluation is made regarding the effect of selected materials on design decisions are listed below.

- Each material has functional, technical, and aesthetic advantages and disadvantages caused by its characteristics. These advantages and disadvantages were the issues that students benefited from or produced solutions for during the project development process. When the students were asked how they benefited from the advantages and disadvantages of the material in the project development process, functional, technical, and aesthetic, the answers given are summarized below (Table 10). While it is seen that the students greatly benefit from the technical, functional, and aesthetic aspects of the materials in the project development process, it is also seen that the limitations of the materials, especially in technical terms, force the students.

Table 10. Advantages and disadvantages of the selected materials

P.N.	Material	Advantages			Disadvantages		
		Technical	Functional	Aesthetics	Technical	Functional	Aesthetics
1	Bus cabin	●	●	●	●	●	●
2	Polypropylene tank	●	●		●	●	
3	FGRP fiberstrong pipe	●	●	●	●	●	
4	Concrete water pipe	●	●	●	●	●	●
5	Truck trailer	●	●		●		●
6	Train wagon	●	●	●	●	●	●
7	Generator cabin	●	●	●	●		●
8	Water tank	●	●	●	●		●

- Based on the data obtained from the questions asked to the students, it is seen that the formal characteristics of the materials are largely decisive in the project development process. At this point, it is seen that materials with cylindrical or circular forms create limitations in the design phase and direct the design process. So much so that the cylindrical volumes used in projects 2, 3, and 4 challenged the student in terms of space usage. On the other hand, students searched for different surface designs. Circular shelf designs, seating fittings following the surface, and exhibition surfaces are some of them.
- It has been seen that modular and connected materials facilitate the project development process, especially in functional terms. The volumes that can be easily combined and separated from each other have been an advantage for students in reaching different and flexible planning solutions. As seen in the examples of the truck trailer, concrete water pipes, generator cabin, and water tank, the students were able to create plan organizations of various sizes by bringing the materials together in more than one form and with different variations.

- When evaluated from a functional point of view, it is seen that the dimensions of the selected materials are generally small and narrow in volume, creating difficulties, especially in spatial planning, as they allow for limited spaces. In the face of this situation, which seems like a disadvantage, the students designed equipment that serves flexible and multifunctional purposes in the furniture they placed in the spaces. At this point, it can be said that the boundaries created by the material trigger the student's creative thinking process.
- Another issue is the technical limitations created by the materials. One of the most obvious problems with the concrete water pipe used in project number 4 is asbestos. Asbestos is a harmful substance that causes various diseases when it enters the body through respiration. For this reason, an insulation solution has been considered in the project despite this problem. Another example is the problem of cylindrical volumes used horizontally in projects 4 and 5. Despite this problem, the students found a solution to the problem of keeping the material fixed with support equipment or by fixing it to the floor. As seen in these examples, it is possible to say that the technical limitations created by the material also trigger the student's thinking and solution-generation processes.
- When considered from an aesthetic point of view, it is seen that the visual properties of the materials are evaluated as an advantage in some projects and a disadvantage in others. In the examples of bus cabins and train wagons, it is seen that the outer appearance of the materials is used as a design element. Since the colors of the generator cabinet used in Project 7 are incompatible, the student felt the need to change its color as it was seen as a disadvantage. At this point, it can be said that the visual properties of the materials are directive, as they directly affect the perception of the project.

The evaluations made in line with the answers given by the students regarding the project subject and the achievements of the project process are listed below:

- At the end of the project process, it is seen that the awareness of the majority of the students about the concept of reuse has increased, and the fact that they can establish its relationship with sustainability is considered one of the most important achievements of the course.
- Students comprehended how waste or out-of-use materials become useful with the right projecting and functioning process. Thus, they realized that out-of-use materials would be considered a resource, not a loss.
- It is seen that the boundaries created by the materials lead the students to produce solutions and trigger their creative thinking processes to find solutions to functional, technical, and aesthetic problems.
- It can be said that instead of using ready-made furniture, the skills of designing and producing details for the limitations of the existing space have improved.
- Another important achievement within the scope of the study is that students witnessed the reuse processes of different materials besides their own by seeing and listening to each other. Thus, students also saw the development processes of different materials.

5. Results

As a result of changing and increasing consumption habits and rapid production, the increase in the amount of waste all over the world causes economic and psychological destruction as well as negative effects on the environment, human health, and all living things. As a result, the damage caused by excessive consumption of the environment has increased the importance of the concepts of sustainability and ecology in the construction sector. The reuse approach in architecture is an important and guiding method in the process of designing sustainable spaces. For this reason, encouraging designers and users to reuse spaces is an important step in reducing the damage to nature and providing a sustainable environment.

The study dealt with the transformation of the volumes provided by out-of-use or ready-made materials into re-use spaces with a different function through a studio study. The study, which emphasizes how materials that are often overlooked, neglected, or out of use can create new stories in space design with the right applications, shows what kind of contributions they can make both functionally and aesthetically. Despite the limitations created by the materials, both creative and environmentally friendly spaces can be obtained by recognizing the material properties well and producing solutions in this direction. Therefore, encouraging designers and users to reduce and reuse waste materials is an important step in reducing the damage to nature and providing a sustainable environment.

While evaluating the existing volumes with a new function, it has been seen that the characteristics of the material such as economy, easy availability, portability, processability, cuttability, combineability, repairability, paintability, and mountability are decisive in the selection of the material to be transformed. It is thought that the volumes evaluated with a reuse approach will raise awareness by making the user and society aware of environmental approaches and the reuse of waste. Conducting the research together with a studio study contributed to students' awareness about reuse spaces.

With the studio study held within the scope of the research, the student’s awareness of sustainability, resource management, waste management, and reuse has increased. In addition, it was observed that the students improved themselves in recognizing the material, designing by considering the advantages and disadvantages created by the material, developing a special design for the place, and developing details at the spatial and reinforcement scales. At this point, the inclusion of courses and topics on the reuse of waste materials in architecture and design-based disciplines will contribute to the awareness of designers in the creation of a sustainable environment.

In addition to raising awareness among students, the research is thought to be a guide for designers and researchers in studies on the subject. Among the most important benefits of the study are raising the awareness of designers about the widespread adoption of the reuse approach and paving the way for further research on the subject.

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Author Contribution and Conflict of Interest Declaration Information

There is no conflict of interest. All authors contributed equally to this manuscript. İrem BEKAR: Designing the research, writing and reviewing the manuscript, and obtaining the materials for conducting the research. Saffet Ertuğrul LÜLECİ: Designing the research, writing and reviewing the manuscript, and obtaining the materials for conducting the research. Mert ÇAKIR: Designing, writing, and reviewing the manuscript and supervising.

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Research on Outdoor Classroom Design in School Gardens

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Abstract

Outdoor classrooms, one of the oldest educational approaches that have existed, bringing learning through the common denominator with nature to the agenda, first emerged in England as a reform movement in education at the end of the 1950s. Outdoor classrooms are a rare educational structure that allows students to interact with nature and experience the opportunities of this interaction with their fully digitalised interaction potentials. In the study, examples of open-air classrooms, which are almost non-existent in Türkiye, have been analysed with inductive content analysis by understanding them with the semi-structured interview technique conducted with architects and landscape architects who are teachers and practitioners. In the end, considering all the evaluations, it was determined that the effects of outdoor classes on students were grouped into four categories: effects on cognitive, psychomotor, development, affective, and social development. Beyond only using a theoretical approach, exemplary outdoor classroom models were developed and interpreted.

Keywords: *Outdoor classroom, spatial education, classroom design, school garden.*

Okul Bahçelerinde Açık Hava Sınıfı Tasarımı Üzerine Bir Araştırma

Öz

Tarihsel anlamda en eski eğitim yaklaşımlarından biri olan, doğa ile ortak payda üzerinden öğrenmenin yeniden gündeme gelmesini sağlayan açık hava sınıfları, 1950'li yılların sonundan itibaren, eğitimde bir reform hareketi olarak ilk önce İngiltere'de ortaya çıkmıştır. Daha sonraları Amerika'da da uygulamaları görülen açık hava sınıfları, günümüzde tam anlamıyla dijitalleşen etkileşim ve iletişim potansiyelleri ile, öğrencilerin doğa ile etkileşime geçmesine ve bu etkileşimin fırsatlarını deneyimlemesine imkân veren nadir eğitim yapılarından biridir. Çalışmada, Türkiye'de örneklerine yok denilecek kadar az rastlanan açık hava sınıfları, öğretmenler, mimar ve peyzaj mimarları ile gerçekleştirilen yarı yapılandırılmış görüşme tekniği ile anlamlandırılarak, tümevarımcı içerik analizi ile çözümlenmeye çalışılmıştır. Çalışmanın sonunda, tüm değerlendirmeler ışığında, açık hava sınıflarının öğrenci üzerindeki etkilerinin genel olarak dört grupta toplandığı saptanmıştır. Bunlar; bilişsel, devinişsel, gelişime etkisi, duyuşsal ve sosyal gelişime yönelik etkileridir. Sadece kuramsal bir yaklaşım ile ele almanın ötesinde, örnek açık hava sınıfı modelleri geliştirilerek yorumlanmıştır.

Anahtar kelimeler: *Açık hava sınıfı, mekansal eğitim, sınıf tasarımı, okul bahçesi.*

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1. Introduction

From the ancient Greek academy, one of the first educational environments of civilisation, to the madrasahs in the medieval Islamic states, education in all different cultures has been based on following an integrated attitude with nature, which is the first teacher. Observing nature closely, reasoning about it, learning through direct interaction, and thus putting forward theories based on practice are some essential activities. However, this egalitarian attitude begins to change towards a high-level approach imposed by man, with the strict discipline of Scholastic Christian thought and the effort to understand the world by drawing the precise boundaries of modern moral methods. After this point, the world is tried to be grasped through the direct execution of the sterilely imposed teachings. Information that is introverted and begins to be memorised with the sharp order of its rigid orders can be seen as the result of the mind reaching to be understood as the only and most perfect way to understand the world on its own. The tools that must maintain the same order are used in classrooms and educational structures, which are the spatial manifestations of this educational dynamic that emerges in social life.

One of the main reasons why the teacher-centred and one-way transfer of knowledge is seen as the correct way is the break with nature. Defining the only way to access the world with the human mind and keeping it above all other elements caused the solidarity understanding between nature and humans to break. In this sense, Ecology philosopher Morton (2017) highlights that we should value other natural phenomena, such as light scattering, life cycle, friction, and thinking ability, which is only one way to access the world. According to the philosopher, we should focus on allowing this gap to exist and adopting a conciliatory attitude to this situation instead of covering the unbridgeable gap between nature and mind by preferring one over the other. It can be foreseen that open-air classrooms, close to this understanding, aim to create a multifaceted learning atmosphere where the student is at the centre, open to exploration and external stimuli.

Many researchers have discussed nature's positive contributions to the child's development. As a result of the studies, it has been determined that nature increases the feelings of self-discipline and self-confidence in the individual, reduces anxiety, and supports creative play (Samborski, 2010; Kuo & Faber, 2004). In a study examining the effects of nature on children's ability to cope with psychological stress, it was found that children with easy access to nature had lower stress levels and higher feelings of self-worth than children who were very close to their hearts. It proves that nature can increase resilience against stress (Wells & Evans, 2003). "How does time outside and contact with nature affect health and learning?" The question is a widely researched topic. It is emphasised in the studies that natural contact reduces stress and creates positive effects on human health. There are two specifically prominent explanations for how nature can reduce stress. For one, nature can stimulate less used areas of the brain, and a lack of concentration distracts from stressors. Second, nature can strengthen cognitive resources such as attention or problem-solving (Largo-Wight et al., 2018).

Nature also has healing properties on the learning activities of children with attention deficit and hyperactivity disorder. Many studies examining the relationship between the time children spend in nature and their ability to focus on the work they do show that children with attention disorders can increase their concentration and improve their focusing skills during the lesson after the time they spend outside (Wells, 2000; Kuo & Faber Taylor, 2004; Mårtensson et al., 2009; Akpınar, 2016; Bogenç, 2021; Yılmaz et al., 2023).

Nature-based games support young children's creativity, agility, balance, and physical activity (McCurdy et al., 2010; Cosco et al., 2010; Milteer et al., 2012). Compared to indoor and traditional playgrounds, outdoor children are more relaxed, happy, focused, creative, and well-behaved. More materials and activities are needed in natural environments, which means more opportunities for competition and socialisation (Dennis et al., 2014). Despite all these positive effects, as Louv (2010) states in our age, "Nature is an abstraction rather than a reality for the new generation. Day by day, nature has become something to be watched, consumed, dressed, and even ignored". At the point reached today, the capacity to enjoy and benefit from nature has evolved into apathy and fear (Altman & Wohlwill, 1978).

Nature-based open-air classrooms offer opportunities for children and teachers to experience the change processes of nature at various temporal and spatial scales. Children can closely observe the life cycles of plants and animals and experience how nature changes from season to season and from year to year. For example, students can observe the decay of wood, the transformation of leaves into humus, the beginning of seeds growing and yielding, and interact directly with plant materials as a game decoration. In addition, students can associate their outdoor experiences with the curriculum and reinforce the lessons they teach indoors better with outdoor classes.

In this context, open-air classrooms, emphasised within the study's scope, stand out as an alternative to the traditional classroom model in which nature is wholly alienated and ignored. It is thought that immersive learning spaces can be created by transitioning to this new and egalitarian model, which reminds us of the reconciliation attitude between humanity and nature from the beginning but is gradually eroded. Within the scope of the study, the extensions of this situation are tried to be explained through the semi-structured interview technique carried out with teachers and vocational practitioners and to develop exemplary open-air classroom models.

1.1. Outdoor Classroom Concept and Its Historical Development

Outdoor classrooms, which can be seen as a general definition of all spatial potentials within the school's boundaries, are teaching-learning spaces where teachers and students can come together and integrate with nature (House, 2018). According to Nelson (2012), the primary function of outdoor classrooms is to fully benefit by strengthening children's interactions with the outside world, both qualitatively and quantitatively. Open-air classes, a teaching method that encourages students to engage in activities related to their interests, are also defined as a learning philosophy that makes users more active physically and includes various learning methods (Jordet, 1998). More specifically, outdoor education is a process that provides for regular activities and personal experiences outside the classroom, where students can use all their senses and creativity. This learning environment provides more spontaneous games, experiences, and social activities for academic activities than the traditional classroom environment offers opportunities (Burnett et al., 2021). At the same time, outdoor education has the feature of being contextual, realistic, and practical. The approach is a gradual process in which students are first introduced to and prepared for outdoor activities in the classroom. Before meeting in the classroom, go out into the open air, where activities occur. In addition, the open-air learning environment represents an informal learning space where student expectations that cannot be realised in traditional classrooms occur. It has a rich structure that can offer different learning opportunities. Researchers emphasise that education in nature is not a method to be applied only on days when the weather is nice but can also be applied on cold or even rainy days if students dress appropriately (Myhre & Dewaele, 2022).

Outdoor learning is not a new perspective; for centuries, many scientists have recognised the positive effects of natural learning environments on children. Friedrich Froebel, who established the first kindergarten in 1837 by using the word "Kindergarten", which means garden for children and translated into Turkish as kindergarten, sees these spaces as a way for people better to understand their place in themselves and the world and to diversify their connections in this sense (Constable, 2012). Being one of the pioneers of breaking away from the traditional education model in which teachers and parents shape the student's perception of the world in an imposing way, Montessori continued her studies on child education with an attitude based on exploration and togetherness with nature, similar to Friedrich Froebel, through the activities chosen by the children themselves (Constable, 2012). In this way, Montessori is one of the leading names that combines self-referential and free choice with indoor and outdoor learning spaces.

Open-air classrooms have emerged in England as a reform movement in education, under the influence of progressive education philosophy, since the late 1950s. In the process up to these dates, it is seen that the teachers are teacher-centred, the students are passive receivers only in fixed rows, and the learning-teaching process is mainly based on listening. After the Second World War, this traditional classroom environment was questioned, focusing on student needs (Shield & Greenland, 2010). This type of classroom, first used in European preschool education, draws attention to the fact

that children can produce and learn independently in a less structured environment (Constable, 2012). Outdoor education, which started to gain visibility with the nature study movement in the Victorian and Edwardian periods of England, gained value as a potential process in which one-to-one relationships with living things are established instead of offering a dry and dull interaction like in museums (Rickinson et al., 2004). In this sense, one of the leading educators, Dr Lilian Clarke, underlined the importance of open-air classrooms and stated that with a pro-active attitude and a learner-centred education model, workbooks should arise directly from the work done in the gardens. The primary reason for the construction of these schools, which were designed as open pavilions due to financial problems, was to provide children with access to fresh air and sunlight (Yaman, 2005). These open-air classes, implemented for the first time in post-war England, started informally in primary schools. In the report titled "Children and Their Primary Schools", published by British educational scientist Bridget Plowden in 1967, the importance of open-air classrooms and informal processes in the education process was mentioned, and incentives were made to disseminate this practice in all schools. American pedagogues visited the open-air classrooms in England, and as a result of the studies, the implementation of open-air classrooms began in the USA (Rothenberg, 1989). Later, considering the effect of natural learning environments on the development of the child, the concept of open-air classrooms started to take place in the education curricula and policies of many countries, especially Scandinavian countries such as Denmark, Finland, and Norway, from an early age (Waller et al., 2014).

This kind of educational venue, which started to be used due to a practical limitation without ideal aims such as making a revolution in education, later brought learning through the common denominator with nature, which is one of the oldest educational approaches that have existed in the historical sense but are new for modern times. There is no data on the practice of outdoor classes, which have evolved in Türkiye.

1.2. Importance and Effects of Outdoor Classes in Education

Open-air classrooms that encourage students to move between indoor and outdoor spaces without interruption create social environments in which the student is the one who reveals the activity and initiates the learning process freely (Nelson, 2012). With the freedom offered by the flexible space, instead of the hasty and single-focused education approach brought by the rote-based teaching process, students learn to use time in an exploration-oriented way in open-air classes. In this sense, it opens new horizons for the learner beyond only human beings, providing multifaceted social interaction opportunities with non-humans, in which every process of understanding the world in cognitive terms embodies, becomes interconnected parts, and the extent is beyond a single approach. With the activities in these places, students can understand that nature has a right with the deep bonds they have established at a young age. With the demonstration that the response of all kinds of interventions on nature will be reflected strongly, open-air classrooms include natural processes in the education and learning process and put physical activities at the centre of spatial experience.

External environments positively affect the child's cognitive and physical development, communication, socialisation and emotional development, socio-cultural identity, concentration level and learning motivation. Some researchers argue that outdoor learning environments are critical in the child's development and that indoor learning environments alone are insufficient for educational activities (Davies & Hamilton, 2018). On the other hand, access to traditional outdoor playgrounds such as streets, gardens, and wildlife parks is decreasing daily (Rickinson, 2004) due to parents' fear of bullying their children, traffic hazards, and decreased natural and playground areas. Today, with fully digitalised interaction and communication potentials, students can interact with nature and experience other aspects of this interaction only on a limited and one-way level in their closed echo chambers. In this sense, open-air classrooms that can be integrated into educational structures are rare areas where children and young people can still interact with the outside world.

In the study of Vural & Yılmaz (2018), researchers determined that appropriate landscaping practices in school gardens contribute to students' satisfaction with physical conditions, environmental awareness, psychological relaxation, learning new things, increase in school success, use for

educational purposes, and reduction of collisions and accidents during breaks. With a similar approach, Schäffer & Kistemann (2012) focus on the contribution of outdoor kindergarten classrooms to subjects such as physical activity, concentration, mental health, and language development (Schäffer & Kistemann, 2012). The opportunity to continuously experience the natural experiences that these environments provide to the students, which results in positive health effects, improves students' communication with other children, their parents, and teachers. These classes, which encourage the development of skills such as calling for help or overcoming problems in emergencies that may be encountered in nature, develop feelings of security and togetherness with the ritual-like activities they perform. The absence of mass-produced toys and the playground and the fact that strict boundaries do not determine game types and are result-oriented could open the way for creative play possibilities with the natural materials in the environment.

Outdoor classrooms, which should be defined as the intersection of many disciplines such as education, architecture, landscape architecture, ecology, and health, stand out in all these disciplines with their different aspects. In landscape architecture, outdoor, playground and environmental learning aspects are emphasised (Kaplan, 2020), while in architecture, behavioural studies that occur within the game-architecture integrity and the effect of gardens are focused on (Khan et al., 2019). The benefits of outdoor environments for children have been widely documented. Nevertheless, in these studies, researchers are concerned about the level, quality, and effects of outdoor learning.

In this context, open-air classrooms are defined as immersive learning tools with multifaceted dialogues between beings living in a typical environment. In these spaces, where an egalitarian approach is thought to exist between humans and non-humans, productive connections and interactions are created where there are no definite distinctions and where there is movement. In this sense, the study expands the discussion with semi-structured interviews. It analyses proposed model proposals beyond just a theoretical approach to outdoor classrooms, examples of which are rare in Türkiye. In this context, the literature was examined to analyse the effects of outdoor classrooms. It was determined that the impact of outdoor classrooms on students was generally grouped into four groups, including effects on cognitive, psychomotor, development, affective and social development.

1.2.1. Effect on cognitive development

Waldron et al. (2016), who put attention to the cognitive importance of outdoor classrooms in terms of the correct interpretation of analytical data and the complete understanding of the reflection of theory in the practical field, emphasise the importance of spatial abilities required for disciplines such as geology. Open-air classrooms, which allow a geology student to perceive the earth, which is the field of study, directly, in three dimensions, apart from the superficial and opaque descriptions of the textbooks, contribute to understanding the dynamic structure of the inferences from everyday experiences. Researchers addressing this issue in geology education provide clues that similar situations can be applied to other fields of study and learning paths. As can be seen from similar examples, a large part of science and intellectual curiosity and learning processes are based on practice. In this context, outdoor classrooms act as critical mediators and learning catalysts that enable the application of raw information in life by mind-filtering it. According to Piaget, the educational philosopher, children's daily natural and built life environments should always be stimulating and keep them alive in a way that pushes them to seek multiple ways of discovery (Berk & Winsler, 1995). The open-air classrooms designed in this direction will create various stimuli and keep the spatial experience alive with their flexible equipment and free-space setups. The learning act occurs in the educational environment where these different stimuli coexist. Thanks to the various potentials and guides of this environment, called the classroom, students can interact actively with stimulants and other entities (Yaman, 2005). Therefore, outdoor classes should have enough external stimuli.

According to the observations made about the roles of primary school students in field studies, improvements in the built environment can directly contribute to cognitive development (Rickinson et al., 2004). In addition to the various positive effects, these spaces, which significantly improve the cognitive abilities achieved in a classroom environment, create long-term "memory episodes", according to Nundy (1999). Thus, such environments have an encouraging role in the observation and

interaction in nature to produce effective results by establishing memory sequences with these experiences, remembering and understanding functions powerfully. Milton et al. (1995), on the other hand, conducted an ecology-themed field study with fifth-grade students. Researchers who observe the development of social skills and their knowledge in the field of ecology say that they internalise the knowledge and extensions of the park they are in through cooperative games and group projects. In addition, they draw attention to the area's development of belonging and self-reliance. Malone & Tranter (2003) focus on problem-solving and creative thinking abilities, and they refer to the expansions of play and external interaction in cognitive development. In this sense, open-air classrooms emerge as an essential element in contributing to the processes of remembering and understanding, the development of social skills, the experience of division of labour-solidarity, and similar skills to students. Learning with different types of cognitive development that enable the child to live in an integrated way into social life is provided through a lived experience.

1.2.2. Effect on psychomotor development

The motor effect, another effect, indicates the child's ability to understand spatial elements and the dynamic structure and functioning of nature and to use it in his/her life. For example, besides versatile and inclusive learning opportunities, the student's eating habits, who continue the natural education process, are shaped according to the living environment (Blair, 2009). The child, who understands the dynamic movement of nature with the development of healthy eating habits, can establish imaginary interactions and strengthen his/her interaction with physical relationships at any time. Users in outdoor classes, which encourage the development of strength and balance, constantly experience the physical activity opportunities offered by this natural medium. In proportion to the intensity of this time they spend, they can establish a coexistence with nature and consider the possible consequences of human impact on the environment (Chawla, 1999).

According to a study by Dennis et al. (2014) on outdoor classroom users, such spaces are generally defined into four basic categories. Experience of the outdoor environment in a natural environment, the performance of the designed rooms, maintenance and sustainability, and official recognition in the eyes of various authorities were found to be intensely physical factors among the prominent features in these categories. Students experience the most influential aspects of being in the natural environment through themes such as adapting to changing seasons, participating in extracurricular activities, establishing different habitats for learning, interacting with other beings, and experiencing physically challenging situations (Dennis et al., 2014). The research conducted by Bogner (1998) in a national park in Germany highlights the importance of giving students the actions they will take in their environment through tools that will lead them to responsibility. In this sense, the student who experiences the environment primarily can understand the importance of participatory and collaborative interaction and adequate preparation (Bogner, 1998; Rickinson et al., 2004). According to Constable (2012), the physical development of children in outdoor classrooms should be given equal importance in developing fine and gross motor controls. Children aware of the built and natural environment around them gain environmental experience by transforming various obstacles and irregular surfaces around them into a part of their actions. Such areas contribute to developing coordination with their potential, such as climbing, crawling, and balancing. According to Atabay (2014), learning environments should not only develop children's cognitive and social aspects with aspects such as exploration, experimentation, play and discussion but also should have intermediaries that allow physical exercises and movement and thus enable the emergence of physical abilities.

1.2.3. Effect on affective development

In the analysis of Khan et al. (2019) on various quantitative and qualitative studies, it was seen that students who were insensitive and uninterested in multiple courses, such as natural sciences, participated with great enthusiasm and motivation when the same courses were taught in open spaces. In this sense, outdoor classrooms can be seen as intermediate planes where the lessons are efficiently transferred and articulated as extensions of each other rather than an option where indoor classrooms will ultimately replace them. Games, another critical factor in permanent learning and producing knowledge, have been determined to increase children's exploration and internalization

potential (Dennis et al., 2014). The study of Fagerstam & Blom (2013) suggests that learning biology and mathematics in an outdoor environment has a positive cognitive and affective impact on 13–15-year-old (Fagerstam & Blom, 2013). Similarly, Eick (2012) reports that the use of the outdoor classroom and nature supports science and literacy learning. On the other hand, students who are in a state of discovery in which their sensitivity to the environment will increase can take responsibility for the space. In this way, they can exhibit behaviours of protecting owning natural and public spaces that a person's belonging cannot limit.

Outdoor classrooms enable them to express themselves more easily with the natural, lively, and dynamic environment created by spatial self-behaviour, enabling emotional integration and maturation. It plays an active role in acquiring self-discipline, self-confidence, and anxiety control (Samborski, 2010; Dennis et al., 2014). Considering that children with more access to the natural environment have a higher potential to cope with psychological problems than children who live in isolation and closed life, they can express themselves better with the spatial possibilities of open-air classrooms. It can be predicted that children who can value their personality will have a solid reaction to the emotional changes they will experience and that their resistance to stressful events will be higher (Dennis et al., 2014). Such abilities can develop in environments such as an open-air classroom where the child can feel more comfortable and accessible. As emphasised, one of the main factors in this situation is the opportunities the built environment provides for the individual. In the study of Nundy (1999) on the development of cognitive abilities in outdoor classes, results revealed that the gains in one emotional and mental domain strengthen the other. Educational processes in open-air classrooms, which are advanced by the close perception and understanding of the natural processes of the child who continues his sensory development, provide similar contributions to the development of respect for nature and the awareness of protecting nature. Such environments also provide self-confidence by enabling the child to move and feel more comfortably and freely in personality development. Students who dynamically experience the built and natural environment in the process can realise the similarity of topics such as responsibility, cooperation, and togetherness with the cyclical processes in nature. In this sense, they have the potential to apply to nature in their later experiences as the primary source of inspiration.

1.2.4. Effect on social development

Regarding social development, the last category of influence, Vygotsky, states that the social environment is a scaffolding in the child's development (Wood & Middleton, 1975). This supportive system allows the child to progress in self-construction and personal development. With each new competence gained, the child advances his/her social skills and mental development. The students in the classrooms where this process occurs actively work to solve the problem and are in social solidarity. The Reggio Emilia early-age education program in Italy can be given as an example of a child development approach that increases learning efficiency through relationships established with others such as peers, teachers, and parents. According to Berk & Winsler (1995), who put the decision-making mechanism shaped through the mutual relations of students and teachers at the centre of development, open-air classrooms are the most suitable places that allow this approach. The impact of these classes on social development gains value through establishing multiple relationships and interactions with many factors, especially the student's peers and teacher.

Based on open-air classrooms, the educational approach creates an accessible learning environment whose boundaries cannot be fully drawn. In this sense, this understanding of education, in which all possible relationships need to be clearly defined and tried to be classified, also reflects on spatial factors. In this respect, it differs entirely from teacher-centred approaches. Outdoor classrooms, where solidarity exists among all elements of human and non-human nature, show that an education method that is not fully human-centred and in which the right of nature is protected and respected is possible. The student in natural processes such as decay, obsolescence, deterioration, rebirth and renewal, which man cannot control, creates a democratic environment in which various relations between different actors are brought to the fore. Considering the current global climate change and ecology-related discussions, it is crucial for such problems affecting the world to be experienced directly in a

social environment and to be included in the memories to embrace the subject thoroughly. An approach based on superficial theoretical knowledge can inclusively affect education to create permanent awareness for the future instead of addressing such problems and not giving enough value. In this sense, teachers and students who closely experience the external extensions of the space can experience the world in a medium where they can respect all existence. The role of the teacher in such a space is to design activity schemes and frameworks in which students can foster collaborative knowledge and dialogue (Berk & Winsler, 1995). In this process, it is necessary to ensure that an ambiguous and constantly changing structure can be experienced. Outdoor environments, whether natural or playground, allow children to be themselves, research, examine, and act actively and freely. In addition, these open and spacious spaces allow peer interaction to occur spontaneously and in an unlimited context (Stan & Humberstone, 2011). Children lay the foundations of socialisation in these areas where healthy communication is established with peers and nature. Acting from a common denominator, such as the discovery of nature, students can make this process more gripping by establishing strong relationships among themselves, and the information and discourses conveyed by the teacher can be seen as more focused and concentrated. They can learn to exhibit solidarity by directly experiencing nature's reflections collectively. Within the multi-layered network of relations in which he/she is directly involved as the leading actor, the child can more clearly integrate the spatial effects of his/her classes into the content of his/her daily life (Dennis et al., 2014). At this point, the necessity of designing and applying free and motivating promoters and guides that can enable students to experience a correct and inclusive approach to spatial design emerges.

As a result of the literature review on outdoor recreation and learning environments, the information obtained on the effects of outdoor classrooms on the child's development is summarised in Table 1 under the headings of cognitive, psychomotor, affective, and social development.

Table 1. Effects of outdoor classrooms on paediatric development (Edited by authors in line with the information obtain from the literature)

Cognitive Development	Psychomotor Development	Affective Development	Social Development
▪ Focusing ▪ Immersiveness ▪ Reducing anxiety ▪ Learning through practice ▪ Enhancement of the curiosity ▪ Multi-layered exploration with sufficient stimulus ▪ Being in active interaction with stimulus ▪ Suggesting solutions through teamwork ▪ Effective observation and interaction ▪ Vital processes of remembering and understanding ▪ Focused learning through teamwork ▪ Creative thinking and problem-solving	▪ Understanding the processes of nature and reflecting it in life ▪ Adaptation to changing climates ▪ Experiencing natural materials and processes ▪ Direct interaction with living creatures ▪ Studying habitats ▪ Observing the changing seasons ▪ Maintenance of natural systems ▪ Having eating habits in nature ▪ Developing endurance and balance ▪ Having responsibility based on recurrences ▪ Consciousness of responsibility based on repetition	▪ 3-Dimensional direct approach ▪ Abundance of stimulus ▪ Participation in lectures ▪ Motivation and enthusiasm ▪ Multi-directional use of senses ▪ Sense of belonging ▪ Appropriation ▪ Taking responsibility ▪ Protecting natural and public spaces ▪ Expression of oneself in a natural, dynamic, and vital environment ▪ Integrity and maturity ▪ Self-discipline ▪ Self-confidence ▪ Freedom	▪ Participation ▪ Collaboration ▪ Solidarity ▪ Being responsible ▪ Active participation and creation in the collective acts ▪ Cooperatively problem-solving ▪ Production of the mechanism of co-decision ▪ Multi-interaction potentials between teachers and students ▪ Free social communication ▪ Emphasis on student-centred education

1.3. Design of Outdoor Classroom

The open-air classroom design, which cannot be thought of independently of an education approach based on sensitivity to nature, examined under four headings based on the versatility and experience it brings, differs from traditional classrooms in many respects. According to the Boston School Spaces Initiative Outdoor Classroom User Manual (House, 2018), these spaces are separate sitting areas for all students and small groups, plantings for the recognition of local fauna, walking paths to explore the

immediate environment, work surfaces to encourage the use of different natural materials, area maps, plant, and animal introductions. Outdoor classrooms should support children's freedom to choose what, how and where they play with what materials. (Bohling et al., 2010). According to a study by Kiewra & Veselack (2016), four essential elements affect children's creativity and imagination: predictable space, abundant and consistent time, open-ended materials, creative play, and adults who support, observe and care about learning should be considered in the design of these spaces. Children's experiences and the surrounding space's design are shaped and directed by the adults with whom they share this environment. In this sense, the prominent elements in terms of space design of outdoor classrooms are flexibility, predictability and having enough space. According to the researchers, these areas, which are designed in such a way that students acquire concepts and knowledge through play, can create their games with changeable, non-fixed and flexible parts, allowing children to spend more quality time with themselves and with each other, and to freely recognise objects. Play is children's way of exploring the world around them. Playful children discover and transform their environment per their needs (Almon, 2013). Children can participate in open-ended games whenever they want, in which they have an active voice. They can often try to entertain themselves and their friends without being forced by external factors. Outdoor classrooms with interesting natural materials encourage children to engage in creative activities instead of ready-made toys where they can only perform specific actions.

Students can experience difficulties in the face of problems with their own developed approaches, observed by teachers, and their information processing and solution-generating skills directly and freely in open-air classrooms. These classrooms, which allow for safe and predictable actions, should give students the freedom to pursue and continue the work they have started and their responsibilities in the daily routine. With these environments, which teach by living, the child can find the opportunity to learn directly the existence of dynamic natural processes, which allows for making free choices and facing its benefits. Outdoor classrooms should have sufficient facilities to encourage the student in learning, physical, social, psychomotor, affective, and cognitive development. On the other hand, Schäffer & Kistemann (2012) draw attention to the immersive characters in the landscape arrangements of forest kindergartens of similar nature and safety because children can construct their games. According to the researchers, even if the students are not present in the environment, they can remember and effortlessly recognise the area so that it is not just a wall. In this way, the experience takes its place in the memory, and the space can become a living place. In this situation, in which the student tries to maintain a solidaristic life flow established on common ground by feeling responsibility for nature, questions can be formed in the mind of the child more quickly, and they can be directed to the outside world more enthusiastically with an effort to seek answers. The purpose of outdoor education is to support the individual's awareness and knowledge about nature, society, nature-society interaction, and self-development. Outdoor education can include activities based on working together, developing new skills, and protecting nature. The intended outcomes of such experiences are to support personal and social development. Similarly, Pürlüsoy & Eliboy (2022) highlight that learning spaces should be designed by considering various factors such as dimensional aspects, spatial organisation, furniture, equipment, materials, educational tools and equipment, lighting, ventilation, climate, colour selection and hygiene conditions. Embodying these design aspects would provide positive educational, physical, emotional, and psycho-social support to students in learning spaces.

2. Methodology

Based on the views of teachers and designers (architects and landscape architects), this study, which aimed to create models for exemplary outdoor classroom design in school gardens, was carried out in a qualitative research design. Qualitative studies that reveal the phenomenon in the context of subjective data, such as the participants' opinions, experiences, perceptions, and interpretations, are the studies that reveal the phenomenon/event in its nature and integrity (Ilgar & Ilgar, 2013; Merriam & Tisdell, 2016). Qualitative studies try to explain, interpret, and give meaning to the researched subject based on the data instead of generalising (Ilgar & Ilgar, 2013). In this context, the Embedded Theory approach, one of the qualitative analysis patterns, was used in this study to present a realistic and descriptive model to the reader using the data obtained. The Embedded Theory method produces theories, concepts, hypotheses, and suggestions directly from the systematically collected and analysed data and is characterised as an inductive model development process (Creswell, 2003; Bitsch, 2005; Onat, 2011).

2.1. Working Groups

Because qualitative research is mainly based on observation and interviews, it is usually conducted with smaller groups and fewer samples than quantitative studies. Another reason large and large sample group are not needed in qualitative research is that observations and interviews start repeating themselves after a certain period. The number of participants in the study is small, and the data obtained are much and detailed (Ilgar & Ilgar, 2013; Baltacı, 2018). Within the scope of the study, a study group of 20 people consisting of teachers and designers (architects and landscape architects) was determined using the maximum diversity sampling, one of the purposeful sampling methods. Purposeful sampling is a method that facilitates the detailed examination of situations that are thought to contain rich information (Yıldırım & Şimşek, 2008). Maximum diversity sampling aims to determine whether there are any typical or shared phenomena among the diverse situations and to examine the different dimensions of the problem according to this diversity (Marczyk et al., 2005). In this context, in selecting the sample, it was considered that the teachers were of different genders, ages, branches, professional experience and education levels and that the designers had other genders, ages, professional experience, and fields of activity. These factors determined ten teachers, seven architects (who have experience in education buildings) and three landscape architects. The codes are used in the text as T1, T2, etcetera for teachers, A1, A2 for architects, and LA1, LA2 for landscape architects instead of the participants' names to ensure the participants' privacy. The research was conducted in the cities of Trabzon and Rize in the Eastern Black Sea Region. Table 2 contains general information about the participants.

Table 2. Information of participants

Participant Code	Gender	Age	Length of Work Experience (Years)	Discipline	Field of work
T1	Woman	38	19	Elementary School Teacher	Elementary School
T2	Woman	32	10	Elementary School Teacher	Elementary School
T3	Woman	41	12	Elementary School Teacher	Elementary School
T4	Woman	43	17	Elementary School Teacher	Elementary School
T5	Man	65	42	Math Teacher	Elementary School
T6	Woman	40	16	Elementary School Teacher	Elementary School
T7	Woman	28	3	Music Teacher	Elementary School
T8	Woman	41	16	School Counsellor	Elementary School
T9	Man	42	16	Natural Sciences Teacher	Secondary School
T10	Woman	33	11	Preschool Teacher	Preschool
A1	Woman	43	21	Architect/Academician	University
A2	Woman	53	33	Architect	Public Institution
A3	Woman	44	22	Architect/Academician	University

A4	Woman	30	5	Architect	Private Office
A5	Woman	31	4	Architect/Academician	University
A6	Woman	52	25	Architect/Academician	University
A7	Man	39	18	Architect	Private Office
LA1	Woman	41	18	Landscape Architect/Academician	University
LA2	Man	35	9	Landscape Architect/Academician	University
LA3	Woman	28	3	Landscape Architect/Academician	University

2.2. Data Collection Tools and Analysis of Data

The study used a semi-structured interview as the data collection method. The reason for using this method in the research is that it is not possible to obtain the desired data with closed-ended questions. The semi-structured interview technique, which is based on pre-prepared interview questions, provides the researcher with the opportunity to obtain more systematic and comparable information (Yıldırım & Şimşek, 2008). In addition to the need to inform the participants in the position of data source about various concepts and to help them explain and exemplify their ideas, additional questions may be needed during the interview; this is another reason for using this technique. In this context, it is aimed to obtain data about participants' ideas about the physical and functional conditions of the school gardens in the region where they live, the purpose and characteristics of qualified school gardens, their knowledge about outdoor classrooms, the possible effects of outdoor classrooms on students, their willingness to teach in an outdoor classroom (only addressed to teachers), the characteristics of an ideal outdoor classroom, to the courses and education levels for which outdoor classrooms are suitable.

The interviews were conducted face-to-face with the participants who wanted to contribute to the study voluntarily. Interviews were conducted at different times with each participant. Questions were conveyed before the interview for the participants' information about the subject. At the beginning of the face-to-face interview, information was given about the purpose of the study. It was ensured that the data obtained would only be used for scientific purposes. And personal information would never be shared. The interviews were recorded through a voice recorder with the participants' permission to facilitate the analysis of the data obtained during the interview and to prevent data loss. Each interview took an average of 20-25 minutes. After the interviews, the audio recordings were deciphered and arranged in the Word program, and the analysis phase was started.

During the analysis phase, the data containing the ideas used and repeated by different participants were determined, codes were created, the codes were arranged in clusters according to their standard meanings, each set was transformed into a category, and the coding sequence continued until a new class did not emerge. Categories are also grouped under a theme. More abstract and general themes are essential in showing the research problem's dimensions. By developing the abstracted themes and the ideas they express, an exemplary outdoor classroom model has been tried to be created.

2.3. Validity and Security

In qualitative studies, research must be valid and reliable at a certain level to be accepted. Determining the validity and reliability of the data collection tools, research design and data analysis used in the research affects the study's credibility and degree of acceptance. Although there are different measurement methods for the validity and reliability of quantitative research, it is impossible to determine the validity and reliability of qualitative research (Guba & Lincoln, 1994; Shenton, 2004). In this context, data collection tools were developed by taking the opinions of experts (3 academician architects) to ensure the content validity of the interview questions about the validity-safety of the study, and the researchers finalised them. To prevent the wrong transfer of data that may arise from the subjective interpretations and assumptions of the researcher, two participants, a teacher and an architect, were given interview analysis, and they approved that their statements were written correctly. In another application, themes and codes related to the validity-security of the study were

reviewed at regular intervals, errors were better recognised, and necessary adjustments were made. In addition, experts who had little contact with the participants and could interpret the findings were consulted to organise the research, name the determined themes, and evaluate the relationship between the theme and the code.

3. Findings

In this part of the study, the answers given by the participants in the semi-structured interviews were analysed with an inductive method and firstly converted into codes, then into categories and finally into themes. Table 3 was obtained when the emerging themes were associated with the research questions.

Table 3. Themes created according to data analysis

Questions of Inquiry	Themes
Opinions on physical and functional aspects of school gardens	Physical Aspects Functional Aspects Security Location Image
Opinions on the purpose of use and characteristics of high-quality school gardens	Functional Aspects Relationship with interior spaces Relationship with nature Spatial Organisation Typology of Spaces Equipment Structure and design of floor Universal design Plant-based design Physical aspects Security Being non-distractive
Current knowledge and ideas of participants in outdoor classrooms	Knowledge source Differences compared to indoor classes Evaluation of its current state in Türkiye
Opinions on the possible effects on students	Effects on cognitive development Effects on psychomotor development Effects on affective development Effects on social development In the cases of natural disasters and pandemics,
Opinions on motivation to have lectures in an outdoor classroom	Motivation to have classes in an outdoor classroom
Lectures and education levels compatible with outdoor classrooms	Education levels Lectures
Opinions on qualities of an ideal outdoor classroom	Type Quantity Design principle Functional aspect Order of sitting Equipment Type of equipment Material of equipment Location Border Type of border element Cover type Characterisation Relationship with nature Design methods for the future

3.1. Views on the Physical and Functional Conditions of School Gardens

As a result of the evaluation of the answers given by the participants, their views on the physical and functional conditions of the school gardens in the region they live in were grouped under five themes: physical features, functional features, location, security, and image. These themes and their codes are presented in Table 4.

Table 4. Participants' opinions on the physical structure and functionality of school gardens in their region

Themes	Codes	Frequency (f)
Physical aspects	Structure of hard floor	10
	Inadequate/Missing garden size	5
	Inadequate/Missing natural areas	5
	Inadequate/Missing equipment	5
	Typical projects/Linear organisation	4
	Using of colours	1
	Type/amount of garden	1
	Inappropriate design and layout on the field	1
	Improper design in the context of climate/Missing covering	1
Functional Aspects	Inadequate spatial diversity/Fewer options	16
	Inadequate functionality	6
	Vague areas	4
	Two-dimensional organisation	2
	Using as a parking lot	1
	Inappropriate to the seasons of the area	1
Location	Urban location	5
Security	Using as a bus-stop area	3
	Situated in a congested urban location.	2
	The inadequate connection between different heights	1
	Hard floor	1
Image	Value	1

As seen in Table 4, the 'physical properties theme' consists of 'hard ground structure', 'insufficient garden size', 'lack of green space', 'lack of equipment', 'type project/uniform arrangement', 'use of colour, type/number of gardens', 'unsuitable layout/design for the land', 'high garden walls', 'unsuitable for climate/lack of top cover' codes. On the subject of 'hard floor structure', emphasised the most, the participants stated that the floors of the school gardens consist of cold-looking hard material coatings such as concrete and asphalt. Regarding the insufficient garden size, the participant with the code A7 stated as follows:

> "*Especially when the physical and functional conditions of the schools in and around Trabzon are considered, it is seen that they are designed and even tried to be located in an inadequate area with limited facilities as far as I can see. It is insufficient to meet the demands of schools to grow, open, semi-open, and closed spaces during the parcelling.*"

This statement shows that school gardens must be qualified to meet present or future needs. 'Lack of green space' means the green area is almost non-existent, and the user's access to the existing green areas is blocked or prohibited. With the statements under the heading of 'lack of equipment/inadequacy', the participants stated that the equipment did not support the development of children, did not attract their attention, and showed standard features. 'Typical project/uniform arrangement' is another subject that the participants complain about. Accordingly, school gardens consist of uniform arrangements similar to each other, such as school buildings. Regarding this issue, the explanation of the participant coded A1 is as follows:

> "*Because all the schools we see around us are similar, just like typical projects, schoolyards always look alike. But they do not differ much from each other functionally.*"

The most emphasised issue regarding school gardens' 'functional features' is 'insufficient spatial diversity/to offer too few options.' The participants stated that the buildings were planned functionally, whereas the school gardens were designed with minimum spatial diversity and more as a gathering and ceremonial area. In this regard, the following statements of the designer with A2 code are included:

> *"In schools, children go out to the schoolyards during breaks. They do not have a job to do. They run wildly, throw away their energy and go inside. There is no other activity because there is no arrangement or opportunity to offer it. The child is just running there, maybe going to the canteen, going out, running, nothing else. Since the ceremony areas are show areas, they are not designed for different events."*

Another issue that most participants agree on about school gardens is 'functional inadequacy'. Due to the limited number of equipment and insufficient physical properties, school gardens offer the opportunity for very few actions that students need and want to do. 'Undefined areas' is a problem only architect's address. Within the scope of this problem situation, the participants expressed that the school gardens are just a void and that there is no regulation to encourage or guide the students. The thoughts of the architect with code A1 regarding this issue are as follows:

> *"… we see that children construct a game they will create in their minds in line with their dreams, in any place not defined for them, not for the planned games. For example, no such area exists for children who want to do an activity with their friends outside. Any part of the school, the children themselves transform that space."*

'Location' is a common theme that teachers and designers emphasise. Under this theme, the location of the schools in the city was mentioned. Under the 'Security theme', the participants prioritised using the school garden as a parking area for the student buses and the vehicles belonging to the school staff, vehicle traffic, and the problems caused by the congested urban location surrounded by buildings. The concept of 'value', the only code under the 'image theme', is related to the fact that the value of the school garden still needs to be fully understood today.

3.2. Opinions on the Purpose and Features of Qualified School Gardens

As a result of interviews with teachers and designers, twelve themes in Table 5 regarding the purpose and characteristics of a qualified school garden were determined.

Table 5. Opinions on the purpose of use and characteristics of high-quality school gardens

Themes	Codes	Frequency (f)
Functional Aspects	Recreative/game activities	15
	Using to learning-teaching	12
	Using to socialisation	9
	Using to relax and resting	6
	Practice/plantation/hobby areas	5
	Individual use/Small group use	3
	Exhibition spaces	2
	Using to eat-drink	1
Relationship with Interior Spaces	Imagery connection	1
	Direct approach	1
Relationship with nature	Inside Nature	3
Spatial Organisation	Activity and gathering areas	4
	Organisation according to age groups	3
	Multi-functionality	1
	Creating sub-units	1
	Seating areas	1
Typology of Spaces	Amphitheatre	2
	Animal shelters	2
	Shadowed spaces	1

	Guest parking lots	1
	Welcoming areas	1
	Ceremonial grounds	1
Equipment	Water element	3
	Moveable spatial equipment	2
	Covering	1
	Being functional and secured	1
Structure and design of floor	Using natural areas	6
	Colourisation	1
Universal Design	It is appropriate to use everyone	2
Plant-based Design	Plantation/Forestry	5
Physical Aspects	Quality	1
Security	Distant with high-density human, vehicle and city areas	1
	Choosing secured material and plant	1
	Balanced isolation	1
Being non-distractive	Balanced communication with the environment	1

As seen from Table 5, according to teachers and designers, 'recreational/game activities' come at the top of their suggestions regarding the 'functional feature', one of the themes related to the purpose and characteristics of a qualified school garden. The views of the A1-coded architect on the subject are as follows:

> *"School gardens are an area where children meet outdoors. The primary function is to be used as an area where the children's need for activity and recreation can be met. Apart from that, areas may allow children to play planned or unplanned activities and games."*

For the same problem, the teacher coded T7 expresses his thoughts as follows:

> *"Considering that children spend most of their days at school, they should have a space to throw their energy away. There should be more useful activities than running for them to have fun and play. There should be areas in the garden to distract their minds after 40 minutes of classes."*

One of the suggestions teachers and designers emphasise most about the functional feature is using the school garden for teaching-learning purposes. In addition, according to the participants, this will support the lessons and significantly contribute to the students. For example, the designer with A1-code made a statement as follows:

> *"…. I think that schoolyards can be used not only for sports, games, and activities but also directly for course content. Apart from that, it is not only for those who are based on such practices, but also, for example, to be able to take painting lessons outside in the summer months. Taking lessons outdoors, such as an open workshop environment, can give children different skills and effects."*

Participants found the school garden's 'use for socialisation purposes' important. They emphasise that social and educational activities should occur throughout the school. The participants think that school gardens will be active in this regard. A5 coded participant expressed their thoughts as follows:

> *"Besides being open spaces, school gardens should serve as a qualified social space. It can be considered not as an intermediate space during breaks but a place for psychological relaxation, a kind of therapy space, and a place where it develops and strengthens social relations. These are things that develop the child socially, psychologically, and physically, as they develop both the psychology of the child -as well as the teachers' preparation for social life, his ecological and environmentally conscious perspective, his relationship with quality space and equipment, and his close contact with the landscape…"*

Teachers and designers defined the spaces where students can rest, read a book, and relieve their mental fatigue during extracurricular hours, with 'use for resting/relaxation'. They also described school gardens supporting students' discovery and learning by doing, with 'application/plant growing

/ hobby areas. This statement is how the designer with code A1 explained their view on the practice/plant growing / hobby areas in the school garden:

> *"For some courses, application areas can also be used directly with educational content. So, a science lesson can be held in a green area there. We used to plant beans. We used to germinate our beans among the cotton. However, it can be carried out outdoors by spreading that growth event over time. For example, it is possible to get a product in a short time with a tomato seedling, or how the sun affects the growth time of parsley and how it affects the rain can be learned directly by using an outdoor environment such as a laboratory environment."*

In the 'spatial organisation' theme, 'group gathering, activity areas' has been a prominent suggestion. With this suggestion, the participants suggested that students should be involved in socialisation, collaborative learning, peer learning. In the 'ground structure and design' theme, giving more space to green areas is necessary instead of the school garden consisting of only hard ground. Similarly, the theme of 'vegetal design' was advocated to show sensitivity to green areas and afforestation by drawing attention to the positive effects of the green element on children and adults.

3.3. Participants' Current Knowledge and Opinions on Outdoor Classes

The data on the knowledge and opinions of the participants about the concept of the open-air classroom, which is the main subject of the study, were discussed in three themes: 'source of information', 'difference from the closed classroom environment', and 'evaluation of the situation in our country' and presented with the codes contained in Table 6.

Table 6. Current knowledge and ideas of participants in outdoor classrooms

Themes	Codes	Frequency (f)
Knowledge source	Creating ideas	6
	Model projects	4
Differences compared to indoor classes	Concentration problem	5
	Having natural lighting, ventilation	3
	Being more free	2
	Classroom administration	2
	Having an awareness of nature	2
	Having more options	1
	Address the individual needs and creativity of students.	1
	Being non-distractive	1
	Direct relation with nature	1
	Freedom of seating/Freedom of listening position	1
	Being flexible and transparent	1
Evaluation of its current state in Türkiye	Inadequate	3
	Not appropriate for the education culture	1

Teachers and designers mainly presented their knowledge of the open-air classroom by 'generating ideas'. A group of architects also stated that they knew open-air classrooms thanks to the 'exemplary school projects' they examined. In another theme, "the difference between open-air classes and closed classrooms", the participants mainly emphasised "focus and concentration problem". The following statements of T1 and A4 coded participants are examples of this judgment:

> "An environment where primary school students can easily be distracted…. Because primary school children can be distracted quickly, they can focus on other materials quickly. In other words, even in a closed environment, 15 people can look out the window simultaneously, even at the sound of a flying bird or a crow." (T1)

> "If there are other objects in the open air that can distract him, then he may not want to work, so he may have trouble focusing." (A4)

It is seen in Table 5 that the participants expressed many positive qualities, while a negative feature about the difference between open-air classrooms and closed-class environments stands out. One participant stated that outdoor classes are 'attention-boosting'.

3.4. Views on the Possible Effects of Outdoor Classes on Students

The opinions of teachers and designers on the possible effects of outdoor classrooms on students are gathered under five themes, and their content is summarised in Table 7.

Table 7. Participants' opinions on the possible effects on outdoor classroom students

Themes	Codes	Frequency (f)
Effects on Cognitive Development	In situ learning, learning with practice, learning with experiment.	6
	Permanent learning	5
	Motivation to learn.	5
	Contributing to academic success/achievement	1
	Creativity	
Effects on Psychomotor Development	Developing psychomotor skills	9
Effects on Affective Development	Providing a more accessible and peaceful environment	8
	Respecting and protecting nature	3
	Being away from technology	1
	Being self-confident	1
Effects on Social Development	Allowing being in a social space	4
	Having the potential to create effective interaction and communication.	2
	Expressing themselves comfortably	2
Using In the cases of natural disasters and pandemics,	Creating healthy environment	2

As can be seen from Table 7, the possible effects of outdoor classrooms on students according to the responses of the participants were examined in five themes: "effect on cognitive development", "effect on motor development", "effect on affective development", "effect on social development" and "use in natural disasters and pandemics". In the theme of 'impact on cognitive development', the participants stated that the outdoor classroom is a lively resource that offers substantial opportunities for 'learning by doing, experiential learning, permanent learning' thanks to its relationship with nature and the opportunities it has. The following statement of the educator coded T8 explains this situation as follows:

> *"Open-air classes will support learning in terms of a wide variety of learning methods, but a permanent learning method. It will be much more useful for children to internalise a small amount of knowledge by experiencing them rather than transferring pages of theoretical knowledge they will forget after a while. This concept of experiencing is the key concept that connects it with the outdoor classroom. Of course, learning by experience is also possible in closed environments, but there are more options in line with the physical qualities of the open environment."*

In the participants' opinions on the subject, some assumptions that learning by doing is more permanent than learning from books. In this context, the child can explore nature one-on-one in open-air classes, and learning will be more permanent and effective when the studies provide practice opportunities. With the same theme of 'motivation for learning', the participants stated that open-air classes would positively affect learning, lessons would become more fun, and students would be more enthusiastic about learning. On this subject, the educator coded S7 expressed the following thoughts:

> *"The child could come to the lesson positively. I think she/he will learn by having more fun in the environment with the bright, natural light and bird sounds compared to the education she/he will receive in a closed environment.*

It is another expected result that the qualities of outdoor classes that support activities and situations such as on-site learning, learning by doing, experiential learning, permanent learning, and motivation

to learn will also positively affect the student's 'academic development and success'. With the theme of "effect on psychomotor development" that emerged in line with the answers given by the participants, it was stated that the open-air classes provide the opportunity for different activities, encourage freedom of movement, and positively affect the nerves in the individual's brain with its fresh air, which will have positive results on the "psychomotor skills" of the student. The views of the A3-coded architect on this theme are given below:

> *"It is known that the positive effects of open air on physical and mental health are at the forefront of gains that require cognitive development. Children have a learning environment that will develop their fine motor skills in the open air. While their motor development is supported, they also show healthy social development as they can express themselves better.*"

Another possible theme of the impact of outdoor classrooms on students, which was reached as a result of interviews with teachers and designers, is "affective development." In the context of this theme, the participants emphasised that traditional learning environments in outdoor classrooms primarily destroyed the perception of limited space and controlling classroom management and offered users an environment where they would "feel freer and more peaceful". In this way, it is among the participants' opinions that students can focus on their work better and enjoy their activities. These positive effects on the child's psychology can also be reflected in their future life. The designer with code A6 states their opinion as follows:

> *These open-air classes seem more beneficial, ensuring children's self-confidence and safety and increasing their interest. So, think about it this way: there is a specific control in the classroom, there may be uncontrolled control outside, or maybe they are both under power and unaware of it. This position gives them confidence. So, they are watching me; are they watching me? Reveals their activities or actions without worrying or paying too much attention to others. Even if a child does it wrong, one may not say anything in the classroom, one is shy, one may not be able to act, and one may not realise what one wants to do, the situation is different with the energy given by the outside, it seems that one can act as he wants."*

Under the title of 'impact on social development', which is another remarkable theme regarding the possible effects of outdoor classes on students, the views of the participants on 'providing a social environment', 'easy interaction and communication', and 'expressing oneself well' come to the fore. Participants argued that such environments in the open-air support communication and interaction between student-student and student-teacher, thus raising individuals with substantial social aspects. With the last theme of this question tab, 'use in natural disasters and pandemics, the participants, which means that education and training continue without interruption with open-air classes, expressed the indirect effect of open-air courses on students. The teachers who participated in the interview were asked whether they would like to teach in the open-air classroom. All the answers given by the participants included positive expressions.

3.5. Education Levels and Courses for Which Outdoor Classes Are Suitable According to Participants

Both teachers and architects were asked which education level and courses the outdoor classrooms are suitable for, and the answers are summarised in Table 8.

Table 8. Participants' opinions on educational levels and lectures suitable for outdoor classrooms

Themes	Codes	Frequency (f)
Education levels	All levels	9
	Elementary School	8
	Secondary School	6
	Preschool	3
	Highschool	2
Lectures	Natural Sciences	9
	All lessons	8
	Fine arts, drama, music	6
	Social sciences and humanities	5

	Mathematics	3
	Physical Education	2
	Psychological Consulting	1
	Turkish	1

While most participants thought outdoor classrooms could suit 'all education levels', 'primary school level' was the second most frequently mentioned type. Those who prefer the 'secondary school level' constitute a substantial number. When evaluated in general, it was determined that these learning environments mostly appeal to younger ages. As a reason for this situation, the participants stated that the students isolated themselves from many things due to test anxiety in advanced age groups and focused only on the exam. The following statements of the teacher coded T5 explain this situation as follows:

> *"The child has a goal in high school; one is locked on that goal. In high school, they study exam-oriented in Turkish conditions. The child knows the value of a question there. That is why he struggles to learn them. So, if you take him out to nature, he sees him as a waste of time. Let that kid learn to learn in the garden, in outdoor classes. He should come to high school to experience the outdoor classroom."*

A1 coded designer drew attention to the learning types that vary according to age levels and stated that open-air classes would be more suitable for younger students (7-11 years old) who are in the concrete operational stage of cognitive development:

> *"Yes, I think that freedom is more limitless, more flexible applications, that is, more abstract thoughts can be more effective for groups of children in periods when information is not dense, but information that can be learned more concretely by seeing from the environment and knowingly is given."*

As seen in Table 8, the 'science' and 'all courses' categories stand out in the theme of 'suitable courses' for outdoor classrooms. 'Visual arts, drama, music' and 'social sciences' were the most cited subjects. According to teachers and designers, open-air classes offer the opportunity to gain knowledge by doing and experiencing more than closed classrooms in nature-related, practice-oriented courses such as science and life studies, where experimental learning is effective. For example, T6 coded teacher expressed this thought as follows:

> *"The science course has a curriculum related to the environment in the 4th grade. These classes can be associated with science lessons and subjects such as environment, nature, recycling, and materials. There can be life studies lessons because we can teach life studies by living."*

Most participants stated that all lessons could be taught in the open-air classroom with the appropriate arrangement and equipment preference according to the weather conditions and the studies. However, a teacher-intensive group of participants did not engage in painting, drama, music, etcetera and advocated that the open air motivates and inspires artistic lessons. The opinion that verbal tasks with social content can be handled easily in the open air has a remarkable rate.

3.6. Views on the Characteristics of an Ideal Outdoor Classroom

The answers given by the participants regarding the characteristics of an ideal outdoor classroom, which is the last question of the semi-structured interview, are grouped into fifteen themes and their contents are presented in Table 9 under the headings of theme, code and frequency.

Table 9. Participants' opinions on the qualities of an ideal outdoor classroom

Themes	Codes	Frequency (f)
Type	Extension of indoor classrooms	3
	Separate from Interior	1
Amount	Multiple	1
Design criteria	Flexibility	5
	Suitable to the seasons	4

	Preventing distractive elements	4
	Creating experiences to observe and explore.	3
	Allowing Freedom of Movement	2
	Zoning/Regioning/Creating sub-units	1
Functional Aspects	Kitchen/Preparing food and drinks.	2
	Individual/Small group Working Spaces	2
	Plantation	1
	Animal Care	1
Seating Order	Different from traditional seating order	4
	Amphitheatre seating order	2
Equipment	Flexibility/Transformability	9
	Nonstable/Moveable	3
	Suitable to activity	3
	Ergonomic	3
	Multi-purpose use	2
	Colourful	2
	Fixed equipment	1
	Protection from sun and wind	1
	Maintenance	1
Type of equipment	Technological equipment	3
	Not standardised equipment	3
	Cushion	2
	Musical Instruments	1
	Book spaces	1
Material of equipment	Natural, wooden materials	10
	Textile-based materials.	4
	Aluminum, steel materials	1
	Plastic based materials	1
Location	Not being close to the entrance area	3
	Sunny areas	2
	Defined, visible spaces.	2
	In front of the ground-level indoor classes	1
	Inside the school garden	1
Border	Openness/Closeness direction	4
	Flexibility	2
	Visual Continuation	2
	Endure to Sun and Rain	2
	Wooden Material	1
	Masonry Material	1
Type of Border Element	Moveable panels	3
	Glass/transparent surfaces	2
	Railing	2
	Plants	2
	Sliding Doors	1
	Equipment	1
	Low-levelled, hollow partition walls	1
	Curtain	1
Cover Type	Protection from sun and rain	6
	Natural/Wooden Materials	3
	Flexibility	3
	With transparent/steel, glass materials	1
	Creating defined spaces	1
	Height	1
Characterisation	Age Group	3
	Individual skill group	1
	Activities according to the education system	1
	Priority	1

Relationship with Nature	Inside nature, natural areas, soil, ground	3
Design methods for the future	Modeling/Prototyping	2

According to the answers given by the participants, in the context of the 'design principles' theme, flexibility, climate-appropriate design, and avoidance of distractions, in the 'seating arrangement' theme, different from the traditional seating arrangement, within the scope of the 'equipment' theme; flexible/transformable, in the theme of 'reinforcement material'; natural, wood material, textile-based material, in the theme of 'border'; the aspect of openness/closure, in the 'top cover' theme; protection from sun and rain have been the most repeated recommendations for an ideal outdoor classroom.

The design principle of 'flexibility', especially mentioned by the designers, means that the outdoor classroom is equipped and arranged in a way that allows different activities to be carried out alternately. The landscape architect with the code LA1 explained his thoughts on flexibility with the following words:

> *"Not all children are equally prone to the same activity. Spatial arrangements should be made in open areas where children can do different activities depending on their wishes."*

Teachers willing to teach in the open-air classroom emphasised that the outdoor classrooms should be 'designed by the climatic conditions' to realise their desires. It has been stated that dispensers can be easily used in outdoor classrooms in all four seasons when necessary, and precautions are taken against climatic conditions such as rain, sun, snow and cold. Again, another issue that teachers focus more on is 'the prevention of attentional elements.' Outdoor classrooms are much richer visually and audibly than indoor learning environments. While this may positively affect the student, it can distract the user. In this context, the participants especially drew attention to the issue of noise isolation.

On the subject of 'spatial organisation', teachers and designers propose a layout for outdoor classrooms where students can sit on a chair or a mat whenever they want, different from the traditional sitting arrangement arranged side by side or back-to-back, and it can be transformed according to need. The most mentioned issue by the participants is about ‘equipment’, one of the critical elements of learning environments. It has been a flexible/transformable feature consisting of detachable and detachable modular blocks that develop the child's creativity, are unstructured, and provide the opportunity to use according to the child's needs. The participant's views on this situation are explained in detail by the M6 coded designer's statements:

> *"As equipment, there are wooden toys, wooden blocks, prisms. In general, if the equipment is something like that, they are open-ended if they are not fixed. If there is a place where they are stored, if the children go and pick them up when they need them, they can organise them according to their activities. Following their ergonomics, it can be light, simple, perhaps hollow, added, multiplied, or added to form a whole at certain heights. Maybe it will be used for sitting. It could be used for doing something else. If the table is already made up of blocks, as if it is on a chair, it will not have a specific function. Whether you get on it or sit down, you can do whatever you want, and it defines its function by itself. This situation also improves the creativity of the child. In the opinion of experts, do not buy ready-made toys for your children. Buy them elements they can play with, deal with, and reveal their talents. Then, inevitably, their imagination develops. They already have that talent."*

Another issue that draws the most attention to reinforcement is 'material.' As reinforcement material, both teachers and designers use natural wood. While emphasising the preference for 'sourced materials', the use of textile-based materials is another type of material mentioned by the participants. In the interviews, 'wood' is the most said material because it is related to nature, gives a feeling of warmth, and does not harm the environment and user health. The view of the designer with the code M6 is the summation of the statements of all the participants regarding the material:

> *"Wood-based material should be preferred as material. Natural wood would be more reliable for children. Natural material makes more sense both visually and tactilely; it is less harmful to children, that is, metal can harm a child. So, its damage may be more than that of wood."*

In the border theme, which effectively transforms open-air classrooms into a defined space, the participants emphasised that the learning environment should not be completely open or closed on all four sides. Nevertheless, there should be a border regarding the 'openness/closedness aspect'. For example, the designer with code A1 offered the following statements about this situation:

> *"I think that a border should be brought. It is partially open on all four sides. And it needs to meet with the school garden more flexibly so that one or two sides can be opened completely. Other surfaces are partially closed or with a border element; this can be a railing, another vertical component, or a curtain element. At least two sides should be opened more flexibly so that they can be opened entirely in a way that can expand.*

Another design proposal that designers emphasise is the 'protection from sun and rain' feature, related to the 'top cover' theme. Since the city where the study was conducted receives precipitation throughout the year, the participants were exposed to sun, rain, wind, etc. It was stated that a top cover that can protect users against natural conditions must be included in outdoor classes. In addition, the participants drew attention to the fact that this top cover is produced from flexible, designed and natural materials that can adapt to changing needs, as in the reinforcements.

4. Conclusion and Recommendations

The answers to the research questions by the teachers in the role of educators and the designers who shape the physical environment in the interviews were analysed. The participants' complaints, opinions and suggestions about the school gardens and open-air classrooms were determined. In the evaluations, it has been determined that there are no significant differences in the views of the participants from different disciplines that affect the quality of education and that they even support and complement each other. In particular, the teachers, the primary users of educational buildings, have experienced the place one-to-one, constantly observing the students, knowing their needs better by communicating, and presenting many problems and suggestions to the designers about the learning spaces—architects, interior architects, landscape architects, etc., who design the physical environment. No matter how experienced the actors are in their profession since they cannot be the primary users of all building types, their experience of spaces with different functions may be insufficient for their designs from time to time, and they cannot master the tasks and requirements of the building as much as the active users. This situation brings to the agenda again how vital user-designer cooperation is and that user participation should be mandatory during the design phase of the projects.

The issue most frequently mentioned by almost all the participants in the evaluations is that the schoolyards in their area are physically and functionally quite inadequate, generally devoid of green spaces, and consist of a void with the appearance of hard ground. This problem is encountered in most of the school gardens throughout Türkiye. Vural & Yılmaz (2018), Aydın Türk et al. (2018), Yılmaz & Ertürk (2016), Karaburun et al. (2015), Safi (2022), Saygın & Güneş (2023), Aksoy (2021), and Başar (2020), there have been studies that support this conclusion. Most of the school gardens in our country have the same conditions, whether built by the state or by a private foundation, person or institution. Due to today's education policy-culture-curriculum and economic conditions, more attention is paid to the interior of educational buildings, and open spaces consist of a restricted, insufficiently sized space between the school building and the surrounding buildings, roads, surrounded by high walls. However, many researchers emphasise the importance of open-air and school gardens in the child's physical, cognitive, and emotional development. While Wells (2000) also argues that being in the natural environment supports the ability to focus and cognitive development, Towell (1997) states that it allows individuals to spend time both mentally and physically effectively in outdoor playgrounds designed according to children's age, growth, needs and interests.

Regarding activities in the school garden, the first thing that comes to mind is recreational/game activities. At the same time, the participants also emphasised the necessity of using a qualified school garden for learning-teaching and social purposes. Similarly, Yıldırım & Özyılmaz Akamca (2017) state in their study that children should interact with the resources of the natural environment, such as animals, plants and soil, and that outdoor environments should be integrated into education. Khan (2012) also states that open-air environments in primary schools will contribute positively to both the development of social-sensory abilities and learning. In short, according to the participants' opinions, an ideal school garden should not only be an environment where the child will play but also have a multifunctional use that offers the opportunity to learn and socialise. In this case, qualified school gardens in the study, intertwined with nature, containing green areas, a rich spatial diversity that can meet the characteristics and needs of different users, and other types of equipment are defined as environments.

Although there is no standard practice or study in our country regarding the outdoor classroom, which is the main subject of the study, the participants expressed the idea that outdoor classrooms would have positive effects on the cognitive, psychomotor, affective, and social development of users by generating ideas or as the basis of sample projects abroad. Khan (2012) also argues in his research that school gardens, which contain the spatial arrangement and functionality of different elements, can offer exciting and multifunctional environments to their users when combined with sensory stimulation and aesthetic quality and that a well-designed outdoor learning environment will support the development of the child in many ways. In addition, in cases such as the COVID-19 pandemic, which has affected our lives in recent years, or the natural disaster experienced by our country, which is in an earthquake zone, open-air classroom environments can be a solution for the healthy continuation of education.

Considering the opinions of both teachers and designers on the characteristics that an ideal outdoor classroom should have and the information obtained from the literature, sample design models have been tried to be developed within the scope of the study on outdoor classrooms.

Figure 1. Schoolyard design

In an idealised school garden with the findings of the study (Figure 1), Priority has been given to the fact that it does not consist of a large hard floor area; instead, it is supported with equipment that will help students' exploration read books, grow plants, green spaces, and support the development of children. In the designed garden, cover elements that can be used for four seasons and that can be transformed are used. With the lawn seating elements created in the garden, storage facilities were

provided, allowing students to store their materials. In addition, together with individual games, playgrounds that enable group work are designed.

Figure 2. The designed outdoor classroom

In the designed outdoor classrooms, the classroom, which allows storing solar energy with its semi-open top cover element, is closed, when necessary, with the screens inside and made suitable for weather conditions and classes with a climate-appropriate design (Figure 2). In the open-air class, different, within the scope of reinforcement theme, Removable-mountable modular blocks with wooden materials, which can be transformed, which are not structured, and can be used according to the child's needs, are used to develop the child's creativity.

The second model study connects the green area with transitions in the school garden on the hard ground. A shaded area was created for the children with the wooden structured cover element placed in the garden area and the sitting logs designed from the same material (Figure 3).

Figure 3. Second model school garden image

In the second model study, an outdoor classroom with indoor and outdoor connection was designed on both the ground floor of the education building (Figure 4). The open-air classroom, attached to the school building, is designed aesthetically in an integrated form with the structure. At the school, which is intended to be semi-open, openings created with different shapes and corridors that provide airflow are made on the side facades to allow seasonal uses.

Figure 4. Modelling of the outdoor classroom associated with the school building

In the designed open classroom, a layout was created with intelligent boards, seating units fixed to the floor and equipment that can be converted according to needs (Figure 5). The equipment placed in the classroom has been designed with a transformable feature consisting of unstructured, detachable modular blocks that improve the child's creativity. The setting unit transforms into a conversation area that is accessed by steps. A fun abacus area has been placed across the classroom for instructors and students.

Figure 5. Outdoor classroom interior image

In the school garden design, where the two sample models, designed in the light of the findings obtained as a result of the study, meet on common denominators, supporting the challenging ground areas with green texture has been determined as the priority criterion. The finding that green places are almost non-existent in the school gardens, and the users' access to the existing green areas is blocked or prohibited, has been reconsidered in case studies with large grass areas and appropriate plant design. School gardens have been arranged where students can relax, read books, grow plants, socialise, explore, and learn by experience. The designed exemplary outdoor classrooms are supported with flexible cover elements that can be adapted to weather conditions, and noise isolation is provided by preventing distractions in the garden area. The equipment used in the open classrooms consists of detachable modular blocks supported by natural material wood, allowing use according to the needs of children. The open-air classrooms associated with the ground floor classroom were modelled in the school garden area, with the model sampling independent of the school building.

Alternative education models for children in nature and outdoors have gained much more importance, especially recently. In today's urbanised environment, it is necessary to identify the application potentials of improved models of school gardens and outdoor classrooms. The atmosphere in which children live also plays a significant role in raising children who will be the architects of our future as individuals who are strong both physically and spiritually. It is undeniable that school gardens, where children spend most of their time, play an essential role in children's

mental and physical development, especially with increasing environmental problems and decreasing green spaces in urban areas. In addition, the vulnerability of a built education system around closed education has been revealed recently, with the COVID-19 epidemic experienced worldwide and the earthquakes in our country that had devastating consequences in 11 provinces. With the COVID-19 epidemic, schools ended face-to-face education to reduce the spread and prevalence of the virus, schools damaged in the earthquake were closed to education, and students and teachers had to switch to 'Distance Education'. In this context, open-air classes will contribute positively to the physical and mental health of the students as an alternative. Public and private schools should be encouraged to hold outdoor courses and incorporate classes into their official curricula.

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A Critical Review and Novel Classification Proposal for Kinetic Roof Structures

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Abstract

Kinetic structures have gained popularity in architecture and structural engineering due to their ability to meet environmental factors and user needs. Among these structures, kinetic roof structures hold an important place, as they are deployable and/or transformable structures that can change their forms between two or more different geometries. Various categorizations of kinetic roofs based on their material, mechanism, and geometry have been offered in the literature. However, in most studies, they are placed under the broader category of kinetic structures. This paper critically reviews existing classifications of kinetic roofs, highlighting their advantages and limitations. Subsequently, a novel detailed classification system for kinetic roof structures is proposed. The superiority, advantages, and shortcomings of this proposed classification are presented. A more comprehensive and tailored classification system for kinetic roofs is provided by this study, contributing to the literature in this area.

Keywords: *Kinetic architecture, kinetic roofs, movable roofs, deployable structures, adaptive architecture.*

Kinetik Çatı Strüktürleri için Eleştirel bir İnceleme ve Yeni Sınıflandırma Önerisi

Öz

Kinetik strüktürler, çevresel faktörleri ve kullanıcı ihtiyaçlarını karşılama yetenekleri nedeniyle, son yıllarda hem mimarlık, hem de inşaat mühendisliği alanlarında oldukça popüler hale gelmiştir. Kinetik çatılar ise, kinetik strüktürlerin bir alt kolu olarak, değişken geometriye sahip olabilmeleri, büyüyüp küçülebilmeleri ve açılıp kapanabilmeleri sebebiyle önemli bir yer tutmaktadır. Literatürde, kinetik çatıları malzeme, mekanizma ve geometrilerine göre ayıran çeşitli sınıflandırmalar bulunmaktadır. Ancak bu sınıflandırmaların çoğunda kinetik çatılar, daha üst bir çerçeve olan kinetik strüktürlerin bir alt kolu olarak ele alınmıştır. Bu çalışmada, öncelikle var olan kinetik çatı sınıflandırmaları eleştirel bir şekilde incelenerek, avantajları ve eksikleri ortaya konmuştur. Ardından, kinetik çatı strüktürleri için literatürde olmayan, yeni ve ayrıntılı bir sınıflandırma sistemi önerilmiştir. Daha sonra, önerilen sınıflandırmanın avantajları ve dezavantajları ortaya konmuştur. Bu çalışma, kinetik çatılar için daha kapsamlı ve özelleştirilmiş bir sınıflandırma sistemi sunarak, literatüre katkıda bulunmaktadır.

Anahtar kelimeler: *Kinetik mimarlık, kinetik çatılar, hareketli çatılar, yayılabilen strüktürler, adaptif mimarlık.*

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1. Introduction

Throughout architectural history, humans have endeavored to design and construct structures that can adapt to changing climatic/ functional conditions and meet visual/ aesthetic demands. In response to these demands, the concept of kinetic architecture has emerged (Megahed, 2016). Although there have been examples of kinetic architecture throughout history, it has become increasingly popular in recent years due to advances in computational design methods, mechanical and construction technologies, and developments in materials science. Additionally, the design and implementation of kinetic architectural structures require interdisciplinary cooperation between architecture, structural design, and mechatronics. This is because the structure must be both static and dynamically stable, and may require electronic control, making it more difficult to incorporate kinetic applications in structures compared to conventional stationary structures (Fouad, 2012; Megahed, 2016). The proliferation of these structures has been accelerated by the increasing diversity of design facilitated by parametric design and the ease of construction utilizing different smart materials and systems. These structures have numerous advantages over conventional stationary structures, including the ability to accommodate changing user demands, adjust lighting and ventilation, diversify the function of the space used, provide architectural aesthetics, and reduce aerodynamic loads (Phocas et al., 2020). In kinetic structures, one or more elements of the structure can be movable. Today, mostly facade and roof systems are used as movable elements while making kinetic designs. For example, kinetic facade systems can be designed to provide conditions such as thermal comfort, energy performance of the building, and user comfort (Yaman & Arpacıoğlu, 2021).

Two fundamental concepts for kinetic architecture research are deployable and transformable structures. While these two concepts have similarities and can be easily confused, there are minor but important differences between them. Deployable structures are structures that can transform from contracted to deployed positions and grow in size. They have two predefined positions and shape changes occur between these two forms. Transformable structures are also changeable and movable, but they are not necessarily deployable (Maden et al., 2019). Kinetic roofs are roof structures that can be deployable and/or transformable, changing between two or more geometries depending on their features. These features may differ depending on the system used. While some examples in the literature can carry loads in motion, others can only support loads in their stationary positions when opened or closed (Ishii, 2000). Kinetic roofs can be traced back to the Roman Colosseum. As technology in mechanisms and materials has advanced, the diversity of kinetic roof designs throughout history has also increased. Kinetic roofs allow the building or the space to be used differently for different purposes. These kinds of kinetic systems are generally designed to protect buildings, spaces, and/or users from external factors such as sun and rain. They also can be used to create indoor or outdoor areas in the building and/or space (Ishii, 2000). In the literature, many examples of kinetic roof structures can be found under the kinetic roof name or else (e. g. movable, convertible, deployable, transformable, retractable). When the examples of kinetic roof structures in the literature are examined, it is noticed that the design of these structures is diversified by considering many different features. These features are the main system/mechanism used, the auxiliary system/ mechanism that plays a role in the operation of the system, the materials used in these mechanisms/ systems, the working principle of the installed system or mechanism, the positions/directions of the designed kinetic roof structure during deployment/transformation.

Considering the studies published by different researchers in the literature, kinetic roof structures are categorized according to their properties. Categorizations were made by looking at different features such as the mechanism, system, material, geometry, and direction used. Although many features are considered, these classifications in the literature do not cover all kinetic roof structures. The aim of this study is to fill this gap in the literature by presenting a novel classification of kinetic roof structures.

2. Materials and Method

In addition to the use of many different methods in this study, the main method is a systematic literature review. Before the presentation of the novel classification of kinetic roof structures, which

is the aim of this study, a series of stages were performed. These stages are data collection, data analysis, analyses of the existing classifications, and definition of the gaps in the existing classifications. The methodology of the study is presented in Figure 1.

In the first part of the study, a systematic literature review is presented, these classifications are general classifications of kinetic structures. This literature review was done chronologically and helped to understand the evolution of classifications over time. During this systematic literature review, the keywords 'kinetic', 'adaptive', 'deployable', 'transformable', and 'movable' were used. This literature review has played a major role in understanding the approaches and methods used in the classifications of kinetic structures.

In the next step of the study, the classifications presented chronologically were analyzed sequentially. The methods and categorization methods used in these classifications are examined. As a result of this review and analysis, the deficiencies, limitations and shortcomings of the existing classifications were identified. By examining the examples of kinetic roofs with different materials, mechanisms, systems and geometric principles presented in the literature, the strengths and weaknesses of the current classifications have been gained.

After the examination and analysis of the existing classifications, the next step was to complete the shortcomings of the existing kinetic roof structure classifications. This includes making up for the lack of definition of kinetic roof structures in existing classifications. The variety of kinetic roofs has not been adequately defined in existing classifications. By identifying these gaps in existing studies, the study makes a more comprehensive proposal for understanding and classifying kinetic roofs. For this purpose, it aims to contribute to the relevant field in literature by proposing a more comprehensive and novel innovative classification system.

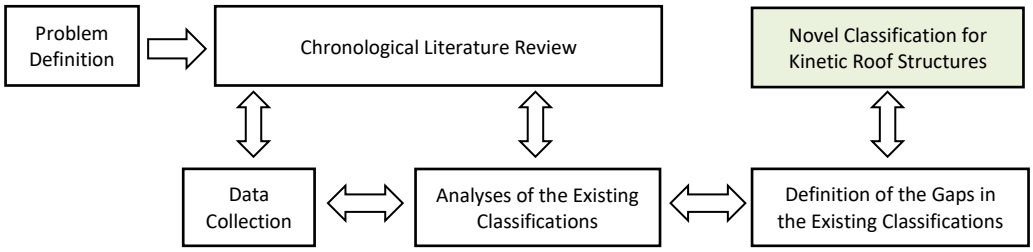

Figure 1. Methodology of the research

3. Findings and Discussion

3.1. Kinetic Structures Classifications in the Literature

In the field of architecture, the design and use of kinetic structures have increased considerably in the last century. With this increase, the interest in categorizing kinetic structures has also increased. In this part of the study, classifications of kinetic structures are given. The classifications are presented chronologically and observations on their classification approaches are presented.

One of the first attempts at classification was made by Merchan (1987). In his classification, he presented a system that divided kinetic structures into two main categories based on the geometry of their main elements, such as struts and surface structures. He then created subgroups based on the type of movement the structure exhibited, such as sliding, folding, and rotating.

Hinged systems were placed in the rotating category since they can only rotate. However, Merchan's classification did not take into account the function of the kinetic structure, such as whether it serves as a roof, wall, or furniture (Figure 2).

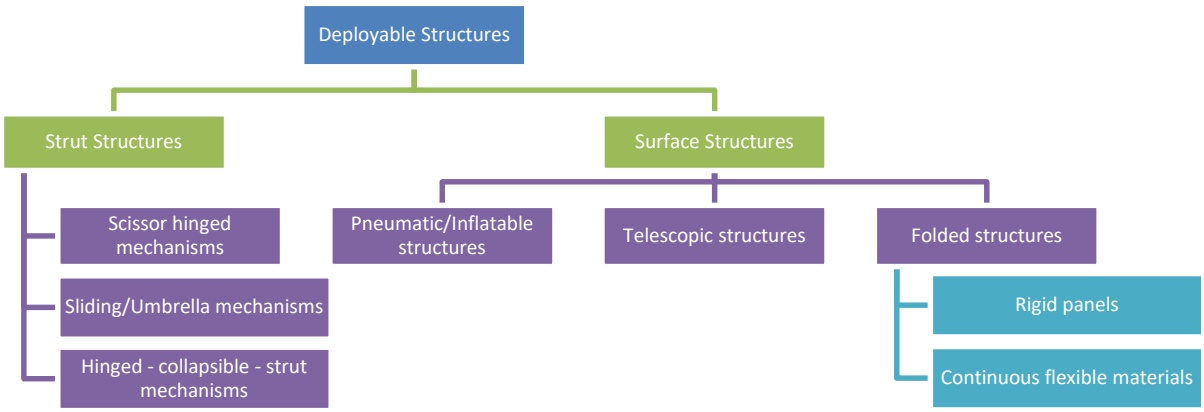

Figure 2. Classification (Merchan, 1987)

Gantes (1991) made another classification attempt, which focused on deployable structures. Gantes divided these structures into subcategories, as illustrated in Figure 3. However, upon a closer examination of the classification system, it becomes apparent that the distinction between the subgroups is not very clear. Gantes' classification system divides deployable structures into two initial subgroups based on their application area: earth-based structures and structures for space applications. Within the earth-based structures subgroup, the structures are further divided into subgroups based on their structural types, with the exception of retractable roofs. On the other hand, there is no corresponding subgroup created for structures designed for space applications.

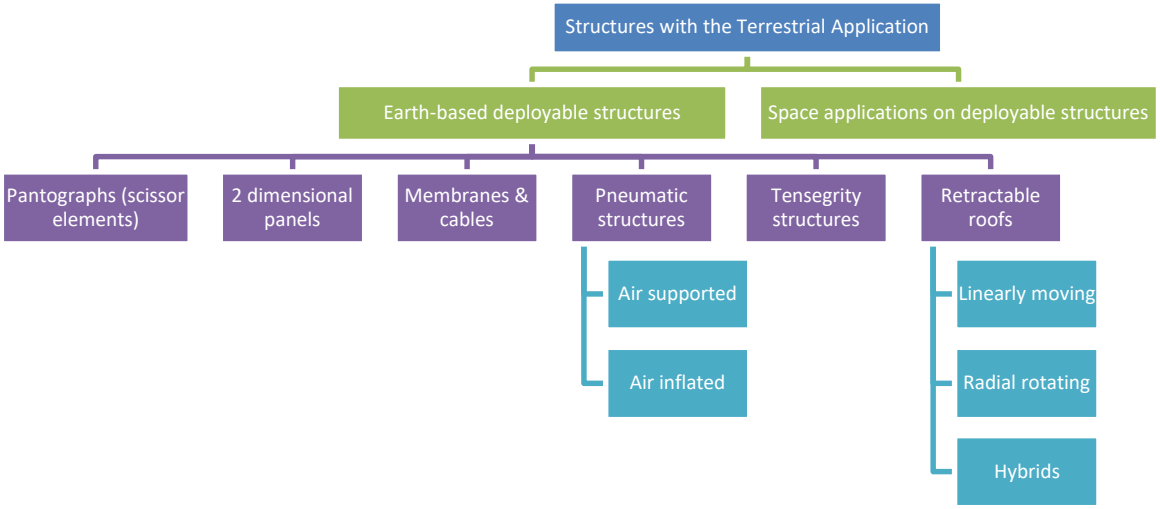

Figure 3. Classification (Gantes, 1991)

Félix Escrig is a notable researcher who has developed classifications for kinetic structures, as documented in his work published in 1996 (Escrig, 1996). However, upon closer examination, it becomes evident that Escrig's classification system has certain shortcomings, including the lack of clear distinction between the concepts of deployable and transformable structures across categories. Escrig's classification system includes eight categories based on the functions of kinetic structures, namely tensile foldable structures, foldable structures, retractable roofs, umbrella structures, mobile structures, tensegrity, and lifting structures, as depicted in Figure 4.

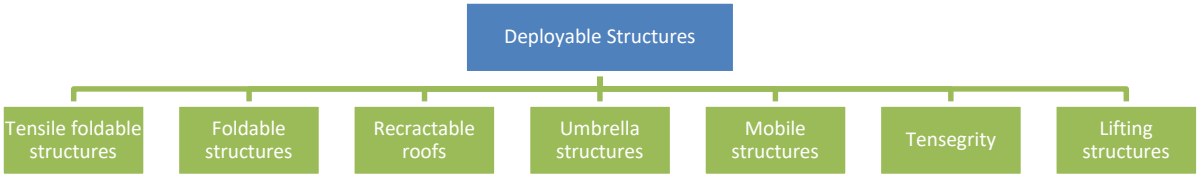

Figure 4. Classification (Escrig, 1996)

In contrast to Gantes, who based his classification on the application area, Pellegrino, a mechanical engineer, categorized deployable structures according to their mechanism and motion typology. In his work, Pellegrino introduced a classification system that divided deployable structures into seven categories based on their kinetic motions and mechanisms (Figure 5) (Pellegrino, 2001). These categories include coiled rods, flexible shells, membrane structures, structural mechanisms, tension truss antennae, rigid panels, and retractable domes. Further, the structural mechanisms category in Pellegrino's classification is divided into three subcategories based on the mechanism types. This classification system offers a more specific and detailed approach to categorizing deployable structures based on their mechanical components and functionality.

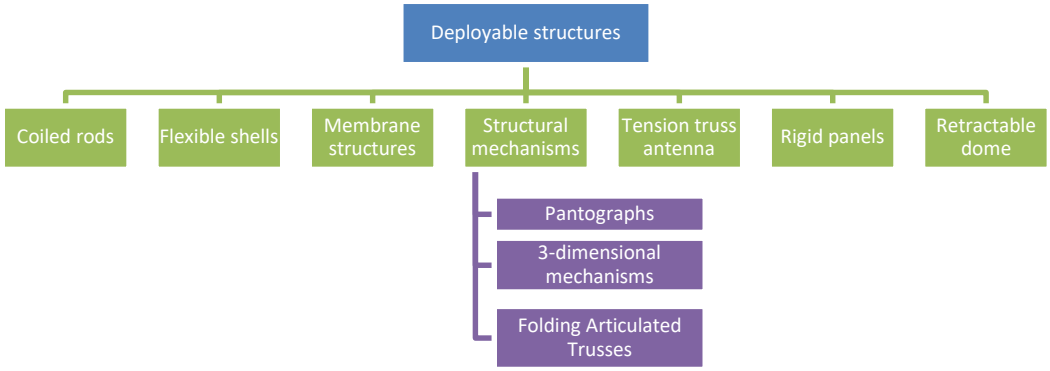

Figure 5. Deployable structures classification (Pellegrino, 2001)

In 2001, Hanaor & Levy (2001) collaborated to produce a new classification of deployable structures (Figure 6). In this classification, Hanaour and Levy mainly dealt with the geometry of the unit elements creating the deployable structures. In the figure, columns represent the morphological aspects and rows represent the kinematic features. Application types are not considered as a criterion for this classification. Both morphological characteristics and kinematic features fall into two main subcategories.

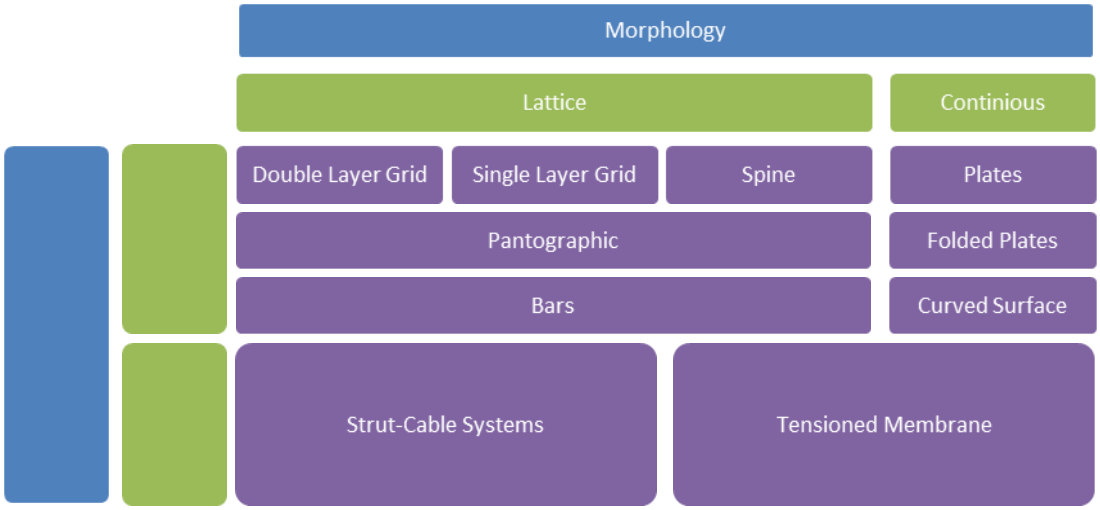

Figure 6. Morphological classification (Hanaour & Levy, 2001)

Koray Korkmaz, a researcher from the Izmir Institute of Technology, developed a classification for kinetic architecture, as seen in Figure 7 (Korkmaz, 2004). This classification system is a comprehensive framework that encompasses all kinds of kinetic architectural products, taking into account various factors such as the variability of geometry and movement, location, form, structure, and material. Korkmaz's classification effectively distinguishes between mobile structures and deployable structures, achieved by dividing the first subgroups into two categories: buildings with variable geometry and movements, and buildings with variable locations or mobilities. Korkmaz's classification is similar to the one proposed by Hanaour & Levy (2001), as they both classify

structures based on the distinction between "soft form and rigid form." Korkmaz's classification system also includes a further division of buildings with variable locations or mobilities into three categories based on their functions.

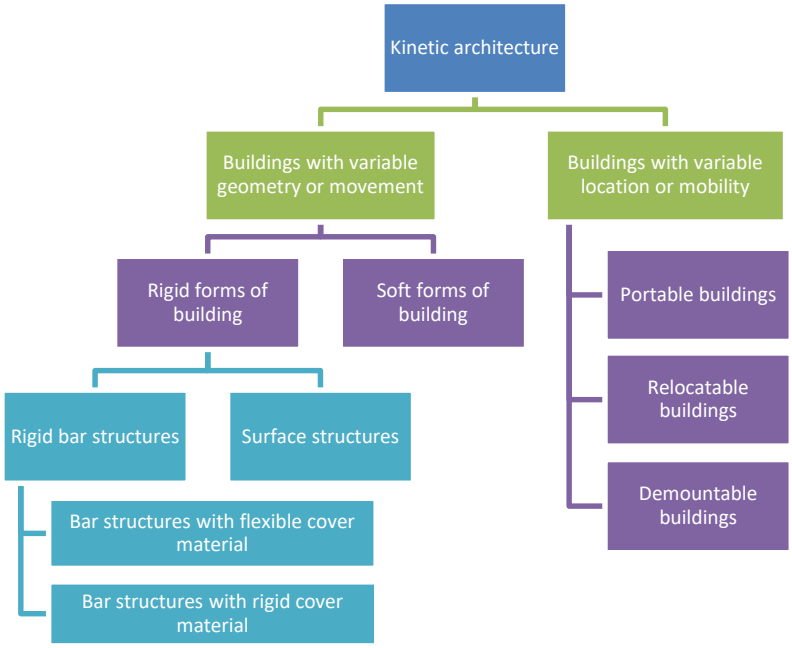

Figure 7. Kinetic architecture classification (Korkmaz, 2004)

In his study, Temmerman (2007) classified deployable structures by considering their structural systems. Temmerman's classification method can be schematized into four groups: spatial bars, foldable plates, membrane structures, and tensegrity systems as seen in Figure 8.

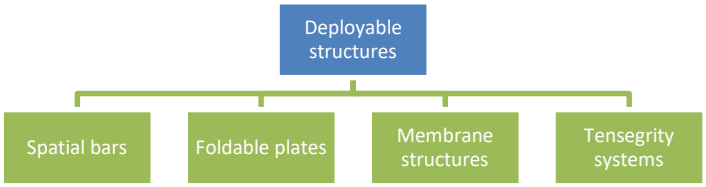

Figure 8. Deployable structures classification (Temmerman, 2007)

In Figure 9, Schumacher et al. (2010) have presented their classification of deployable structures based on the materials they are made of. They have distinguished between two categories: rigid and deformable materials. Rigid materials are further divided based on the type of movement they allow, either rotational, translational, or a combination of both. In contrast, deformable materials are classified based on the properties of the material, either flexible or elastic.

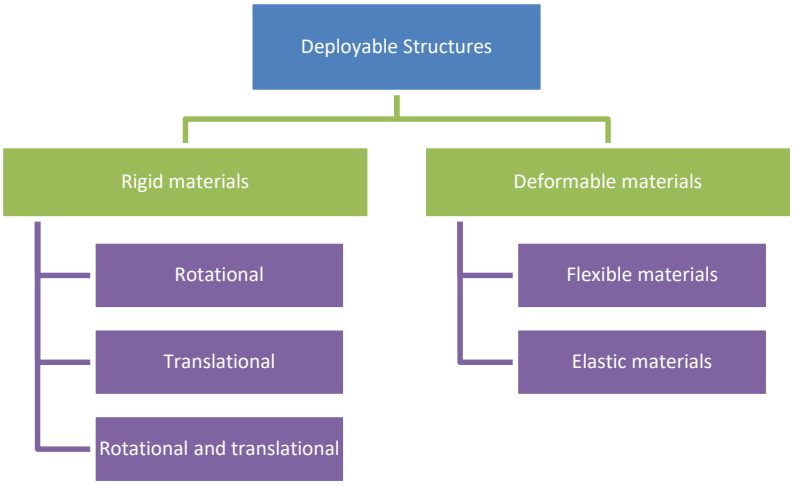

Figure 9. Classification (Schumacher et al., 2010)

In his publication, Asefi (2010) classified transformable structures, one of the subcategories of kinetic architecture. It is seen that more than one classification method is used in this classification. A three-level classification was created by considering material, function, structural type, and geometry as can be seen in Figure 10.

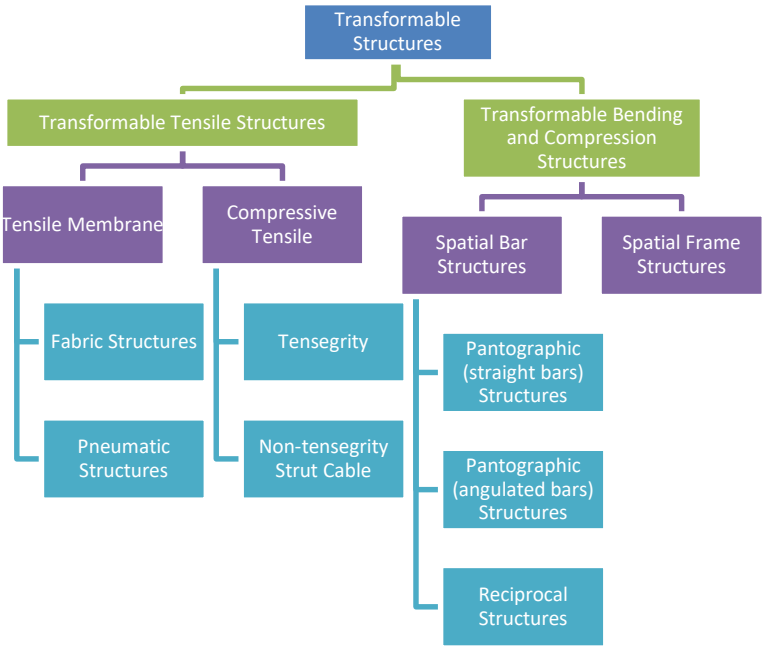

Figure 10. Classification (Asefi, 2010)

Stevenson proposed his classification in 2011, as seen in Figure 11. The physical transformations, which are position, size or shape change, position in space, and direction of transformation, constitute the main factors in Stevenson's classification. The disadvantage of Stevenson's study is that it is difficult for pneumatic mechanisms to find their place in this classification (Stevenson, 2011). The system to be classified in Stevenson's classification can be placed at an intersection in the categories of physical transformation and position in space and direction of transformation. For example, Stevenson listed the movements that provide physical transformation as the change in shape, change in size and change in position. The subcategories of the position in space and direction of transformation category are listed according to both their 2D and 3D properties and whether their patterns are centric or linear. Although shown in the table, a more flexible placement can be made in Stevenson's original classification.

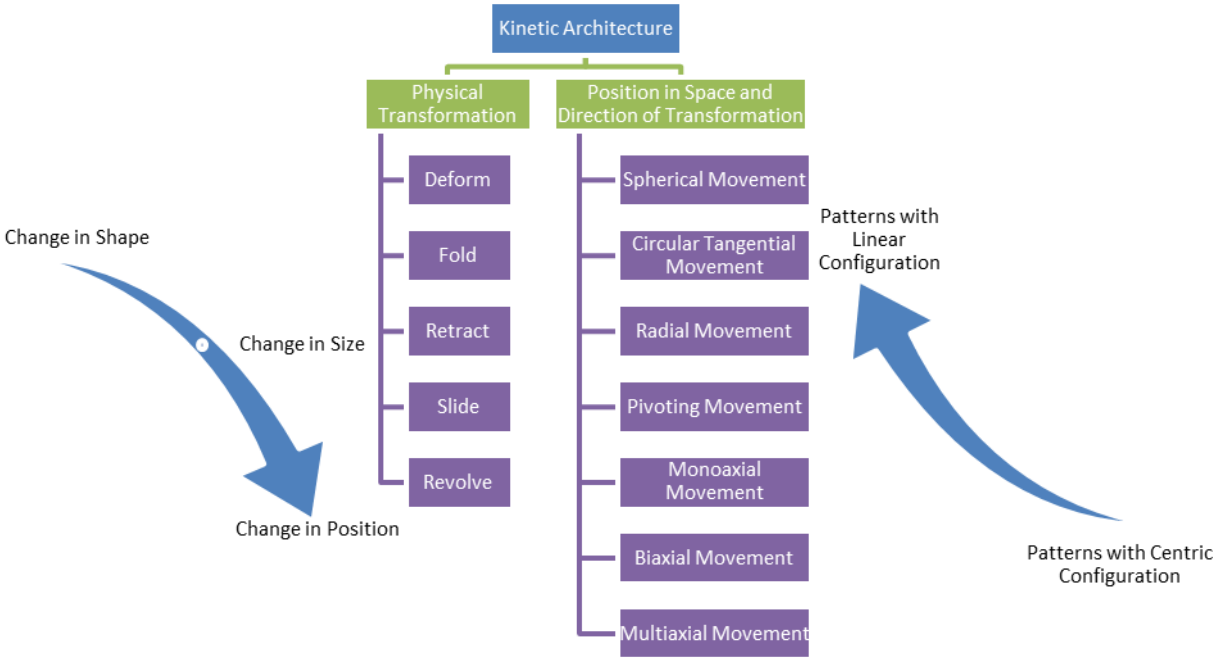

Figure 11. Classification (Stevenson, 2011)

Lee (2012) classified the structures that can change in his thesis. Structures with variable location, geometry, and/or mobility are discussed. In Lee's classification, these structures are divided into four according to their function and structural type. These are adaptable, kinetic, responsive, and transformable below in Figure 12.

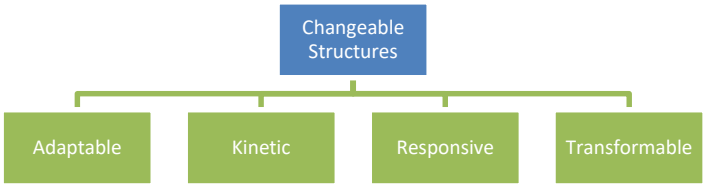

Figure 12. Classification (Lee, 2012)

In their classification, Del Grasso and Basso (2013) created subgroups not mentioned in previous classifications. Del Grasso and Basso used functions as criteria for their classifications. These are compliant mechanisms as a sub-group of deformable structures and morphing trusses as a sub-group of rigid links. The classification is schematized below in Figure 13.

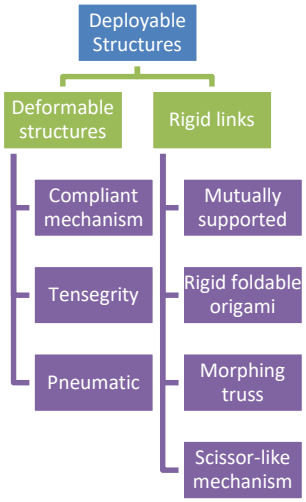

Figure 13. Classification (Del Grosso & Basso, 2013)

Rivas Adrover proposed a rather elaborate classification. At the beginning of the classification published in his book “Deployable Structures,” deployable typologies are divided into two main approaches. The first class is later divided based on their structural properties, and the second class is divided based on the inspiration of the structures. Unlike previously presented classifications, nature-inspired structures were also included. Flexible and combined groups have been added to the distinction between deformable and rigid in previous classifications (Adrover, 2015). This classification is seen below in Figure 14. Adrover mentions two groups named flexible deployable and combined deployable for topologies that do not belong to rigid deployable and deformable deployable components. She created subgroups under these four main groups, considering the inspired structural components. There are a few points that Adrover overlooked. For example, strut-cable systems are more appropriately presented in the subgroup of deformable deployable but presented as a subgroup of combined deployable. Adrover did not keep the examples she gave as belonging to general groups, but by specifying them, causing the classification to become more complicated.

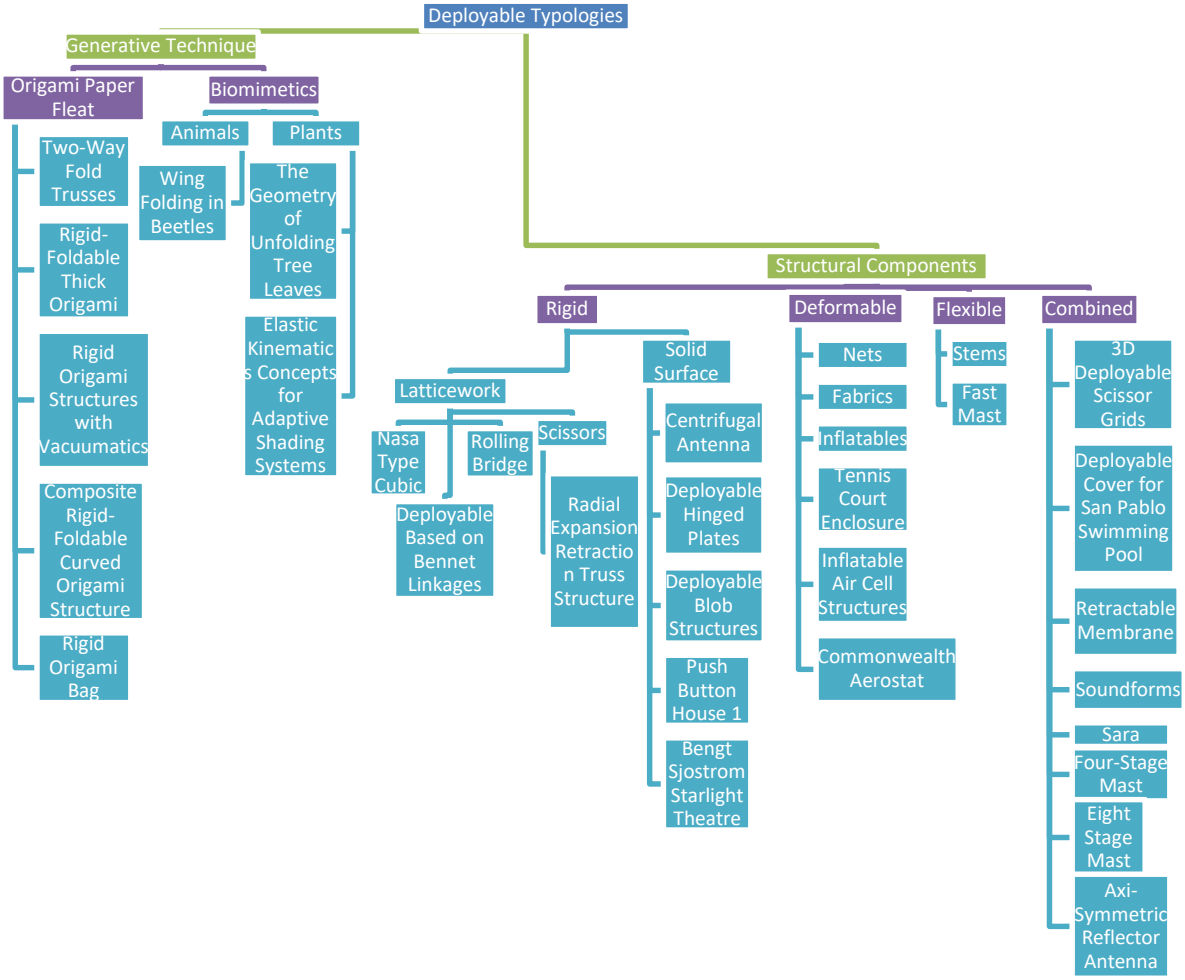

Figure 14. Deployable typologies classification (Adrover, 2015)

Kinetic roofs are a sub-category under the concept of kinetic structure. For this reason, although kinetic roofs are the subject of many studies in literature, they have not been explicitly classified by most researchers. There are several individual classifications proposed for kinetic roof structures. For example, Frei Otto and Berthold Burkhardt made a classification for retractable roofs in their article published in 1972, as seen in Figure 15. This classification has three main categories: "construction systems, types of movement, and directions of movement” (Otto & Burkhardt, 1972).

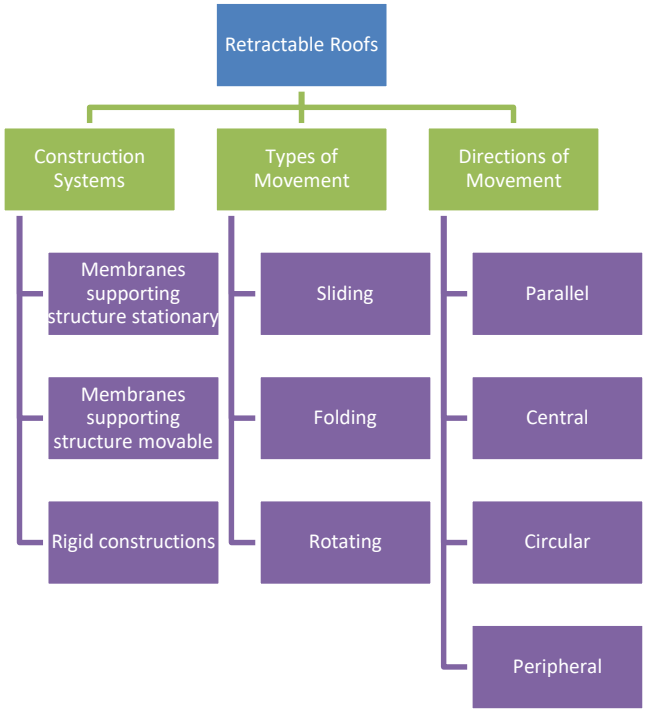

Figure 15. Retractable roofs classification (Otto & Burkhardt, 1972)

Otto and Burkhardt's classification of deployable/transformable structures is based on whether their supporting parts are stationary or movable. The classification system considers the type of roof, movement type, and direction of movement to create subgroups. Stationary supporting structures are classified under the membrane subgroup and further categorized based on their type and direction of movement. Similarly, movable supporting structures are also divided into subcategories using the same approach, as illustrated in Figure 16.

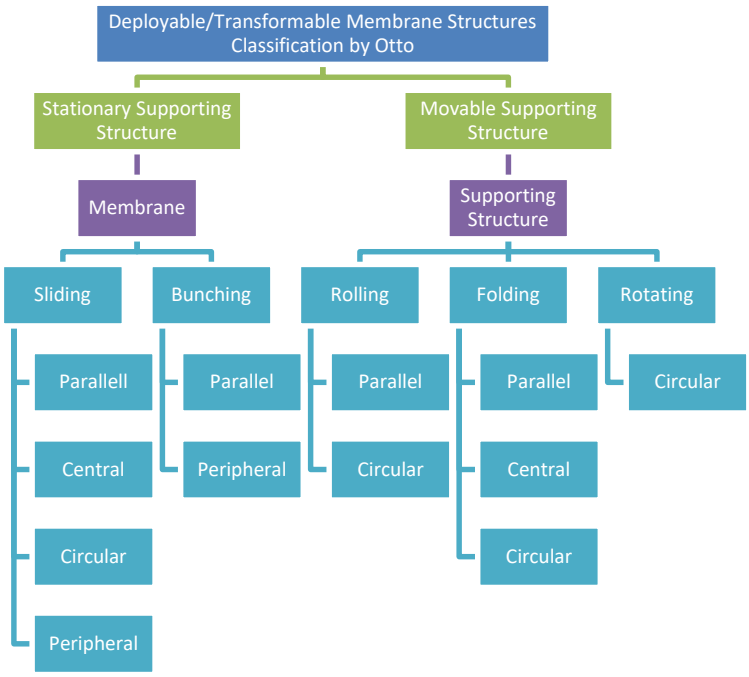

Figure 16. Deployable/transformable membrane structures classification (Otto & Burkhardt, 1972)

There are also classifications explicitly made for membrane kinetic roofs. In the 1950s, a team led by Frei Otto conducted many studies on kinetic membrane roofs and published a classification (Ishii, 2000). Deployable membrane structures were classified in the diagram below in the study by Mollaert (Otto & Burkhardt 1972; Mollaert, 1996). As in Otto & Otto & Burkhardt's calcification, supporting structures are divided into two according to whether they are static or movable. These

primary subcategories are then subdivided into secondary subcategories based on movement types (Figure 17).

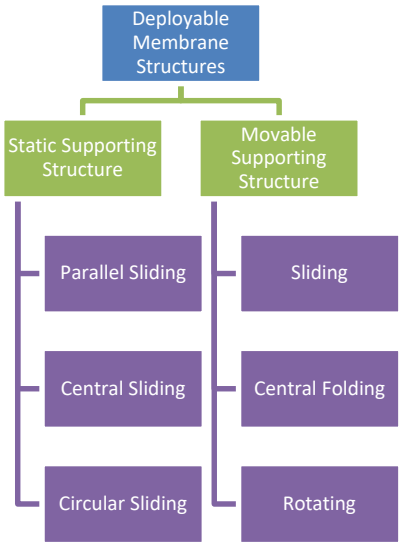

Figure 17. Deployable membrane structures classification (Mollaert, 1996)

3.2. Evaluation of Kinetic Structures Categorization: A Review of Existing Classifications

After examining various classifications of deployable and kinetic structures, it can be observed that most of them focus on kinetic structures in general rather than kinetic roof structures specifically. While there are some classifications that include categories for kinetic roofs, such as retractable roofs or deployable roofs, these can also be grouped into sub-categories based on their mechanisms, movement types, or materials.

For instance, in Merchan's (1987) classification (Figure 2), even though there is no specific category for kinetic roof structures, examples of such structures kinetic roof structures can be found in all groups of strut structures and in pneumatic/inflatable and folded structures groups of surface structures. Similarly, in Gantes' (1991) classification (Figure 3), although a special sub-group called retractable roofs is given for kinetic roof structures, kinetic roofs are also classified under other categories such as pantographs, two-dimensional panels, membranes and cables, pneumatic structures, and tensegrity structures.

In the classification organized by Escrig (1996) according to function and structural types, a subgroup called retractable roofs was created for kinetic roof structures, as in Gantes' work (Figure 4), but deployable roofs with folding movement are included in both the retractable roofs and foldable structures categories.

Pellegrino's (2001) classification (Figure 5) offers a more segregated order, with a separate category for the retractable dome subgroup that covers some of the kinetic roof structures and a classification system based on mechanisms and materials but in this classification, kinetic roof structures with different functions and structures are distributed into other subgroups.

Hanaour and Levy's (2001) classification (Figure 6) uses morphological and kinematic aspects to classify kinetic roofs based on mechanisms, materials, the rigidity of the material, and kinetic properties. Kinetic roof structures can find their place in all the overlapping groups.

In Korkmaz's (2004) classification (Figure 7), kinetic roofs can be categorized under the rigid bar and surface structures sub-categories. Temmerman's (2007) classification (Figure 8) divides structures into four categories, with examples of kinetic roof structures present in each category. Schumacher et al.'s (2010) classification (Figure 9) based on material and movement type, kinetic roof structures can be included in all subgroups according to their material and movement. It separates kinetic roofs using rigid materials such as panels from those using deformable materials such as membranes. Asefi's (2010) classification (Figure 10) separates only transformable structures based on forces on

the first level of classification and, after that divided into sub-categories based on structural types and functions. There is no special subgroup for kinetic roof structures, as in most of the classifications examined above. They can be included in subgroups according to their material, function, structure type, and geometry.

In Stevenson's (2011) classification (Figure 11) all subgroups were formed according to the movement type, it offers a system that allows for specific categorization of kinetic roofs based on changes in shape, size, position, and direction in space. In Lee's (2012) classification (Figure 12), generally changeable structures are divided into four basic categories depending on their functions and structural types. In Lee's classification kinetic roof structures may belong to one of these groups or to several at the same time.

Del Grasso & Basso's (2013) classification (Figure 13) generally classifies deployable structures, but kinetic roofs can be placed in both the deformable structures and rigid links sub-categories. Finally, Adrover's (2015) classification (Figure 14) is unique in that it is supported by examples and focuses specifically on deployable typologies. In Adrover's classification, only the structure type is considered. In this study with many subgroups, kinetic roof structures may be included in different subgroups.

The common features of all these studies are that they are general classifications and they have not been able to create sufficiently specific subgroups for kinetic roof structures as they try to group large types such as kinetic, deployable, transformable, changeable, etc.

Otto's retractable roof classification divides kinetic roof structures into groups according to important characteristics such as structure type, movement type, and direction. Another work of Otto, the classification of deployable/transformable membrane structures, although not specific to roof structures, is a sufficient classification to be used in terms of the approach of creating subgroups (Otto & Burkhardt, 1972).

As a result of all these findings, it is clearly seen that there is an insufficient number of studies in the literature for the classification of kinetic roof structures only by considering different features. Nowadays, the increase in design and use has increased the diversity of kinetic roof structures. This diversification has led to the need to classify and group these structures.

To summarize, Table 1 provides an overview of the different classifications reviewed, including the author, publication year, what is classified, and the criteria used for classification.

Table 1. Evaluation of existing classifications

			Classification methods					
Author	Year	Classification	Material	Function	Structural type	Movement type	Movement direction	Geometry
Merchan	1987	Deployable Structures	✓		✓	✓		✓
Otto & Burkhardt	1972	Deployable/ Transformable Membrane Structures			✓	✓	✓	
Otto & Burkhardt	1972	Retractable Roofs			✓	✓	✓	
Gantes	1991	Structures With the Terrestrial Application		✓	✓	✓		
Escrig	1996	Deployable Structures		✓	✓			
Mollaert	1996	Deployable Membrane Structures			✓	✓	✓	
Pellegrino	2001	Deployable Structures		✓	✓			
Hanaour & Levy	2001	Deployable Structures		✓	✓			✓

Korkmaz	2004	Kinetic Architecture	✓	✓	✓			✓
Temmerman	2007	Deployable Structures			✓			
Schumacher et al.	2010	Deployable Structures	✓		✓	✓		
Asefi	2010	Transformable Structures	✓	✓	✓			✓
Stevenson	2011	Kinetic Architecture				✓		
Lee	2012	Changeable Structures		✓	✓			
Del Grosso & Basso	2013	Deployable Structures		✓	✓			
Adrover	2015	Deployable Typologies			✓			

3.3. Proposed Classification for Kinetic Roof Structures

In the proposed classification seen in Figure 18, kinetic roof structures are divided into three main categories as membrane, rigid bar, and rigid panel, depending on the type of primary system used. Membrane kinetic roof structures are first classified according to movement type and direction. Rigid bar kinetic roof structures are classified according to the movement type. It is difficult to determine the direction of any movement due to the multi-directional nature of the system. Rigid panel kinetic roof structures are also classified according to movement type, direction, and whether there is an overlapping situation. Examples of all subcategories are in section 4.1.

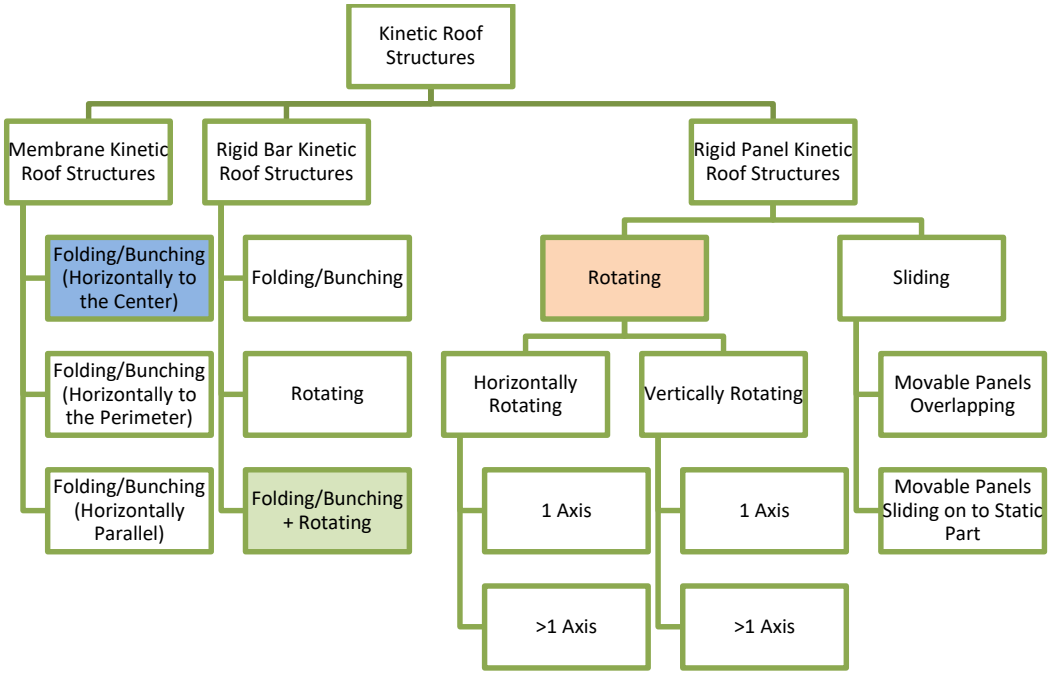

Figure 18. Proposed kinetic roof structures proposed classification

Although the proposed classification covers many of the deployable/ transformable roof structures, some kinetic roof structures can be grouped into more than one subgroup. As an example, umbrella-like kinetic roof structures are structures that serve the same function as a simple umbrella. The proposed classification divides umbrella-like kinetic roofs into three main categories: membrane kinetic structures, rigid bar kinetic structures, and rigid panel kinetic structures, as can be seen in Figure 19. There are also examples where these systems are used together (for instance, membrane+rigid bar used together for the same structure), so the classification is based primarily on which system is used. Since umbrella-like systems are highly popular and are the first examples of kinetic roof structure although umbrella kinetic roof structures belong to the marked categories of the proposed classification given in Figure 18, it is given separately.

When considering umbrella-like kinetic roof structures as an example, it becomes evident that a single system can belong to multiple categories. For instance, umbrella-like kinetic roof structures can be classified into three categories: membrane, rigid bar, and rigid panel. An example of a membrane umbrella-like structure is Mush Balloons, designed by Osaka (Otto & Burkhardt, 1972). Rigid bars are the most employed material for the mechanisms in umbrella-like structures. Frei Otto and Bodo Rasch not only provided design examples but also practical applications. The umbrella-like canopies at the Bundesgartenschau, the umbrella-like canopy structure for Pink Floyd's concert, the Schirm Prototype, the umbrella canopies at Medina Prophet Mosque, the three umbrella canopies at Al-Hussein Mosque, the umbrella canopies at Madinah Piazza, the Prototype U53, the four octagonal umbrella canopies at Schlossplatz, the umbrella canopies at Jeddah airport, and the umbrella canopies designed for Fort Worth Texas are all instances of rigid bar umbrella canopies (Otto & Burkhardt, 1972; Otto & Rasch, 1996; Nerdinger, 2005; Fournier et al., 2008; Michalski et al., 2011; Wikipedia contributors, 2022a; U53-Prototyp. SL Rasch, n.d.). Koray Korkmaz's architectural umbrella and Jaksch and Sedlak's foldable umbrella canopy serve as examples of rigid panel umbrella canopies (Korkmaz, 2005; Jaksch & Sedlak, 2011). When examining these examples, it becomes apparent that they may fall into different sub-categories as shown in the table presented in Figure 18. Similar to this example, various kinetic roof structure systems can be categorized into one or more specific categories.

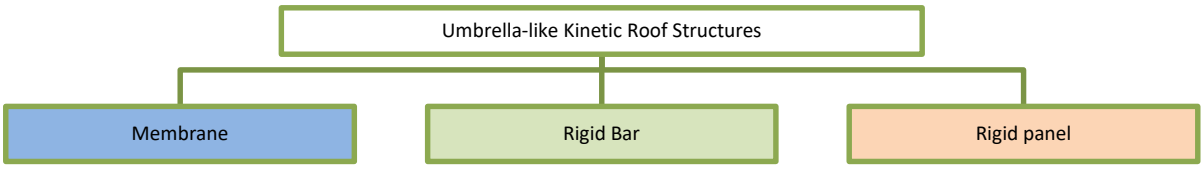

Figure 19. Proposed classification of the umbrella-like kinetic roof structures

3.4. Examples for Categories of the Proposed Classification

3.4.1. Membrane kinetic roof structures

Membrane kinetic roof structures are the first of the three systemic subcategories of the proposed classification. The membrane is a material suitable for kinetic roof design as it is light in structure and flexible enough due to the material (Mollaert, 1996). In addition, another advantage of the membrane material is its compactness, which provides ease of storage. In membrane kinetic roof structures, auxiliary elements are used to stretch the opening and closing of the membrane (Ishii, 2000). The membrane, which acts as a roof with the folding/bunching movement, can perform this movement in different directions according to the design.

3.4.1.1. Folding/bunching (horizontally to the center)

The Stureplan pavilion in Stockholm is an example of this subgroup (Figure 20). The membrane is supported by steel cables fixed on a circular steel beam. The structure is demountable and can be reassembled in 24 hours (Stureplan Pavilion, n.d.).

Figure 20. Stureplan Pavillion's membrane roof (Stureplan Pavilion, n.d.)

3.4.1.2. Folding/bunching (horizontally to the perimeter)

In 2000, Ozawa and Kawaguchi designed a membrane roof system for retractable roof systems. In the initial state, the membrane on a cylindrical geometry is twisted by rotating the rings in opposite directions (Figure 21). When folded, the membranes overlap and close, and the area formed by the membranes can be tensioned by applying internal air pressure. Another way to implement this process is the air-supported system. A single-layer system is created by replacing the cylinder rings with cables, and the internal air pressure is increased. The advantage of both methods is that they are easy to apply and have a simple structure, but the problem is the deformations that may occur in the membrane (Ozawa & Kawaguchi, 2000). Considering a round roof, it did not make sense for the membrane to fold out from the middle because the circumference of the round membrane would change at each point.

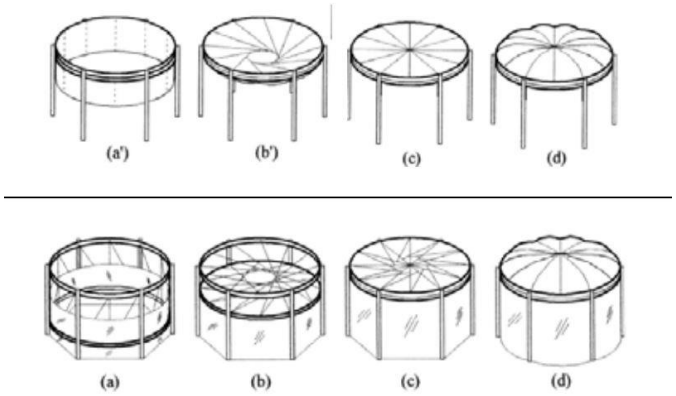

Figure 21. Cylinder membrane (Ozawa & Kawaguchi, 2000)

3.4.1.3. Folding/bunching (horizontally parallel)

The roof of Primorski Park's summer theater is another example of a horizontally parallel folding membrane kinetic roof See Figure 22). The system, which can be opened in about 20 minutes, consists of a PVC-coated polyester membrane and secondary element cables. The cables are fixed to the two-belt truss system (Wikimapia, n.d.).

Figure 22. Primorski Park Summer Theatre (Wikimapia, n.d.)

3.4.2. Rigid bar kinetic roof structures

Rigid bar kinetic roof structures are the second systemic subcategory of the proposed classification. Systems using rigid bars have started to be used and developed frequently in architectural applications. They can create kinetic arches, domes, and roof systems by combining them with auxiliary elements such as membranes and cables. These structures consist of tension and compression elements and are easy to transition from a flat configuration to different geometries. Movement can be achieved using actuators, motors, or compression elements. Rigid bar kinetic roofs, which can be classified according to the type of movement, are divided into three as folding/bunching, rotating, and folding/bunching + rotating.

3.4.2.1. Folding/bunching

The roof structure designed by Félix Escrig for a swimming pool in Seville, Spain, is a remarkable example of rigid bar kinetic roof structures with the movement of folding/bunching (Figure 23). He used two identical side-by-side structures with spherical curvature to cover the entire pool. The structure's skeleton is covered with a fabric that can fold/bunch together with the main structure (Valcárcel, 2022).

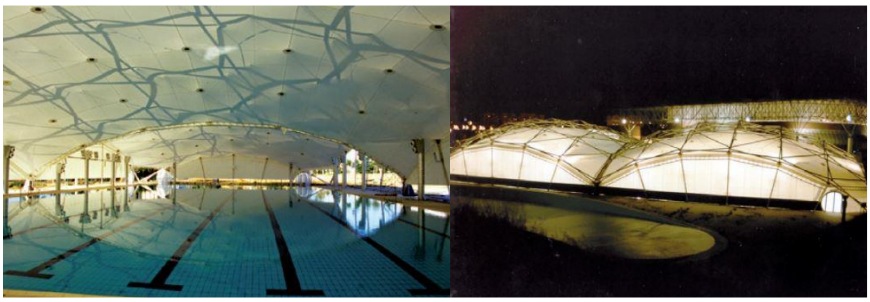

Figure 23. Roof structure for swimming pool (Valcárcel, 2022)

3.4.2.2. Rotating

The roof of the Emergency Call Center in St. Gallen, Switzerland, is an example from Santiago Calatrava (Figure 24). The roof system consisting of aluminum elements opens and closes with the rotating movement of these sequential elements. The structure consists of four-bar linkages, and they can move together thanks to the input link that connects these four-bar linkages (Korkmaz, 2004; Akgün et al., 2013).

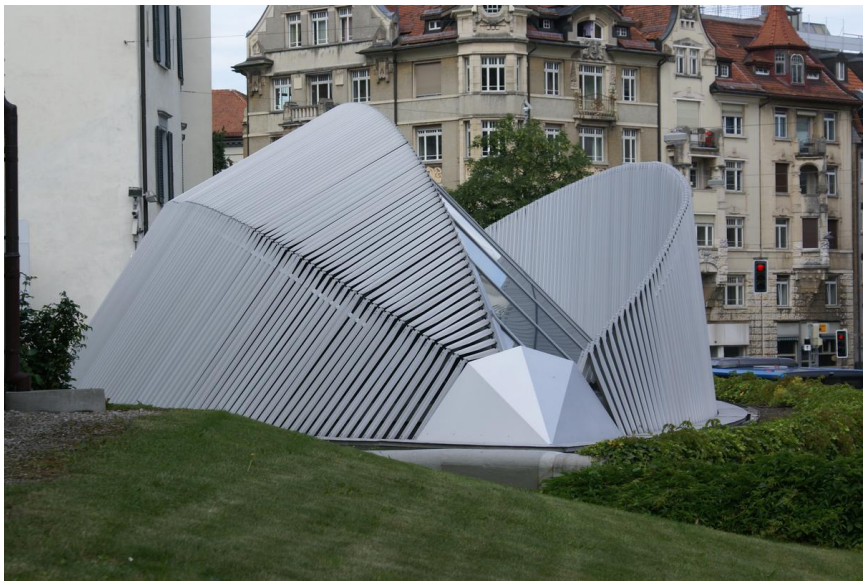

Figure 24. Emergency call center deployable roof (Santiago Calatrava Architects & Engineers, n.d.)

3.4.2.3. Folding/bunching + rotating

Natalia Torres proposed a deployable arch design in her Ph.D. work. She used articulated bars, folding panels, and a membrane in her deployable arch design (See Figure 25). The design has an opening system that prevents the rupture of the membrane. The system folds/ bunches while deploying and rotating on the horizontal axis (Torres, 2017).

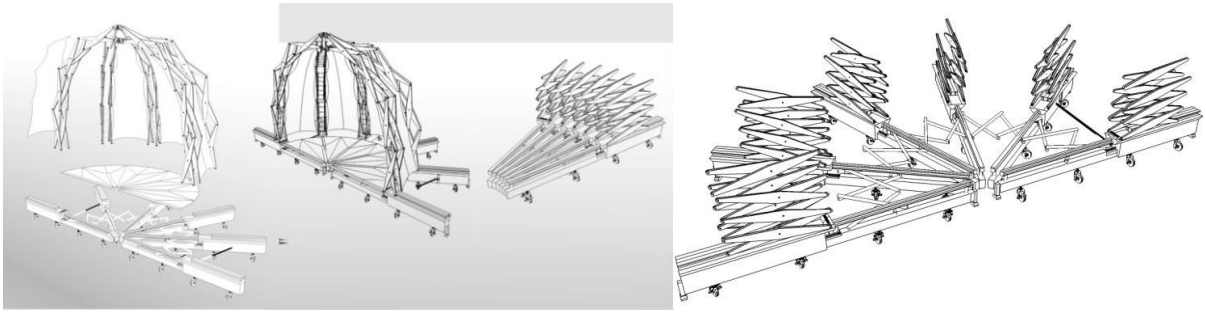

Figure 25. Deployable arch design (Torres, 2017)

3.4.3. Rigid panel kinetic roof structures

The last of the three systemic sub-categories of the proposed classification belongs to rigid panel kinetic roof structures. The number of kinetic roof structures composed of rigid panels has increased gradually since the middle of the 20th century. While the first examples were generally stadium roofs, the variety of uses has increased. Its use is quite common from past to present. Again, as in rigid bar kinetic roof structures, it is categorized according to the type of movement. It is also divided in itself again towards the direction of movement.

3.4.3.1. Rotating

a. Horizontally Rotating

Fukuoka Dome is an example of a kinetic roof with a horizontally rotating movement (Figure 26). It is opened by rotation on a single axis vertically. The roof can be completely open in about 20 minutes, spans 213 meters, and height is 84 meters. It consists of three panels, and when opened, it exposes 2/3 of the stadium (Tanno et al., 1994; Zaizen et al., 2000).

Figure 26. Fukuoka dome (Klook Singapore, n. d.)

Although the Fukuoka Dome rotates on a single axis, there are also examples that rotate on more than one axis. For example, Sapporo Media Park Spica.

b. Vertically Rotating

Merck Serono Headquarters is an example of a kinetic roof that rotates horizontally on the same axis (Figure 27). It has a 60-meter-long roof made entirely of glass (Werner Sobek, n.d.). Qi Zhong Stadium is an example of the kinetic roof with a vertically rotating movement, but on more than one axis despite the Merck Serono Headquarters.

Figure 27. Merck Serono headquarters (Werner Sobek, n.d.)

3.4.3.2. Sliding

a. Movable Panels Overlapping

The Rogers Center (formerly Skydome) is an example of a kinetic roof structure that moves horizontally (Figure 28). The kinetic roof, with a span width of 180 meters and a height of 86 meters, consists of one fixed and three movable panels. The roof, which can be opened in about 25 minutes, makes an overlapping sliding movement (Mohamed & Abu Elfadle, 2013).

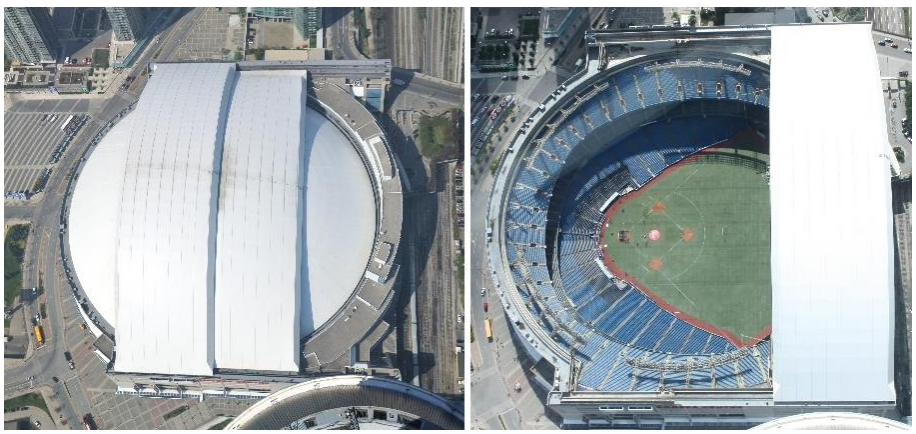

Figure 28. Skydome (Renamed Rogers Centre) (Urban Toronto, n.d.)

b. Movable Panels Sliding onto Stationary Part

Johan Cruyff Arena, formerly known as Amsterdam Arena, is an example of a kinetic roof that moves horizontally, where movable rigid panels do not overlap; instead, movable rigid panels slide over one or more of the fixed parts in the roof system (Figure 29). The roof comprises two main panels that can be opened in 30 minutes (Mans & Rodenburg, 2000).

Figure 29. Johan Cruyff Arena (Stadiumdb.com Stadium Database, n.d.)

4. Conclusion and Suggestions

There exist several classifications of kinetic structures in the literature of architecture, each of which offers unique perspectives and categorizations. While some of these classifications demonstrate similarities, they are still distinct from one another. Notably, few classifications specifically categorize kinetic roof structures, which suggests a need for a more comprehensive and dedicated classification system for this architectural element. This paper examines and interprets various classifications of kinetic structures and kinetic roof structures, including studies by Merchan, Gantes, Escrig, Pellegrino, Hanaour and Levy, Korkmaz, Temmerman, Asefi, Schaffer and Vogt, Stevenson, Lee, Del Grosso and Basso, and Adrover (Merchan, 1987; Gantes, 1991; Escrig, 1996; Pellegrino, 2001; Hanaor & Levy, 2001; Korkmaz, 2004; Temmerman, 2007; Asefi, 2010; Schaffer & Vogt, 2010; Stevenson, 2011; Lee, 2012; Del Grasso & Basso, 2013; Adrover, 2015). Furthermore, it also looks into Otto's retractable roof classification, the Institute for Lightweight Structures' deployable/transformable membrane structures classification, and Mollaert's deployable membrane structures classification (Mollaert, 1996). While all of these classifications include kinetic roof structures, they differ in how they categorize them. For instance, some classifications specifically distinguish kinetic roof structures as a subcategory or main category, such as Retractable Roofs, Kinetic Roofs, and Movable Roofs. However, other classifications do not have a specific category for kinetic roof structures and instead, place them under other categories such as material connected to the mechanism. Therefore, kinetic roof structures are often located under multiple categories in some studies. Overall, the lack of a dedicated and extensive classification system for kinetic roof structures, despite their widespread use in architecture, is apparent.

A novel classification system for kinetic roof structures is proposed, which aims to categorize them based on the system used for movement. The classification comprises three main groups: Membrane Kinetic Roof Structures, Rigid Bar Kinetic Roof Structures, and Rigid Panel Kinetic Roof Structures. Once the type of system is determined, further subcategories are established based on characteristics such as movement type, direction, and the number of axes where movement occurs. Each main category has several subcategories that help to differentiate between types of kinetic roof structures. For instance, the subcategories for membrane kinetic roof structures consider types of folding/bunching movements. Meanwhile, the subcategories for rigid bar kinetic roof structures take into account either folding/bunching or rotating movements. Rigid panel kinetic roof structures are primarily divided into two categories: rotating and sliding movements. The rotating movement subcategory is further divided into two according to the first horizontal or vertical, and these

subcategories are then differentiated based on the number of axes involved. The sliding movement subcategory is divided into two based on the overlap of moving or still panels.

Overall, this classification system aims to provide a comprehensive framework for organizing kinetic roof structures based on their characteristics and movement systems. By doing so, it will help architects and engineers to better understand and communicate the design and construction of these complex architectural elements.

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Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to the article. There is no conflict of interest.

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A Multi-Dimensional Analysis of The Relationship Between Design and Material in Terms of Sustainability

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Abstract

The importance of sustainability issues has increased in every field. Industrial design is one of the important areas that will contribute to sustainability. In the article, it is focused on how to contribute to sustainability through design. The article focuses on the use of recyclable, environmentally friendly materials and reducing material consumption. Within the scope of the article, various studies have been carried out that examine the design-material-sustainability relationship. First, the importance of sustainability in industrial design was investigated. Secondly, the relationship between material and design in industrial designs has been examined in terms of sustainability. Thirdly, products focusing on sustainability have been designed by the students of the industrial design department. Fourthly, an experimental study focusing on sustainability in industrial design was conducted. The experimental study was carried out on metal furniture. Furniture design has been developed in a way that reduces the use of materials, the number of parts, and the number of processes in production and contributes to sustainability. Experimental study shows that design has a calculable impact on sustainability. All studies in the article show the effect of design on sustainability.

Keywords: *Sustainable design, material, energy sources, production process.*

Tasarım ve Malzeme İlişkisinin Sürdürülebilirlik Bakımından Çok Boyutlu İncelemesi

Öz

Sürdürülebilirlik konusunun önemi her alanda artmıştır. Endüstriyel tasarım sürdürülebilirliğe katkı sağlayacak önemli alanlardan biridir. Makalede tasarım yoluyla sürdürülebilirliğe nasıl katkı sağlanacağı üzerinde durulmaktadır. Makale, geri dönüştürülebilir, çevre dostu malzemelerin kullanımına ve malzeme sarfiyatını azaltmaya odaklanmıştır. Makale kapsamında tasarım malzeme sürdürülebilirlik ilişkisini inceleyen çeşitli çalışmalar yapılmıştır. İlk olarak endüstriyel tasarımda sürdürülebilirliğin önemi araştırılmıştır. İkinci olarak endüstriyel tasarımlardaki malzeme tasarım ilişkisi sürdürülebilirlik açısından incelenmiştir. Üçüncü olarak endüstriyel tasarım öğrencileri tarafından sürdürülebilirliğe odaklanan ürünler tasarlanmıştır. Dördüncü olarak endüstriyel tasarımda sürdürülebilirliğe odaklanan bir deneysel çalışma yapılmıştır. Deneysel çalışma metal bir mobilya üzerinde yapılmıştır. Mobilya tasarımı ürünün parça sayısını, üretimdeki işlem sayısını azaltacak ve sürdürülebilirliğe katkıda bulunacak şekilde geliştirilmiştir. Deneysel çalışma tasarımın sürdürülebilirlik üzerinde hesaplanabilir bir etkisi olduğunu göstermektedir. Makaledeki tüm çalışmalar tasarımın sürdürülebilirlik üzerindeki etkisini göstermektedir.

Anahtar kelimeler: *Sürdürülebilir tasarım, malzeme, enerji kaynakları, üretim süreci.*

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1. Introduction

Nowadays, consumption is increasing gradually due to the growth of population and technological developments. The resources are getting decreased. Therefore, sustainability concept has become more important in every field. Industrial design is one of the important areas that will contribute to sustainability. Decisions taken during the design process are important in terms of sustainability. Industrial design includes the actions of designing, producing, using, and consuming. Industrial design is an area where materials, workforce, and energy are consumed. Thanks to the design, the consumption caused by the production processes can be reduced. There are several components that are effective in sustainable design. These components include the use of environmentally friendly materials and energy resources, energy-saving products, reducing material consumption, the number of processes in production and energy consumption, the use of natural and renewable energy resources, the shape, size, and number of parts of the product. Reducing the use of non-recyclable materials in industrial design can be beneficial for sustainability. Design is a creative field. The creative aspect of design can be beneficial for producing sustainable solutions. It is important to focus on sustainability in the design process. It is important to take decisions on design that contribute to sustainability. Thanks to industrialization, the production volumes of the products are very high. Sustainability becomes much more important in industrial design due to the high production volume. Industrial designs should be developed by paying attention to the environmental effects. Designers and manufacturers have to be conscious of sustainability.

In the article, it is discussed how product design can contribute to sustainability. Sustainability in industrial design is discussed in the article by focusing on the design-material relationship. In addition, the article focuses on the use of recyclable, long-lasting, eco-friendly materials and reducing material and energy consumption. Within the scope of the article, some examples of sustainable design are examined. In addition, some suggestions for developing sustainable designs are shared. A pilot experimental study has been performed to support these recommendations. Within the scope of the article, various studies have been carried out to show the effect of design on sustainability. First of all, a literature search was performed about sustainability in industrial design. Studies on sustainability in industrial design and product examples have been researched. Later on, material-design-sustainability relationships were examined in various examples of industrial design. It has been determined by what kind of factors these products contribute to sustainability. And also, new product design projects which focus on sustainability were developed. These projects have been developed by the students of industrial design dept. The project was carried out by the team which the author is in. In the projects, priority was given to the use of eco-friendly materials, the use of natural energy resources, and the limited use of energy. And also products that produce energy have been designed. Therefore, industrial designs contribute to sustainability using different features. In another section of the research, an experimental study was performed. This experimental study was executed on metal furniture. The results of the experimental study show the calculable impact of design on sustainability.

2. Material and Method

One of the methods used within the scope of the article is the literature scan. In recent years, various research and studies on sustainability have been carried out in Turkey and on international platforms. Studies on sustainability associate sustainable development with a political perspective, planning, environmental conditions, green cities, and green buildings. Studies on sustainability in direct product design are relatively less. Among these studies, there are projects carried out under the leadership of Politecnico di Milano. Manzini has performed studies and publications on sustainability. Also, some design firms and design schools work on sustainability. These companies produce sustainable products aimed at social support and intended for daily needs. In underdeveloped countries, many things such as energy resources, materials, budget, and production opportunities are limited. Therefore, products for the needs of people living in underdeveloped countries are important. In the research also the products and design approaches of different companies were examined in terms of sustainability.

During the research process, it has been observed that there has not been enough study on some issues in the field of sustainable design. Within the scope of sustainability, it has been observed that

there were fewer studies on topics such as material selection for the product, material savings, design with fewer parts, use of recyclable materials, and low-cost and sustainable production methods. For that reason, in the article, the studies carried out within the scope of sustainable design are directed to these indicated issues.

One of the methods used in the article for this purpose is the design. Within the scope of the project, the students designed different products in terms of sustainability. The students used eco-friendly materials and natural energy sources to provide their designs become sustainable. Also, products that produce their energy have been designed. Traditional and simple production techniques have been preferred in the production of some products. All of the products are user-friendly and eco-friendly products that will make the lives of the users easier. In addition to these, an original experimental study has been carried out in the laboratory by the author of the article. The experimental study has been carried out on a metal chair. The method of the study is to measure the amount of shape changes with strain gauges. In the experimental study, the strain gauges have been sticked to the critical points of the furniture. Deformations at these points have been measured. According to the measured amounts of shape changes, the tension values at different points of the furniture have been calculated. Computer-aided programs such as the "finite elements" method have been used to calculate the tensions. Based on the data of this experimental study, the furniture has been redesigned without decreasing its strength. The redesigned furniture has better features in terms of sustainability. The redesigned furniture is thinner. The furniture is produced with fewer materials and fewer parts, it is lighter, the production process is shorter, the workforce in production is less, and it is more economical. With this experimental study, it is being demonstrated the calculable effect of technical methods used in industrial designs, on sustainability.

3. Research Findings

3.1. Sustainability Concept and its Historical Background

Çınar's research indicates that the concept of sustainability has a long history of preserving nature (Çınar, 2014, p.231-240). According to this research, Hittites, one of the oldest cultures of Anatolia, regarded water resources and springs as sacred. This situation can be understood from the Hittite Monument in Eflatunpınar. Besides, it is indicated that having been an ancient culture, they protected forests, trees and they had a developed sense of nature protection. O'Riordan takes the idea of sustainability to very ancient histories, even to ancient Greek mythology, and states that this concept emerged in Gaia, the earth goddess in Greek mythology (O'Riordan, 1998, p.29-50). According to belief, the actions of the country's rulers must have been satisfactory to Gaia, and the country should live in peace and prosperity. The aim was that the activities should bring positive results (Bozloğan, 2004, p. 1011-1028).

According to a study by Kaplan quoted from Hermann Hill: "The concept of 'sustainable development' was first employed in the legislation issued to prevent the destruction of Karaorman in the Baden region in the Federal Republic of Germany in the late 18th and early 19th centuries. This legislation, it was aimed to ensure the sustainability of the forests in meeting the wood requirement, as well as to maintain their feature of wind prevention, their capability to meet the water requirement, and their characteristic of being recreation areas. Therefore, it was thought that to benefit from the forests, not only did they have to observe the requirements of the day, but also they had to reproduce them to serve the later generations" (Kaplan, 1999, p.160; Hill, 1993, p. 56).

"E.F. Schumacher was known for his *small and sustainable systems* for social and economic development. Within this context, in his book "Small is Beautiful", Schumacher tackled the human and environmental damage caused by the 'worship of the giant' and put forth the idea of 'localization' as a solution. As the 'most rational' method for economic life, he suggested that the form of production, consumption, and organization should be as local and small as possible. He also recommended the use of local resources for local needs" (Akkuş, 2011, p. 131-136). In his book entitled "Small is Beautiful" published in 1973, Schumacher argued: "... a great effort must be spent to overcome the present negative situation" and he tackled "economic sustainability". He stated: "the concept of sustainability" was not compatible with the present looting attitude which created a share of joy in the situation

where “the luxury for our predecessors has become a daily necessity for us” (Schumacher, 1995; Bozloğan, 2004, p. 1016).

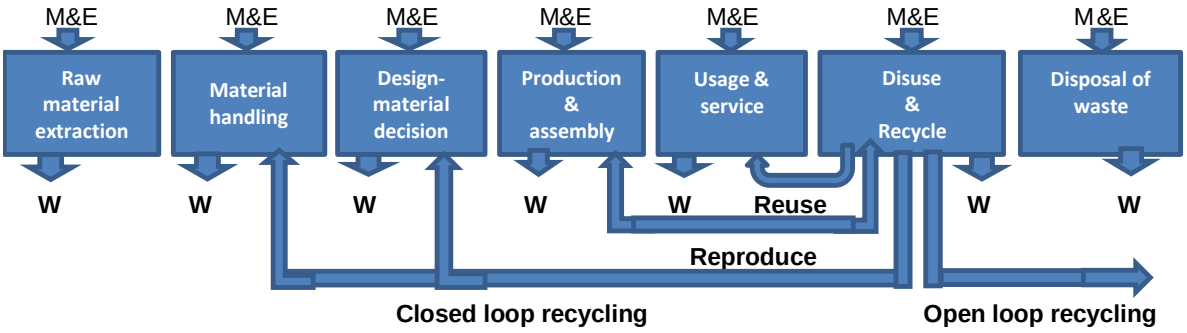
In the second half of the 1970s, debates began on the basic principles of sustainable development. In the spring of 1987, the World Commission on Environment and Development (WCED) published the Brundland Report. The report entitled “Our Common Future” coined the term “sustainable development”. By stating “A world in which poverty is endemic will always be prone to ecological and other catastrophes”, the report defined sustainable development in general terms as follows: “Sustainable development seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future” (Torunoğlu, 2023).

In 1992, at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, it was revealed that the application of unsustainable models of production and consumption, especially in industrialized countries, caused the natural cycle to become more and more distorted. On the other hand, using energy and resources in more efficient production processes, and developing and preferring cleaner production methods in all processes of the product life cycle, to minimize waste during production and after use were considered strategic objectives (United Nations Sustainable Development, 1992). Regarding this crucial issue, it is quite evident that the concept of sustainability would be at the center of the relationship between design and material based on product design.

The Kyoto Protocol which is linked to The United Nations Framework Convention on Climate Change could enter into effect only in 2005 when countries that accounted for a specific gas emission rate accepted it. The Intergovernmental Panel on Climate Change (IPCC) was held as part of the Towards 2020 - Kyoto-Type Climate Change Negotiations and scenarios of future changes in world order were developed Four main scenarios were drawn from the data. “B1 (A homogeneous and ecological world): Rapid economic growth will take place, but changes will shift toward a service and information economy. Instead of material intensity, clean technologies for resource efficiency will come into prominence Global solutions will be provided to economic, social, and environmental sustainability” (United Nations, 1998).

In the B1 scenario set by the IPCC, the shift of changes toward a service and information economy, and the prominence of clean technologies for resource efficiency have been pointing out the approach to the material in relation to product design, which is also noteworthy for this paper’s perspective.

Table 1. Product life cycle process and environmental effects developed according to product design (Kasap & Peker, 2011, p. 102; Keoleian, 1995, p. 7)



M&E: Material and Energy
W : Waste (Gas, liquid, solid)
: plastic

The article entitled “An Environmentalist Approach: Green Design” examines the entire phases of the product life cycle with a holistic and proactive approach (Kıvılcım, 2013, p. 15). It states that after the industrial revolution, “buy, build, sell” industries, which have increased rapidly over the course of 200 years, are responsible for their irresponsible behavior of polluting the environment and shortening the life cycle of products to sell more (Kasap & Peker, 2011, p. 101-116).

In the process of Table 1, 80% of the environmental impacts of a product throughout its entire life

cycle are determined within the scope of design. The process of recycling, redesign, reproduction, and reuse is assessed in a holistic process against environmental influences that may arise during the life cycle of the product. The measures on the basic elements of environmentally protective design, green design, etc., cannot be taken, decided, or applied solely by the designer. It is evident that the designer can carry out all these measures and analyzes according to the production decisions which will produce the product and in the context of production systems depending on the production policies of the business. With regard to the designer and manufacturer, the entire process of the product life cycle must function as a whole.

3.2. Material Concept and Product Design

The mid-20th century was a period of breakthroughs in the development of materials. From this point of view, it could be said that every society and every age is shaped by a certain material. For example, stone was dominant in the productions of the Middle Ages. In the modern age, Mendelejew's renowned table on the periodic systems of the elements is still valid. This is because when examined closely, matter remains as matter and the operations are carried out on the same atoms. This structural characteristic of matter allows for various combinations and makes it possible to constantly develop new materials. Accordingly, matter is the substance of which everything is made. Material is a form of matter undergoing transformations, which can be synthesized, applied, and used. In other words, new forms can constantly be obtained. Considering that the designed products will be produced in high quantities with mass production, the importance of material selection has been increasing. It is important to choose the right materials in many aspects such as the strength of design, reliability, easy production, appearance, identity, price, style, and marketing.

The book entitled “New Chairs-Design, Technology and Materials”, a design concept and edited by Mel Byars is about seating furniture (Byars, 2006, p. 28-142). Based on works by many designers it primarily examines materials. In connection with this, it examines production technologies as well as how product design is related to the material. The research has thoroughly examined designs made with new, environmentally protective material. Materials such as steel plate, steel wire, aluminum, steel reinforced plywood, fiberglass, carbon fiber, epoxy, ready-made plastic, hardened cotton, rattan straw, or reed are materials that are now required to be developed as indispensable production materials for the design area. In this case, the designer and the manufacturer should work in cooperation. They should decide together whether the new materials will be small, medium, or large series, and conclude what will be the user’s behavior. They should consider that during the design process, they will have to do experimental work in parallel with each other.

3.3. The Idea of Design with Eco-Friendly Material and Technology

It is noteworthy that furniture design can be considered to be a good example of eco-friendly materials. According to the materials employed, pieces of furniture can be classified as wood, plastic, natural stone, glass, or composite materials. In an early period, pioneer designers also employed quite different materials.

In traditional solid production, natural materials such as wood and stone were mainly employed, whereas “in the process of new material development wood by-products were first employed in furniture design. Products such as plywood, chipboard, and fiberboard are materials developed from first environmentalist approaches thanks to their cheap and easy production which will respond to industrial production” (Yüksel, 2012, p. 48-51). From the 1950s, “In his wood-pressed furniture, Poul Kjærholm employed also natural and alternative materials from different fields. Some of these materials are rope, chicken wire, inexpensive powder aluminum mold material, and fiberglass. He was also impressed by the sculptor and designer, Gunnar Aagaard Andersen who carried out model studies with newspaper, chicken wire, etc. Poul Kjærholm performed inexpensive simple production experiments with these unusual materials” (Sheridan, 2007, p. 32-48). Apart from that, he mixed Peter Murdock’s papier-mâché with biodegradable synthetic material and turned it into a kind of cardboard material made into a thin layer, which gained strength through the folding method. Thus, he constructed furniture which could only carry children. Numerous layers would be necessary to carry adults. Frank Gehry employed a different material, a recyclable laminate material known for its flat

sheets, because it is cheap, and it can wiggle. Thus, by bending this material in three layers he obtained chairs which can also be sold today.

In terms of eco-friendly designs, the 1950s are considered to be a pioneering date as the years 1960s and 1970s were years when very expensive objects or pieces of furniture were designed and produced in the name of originality. Post-Modern and Memphis movements after Modernism; Primitive Art and Design Movement saying that art is in life; Ready Made movement which includes the use of everyday material and objects served as a model or became a pioneer for lives, designs, and productions of that period. It is also worth noting that some of them appeared as reaction designs.

The idea of making furniture from waste products led many designers to be a pioneer in this issue. For example, in 1953 Benjamin Baldwing designed a chair from a tractor seat. In 1963, Gaetano Pesce constructed furniture from waste polyurethane resin with different densities and he shaped the material by hand or by mold. He aimed to incorporate and synthesize industrial and hand production to create furniture models. Ettore Sottsass, the founder and a member of the Memphis Group said "We use everything done today. Production belongs to today, not the next generations." This thought had significance for his time because of its use of a variety of objects. Today, although its significance can be arguable, it accomplished a certain process. An example of the Primitive Art and Design Movement was produced in 1985. This is the "Prince Imperial" Chair by Elizabeth Garouste and Mattia Bonnetti. Composed of a tree branch in a vertical position and wooden plaques connected to it and surrounded with raffia on the seat and back, this chair represents a good example of primitive art. Ron Arad's waste car seat can be given as a significant example of sustainable design inspired by the movement of Ready Made. In this approach pioneered by Marcel Breuer and Andy Warhol, the idea that any object can be used as a sitting object affected sustainable design (Fiell & Fiell, 2002, p. 465, 560-563, 597).

The book entitled "Product und Umwelt (Product and Environment)" having a 1974 edition, tackled thoroughly several studies and contributed to sustainable design. Among these studies, the following can be counted: Gillo Dorfles's "Solutions Which Feel the Negativity Around Someone's Environment", Udo Haase's "Solutions to Traffic Problems", Ernst Bonda's "New Evaluation of Waste Paper", Michael Walz's "Less Consumption with Greater Meaning", Jan Kotik's "A Political Economy Analysis", Wulf Rüdiger Lutz's "Social Design" (Priewe, 1974, p. 23-120). In the 1990s, Herman Miller Company gave great importance to sustainability in order to protect the environment and ensure the sustainability of the future life of mankind. The company has been still implementing its practices in this direction.

Herman Miller operates with the principle that sustainable products require sustainable materials. Therefore, they have been carrying out a thorough examination of the materials, ingredients, and molecules in order that they could be trustworthy for people and have positive effects on the environment. In these examinations, it has been revealed that a middle-class American family has been using four million kilos of material for their needs in a year. Accordingly, Herman Miller has developed a rigorous protocol for assessing the life-cycle impacts of every product to recycle it for environmental health. Herman Miller has developed a sustainability protocol that measures the environmental impacts of materials, evaluates and balances performance, cost, and aesthetic criteria along with environmental criteria, and integrates them into product design with a holistic approach. The company has prepared Design for Environment Guidelines. It also created an assessment tool that analyzes the potential of product design (Bony & Lee, 2009).

Since 2001, the DfE team has been collecting information on the chemical structure of the material, and carbon emissions associated with the use of energy for the extraction, installation, distribution, and lifetime of raw materials to determine the carbon footprint. Recently, the company has announced that for its worldwide operations, it has been using 100% renewable electric energy. After more material research, the company developed a part made completely of a recyclable material which is cheaper than the original design for the development of the Mirra chair. In addition, instead of polyvinyl chloride, a combustible material, the company employed a thermoplastic elastomer for the chair's arm pad. It should also be noted that Herman Miller does not neglect processes with supplier

and distribution chains (Herman Miller, 2017). Over the last few years hopeful improvements have been witnessed.

Figure 1. Arçelik Piano Series washing machine (Alışveriş rehberi, 2017

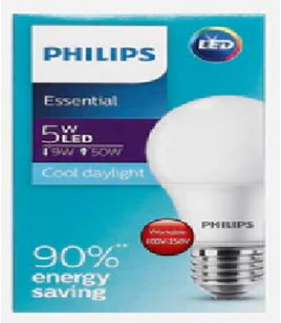


Figure 2. Philips LED lamps (ShopSM, 2017)

Figure 3. John Deere released R series tractors (John Deree, 2017)

There has been a decrease in the direct consumption of natural materials and the use of more energy-conserving materials with the increase in the research on bio-based materials. For example, the company Arçelik has been evaluating energy saving very well in its white goods. Arçelik Piano Series washing machine is produced for energy saving (Figure 1). Philips LED bulbs are highly efficient and have a very long lifespan. These lamps provide up to 90% energy savings compared to incandescent lamps (Figure 2). John Deere released R series, PVX and PSX engines are environmentally friendly. John Deere released the R series, mid-segment tractors with the PowerTech PVX and PSX engines featuring the latest technology products to provide green efficiency, diesel solution, and high power (Figure 3).

Figure 4. Ebm-Papst Company produces eco-friendly fans (Empapst, 2017)

Figure 5. Ebm-Papst Company produces eco-friendly fans made of aluminum-inserted plastic material (Empapst, 2017)

Figure 6. Wood and plastic-reinforced epylene granules (Empapst, 2017)

Ebm-Papst Company is attracting attention with its fans made of biomaterial and selling them on the international market. Ebm-Papst has been producing energy-saving fans for many years in ventilation, air conditioning, and refrigeration technologies. These fans have become energy-saving models thanks to high-efficiency engines and aerodynamically developed wings (Figure 4, Figure 5). By 2015, 15% of plastic materials have been replaced with "biomaterial". Production materials may consist of an aluminum-inserted plastic material, and of “epylene”, a wood and plastic composite material (Figure 6). They are light and easy to shape. Compared to conventional cast blades, aluminum is a material which consumes fewer resources. Bio-based materials are generally cellulose fibers, soya-based biocomposites, fibrous and wood-based particle boards, corn protein and natural biopolymers called zein, corn seed starch used in obtaining packaging pellets, granules, etc.

Designers have often considered nature as a ‘role model’ to find new solutions. Through experiments with living organisms, organisms such as bacteria, fungi, and algae were also included in the design process. The transfer of features from bio-systems to design makes new possibilities available in materials. Some of these features are structure, appearance, metabolism, growth, response, adaptation, motion, and reproduction.

The paper entitled “An Investigation on Growth Behavior of Mycelium-based Material In A Fabric Formwork” points out that the obtainability of an entirely natural material that can grow in the mold

indicates that this organic material can be widely employed in the field of design (Elbastı & Alaçam, 2016). In their works on eco-friendly design furniture, Ivy Liu and Jian Wong classified eco-friendly furniture in four groups (Liu & Wong, 2013, p. 10-154).” Recycling and reuse, production with natural materials, technological and handicraft production, and other approaches, such as pieces of furniture with alternative or multi-purpose use; furniture which can produce plants on their legs; designs with highly efficient use were developed.

It is also possible to ensure sustainability with the help of technological designs. Özcan, Çelebi & Arpacıoğlu developed a modular system for obtaining water (Figure 7). In this study, a pilot system using solar energy has been developed in terms of water and energy efficiency. This system cools the gaseous water in the air in a controlled manner with the help of thermoelectric modules. It also stores water by condensation. The proposed system includes different modules. These modules are such as fans, water tanks, and thermoelectric coolers. Thanks to this system, plants growing in different areas can be irrigated with water obtained from the air with optimum efficiency. It is aimed to protect water resources by developing a system using solar energy. (Özcan, Çelebi & Arpacıoğlu, 2022).

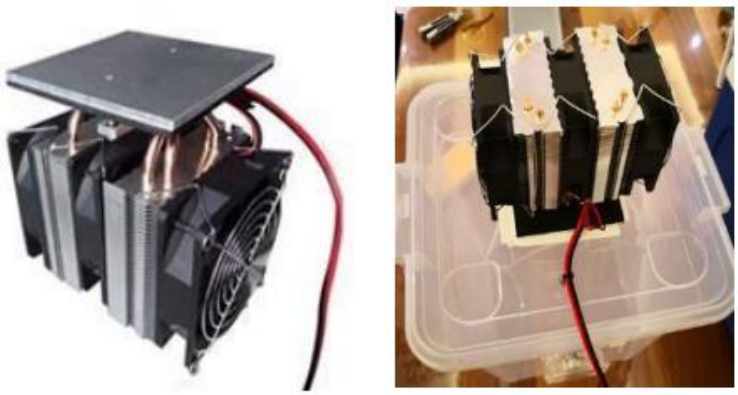


Figure 7. Thermoelectric cooler module block and water tank with copper, aluminum cooler, and fan circulation used in the system (Özcan, Çelebi & Arpacıoğlu, 2022)

3.3.1. Sustainable design studies

Sustainable design requires multi-dimensional thinking. The process necessitates being eco-friendly in every step, from gathering raw material to the decision of processed material to the sale of the product to its storage, service, use, and recycling of the material after its use and even to the process in the production environment and energy saving.

A great number of projects were realized in the İstanbul Technical University Department of Industrial Product Design from 2003-2012 regarding sustainable design. The author of this article and her team also took part in the projects carried out in the ITU Industrial Design Department. The projects addressed sustainability from different perspectives. Guided by the author of the article and her team, 8th-semester students designed various products focusing on sustainability. Students designed different products for different companies. Some companies were producing both with traditional methods and with machines. For this reason, products have been developed in accordance with the production methods of the companies.

Some of the projects can be found in the following examples (Figure 8, Figure 9). Students developed their designs by focusing on different aspects of sustainability. Some designs focused on the use of eco-friendly materials (Figure 8). Some designs focused on production with simple production techniques without consuming much energy (Figure 7c). Some designs focused on creating awareness of sustainability (Figure 8d, Figure 9).

Some designs that contribute to sustainability by using environmentally friendly materials are shown below (Figure 8). One of the projects is a book display unit (Figure 8a). One of the important features of this book stand is that it is made from pieces leftover from furniture production. Another feature of the book stand is its easy disassembly and assembly. The modularity of the design simplifies production

and reduces the cost. The use of ready-made metal profiles in the product speeds up production and reduces the cost.

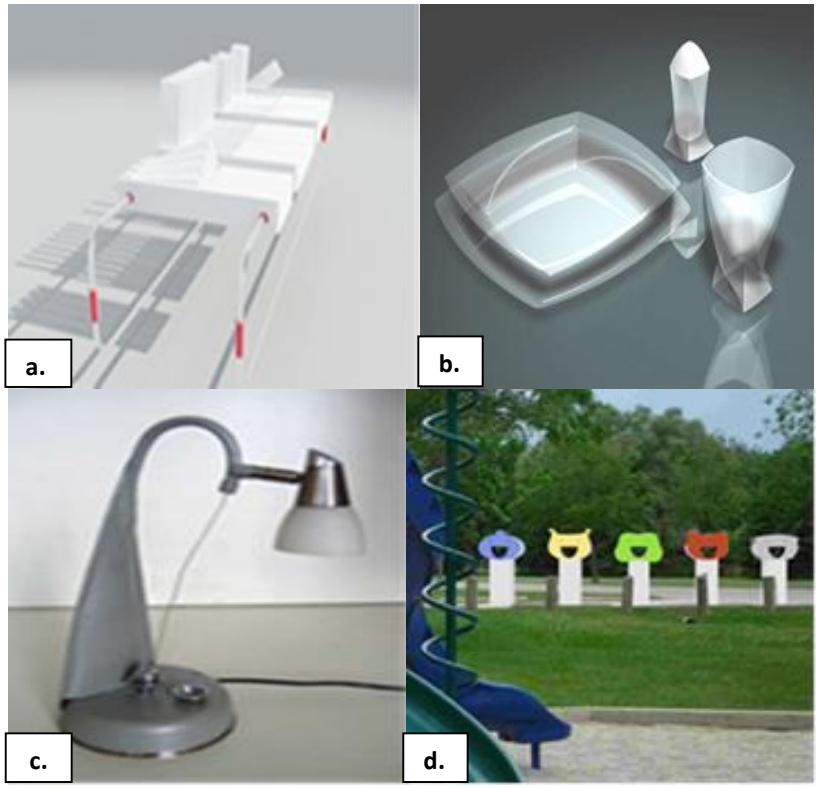


Figure 8. Sustainable-oriented designs focused on environmental materials. **a.** Book display unit designed by Sabiha Yıldız, **b.** Tableware designed by Gökhan Karasu, **c.** Table lamp designed by Aybige Keskin, **d.** Waste container designed by Merve Karasu

Another design is tableware (Figure 8b). The tableware is made of glass. In order to popularize the use of glassware, the designer produced all the pieces of tableware from glass. Although the plates are usually produced from porcelain and ceramic, the designer produced the plates from glass.

Another design is the table lamp (Figure 8c). The table lamp was designed for children. An easy-to-use and safe lamp has been created. The table lamp is produced from eco-friendly materials such as metal and glass. In the production of the lamp, manual production, and machine production were used together.

One of the projects was designed to raise awareness about sustainability (Figure 8d). This design is a garbage system design for waste materials. This product aims to raise awareness among children about waste materials and sustainability. However, it is aimed that children can easily understand the waste garbage. Therefore, different material containers are produced in different colors.

Some designs that contribute to sustainability with the use of energy are shown above (Figure 9). One of the projects is a waste bin (Figure 9a). The waste bin is built into the floor. The waste bin uses solar energy. This waste bin stores energy with simple solar panels. Solar energy has enabled the waste bin to move up and down the floor. Systems that produce their energy are very important for cities and energy conservation.

Another product is a light buafor design for marinas and the sea (Figure 9b). This product also stores solar energy. The product illuminates the surroundings with the energy it stores. It is a very useful and eco-friendly product for marinas.

One of the projects is a cooling system design (Figure 9c). It aims to cool fruits and vegetables with natural methods in rural areas and camping areas. Clay is used in the product. The product performs its function in the best way thanks to its design and material.

Another project is a hair dryer design (Figure 9d). This product uses infrared rays instead of metal wire resistances. During the design process, the designer researched energy systems. Designer researched the energy system mentioned in an article and a patent. The designer used this energy system in the hair dryer he designed. This project has served to save energy. Besides, the designer has found safety measures to prevent hair and the body of the product from burning.

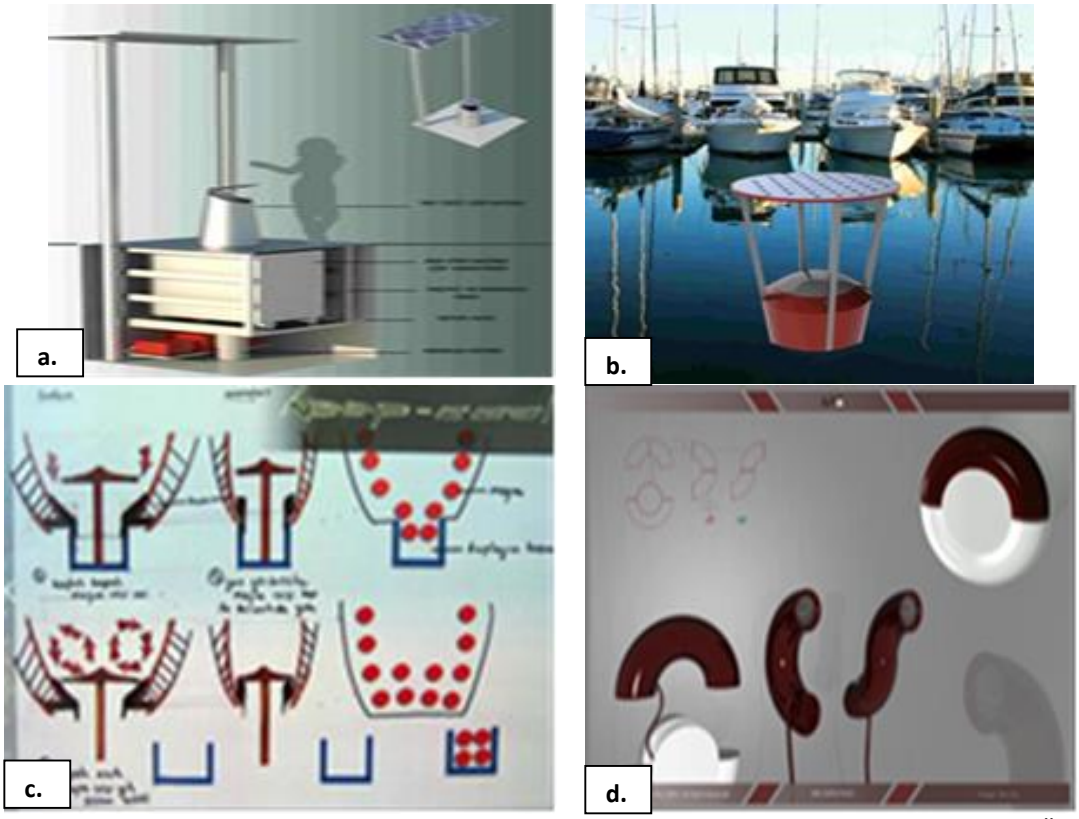


Figure 9. Sustainable-oriented designs focused on energy saving. **a.** Waste bin designed by Hilal Özdil, **b.** Light buofor designed by Sinan Sever, **c.** Cooling system designed by Mert Sezer, **d.** Hair dryer designed by Burc Öç

It is observed that all products developed with the theme of sustainability in industrial design contribute to sustainability by means of different features. Some of the products are produced with eco-friendly materials. Some of the products use natural energy sources. Some of the products use energy resources for minimum amounts. Some products store energy and produce their energy. And some products have been produced with traditional, simple, low-energy consuming production techniques. These products contribute to sustainability by reducing energy consumption in production. Some designs use new technologies and consume less energy while operating. Some of the products contribute to sustainability by raising awareness about sustainability.

As can be seen from the products developed within the scope of the article, it is possible for various sustainable designs to be made. Original projects focusing on different aspects of sustainability can be developed.

More attention should be paid to sustainability in the near future. It can be said that sustainable designs should become widespread. It would be beneficial to consider issues such as sustainable design, eco-friendly design, and social design in industrial design. Thus, the design of the future will be in its ideal position.

3.3.2. A laboratory study based on sustainable design

It should be noted that for quite a long time, the author of this article has been examining materials on the basis of product design and working on realizing the design with minimum materials, minimum parts, and environmentally protective material (Günal Ertaş, 2007, p. 120, 121).

a.

Here, a study carried out in the context of sustainability is described. The study was carried out on a chair with metal construction. It is aimed to develop the chair in terms of sustainability. That's why the chair was redesigned (Figure 10a, Figure 10b, Figure 10c, Figure 10d, Figure 10e).

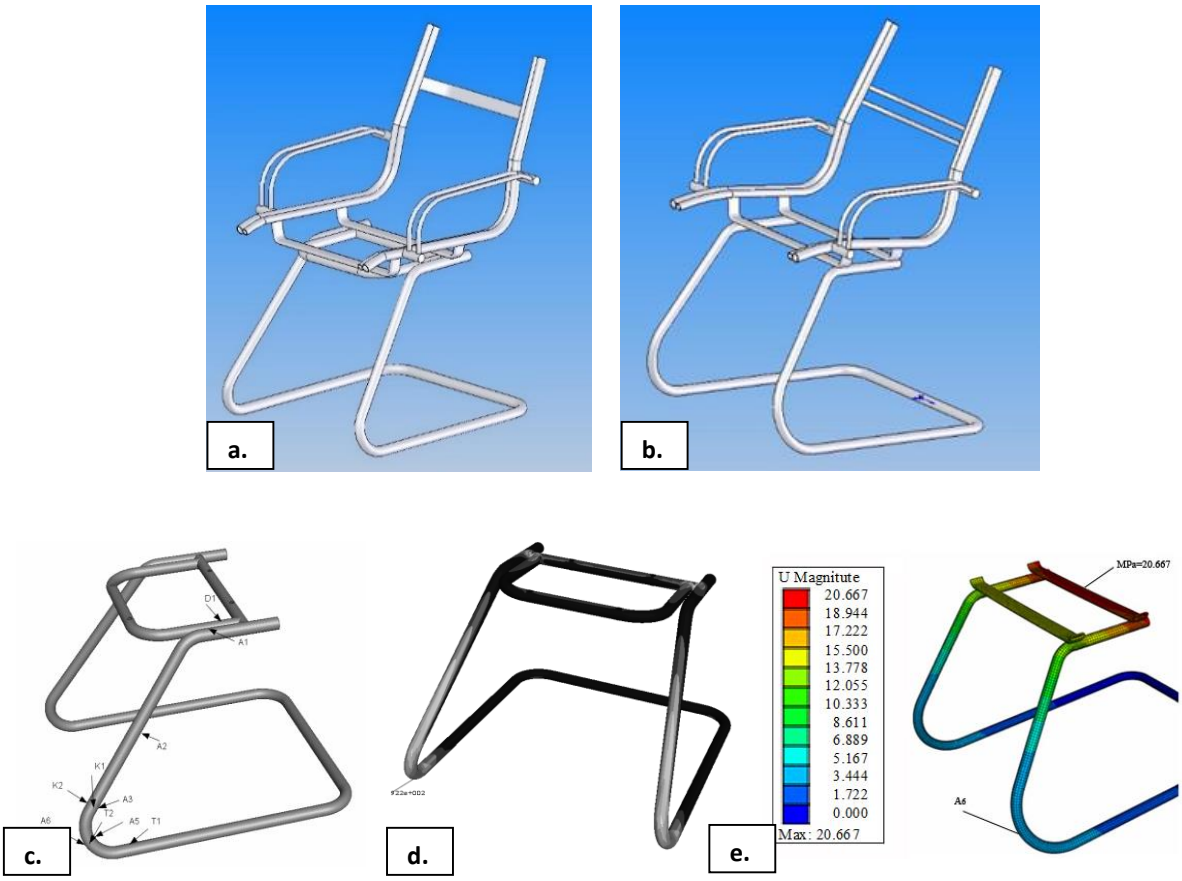


Figure 10. The original and redesigned version of the chair and tension diagrams of these chairs Upon laboratory experiments, a new chair frame is proposed with a reduced number of components (Günal Ertaş, 2007, p. 120, 121) **a.** Original chair made of tubular profile, **b.** Redesign of tubular chair, **c.** Measurement points of the chair, **d.** Tension diagram of the original metal chair, **e.** Tension diagram of the redesigned chair

In the experimental study, strain gauges were placed on the metal chair. Deformations at different points of the chair were measured. The tensile and strength values in various parts of the chair were calculated. Then the original chair was redesigned. The weight, tension, and strength values of the redesigned chair were calculated in a computer program. The original chair and the redesigned chair were compared with each other. The newly proposed chair design is advantageous in terms of sustainability (Günal Ertaş & Şatır, 2021). Figure 10a shows a metal chair design. Figure 10b shows the redesign of the chair. The new chair is made of another type of steel by reducing the parts and material of the original chair. The redesigned chair has advantageous aspects compared to the original chair.

Both experiments and computer analyzes have shown that the redesigned chair is sustainable. The tensions at various points remained below the yield stress. So, no problems occurred with the redesigned chair. The redesigned product has achieved goals such as reducing the number of parts, lightening the structure, reducing the cost, and shortening the production process. Although the dimensions were reduced and some parts were removed, the structure is still a resistant one. During the redesign process, the visual effect of the original chair design was preserved, the production process was shortened, the cost was reduced, and the required strength was provided.

The differences between the original chair and the redesigned chair are interesting and striking. The superiorities of redesigned chair over the original chair are expressed below:

- The weight of the current chair's frame structure is 13 kg. The suggested frame structure of the chair is 9 kg. A redundant 4 kg was removed by reducing the length of the pipe, decreasing the number of parts, and changing the steel employed. The product became more portable.
- The metal pipe diameter of the original chair is 25 mm whereas the metal pipe diameter of the new design is 21 mm i.e. 4mm less.
- The proposed redesigned new chair is 4 pieces fewer than the other (Günal Ertaş, 2007).

The reduction in the number of parts in the structure made welding unnecessary at four points, thus decreasing the number of processes and shortening production time. The new design is lighter by making the diameter of the metal frame construction smaller and by reducing the number of parts. Lightness also makes the design easier to use. It is evident that thanks to all these new features, the production of the chair has been improved in terms of sustainability (Günal Ertaş & Şatır, 2010).

A sustainable design viewpoint requires that factors related to people as well as technical and aesthetical factors are considered together. Sustainable products can be produced with the help of industrial designs developed with the help of technical methods. It is of vital importance in terms of economy and environment that the design is made by paying attention to the following issues: selection of eco-friendly materials suitable for design; optimization in utilization of material and components; utilization of fewer materials and components without compromising sturdiness; choice of eco-friendly material that prevents depletion of natural resources; production with easily available materials.

Traditional methods can be used in industrial design. In addition, advanced technologies and modern production methods can be used in industrial design. Eco-friendly sustainable products can be produced with the help of contemporary manufacturing techniques and new technologies. During the design process, some software can be used such as finite elements, Solidworks, and various measurement, testing, and analysis methods. These programs can help to produce sustainable design (Günal Ertaş & Şatır, 2021).

4. Evaluation and Conclusion

As we see in Table 1 in the case studies, in the article, in the experiences of Herman Miller Company sustainable design is a very comprehensive process. This process includes various stages such as material selection, application of eco-friendly production methods, energy saving, service, purchasing, recycling process, and usage of recycled materials (Kasap & Peker, 2011; Keoleian, 1995). All details regarding sustainability should be considered in design decisions. Even the acquisition of raw materials alone affects other decisions. Hence, it can be argued that sustainable design should include the following stages:

- **Preliminary design decisions made in collaboration with the business:** At this stage, the designer and the experts on the subject give idea support. Designers should know the eco-friendly materials suitable for their designs.
- **Design process decisions:** At this stage, decisions could include the following objectives: to reduce resource consumption, not to harm the environment, for example, the selection of bio-based, recyclable materials, to ensure minimum material consumption, to evaluate waste materials, to reduce the number of parts of the product, to determine ideal dimensions of the product, to enable the product to occupy less space during transportation and storage, to provide modularity, to design replaceable parts in the product in case of malfunction, to ensure the product reliability and long-lasting use, to develop relations between production,

material shape, cost and environmental effects, to discover the possibilities and limitations of design (Günal Ertaş & Şatır, 2010).

- **Production process decisions:** At this stage decisions on the following points would be significant in terms of sustainability: the selection of regional, environmentally protective, bio-based, non-chemical material, using recycble materials, reduction in the material to be processed, the production process with fewer operations and less waste, reducing the number of components and adjustments of product, the optimization of material wall-thickness, creating various solutions to extend the service life of products, the reduction of energy consumption, decreasing workmanship, reducing the number of operations and production time of production process (Günal Ertaş & Şatır, 2021). Some of these decisions affect the price of the product and the amount of sales.
- **Decisions regarding the use of products after sale:** Decisions regarding the use of the product after sale may include the following purposes: to facilitate the use of products, to reduce energy consumption, to give importance to energy saving systems, to reduce the amount of material to be consumed during usage, to facilitate product maintenance and cleaning, to encourage and raise awareness of product users, to support the long service life of the product.
- **Decisions on second use or recycling of the product:** Products should be produced with recyclable and reusable materials such as paper, glass, metal, and plastic. Some products made of glass, stainless steel, rustproofed tin, and metal are very suitable for second use. In addition, almost all eco-friendly products can be recycled.
- **Modular design:** Designing modular products can contribute to sustainability. Thanks to modularity, it can be ensured that the products are low-cost, long-lasting, and offer different options (Sonego, Echeveste & Debarba, 2018).
- **Changeable parts of the products:** Products can be sustainable through design. The parts included in the products can be changed and renewable. Changing the parts of many products such as household appliances, furniture, office systems, and vehicles will extend the product life. This will increase the sustainability of the products. Changeable parts can contribute to sustainability in design (Holtewerta & Bauernhansla, 2016; Interchangeable Products with an Advantage, 2023).

The product parts can be recycled by using environmentally protective, correctly selected materials. Product material can be dissolved in nature and sustainable design can be achieved by making it harmless to nature.

The characteristics expected from the design vary depending on the correct components in accordance with the current environmental protection conditions. It can be claimed that industrial designs are expected to contain the following characteristics: authenticity in terms of sustainability, high performance, long life, effective work function, robustness, lightweight and low cost. By optimizing the quantity of the material, the number of the product parts, and the size of the parts, the lightness of the product is ensured, the production period is shortened, and the cost is reduced. It is also worth noting that the energy consumption for production is tightly connected to all these optimizations.

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Author Contribution and Conflict of Interest Declaration Information

The article is single-authored and has no conflict of interest.

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Examination of Methods Employed in Industrial Archaeology Conservation: Case of Beykoz Leather and Shoe Factory

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Abstract

This paper focuses on examining the transformation of the Beykoz Leather and Shoe Factory area, investigating the qualities of the buildings in the area, and evaluating them in the context of industrial archaeology. The study aimed to determine whether each of the four conservation methods determined by TICCIH and ERIH organizations and Rolf Höhmann (1992) are preferred for the buildings of the Beykoz Leather and Shoe Factory. Data collection was carried out in 5 years between 2018-2022. Data were collected through on-site observation, analysis of relevant documentation, and interviews with the Kundura Hafıza (Shoe Memory) unit established within the factory during multiple site visits. The original aspect and importance of the study is to conduct and comprehensively evaluate all three of the literature study, fieldwork, and data analysis within the scope of the study.

Keywords: *Conservation, industrial archaeology, cultural heritage, transformation, adaptive reuse.*

Endüstri Arkeolojisini Koruma Yöntemlerinin İncelenmesi: Beykoz Deri ve Kundura Fabrikası Örneği

Öz

Bu çalışma, Beykoz Deri ve Kundura Fabrikası yerleşkesinin geçirdiği dönüşümü incelemeye, yerleşkedeki yapıların niteliklerini tespit etmeye ve endüstriyel arkeoloji bağlamında değerlendirmeye odaklanmaktadır. Çalışma, Beykoz Deri ve Kundura Fabrikası'nın dönüşümde yerleşkedeki yapılar için TICCIH ve ERIH komiteleri ile Rolf Höhmann (1992) tarafından belirlenen dört tarihi yapı koruma yönteminden hangisi/hangilerinin tercih edildiğini belirlemeyi amaçlamıştır. Veri toplama 2018-2022 yılları arasında, 5 yıllık periyotta gerçekleştirilmiştir. Veriler, yerinde gözlem, ilgili belgelerin analizi ve fabrika bünyesinde kurulan Kundura Hafıza birimi ile çoklu saha ziyaretleri sırasında yapılan sözlü görüşmeler yoluyla toplanmıştır. Yapılan tüm araştırmalar, analizler ve tespitler, yerleşkedeki endüstriyel arkeolojinin korunması için dört koruma yönteminin her birinin ayrı ayrı tercih edildiğini göstermiştir. Çalışmanın özgün yönü ve önemi, çalışma kapsamında literatür çalışması, saha çalışması ve veri analizi olmak üzere üç yöntemin beraber yürütülerek kapsamlı bir şekilde değerlendirilmesidir.

Anahtar kelimeler: *Koruma, endüstriyel arkeoloji, kültürel miras, dönüşüm, yeniden işlevlendirme.*

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1. Introduction

Humans are the only elements of the habitat to produce their structures for protection, shelter, production, and accomplishment of other needs (Çiftçi & Arpacıoğlu, 2021). To fulfil their needs, humans initiated the process of creating an artificial environment within the habitat. Constant changes take place across people, societies, needs, natural environment, and artificial environment, which create variability in the needs and use of buildings, forcing the architecture to change (Ahunbay, 2014).

When buildings cannot meet the changing social, historical, cultural, economic, technological, and environmental needs of their era, they lose their functions and get abandoned (Altınoluk, 1998). Although these buildings become old and are not functional, they continue to exist physically because their structural lives do not come to an end (Cengizkan, 2006). For the buildings to stay in use and not become inactive, they need to keep up with rapid changes and continue to be useful.

Industrial areas remained on the periphery of cities at the time they were built. But, as a result of the growth and expansion of cities over time, they have become a part of the urban areas and are one of the most important potential areas in the ongoing transformation process (Atagök, 2000). With proper spatial planning, these large areas can become a breathing point for growing cities as peripheries expand. Therefore, the conservation and reuse of these areas ensure that people of the cities are aware of conservation and are willing to turn these areas into places embraced by the citizens.

The history of conservation dates back to the first ages. It can be seen that the temples were preserved in an orderly manner in the early ages. The awareness of preserving the historical and cultural values of the buildings and transferring them to the next generations increased after rapid urbanization. In the 20th century, methods of preserving industrial archaeology became an important topic of discussion in architectural literature.

Beykoz Leather and Shoe Factory is an area officially recognized as a historical monument and where all cultural and natural assets are under legal protection. The reason for choosing this area within the scope of the research is that it is one of the industrial facilities with the highest social and economic capacity when it is actively used. Factory, one of the rare examples of industrial cultural heritage that had operated uninterruptedly with its history dating back to the early 1800s, has a rich history covering the Ottoman Empire and the Republic of Turkey. The factory was a pioneer for the Ottoman Empire in terms of modernization with leather products. It was established in Beykoz, one of the most magnificent points of the Bosphorus. It is one of the biggest factories in the Balkans. In this historical area, which is one of the most beautiful points of the city due to its location, the industrial structures that have been challenged over the years have still managed to survive. For this reason, the protection of the area is very important for the city.

Beykoz Shoe and Leather Factory was a structure that was constantly renewed, articulated, and evolved with efforts such as capacity increase, and changes in production methods and technologies. The industrial area, which grew over time as a living organism, had structures that differed in quality due to changes in construction techniques and architectural understanding over time (Küçükerman, 2020). Therefore, the investigation of the Beykoz Leather and Shoe Factory is an important case study for architectural literature.

Although the conservation and reuse of many industrial archaeology works have been widely discussed in different academic studies, the methods of conservation and reuse of the Beykoz Leather and Shoe Factory have been sparsely studied. Therefore, this study focused on the methods that were used for the conservation and reuse of Beykoz Leather and Shoe Factory; a case study was conducted to fill the aforementioned gap in the literature.

1.1. Industrial Archeology

Industrial buildings that emerged with the industrial revolution have met the needs of cities for many years. Buildings that were constructed away from the city centers for the sake of people's health, the need for large land areas, and proximity to water sources, became structures within the city center. They paved the way for the development and growth of the cities, shaped them, and allowed cities to grow in line with industry. However, historical factories have closed or lost their functions over time across the world due to being unable to operate efficiently, being technologically inadequate, and polluting city centers (Föhl, 1994).

Industrial archaeology was first introduced in England (an active center of industrialization) in the second half of the 20th century when industrial structures were threatened with extinction. After the issue of urban transformation came to the forefront and awareness regarding the preservation of historical culture grew, the dysfunctional industrial structures that remained in the city centers were accepted as an important cultural heritage and the concept of industrial archaeology became widespread.

Industrial heritage included all units that emerged as a result of the industrial process, together with their equipment. In this context, industrial archaeology includes all fields related to various industries (Köksal, 2005). Out-of-use architectural structures, production equipment, building parts, and settlements, along with the natural and urban landscapes these structures are placed within constitute the industrial heritage (ICOMOS, 2013). The International Committee for the Conservation of the Industrial Heritage (TICCIH), which carries out activities to preserve industrial heritage, defines industrial heritage in the Nizhny Tagil Charter published in 2003 as follows: Industrial heritage consists of the remains of industrial culture that are of historical, technological, social, architectural or scientific value. These remains consist of buildings and machinery, workshops, mills and factories, mines and sites for processing and refining, warehouses and stores, places where energy is generated, transmitted, and used, transport and all its infrastructure, as well as places used for social activities related to industry such as housing, religious worship or education (TICCIH, 2003).

With the first attempts to preserve industrial buildings as well as buildings that can be included in the scope of cultural heritage according to conservation criteria, the methods of preserving industrial archaeology, defined as the act of researching and uncovering old industrial buildings, became an important topic of discussion in the architectural literature in the 20th century.

1.2. Industrial Archaeology Conservation Methods

The change in needs, the emergence of new production methods, and the development of technology necessitated the change of factory structures (Günay, 2002). In particular, after the Second World War, some changes took place in the use of industrial structures around the world. In this period, the industrial facilities that were functionally obsolete and could not keep up with the change became inadequate and lost their functions over time. Areas with historical background and value were abandoned and left idle (Altınoluk, 2000).

After the functionality of industrial buildings came to an end, their conservation and reuse intensified towards the middle of the 20th century. The formation of historical and environmental awareness over time was a factor that triggered the conservation and reuse of industrial archaeology (Atagök, 2000).

Conservation and transformation of these structures, which today reveal themselves as industrial archaeology, are common all over the world. This is primarily because these areas shed light on the historical background of the society and the cities. Reviving these buildings, instead of watching them disappear, is an indicator of the value attributed to the past. In this context, cultural heritage buildings on a global scale are considered within the framework of international criteria, their values are recognized, and efforts are made to regain their place in contemporary life.

The correct conservation and revival of an industrial building or facility can be achieved by determining the necessary conditions and choosing the appropriate preservation method accordingly. If the historical and cultural values of the industrial heritage are determined comprehensively, it can be

ensured that said heritage is protected by appropriate methods (Köksal, 2005). The World Heritage Committee and the Council of Europe are working on the identification, research, and scientific analysis of the heritage, and the determination of conservation methods according to its unique nature. From this point of view, structures within the scope of industrial heritage are protected by various methods in line with the criteria set by organizations such as TICCIH and ERIH (European Route of Industrial Heritage). The protection methods specified by all these institutions and organizations are grouped under four preservation methods categorized by Höhmann: Complete conservation without any intervention or conservation without providing a new function with minimum intervention, conservation by providing it with a function similar to its old function with little intervention, conservation providing museum function, reuse with a different function (Höhmann, 1992). The methods applied in the conservation of industrial archaeology may differ based on the buildings and structures.

1.3. Beykoz Leather and Shoe Factory

In 1810, Tabakhane-i Klevehane-i Âmire was established on the coast in Beykoz (Istanbul), amidst wide plains and rich water resources. This facility produced military shoes and boots for the Ottoman army. Beykoz Leather and Shoe Factory was one of the important facilities of the traditional leather industry that faced the Industrial Revolution that took place in Europe at the beginning of the 19th century. This factory was one of the rare facilities where the industrial revolution was implemented and long-lasting continuity could be achieved. Various breakthroughs were experienced over time, and the boundaries of the factory expanded accordingly. In 1842, steam engines started to be used in the factory and the technical equipment of the facility was improved. During this period, the factory was equipped with a 40-horsepower steam engine, two steam boilers, and 70 leather wells. In 1912, production capacity was increased with two diesel engines imported from Europe, new machines, and another steam boiler (Küçükerman, 2020).

After falling under Sümerbank's ownership in 1933, the name of the facility was changed to Industrial Facility of Sümerbank for Leather and Shoe in 1939 (Toros, 1954). From 1936 to 1940, the number of workers at the factory nearly doubled. Thus, Beykoz Leather and Shoe Factory created a significant level of employment in the Beykoz district (Küçükerman, 1988). The wedding hall, summer and winter cinemas in the Beykoz Leather and Shoe Factory clearly show the effects of the factory on social life. The factory was instrumental in meeting on common ground, having neighbourly relations, and social sharing.

Although Beykoz Leather and Shoe Factory increased its production by adding many manufacturing departments to its structure, the factory recruited its last workers in 1984 (Küçükerman, 2020). Production ceased in 1999 due to negative financial indicators and phosphorus pollution caused by the factory. The factory was privatized in 2003 and production was completely closed.

Structures for warehouse areas, technical areas, and similar functions have been altered as the production scheme has changed over time, completely in line with the needs. 53 buildings in the industrial area have ceased to operate. The area consisted of many different structures, from small workshops that began to be built at the beginning of the 19th century, to industrial-functional structures that evolved into more complex structures (Küçükerman, 1988). The area had buildings allocated for manufacturing, social events, warehouses, and offices, along with 32 flats in four blocks with sea views. In addition, the factory area included forest areas. It had a 350-meter front to the Bosphorus. The orientation, positioning, and geometry of the buildings in the area are planned in such a way that the use of daylight in architecture is abundant. The amount of sunlight taken into the buildings is sufficient to meet the users' needs in terms of quantity and quality (Çiftçi & Arpacıoğlu 2021).

Today, the entire land area of 182,250 square meters of the Beykoz Leather and Shoe Factory has turned into a movie plateau that hosts a museum, an open-air concert and cinema area, and an indoor movie theatre. There are 25 registered industrial structures in this area. During the transformation,

the natural historical texture and identity of the industrial area were preserved and maintained. This industrial area still contains many traces of the past.

An evaluation of the present structure together with its old manufacturing buildings, social structures, and green areas, allows us to describe this area as a breathing point for the urban fabric, both culturally and recreationally.

The oldest and at the same time the most common production area of the Ottoman industry is leather. Beykoz Leather and Shoe Factory is a prominent factory of the Ottoman industry with its leather products. Winning a gold medal at the Vienna International Fair in 1877 can be shown as a success proving the quality of Beykoz Leather and Shoe Factory's production (Küçükerman, 1988). The area is one of the rare factories that is also socially active and has created a workers' neighbourhood culture around it.

2. Material and Method

The present study focuses on examining the transformation of the Beykoz Leather and Shoe Factory area, investigating the qualities of the buildings in the area, and evaluating them in the context of industrial archaeology. The study aimed to determine whether each of the four conservation methods determined by Höhmann (1992) is preferred for the buildings of the Beykoz Leather and Shoe Factory.

(1) Complete conservation without any intervention or conservation without providing a new function with minimum intervention: This method aims to preserve industrial archaeology as an outdoor museum.

(2) Conservation by providing it with a function similar to its old function with little intervention: In this method (preferred for industrial areas), some older functions are preserved alongside the development of some new functions.

(3) Conservation providing museum function: It is a method that aims to re-function buildings as museums. This method applies to buildings that are capable of presenting sufficient technical information about their era and have not endured much damage nor lost a lot of their original equipment.

(4) Reuse with a different function: In this method, the aim is to integrate the building and the space into the present day and bring it back to life with a different function.

Literature review, archive review, on-site examination, and documentation of the structures related to the study area were used within the scope of the study. Field trips were made with the Kundura Hafıza (Shoe Memory) unit established within the Beykoz Leather and Shoe Factory. The details of the one-to-one interviews with more than 200 former factory employees and their relatives brought together by the Kundura Hafıza team, photographs taken during the factory's active period, documents, and drawings were examined. In addition, the archive of Kundura Hafıza, industrial machinery, materials, and personal belongings of the employees from the factory's active period was examined and photographed on site in the new museum area in the building, which had been the carpentry shop of the factory at that time.

Data collection was carried out in 5 years between 2018 - 2022. Data were collected through on-site observation, analysis of relevant documentation, and interviews with the Kundura Hafıza team during multiple site visits. The transformation of many buildings that took place in this process was observed on-site during field visits. Reinforcement work in structurally weak buildings was documented as well.

3. Findings and Discussion

Höhmann (1992) described four methods for the conservation of industrial archaeology. These methods can be listed as complete conservation without any intervention or conservation without providing a new function with minimum intervention; conservation by providing a function similar to the old function with a little intervention; conservation by providing a museum function; and reuse with a different function. Different methods can be preferred in line with different requirements for

the conservation and reuse of industrial archaeology. At this point, the following objectives should be considered as a priority when making decisions:

•To exhibit the industrial heritage,

•To carry out activities that will increase the knowledge and awareness of the public,

•To obtain information and learn examples from international practices and institutions, and

•To evaluate the economic aspect in the context of implementation and sustainability of decisions.

The present study examined the transformation of Beykoz Leather and Shoe Factory in terms of four methods of Höhmann (1992) for the conservation of industrial archaeology.

3.1. Complete Conservation Without Any Intervention or Conservation Without Providing a New Function with Minimum Intervention

Preserving industrial archaeology as it is and ensuring that it is passed on to future generations is a process with many historical and cultural benefits. In addition, the conservation of historical buildings is often more economical than constructing new buildings. The Venice Charter (ICOMOS, 1964) states: 'The conservation of monuments is always facilitated by making use of them for some socially useful purpose. Such use is therefore desirable, but it must not change the lay-out or decoration of the building [...].' Conservation of vacant and unused buildings that lost their function can be achieved by applying the right conservation principles and evaluating the structures correctly. Based on the historical and cultural function of the conservation; traces, equipment, data, and details of the identity and original function of the building should be preserved and integration of the old function with the building should be emphasized and brought to the fore.

An on-site examination of the Beykoz Leather and Shoe Factory helped determine whether the conservation method of complete conservation without any intervention or conservation without providing a new function with the minimum intervention was preferred. Many buildings and areas have been protected by this method in the industrial area. The area of the leather cabinets, where raw leather was processed and made ready for shoe production by resting in some chemical liquids, is subject to the conservation method of complete conservation without any intervention or conservation without providing a new function with minimum intervention (Figure 1). Industrial archaeology has allowed the historical leather cabinets of the factory, to be restored and preserved, as they were in earlier times (Figure 2). Also, the old and new shoe factory buildings, tire operation revision buildings, raw leather warehouse (Figure 3), water tank, and fire station located in the industrial area are preserved as they were.

Figure 1. Conservation of leather cabinets without any intervention

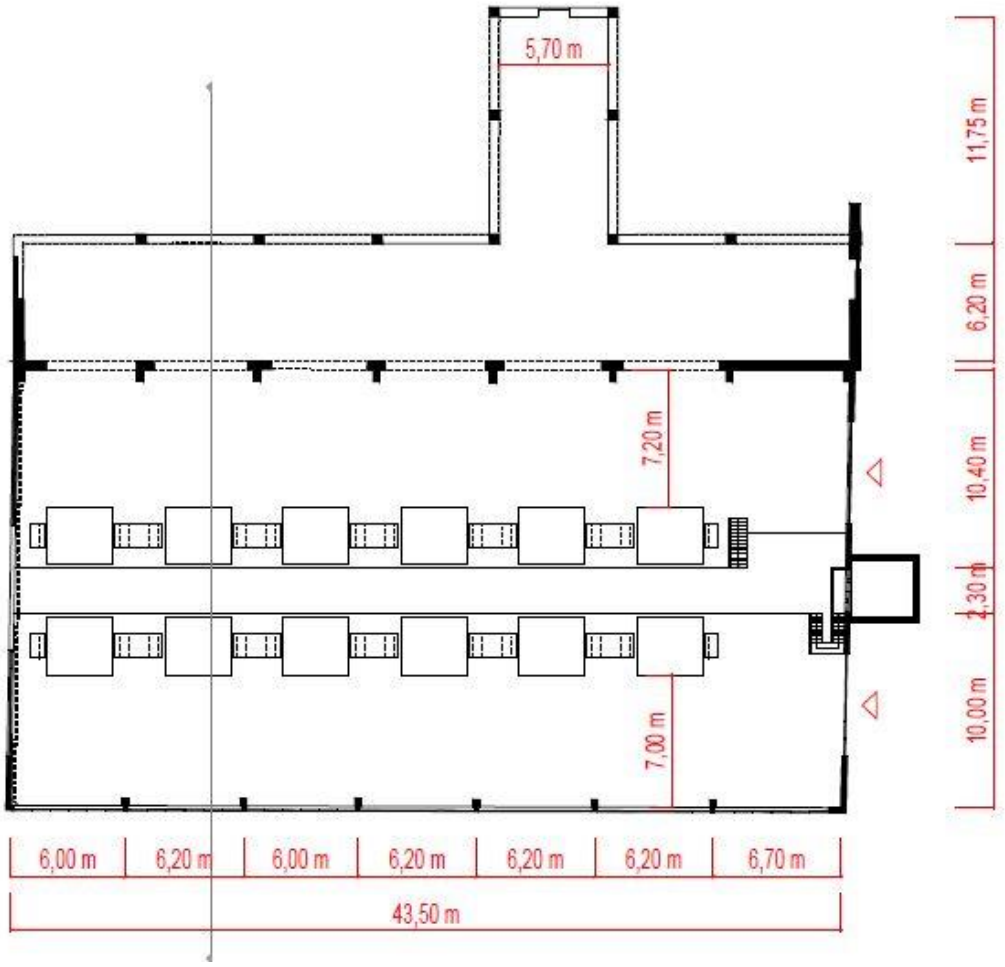

Figure 2. Plan of conservation of leather cabinets without any intervention (Beykoz Kundura, 2022)

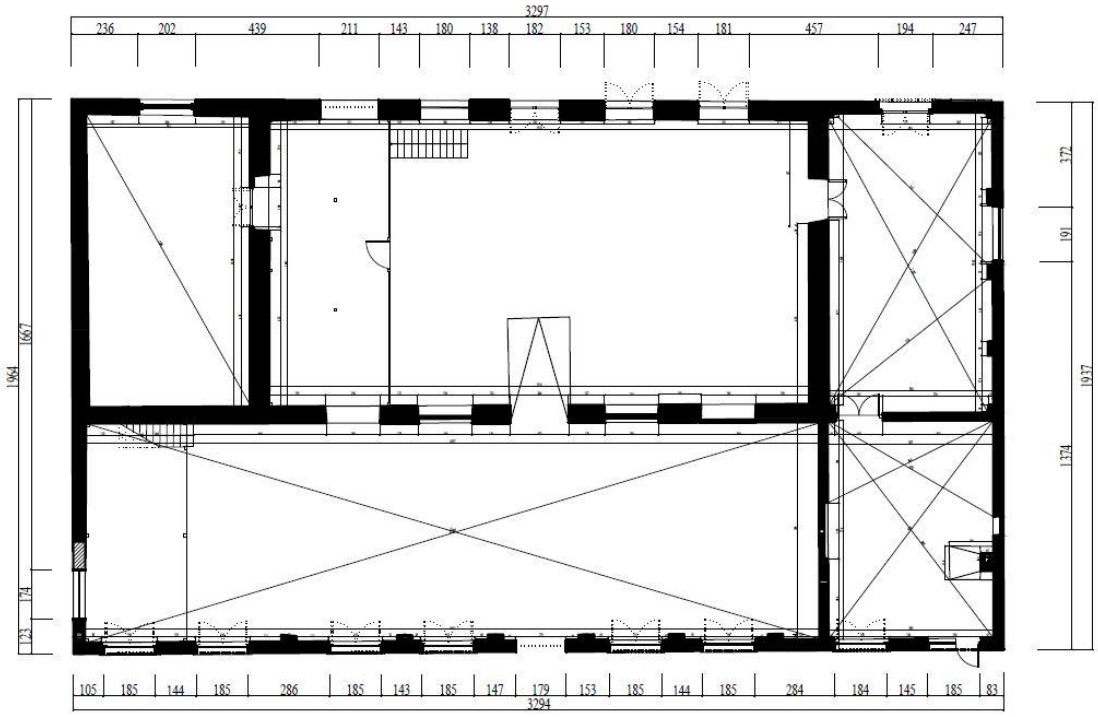

Figure 3. Plan of conservation of raw leather warehouse without any intervention (Beykoz Kundura, 2022)

It is important to identify the industrial buildings and to preserve them as they are, together with the parts that convey information about the production style of the period and their environment.

3.2. Conservation By Providing a Function Similar to The Old Function with A Little Intervention

Another approach adopted in conservation methods is to preserve buildings with very little intervention. This method ensures that the building is protected along with the continuity of its us to prevent it from falling into an idle state again. In terms of ensuring the continuity of use, it is primarily evaluated whether the function of the building adapts to today's needs.

The charter of Carta Del Restauro states that 'it is acceptable to provide new uses to living, that is, standing monuments, only not far from their original function and where necessary adaptations can be made to the building in such a way that it does not cause significant damage' (ICOMOS, 1931).

An on-site examination of the Beykoz Leather and Shoe Factory helped determine whether the conservation method of conservation by providing a function similar to the old function with a little intervention was preferred. There are many buildings and areas protected by this method in the industrial area. The warehouse area used for storage is subject to this conservation method (Figure 4). The building, which was used as a sheet metal warehouse during the factory's active period, is used as a storage area for hundreds of hand tools and machines used in the factory period. The office sections in the new shoe factory building, built towards the end of 1950, have been transformed into the accounting and human resources offices of Beykoz Kundura today. The Czech house, which was used as an accommodation and working area for engineers at the time it was built, is used as a boutique hotel with a function close to its former function (Figure 5).

Figure 4. Conservation of the warehouse by providing a function similar to the old function

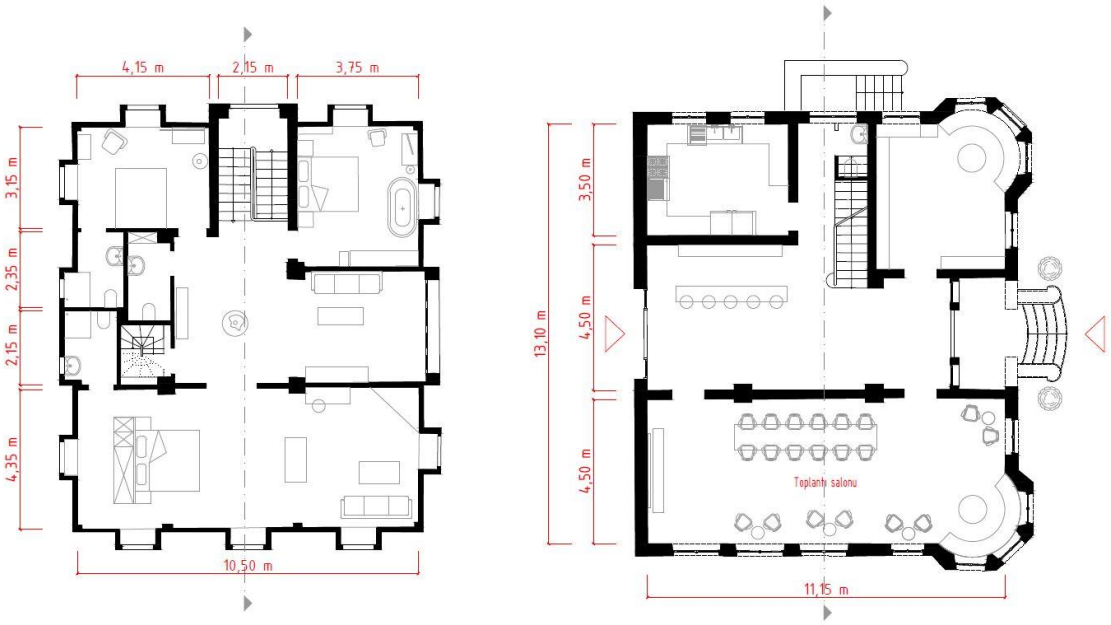

Figure 5. Plans (ground floor on the left and first floor on the right) of conservation of the Czech house by providing a function similar to the old function with a little intervention (Beykoz Kundura, 2022)

It is easier and more convenient to reuse the buildings with a function that needs functionally similar spatial programs and spatial scenarios than to use them with a different function. The old units of the buildings, which were used with a similar function to the old ones in Beykoz Leather and Shoe Factory, could be reused for the new function without the need for any intervention or with simple renovations.

3.3. Conservation Providing Museum Function

The buildings which have been re-functionalized from factory to museum ensure both the preservation of industrial heritage and the revival of history. The transformation of an industrial building into a museum not only provides the sustainability of architecture but also brings historical sustainability with it.

An industrial museum is expected to answer the question 'What changes have occurred in the economic, social, urban, and ecological areas in and around the industrial facility with industrialization?' (Engelskirchen, 1998). For this reason, the industrial museum must provide information such as the economic and technical development of the period in which the building was built, the daily lives of the workers, the way the products are used in daily life, as well as social and cultural information (Föhl, 1994). In the use of industrial areas as museums, it is important to convey information about the unique environment of the industrial building such as sound, noise, and smell. Often large machines such as steam engines are exhibited in museum galleries as monument-like objects (Blockley, 1999). Industrial archaeology machines provide essential data for understanding the industrial process. It is not possible to protect industrial areas, which have completely lost their equipment and traces of old functions, by turning them into museums. It would be misleading to create museums where machines brought from different places are exhibited as if they were there before. The best solution would be turning the equipment, even while working, of industrial buildings into a museum to enable visitors to observe the function of this equipment and learn by experiencing their development in history.

An on-site examination of the Beykoz Leather and Shoe Factory helped determine whether the conservation method of conservation providing a museum function was preferred. There are many buildings and areas protected by this method in the industrial area. The entire old carpentry area of the Factory and the foyer areas are currently used as Kundura Sahne (Stage) and Kundura Sinema (Cinema). As part of the re-functioning of Beykoz Shoe and Leather Factory, the industry museum in the carpentry structure explains both the industrial culture of the factory, which had continued for nearly two centuries and the social life shaped around it (Figure 6). The energy system in the boiler

room of the old factory is exhibited as an industrial heritage in the middle of the carefully designed Kundura Sahne. A part of the boiler room of the old factory is exhibited to visitors in the foyer of Kundura Sinema.

Figure 6. Conservation of carpentry structure by providing museum function

Industrial heritage buildings and equipment in the area are preserved as industrial archaeology. In the industry museum created this way, information and narratives are presented on many subjects such as production techniques, objects produced, the history and evolution of production, its place in the history of technology, the work of workers, and ordinary working days. In this sense, in the created museum, pictures, documents, and examples of leather in the production phase are exhibited, together with the background of leatherwork, the production stages, and the evolution of leatherwork in the factory together with the buildings over time. Shoe samples, which are the products of the factory from the early 19th century onwards, are exhibited in the factory's museum today. With the help of these examples, it is possible to evaluate the development of shoe tradition and art in terms of technique and design. The archive section in the carpentry not only exhibits preserved machines but also records the oral history studies carried out with the former employees of the factory and their relatives after 2015.

The re-functioning of this area, which is very important for the people of Beykoz, to bring it into social life, and the use of a few of the buildings in this area as museums, have enabled them to be used by different cultures, genders, and age groups, and by this way, many more people can benefit.

3.4. Reuse With a Different Function

The deprivation of regular maintenance and repair of a non-functioning and abandoned building causes faster destruction of its structure. Time, natural conditions, and many other factors accelerate the deterioration of structures. In these circumstances, reusing the structures with a different function for conservation can be a good solution. The main purpose of reuse is to extend the lifetime of the building by making it alive again. In this case, the historical value of the building and its environment is protected by a change in function. Instead of demolishing structures that have lost their function, reusing them with necessary interventions is a method that has been used for centuries. Evaluating old materials and equipment are important factors in ensuring the continuity of history and monuments (Schweger, 1985). Article 10 of the Venice Charter (ICOMOS, 1964) states: 'Where traditional techniques prove inadequate, the consolidation of a monument can be achieved by the use of any modern technique for conservation and construction, the efficacy of which has been shown by

scientific data and proved by experience.' It is still being determined whether smart materials with special dynamic properties can be used to reuse historic buildings (Topal & Arpacıoğlu, 2020).

Re-functioning industrial monuments often offer different options than other building types. Industrial buildings are generally quite simple in terms of structure; therefore, they can accommodate a wide range of options in the selection of new functions (Köksal, 2000). However, while re-functioning the building, the features that make it unique should not be spoiled. It is necessary to preserve the carrier systems, window proportions and profiles, interior openings, wall texture, courtyards, rails that provide transportation within the facility, and other similar features of such buildings. Achieving these depends on finding the appropriate function and performing the application correctly.

While determining the new functions, the historical and industrial archaeology values of the factories should not be ignored, the new functions should not lose the traces of the old functions integrated with the buildings and the area. The preservation of traces, equipment, data, and details of the identity, and original functions of the buildings ensures the monumentalization of the old functions by emphasizing their historical background and industrial culture. The selection of the new function and the nature of the implementation are directly related to each other. Therefore, the main decisions must be made correctly first. For reuse efforts, it is common that public cultural and artistic use is preferred over individual use (Zöpel, 1985). It is aimed at wide participation that is not isolated from the land, that contributes to cultural development by considering the local users, and that prevents destruction and unconsciousness. Thus, while industrial monuments come back to life, they also contribute to the urban culture.

An on-site examination of the Beykoz Leather and Shoe Factory helped determine whether the conservation method of reuse with a different function was preferred. There are many buildings and areas protected by this method in the industrial area. Kundura Sinema, which was created as a part of the boiler room restoration project in 2019 (Figure 7) is the most intensive example of this method of restoration (Figure 8). The building, which was used as an oil rendering plant during the active years of the factory, functions as a cafe, seminar room, and activity area today. Also, many buildings in the industrial area have been preserved and transformed into a form that serves as a decorative series-film stage where many projects can be created using the green box and technological fiber infrastructure. The new shoe factory building is used for cinema and music events as well as the shooting of TV series and movies. The forge structure, which is the old iron workshop of the factory, is used as a restaurant open to the use of guests participating in the events organized within Beykoz Kundura, remaining faithful to its historical features and structure. The additional structure of the carpenter’s workshop is used as a children's workshop area. Some of the rows of buildings called Leather Wells are used as restaurant kitchens, offices, and temporary accommodation areas. The cafeteria structure at the factory entrance is now used as a technology office and training area. The union building is used as a cafe.

Figure 7. Reuse of the boiler room with a different function

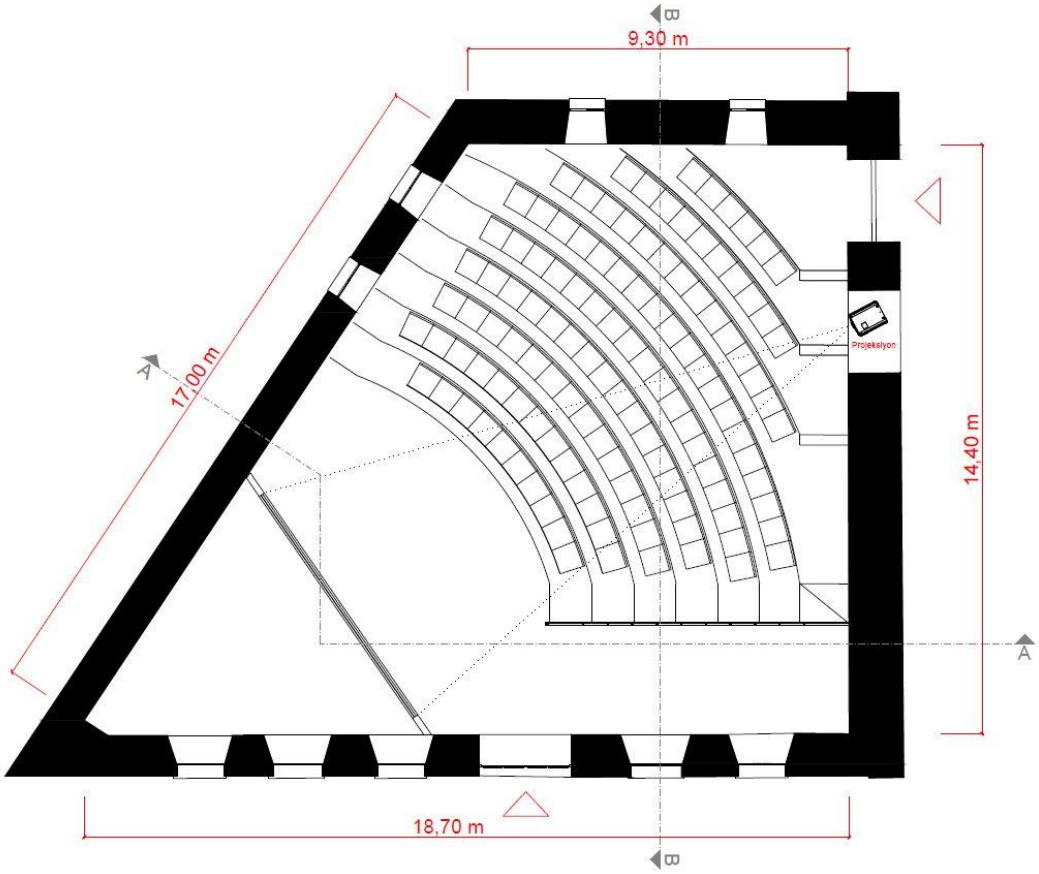

Figure 8. Plan of reuse of the boiler room with a different function (Beykoz Kundura, 2022)

Conservation proposals put forward are in line with the continuation of some structures in the area with a different function. The multifunctional use of the area has allowed it to be a visible space for the city and its inhabitants by serving more types of users.

4. Conclusion and Suggestions

Conservation of industrial archaeology is important both in terms of architectural memory and social memory. Numerous elements, such as facade, materials and construction techniques, equipment, furnishing, decoration, and plan scheme of the buildings, are information sources that illuminate the advancements of human history. Conservation is an important architectural approach in terms of both maintaining original structural values and ensuring the transfer of industrial heritage to future generations. Additionally, conservation is a sustainable approach. In contrast to conservation, the demolition of a building and the construction of a new one from scratch causes great harm to the environment, both in terms of waste generation and use of materials. Therefore, preserving and keeping alive industrial archaeology has several positive outcomes.

Preserving only a single structure or detail makes it difficult to understand industrial archaeology's dimensions and content. Therefore, for the conservation of industrial areas, it is important to properly determine and evaluate all parts of the area that convey information about the production style of a period and its surroundings.

The functional suggestions put forth after the Beykoz Shoe and Leather Factory lost its function and was privatized were aimed at preserving the area in a multifunctional structure. Since industrial archaeology is subject to unearned income in terms of large areas, building stock, and location, the factory is reused with multiple functions, which allows it to be a space for the city and its people, serving various users. Moreover, it has continued to preserve its feature of being an element that will increase the economic return, which is one of the main conditions for the protection and survival of the area.

The conservation and reuse of this facility, which has historical and cultural value for the people of Beykoz district and İstanbul, is valuable in many respects. By conservation and re-functioning, the buildings in this area are equipped with cultural functions, such as a museum, open-air concert and cinema area, indoor movie theatre, and a film plateau that hosts movies, TV series, and video clips. This allows the area to be used by different cultures, gender, and age groups, allowing more people to benefit from the area.

After the closing process of the factory started with the decision of the Council of Ministers, the factory area turned into one of Turkey's most important TV series and movie plateaus. The area, which has been protected as a monument by registering its buildings, has become an industry for a period and an institution that shapes the cultural and artistic life of the time. It should not be forgotten that the transformation of the factory is for the public good. Even though the buildings in the area are transformed, their original names turn them into places of memory. The original venue names of the factory, such as Tire Operation Revision Buildings, Oil Rendering Plant, and Leather Cabinets, are still used in the field. In addition, the Carpentry Area, where the exhibition takes place, is still a place with its original name, where we can see the machines still used in the period and the wooden shoe molds that were produced. Machines are indispensable elements of the industrial heritage as they reflect both the stages of shoe production and the technology of the period in which they were produced.

The principles applied in the Beykoz Leather and Shoe Factory transformation project were determined according to the size of the area, its location in the city, and the decisions of the authorities. The main strategies for the transformation project can be listed as follows:

• To ensure the integration of the area with the city.

• To transform the area by assigning needed and appropriate functions, considering the physical and social structure of the city, in a dynamic context.

• To ensure that the area contributes to the city economically, socially, and culturally with the conservation and reuse programs to be implemented.

All the research, analysis, and on-site determinations reveal that each of the four conservation methods determined by Höhmann (1992) is preferred separately for the conservation of industrial archaeology in Beykoz Leather and Shoe Factory (Figure 9).

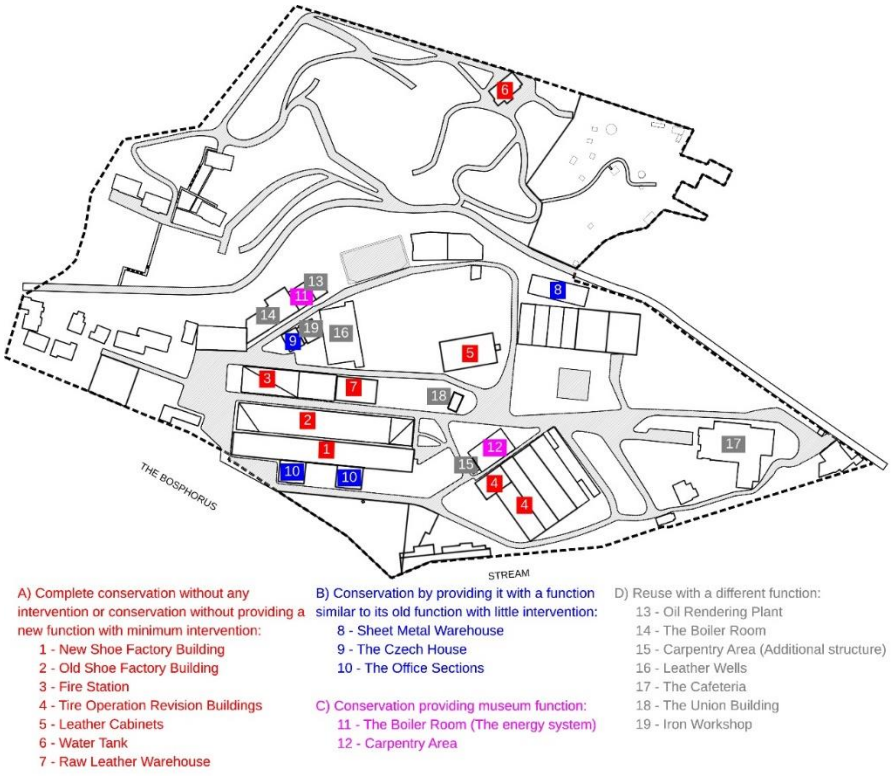

Figure 9. Map of conservation methods of buildings in Beykoz Leather and Shoe Factory

The structures that have survived from the past to the present in all industrial heritage areas indicated on the map have been preserved in line with different requirements with the four different protection methods described above (Figure 9). At this point, the ones that are prioritized in the decisions given for Beykoz Kundura; It is the implementation and sustainability of approaches such as exhibiting the industrial heritage, carrying out studies that will increase the knowledge and awareness of the public, taking information and examples from international practices and institutions. This situation has been possible with different protection methods being proposed, without forgetting that the main purpose is to keep the urban identity and memory alive while remaining within the concept of protection.

After the production of Sümerbank Beykoz Leather and Shoe Factory ceased, a new and different life was created within the remaining industrial heritage. To achieve this, different methods were used together, namely: complete conservation without any intervention or conservation without providing a new function with minimum intervention, conservation by providing it with a function similar to its old function with a little intervention, conservation providing museum function, and reuse with a different function. With its conservation and re-functioning methods, the entire factory area can be considered an example of a planned transformation as an industrial heritage and open-air museum.

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The article complies with national and international research and publication ethics. Ethics Committee approval was not required for the study.

Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to the article. There is no conflict of interest.

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Interior in Residential Premises That Support Ageing in Place for Older Users

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Abstract

One of the effective factors in enabling individuals to age in place and to spend their old age periods more actively and with better quality is the physical environmental characteristics of the dwelling and its immediate surroundings. In this study, which is based on the assertion that individuals prefer to live in their own homes in old age, it is aimed to determine the features that should be carried by the houses that will support the aging in place of elderly individuals and to reveal the design principles. For this purpose, semi-structured interviews were conducted with 70 elderly users aged 65 and over in their residences. General frequency distributions and chi-square test analyses of the obtained data were performed in SPSS statistical program and descriptive content analysis was performed on open-ended questions and the data were examined with the comparison tables created. Then, all the data obtained from the field study are evaluated together with the literature information and the principles that should be considered in the renovation of the houses for the use of elderly users in line with the new needs are presented. With the design principles presented, it is envisaged that elderly users will continue their lives in a better quality and active way in their residences by extending the time they can be self-sufficient.

Keywords: *Aging, aging in place, residential, interior design.*

Yaşlı Kullanıcılar İçin Yerinde Yaşlanması Destekleyen Konutlarda İç Mekân

Öz

Bireylerin yerinde yaşlanabilmelerinde, yaşlılık dönemlerini daha aktif ve kaliteli geçirebilmelerinde etkili faktörlerden biri de konut ve yakın çevresinin fiziksel çevre özellikleridir. Bireylerin yaşlılık döneminde kendi evlerinde yaşamayı tercih ettikleri savı üzerine temellenen bu çalışmada, yaşlı bireylerin yerinde yaşlanmalarını destekleyecek konutların taşıması gereken özelliklerin belirlenerek tasarım prensiplerinin ortaya konması amaçlanmaktadır. Bu amaç doğrultusunda 65 yaş ve üzeri 70 yaşlı kullanıcı ile yaşamlarını sürdürdükleri konutlarında yarı yapılandırılmış görüşmeler gerçekleştirilmiştir. Elde edilen verilerin SPSS istatistik programında genel frekans dağılımları ve ki-kare testi analizleri edilmiş ve açık uçlu sorularda betimsel içerik analizi yapılarak veriler oluşturulan karşılaştırma tablolarıyla irdelenmiştir. Ardından alan çalışmasından elde edilen tüm veriler literatür bilgileriyle birlikte değerlendirilerek yaşlı kullanıcılar kullanımına yönelik konutlarda yeni ihtiyaçlar doğrultusunda tadilatında dikkat edilmesi gereken prensipler sunulmaktadır. Sunulan tasarım prensipleri ile yaşlı kullanıcıların kendi kendine yetebildikleri süreyi uzatarak konutlarında daha kaliteli ve aktif bir şekilde yaşamlarını sürdürmeleri öngörülmektedir.

Anahtar kelimeler: *Yaşlılık, yerinde yaşlanma, konut, iç mekân.*

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1. Introduction

One of the most prominent demographic phenomena in the last century is that the proportion of the elderly population is increasing throughout the world. The world population is rapidly aging as a result of decreased fertility, rising living standards, and prolonged life span due to developments in the field of health and technology. As a multifaceted and multidimensional process, the phenomenon of old age is defined in different ways depending on the discipline in which it is addressed. In its definition of chronological old age, the World Health Organization considers the beginning of old age as 65 years of age and defines the 65-74 age range as young old age, 75-84 years of age range as advanced old age, 85 years and above very advanced old age (World Health Organization, 1989; World Health Organization, 1999).

Depending on the increasing age in old age, there are many changes in physical, sensory, social, and psychological aspects in individuals. Physiological changes and loss of power during this period make it difficult for individuals to perform their daily activities. Losses in muscle mass and elasticity, various joint disorders due to kneeling, bending, and lying movements become difficult to do, while pain in the joints, weakness, etc. caused by the weakening of the grip and holding movements of the elbows, hands and fingers caused by the weakening of the grip and holding movements of the elbows, hands and fingers are experiencing a decrease in dexterity. However, during this period, due to the loss of strength in the arms and legs, there is a decrease in physical exertion, and difficulties in lifting, pushing and pulling objects (Arpacı, 2005; Çakır, 2004; Hazer, 2012; Johnson, Duncan, Gabriel & Carter, 1999; Kalınkara, 2017; Terakye & Güner, 1997). With the increase in age, there are also various sensory losses such as loss of vision, hearing, smell and taste abilities, and loss of sense (Johnson et al., 1999; İmamoğlu, 2015; Pinto, De Medici, Zlotnicki, Bianchi, Van Sant & Napou, 1997). Along with old age, individuals also experience several changes in perceptual and cognitive aspects. During this period, with deformations in the central nervous system, a decrease in learning, perception, reasoning ability, short-term memory loss, forgetfulness, and decreases in behavior and reflexes occur (Çakır, 2004; Hazer, 2012; Kalınkara, 2017).

Many factors affect the social life of individuals, such as the decrease in income level with the termination of the active work process in old age, the relative distancing from social life, the change in social roles and status (Günay, Aydıner, Şahin, Demirci & Oğuz, 2016; Hablemitoğlu & Özmete, 2010; Kurt, Beyaztaş & Erkol, 2010). From a psychological point of view, the feeling of fear of death can be seen in individuals in old age, changes in emotional status, loneliness, and increased age (Kemppainen Ozer, 2006; Kimmel, 1988; Koşar, 1996).

User requirements are directly related to the characteristics of the user, and the physical, sensory, social and psychological changes that occur in individuals in old age differentiate their physical and psycho-social requirements or, sometimes, within these requirements, priorities may change. Specifically, the spatial requirements defined about the user characteristics, the actions performed in that space and the furniture/equipment/equipment needed when performing these actions differ depending on the changes occurring in old age. Static and dynamic anthropometric dimensions, which change about physiological changes occurring in old age, make it necessary to consider these dimensions in determining formal and dimensional features in spatial or furniture/equipment scale designs for the use of older individuals. Similarly, changes in the capability of holding, grip, etc. make it necessary to evaluate the equipment characteristics in this context, especially in kitchens where the use of various equipment is intensive. Increased age-related movement restriction and rapid fatigue entail the types of actions of individuals, the way they perform actions, the frequency of use of spaces in housing, and changes in inter-spatial relationships. The old age period is a period where both health problems and various household accidents are more intense with changing physiological characteristics and loss of yeti. When determining the conditions for meeting health and safety requirements, it is very important to consider the sensory characteristics that change in old age. During this period, due to decreased vision due to the increased age, the level of luminance needed and the need for the use of various color and texture contrasts is increasing. Again, age-related hearing loss modifies the auditory requirements, while audible stimuli

in various equipment used in residential buildings are supplemented with visual stimuli, or some acoustic arrangements are necessary. In old age, the decrease in body temperatures causes an increase in the temperature degree needed in space. Bathrooms are spaces where the need for thermal comfort of individuals in old age is prominent. Besides these, sensory changes in individuals also influence visual requirements and play a role in material, color, texture, and lighting preferences. It is important to meet the visual requirements of individuals in performing food preparation actions such as cutting, and chopping, especially in the kitchen space. The safety requirement is defined as primarily associated with the feeling of being safe, both physically and psychologically. Due to the higher risks of accidents such as slipping, falling, etc. in old age, the feeling of physical security and emotional security with loneliness comes to the fore. Along with all these physical requirements, as well as the changes experienced in old age, psycho-social requirements also change.

Many studies show that in old age individuals prefer to continue their lives in their own homes (Burr, Mutchler & Warren, 2005; Kalınkara & Arpacı, 2013; Kalınkara & Kalaycı, 2019; Lansley, Flanagan, Goodacre, Turner-Smith & Cowan, 2005; Lecovich, 2014; Peek, Luijkx, Rijnaard, Nieboer, Voort, Aarts, Hoof, Vrijhoef & Wouters, 2016; Pinto, De Medici, Van Sant, Bianchi, Zlotnicki & Napoli, 2000; Rioux, 2005; Tang & Pickard, 2008; Tanner, 2001). It is defined as aging in place when individuals continue their lives independently, actively, and socially in their existing dwellings and the environment they are accustomed to for as long as possible, regardless of age, income, and abilities. Aging in place allows older individuals to be able to self-enough, allowing individuals to keep control and control rights over their lives in their own hands (Cook, Yearns & Martin, 2005; Fiessel, Kulyk, Peel, Pfeifer, Robert & Statler, 2013; Kalınkara & Arpacı, 2016; Low, Molzahn & Kalfoss, 2008; Pynoos, Nishita & Kendig, 2007; Salomon, 2010). Aging in places, which encourages individuals to grow old in a familiar environment/where they are accustomed, makes individuals feel peaceful and happy, as well as reduces the need for corporate care (Gillis, 2011; Kalınkara & Arpacı, 2013; Kalınkara & Kapıkıran, 2017; Vasunilashorn, Steinman, Liebig & Pynoos 2012; Wiles, Leibing, Guberman, Reeve & Allen, 2011).

In the environment where individuals belong, in their own homes, aging in place with another expression, and the physical environment possibilities that support it positively affect their life satisfaction. Life satisfaction, in other words, subjective quality of life, is an important element of quality aging. To increase life satisfaction, first of all, living conditions must be improved. In this sense, the characteristics of housing and its immediate surroundings are also one of the main elements affecting life satisfaction. Depending on the extent to which the home and neighborhood in which older individuals live meet the individual's needs, daily life activities, leisure time assessment and levels of participation in social life differ. Since the living space in old age is often limited to the housing and its immediate surroundings, it depends on the fact that the physical characteristics of the housing and its immediate surroundings are compatible with the physical characteristics, needs, and expectations of older individuals (Zorlu & Onur, 2019).

2. Material and Method

It is important that in old age the dwellings are designed in properties that will support on-site aging. For this, first of all, the planning scheme of housing must comply with the norms of housing use of elderly individuals. In this context, it is important that the location of the spaces within the housing and the relationship with other spaces are correctly established. In addition, each space must be organized by the purpose of use and the actions taking place in it. The changing characteristics of individuals should be taken into account in the provision of physical comfort conditions in housing, in the selection of furniture/equipment and materials, some architectural details (Zorlu, 2017). In this study, the needs, desires, and expectations of individuals in their dwellings in everyday life during old age are determined and the features that should be considered in the interior design of dwellings to support in-place aging are discussed.

2.1. Participant Group

This study, which is based on the argument that individuals prefer to live in their own homes in old age, aims to determine the design principles by determining the characteristics of the housing that will

support their aging in place of elderly individuals. For this purpose, within the scope of the study; It is aimed to determine the requirements of individuals regarding housing in old age, determination of desires and preferences, and the characteristics that they are not satisfied about their existing housing. Within the scope of the study, answers are sought to the questions to determine what are the factors that affect the choice of aging in the place of individuals, which space they spend the most time in their dwellings, and what the norms of space use are. Based on the results of the analysis of the data obtained, the principles to be considered in the housing intended for elderly users or in the revision of existing housing in line with new needs are presented.

The study was carried out in the provincial center of Trabzon in Turkey. According to the data of the Turkish Statistical Institution for 2018, 27,516 elderly individuals live in Trabzon provincial center. 90% reliability and 10% error margin were observed in determining the number of participants, and the study was carried out with 70 participants aged 65 years and older in the framework of the World Health Organization's chronological definition of old age. 8 participants aged 20, 85 years, and older were interviewed in the 65-74 age range 42, 75-84 years. In determining the participants, the criteria of having lived alone or together with his wife in the Ortahisar district, being mentally healthy, having the ability to communicate, and having been living in the same housing for at least 10 years were taken into account. The snowball technique, which is one of the sample selection methods in qualitative research methods, was used in sample determination.

2.2. Research Design

In accordance with the goals and objectives determined within the scope of the study, the research design was established in 3 stages. In the first stage, literature related to old age, quality of life, life satisfaction, active aging, and on-site aging was scanned about the study topic. In the second stage of data collection, semi-structured interviews and identification studies/observation were conducted with 70 elderly participants from qualitative research methods. Before the study, a pilot study was conducted to test the comprehensibility of the questions in the interview and the questions were revised by the data obtained. The interviews were conducted face-to-face by attending the residences where they live in line with appointments received in advance from 70 elderly participants. Interviews lasted about 60 minutes with each participant. The answers to the interview questions were converted into text after the interview and listened to the voice recording of the permissions received from the participants. Questions in the interview form are collected in 3 main headings. The first group of questions is aimed at determining the user profile/properties. This title includes questions related to age, gender, marital status, educational status, occupation, working status, and level of economic income. The second group of questions is aimed at identifying users' housing preferences in old age and their reasons for choosing this preference. The third group of questions includes usages/norms and assessments both in general and in particular of living space, kitchen, bathroom, and bedroom spaces related to the current housing in which users live. The fourth group of questions is aimed at learning the assessment of users about how they want to have a residence. Answers to open and closed-ended questions in the interview form and the needs, desires, and expectations of elderly users related to their housing were identified. In addition, the current status of living space, kitchen, bedroom, and bathroom spaces in their residences was determined by photographs by obtaining permission from the users during the interviews to be used in the evaluations.

The third stage of the study relates to the analysis of data obtained from semi-structured interviews. In the answers given to the open-ended questions, the answers showing similarities with each other were grouped under the same headings by descriptive content analysis, and a data grouping was made. The grouped data were analysed in the SPSS statistical program used in quantitative data analysis and general frequency distributions were calculated. Considering that participants had multiple responses to open-ended questions, instead of predominantly determining the answers, their weight was proportioned to the number of participants (70). However, whether it is statistically related among the responses given to questions related to each other (the properties that are loved in the spaces located in their current residences, unloved properties, and the space of their dreams) were analyzed by the chi-square test in the SPSS statistical program and also analyzed by creating comparison tables. Finally,

all the data obtained from the field study and the information contained in the literature were evaluated together and the results of the study were revealed.

3. Findings and Discussion

The findings from the study were collected in two tables: demographic information on users, users' housing preferences, assessments of their current housing, and assessments of how they wanted to own housing. The majority of participants in the interview are in the 65-74 age range, women, high school graduates, housewives, and income status between 2,500-5,000TL. Part two findings correlate to users' housing preferences. When older users were asked where they wanted to spend their old age periods, almost all (97.1%) expressed their desire to live in their own homes or grow old on the spot. Among the reasons for users prefer their own homes, mainly because they feel more comfortable and free in their homes, feelings of being independent and not wanting to be a burden on another person were found to be effective. When considering users' reviews about their existing housing, users are predominantly (41%) living in the same housing for at least 25 years and are satisfied that their dwellings are mainly close to public transport, green spaces, and shopping facilities. When older users were asked what the home they live in meant to them, a large part expressed a sense of being peaceful and happy. Users have stated that they have the most living space in their homes and spend time on the balcony. The physical environmental factors related to the location such as being on the street, being close to the park, and seeing the sea are at the forefront (Table 1).

Table 1. Users' housing preferences and reviews about the housing they live in

User Profile		**(%)**
Age	65 - 74	60,0
	75 - 84	28,6
	85 and above	11,4
Gender	Female	67,1
	Man	32,9
Educational status	Primary School	10
	Middle School	18,6
	High school	48,6
	University	21,4
	Graduate Education	1,4
Profession	Housewife	40,0
	Civil servant	37,1
	Private sector	22,9
Working status	Retired	55,7
	Not working	40
	Working	4,3
Economical situation	0 - 2.500	41,4
	2.500 - 5.000	51,4
	5.000 - 10.000	7,2
	10.000 ve üzeri	0
Housing preference and reasons of users		**(%)**
Housing preferences	Own house	97,1
	Care	2,9
	New housing estates designed for elderly people	0
	Next to your child	0
Reasons for choosing where they want to live	A sense of comfort, freedom, not being a burden	65,7
	Feeling happy and peaceful	21,4
	Connection with the past, habit	17,1
	Neighborly relations	10,0
General evaluations of users regarding their residences		**(%)**
Residential period of use	25 years and above	41,0
	20-24 years	18,6
	15-19 years	21,4

	10-14 years	18,6
Features they like in the immediate vicinity of their home	Proximity to public transport	54,3
	Green spaces	54,3
	Shopping opportunity	50,0
	Landscape	40,0
	Proximity to healthcare	24,3
	Proximity to the city center	20,0
	Proximity to public service	7,1
Meaning of house	Peace and happiness	57,1
	Home	28,6
	Freedom	28,6
	Memory and belonging	20,0
The place where they spend the most time in their homes	Living space	74,3
	Other (balcony)	15,7
	Kitchen	10
	Bedroom	0
	Bathroom	0
Favorite feature of the house	Positive physical environmental characteristics of the location	54,3
	Proximity to public service in the immediate vicinity	27,1
	Physical factors related to housing	20
	Positive social environment factor	14,3
	Daylight	12,9
	Semi-open space use	10,0
	Garage, parking lot, parking space	5,7

When users are asked about their favorite and disliked features related to living space, kitchen, bathroom, and bedrooms; expressed features of living space in living space and kitchen space dimensions and organization of space in the kitchen come to the fore, while the features of the bathroom, daylight in the bedroom, space dimensions and the way of organization are insufficient is expressed as a higher priority. When asked how users want to continue their lives in a dwelling, the answers to the size, reinforcement features, and organization were mainly at the forefront of all the spaces discussed within the scope of the study (Table 2).

Table 2. Findings on users' current housing evaluations

Users' evaluations of their current residences		**(%)**
The features they like/satisfy in their living space	Space size and placement	32,9
	Positive characteristics of furniture and accessories	27,1
	Orientation and scenery	20,0
	Positive features of daylight	20,0
	In-residential location	11,4
	Semi-open space use	10,0
	Furniture and accessories with a moment value	10,0
Features that they do not like/are not satisfied within their living space	Small space size and layout	41,4
	Negative features of furniture and accessories	20
	Thermal comfort	12,9
	Lack of daylight	11,4
	In-residential location	7,1
	Semi-open space use	7,1
	Orientation and landscape	2,9
Features they like/satisfy in their kitchen	Space size and placement	27,1
	Positive attributes of equipment, work, and storage space	25,7
	Semi-open space use	22,9
	Positive features of daylight	17,1
	Orientation and landscape	15,7
	In-residential location	15,7
	Thermal comfort	7,1
	Accessibility	2,9

Features they dislike/dissatisfied in their kitchen	Small space size and layout	48,6
	Negative characteristics of equipment, work, and storage space	25,7
	Accessibility	18,6
	Thermal comfort	8,6
	Lack of daylight	7,1
	In-residential location	4,3
	Orientation and landscape	2,9
Features they like/satisfy in their bathroom	Positive features of the bathing area	31,4
	Space size and placement	25,7
	Positive characteristics of the equipment	20,0
	Thermal comfort	18,6
	In-residential location	15,7
Features they dislike/dissatisfied with within their bathroom	Negative features of the bathing area	38,6
	Small space size and layout	37,1
	Thermal comfort	18,6
	Accessibility	12,9
	Insufficient storage	7,1
Features they like/satisfy in the bedroom	Positive features of daylight	38,6
	Positive features of fittings, furniture, and accessories	35,7
	Relationship with the bathroom	15,7
	Space size and placement	14,3
	Orientation and landscape	12,9
	Semi-open space use	4,3
Features they dislike/are dissatisfied with in the bedroom	Small space size and layout	35,7
	Negative features of furniture and accessories	21,4
	Orientation and landscape	17,1
	Access to storage volumes	14,3
	Lack of daylight	10,0
	In-residential location	2,9
Features of the type of residence that users want to live in		**(%)**
Features they want to have in their living space	Space size and placement	64,3
	Daylight	44,3
	Orientation and landscape	40,0
	Semi-open space use	35,7
	Positive characteristics of furniture and accessories	21,4
	Single volume solution of living room and kitchen	18,6
	Aesthetic factors	11,4
	Special field of action	10,0
Features they want to have in the kitchen	Space size and placement	60,0
	Features of fittings, furniture and accessories	38,6
	Daylight	31,4
	Semi-open space use	25,7
	Single volume solution of living room and kitchen	24,3
	Accessibility	20,0
	Orientation and landscape	10,0
	Aesthetic factors	8,6
Features they want to have in the bathroom	Suitability and nature of the bathing area	64,3
	Space size and placement	54,3
	Relationship with the bedroom	22,9
	The nature of the reinforcement and storage space	22,9
	Thermal comfort	12,9
	Grab bar and seating element	10,0
	Aesthetic factors	4,3
Features they want in the bedroom	Features of fittings, furniture and accessories	52,9
	Space size and placement	38,6
	Daylight	37,1
	Orientation and landscape	21,4
	Relationship with other places	17,1
	A special area of activity	17,1
	Access to the bed and closets	10,0
	Aesthetic factors	8,6

4. Discussion

In the analysis of data obtained from semi-structured interviews with elderly individuals, it was first questioned whether there was a statistically significant relationship between the answers to the questions by chi-square test in the SPSS statistical program. In the second stage, the relationships between the most beloved, unloved and desired characteristics for living space, kitchen, bedroom and bathroom spaces in the residential area were compared with comparison tables prepared with data based on the general frequency distributions of the answers to the questions.

Age, gender, marital status, educational status, occupation, working status, each of the variables, housing preferences, housing close environment characteristics, meaning of the house, the most time spent and the living space of their dreams, whether there is a statistical correlation between the answers to the questions of kitchen, bathroom and bedroom, whether there is a statistical correlation between the questions of the SPSS statistical program chi-square tested by the test. According to the applied Likelihood Ratio test, only a significant relationship between age and residential close environmental characteristics was found. (LR:6,684, df:2, p:0,035 p<0,05) (Table 3). The source of the difference is that elderly users over 85 years of age emphasized the importance of proximity to health services near housing. This situation was considered as an indication that proximity to health services near housing in the advanced old age period is more priority than shopping opportunities and social activities.

Table 3. The relationship between the characteristics of the residential neighborhood and age

Pleasant features in the residential neighborhood		**Age**						**LR**	**df**	**P**
		65-74		**75-84**		**85 and above**				
		%	Adj. Res.	%	Adj. Res.	%	Adj. Res.	6,684	2	,035
Proximity to healthcare	Mentioned	10,0	-1,8	7,1	,1	7,1	2,7			
	Didn't mentioned	50,0	1,8	21,4	-,1	3	-2,7			

When the answers given by older users about what they like, dislikes and how they want to continue their lives in a living space, the dimensions of the space and the layout of the furniture in the space were the first highlighted feature. Users were first expressed in the ranking of the positive and negative characteristics of their living spaces, while daylight and landscape were other issues that stood out in the characteristics of the living space they wanted to have. Regarding the size and organization of the living space in their dwellings, users expressed their positive characteristics with phrases such as *"big and wide", and "big enough to walk comfortably*", and negative features with *phrases such as "cramped and narrow constantly strike my leg against the coffee table in the middle"*. These statements reveal the importance of furniture placement as well as the size of the space to be able to move comfortably in the space due to decreased mobility due to age. Another issue that is being discussed about the living space they want to have is the characteristics of the seating facilities in the space. About the furniture in their living space, users note their positive characteristics with phrases such as "having a comfortable and spacious seat where I can lie down..", "having a coffee table next to my seat where I can put my medicine", "my seats are not too hard and very soft", "easy to *carry", "my furniture is very soft", "my seats are very soft expressed negative properties with phrases such as "be"*. Due to decreased muscle mass and loss of elasticity in old age, users have difficulty performing actions such as lifting, lying down, and pulling. The inability of furniture and equipment to meet the changing physical characteristics of elderly users is one of the main reasons for complaining. It is important that the dimensional and formal characteristics of the seats in this space are suitable for users. Users want their seats to be at a height where they can sit and get up comfortably, not too hard or too soft. However, the landscape and the daylight factor are other prominent topics in the living space. Users noted that *they care about turning to the landscape in their residences with expressions such as "Sun is my joy* to life", "Sun is my joy to life", "sun adds *life to my life", "it's nice to see the garden through the window", "Passing cars sound to me, I don't feel lonely", "it's nice to see the garden through the window", "I love watching people passing through the street*". The relationship of living

space with the environment becomes more important for them to spend a very large part of their daily lives in the living spaces of the residential living space. For users to feel happier and not isolated from society, the orientation of the living space to a street, road, or street is very important. Besides these are the features that users want to have in the living space that they do not mention in their existing residences but want to have; the setting of the living space in the same area as the kitchen and the presence of areas related to the free time activities of users. When the table is evaluated in general, the characteristics that users complain about in their living space and the characteristics of the living space they want to own/live in show consistency (Table 4).

Table 4. Users' evaluations of living spaces

Features liked/satisfied in the living space	%	Dissatisfied/disliked features in the living space	%	Features they want to have in their living space	%
Space size and placement	32,9	Small space size and layout	41,4	Space size and placement	64,3
Positive features of furniture and accessories	27,1	Negative features of furniture and accessories	20,0	Positive features of daylight	44,3
Orientation and landscape	20,0	Thermal comfort	12,9	Orientation and landscape	40,0
Positive features of daylight	20,0	Lack of daylight	11,4	Positive features of furniture and accessories	35,7
In-residential location	11,4	In-residential location	7,1	Semi-open space use	21,4
Semi-open space use	10,0	Semi-open space use	7,1	Single volume solution of living room and kitchen	18,6
Furniture and accessories with a moment value	10,0	Orientation and landscape	2,9	Aesthetic factors	11,4
				Special area of action	10,0

When the answers given by elderly users about what they like, dislike and how they want a kitchen in the kitchen of the dwelling they live in are evaluated together, the space size and placement and the features of equipment, equipment, work, and storage space in the space are the first two issues expressed in all three groups. Satisfaction was expressed with the use of semi-open space in third place for their favorite properties in their kitchens, while the difficulties in accessing storage areas were highlighted in the ranking of negative features. Regarding the kitchen they want to have, enough daylight requests are indicated. The *fact that users express their positive characteristics with expressions such as "large and spacious", "wide, square and rectangular*", "*small", "being in the form of a narrow and long corridor"* and negative properties, reveals that the size and geometry of the space are an important factor in the comfortable use of space. Users note that countertop space, kitchen cabinets, and dining tables in their kitchens are convenient for performing food preparation, cooking, and eating actions while complaining about a lack of adequate storage space in the kitchen and a lack of countertop spaces. Users should be happy with statements such as *"having a bench area", "having a low bench", "having a large number of large cabinets", "having a low bench", "having a large number of* large cabinets", "*having a narrow and small countertop", "upper cabinets high", "not having enough cabinets" have emphasized the* negative characteristics associated with the facets. The height shortening, and limiting the stretching and bending distances, which are common in old age, make it difficult for users to perform their actions in the kitchen. This situation reveals the importance of designing the equipment, equipment, and working areas in the kitchen taking into account the changing anthropometric dimensions and power losses of users. Users expressed the use of daylight factor and semi-open space in the kitchen as well as in the living space, both among the favorite features of their existing kitchens and among the features of the kitchen they want to have. Users note that their kitchen is bright positively affects their visual comfort, especially in the actions of preparing food in the kitchen. Users often consider semi-open spaces associated with the kitchen as storage space if kitchens also have insufficient storage space. The fact that the kitchen is directly related to the semi-open space is also a highlight of the kitchens they want to have. Users have expressed problems

with accessibility to storage units in their kitchens as a negative feature and emphasized that they can easily access the kitchens they want to have. Factors such as neck shortening with increasing age, loss of flexibility of muscles, various joint disorders, and loss of strength cause limitations in lying down and squatting movements and cause access problems in kitchens, especially in the use of storage units. Users have stated that they want to have an open kitchen in the same space as the living space of their kitchen within the features of the kitchen they want to have, although they do not express it as a negative feature in their existing Housing (Table 5).

Table 5. Users' evaluations of the kitchen

Favorite features in the kitchen	%	Uncomfortable features in the kitchen	%	The features they want to have in the kitchen	%
Space size and placement	27,1	Small space size and layout	48,6	Space size and placement	60
Positive characteristics regarding equipment, working and storage space	25,7	Negative characteristics regarding equipment, working and storage space	25,7	Positive characteristics regarding equipment, working and storage space	38,6
Semi-open space use	22,9	Accessibility	18,6	Positive features of daylight	31,4
Positive features of daylight	17,1	Thermal comfort	8,6	Semi-open space use	25,7
In-residential location	15,7	Negative features of daylight	7,1	Single volume solution of living room and kitchen	24,3
Orientation and landscape	15,7	In-residential location	4,3	Accessibility	20
Thermal comfort	7,1	Orientation and scenery	2,9	Orientation and landscape	10
Accessibility	2,9			Aesthetic factors	8,6

When the answers of older users about what they like, dislike, and want a bath in their existing bathroom are considered together, the first highlight is the characteristics of the bathing section, and the second is the size and placement of the space. Users are satisfied that the area where they carry out the bathing action *is large, convenient, and convenient to them, emphasizing their positive properties with phrases such as "without bathtubs", "being flat", and "being on the same level as the floor", "it is bad to have a bathtub", "difficult to enter by stepping into the place of bathing*". They have voiced.

The most common complaints about users in the bathroom are mainly the bathtub in the bathing section. Increased age-related power losses, weakening of muscles, shortening of steps, and balance problems cause users to have difficulty getting in and out of the bathtub. Difficulties with movement constraints and the possibility of accidents such as slipping and falling reveal the importance of the physical nature of the washing area.

Users are satisfied that their bathroom is the size they can perform their actions, and complain about the fact that it is small. This suggests that the size of space is an important factor for users in the comfortable use of their bathrooms, as in other spaces in the residential area. About their bathrooms, users listed the size and characteristics of equipment and equipment, and thermal comfort conditions as positive characteristics, while they noted access difficulties and inadequacy of thermal comfort conditions as negative characteristics.

The fact that the bathroom is cold when performing the bathing action for thermal comfort is an aspect that users complain about. For the bathrooms they want to have, they have expressed that they want the bathroom to be close to the bedroom, different from the characteristics of the equipment and storage areas. The proximity of the bathroom to the bedroom is among the characteristics that are desirable to have a directly related bathroom, especially since they often need to go to the toilet at night (Table 6).

Table 6. Users' evaluations of the bathroom

Positive features in the bathroom	%	Negative features in the bathroom	%	Features they want in the bathroom	%
Positive features regarding the bathing area	31,4	Negative features regarding the bathing area	38,6	Positive features regarding the bathing area	64,3
Space size and placement	25,7	Small space size and layout	37,1	Space size and placement	54,3
Positive characteristics regarding reinforcement and equipment	20	Thermal comfort	18,6	Adequacy of reinforcement and storage space	22,9
Thermal comfort	18,6	Accessibility	12,9	Relationship with the bedroom	22,9
In-residential location	15,7	Insufficient storage space	7,1	Thermal comfort	12,9
				Grab bar and seating element	10
				Aesthetic factors	4,3

When we looked at the answers that older users gave in their existing bedrooms about what they like, dislike and how they want a bedroom, different from other spaces, the characteristics they love in the existing bedrooms, the aspects they complain about, and the characteristics of the bedroom they want to have are similar, but it has been seen that their rankings are different from each other. Users expressed that they wanted their bedrooms to receive plenty of daylight so that when they woke up in the morning, they started the day fitter and happier. Daylight also increases their psychological state and quality of life. They complained when their room didn't get as much sun as they wanted and emphasized the importance of getting sun when sorting out the characteristics of the bedroom they wanted to have. Another aspect that users are most uncomfortable with in the bedroom is the small size of the space. Regarding the smallness *of space, users noted that there is not enough space to move around the bed, especially with phrases such as "the bed is too cramped and narrow"*.

The most positive and negative aspects of the furnishings and furniture in the bedroom were the characteristics of the bed and dressing closet. With *their furniture, users have highlighted features that they are pleased with such phrases as "having a comfortable bed that can sleep", and "the bed is neither too high nor too low*".

Users want the bed height to be at the appropriate height for them and that their beds are not too rigid. In old age, complaints of body aches and rapid fatigue increase. Therefore, the necessary conditions for quality sleep must be provided both to relieve body aches and to wake up fit. They complain about the lack of storage space in the bedrooms and because they have problems with access to high shelves. In addition, some users expressed satisfaction with the opening of the bedroom window into a green area, while some users complained that they were only seeing another building when they looked through the window. Orientation to the view in the bedrooms as well as in living spaces has emerged as a feature that is cared for by users. Because users want to reach the bathroom as soon as possible when they wake up at night, they care that the bedroom is as close to the bathroom as possible, or a bathroom inside the room. In addition, the bedroom has a space that allows them to perform other activities such as reading books, prayers, etc., which is another issue that users emphasize (Table 7).

Table 7. Users' evaluations about the bedroom

Favorite features in the bedroom	%	Uncomfortable features in the bedroom	%	Features they want in the bedroom	%
Positive features of daylight	38,6	Small space size and layout	35,7	Positive features of fittings, furniture, and accessories	52,9
Positive features of fittings, furniture, and accessories	35,7	Negative features of fittings, furniture, and accessories	21,4	Space size and placement	38,6
Relationship with the bathroom	15,7	Orientation and landscape	17,1	Positive features of daylight	37,1
Space size and placement	14,3	Accessibility	14,3	Orientation and landscape	21,4
Orientation and landscape	12,9	Insufficient daylight	10	Relationship with other places	17,1
Semi-open space use	4,3	In-residential location	2,9	A special area of activity	17,1
				Access to the bed and closets	10
				Aesthetic factors	8,6

5. Conclusion and Suggestions

One of the factors that are effective in enabling individuals to age in place and to spend their old age periods more actively and with high quality is the physical environmental characteristics of housing and its immediate surroundings. The characteristics, requirements, wishes, and expectations of older users should be considered both in the overall planning of the housing and in the arrangements to be made on the scale of individual space and furniture characteristics. Within the scope of this study, the results obtained by examining the data obtained from semi-structured interviews for determining the needs, desires, and expectations of elderly individuals on the scale of Trabzon city center are transferred.

According to these results, users prefer to age in their own homes, in other words, to age in place, for reasons such as being independent and comfortable regardless of the conditions, the feeling of home, and neighborhood relations. This result shows that psycho-social factors are relatively more effective in the reasons for preferring aging in place. Although elderly users want to have public transport facilities, proximity to parks and gardens, and shopping opportunities near the residence, the desire to be close to health services comes to the fore, especially in advanced old age.

Users spend most of their time in the living spaces of their houses in their old age. In the living spaces of the houses, the size of the space, the formal and dimensional features of the furniture, and the layout are the most important features that users emphasize when expressing their complaints, wishes, and expectations. In addition, the desire for living spaces to be bright and spacious is another prominent issue. In order to be able to socialize even passively in periods when the living space is limited and not to be isolated from society, it is also of great importance that the living space opens to a semi-open space and is directed to the street or street. For this reason, living spaces for the use of elderly users should be of a size where users can easily perform their actions without difficulty in movement. Comfortable circulation should be ensured in the furniture placement in the space and walking routes should be left empty. For elderly users living alone not to feel lonely, there should be a comfortable seat by the window where they can watch the outside. The seats in the space should be placed by considering the necessary distances for chatting and watching television. The seats should be of such a nature that users can rest by lying down when they want and allow them to sit and get up comfortably. Light-colored furniture should be preferred as much as possible in the living space so that the eyes of the users do not get tired perceptually and mentally. Living spaces should be orientated towards the view and should receive sufficient natural light. In addition, living spaces should be designed to be directly related to semi-open spaces.

The most important aspects that users pay attention to in kitchens are the size of the space, the adequacy-dimensional suitability of the working area, and the accessibility of storage areas. Users have access problems, especially to the upper cabinets in the kitchen. This situation causes many parts of the existing cabinets to remain dysfunctional in daily use. In line with this information, to support aging in place, kitchens should be large enough for elderly users to comfortably prepare, cook, and eat food. Square or rectangular kitchens should be preferred for ease of use. Functionality should be prioritized in the kitchen, considering that users can get tired quickly due to increasing age. Since users have difficulty standing for a long time, a second counter area should be created in the counter area that allows sitting. These benches should be considered as an area where users can prepare food and eat their meals at the same time. In addition to these, attention should be paid to access to storage units in kitchens. In particular, the height of the storage units on the counter should be suitable for the access distances of elderly users, and in-cabinet systems that facilitate access should be used in sections where access is difficult.

The most emphasized issue in the bathroom space is related to the characteristics of the washing area. Users have difficulty bathing in the bathtub and prefer both floor shower areas for bathing actions. Due to the limitations in their mobility, users especially want grab bars in the shower and toilet areas. For this reason, newly designed or renovated bathrooms should be large enough to meet the daily needs of elderly users, and the shower area/washing area should be designed as both floors and include a fixed seating element and grab bars to be supported during sitting and getting up. Grab bars should be installed on the sides of the toilet bowl and washbasin to help users feel safe by reducing the risk of falling.

The most satisfying point for the users in the bedrooms is that they receive daylight. In addition to this, the features related to the bed and wardrobe in the bedroom are at the forefront for the users. It is especially important for users that the bed they sleep in is comfortable and comfortable. In addition, easy access to the upper shelves of the dressing cabinets should also be taken into consideration. Bedrooms should be large enough for the actions to be performed in the space, bright, and directly related to the bathroom as much as possible. A bed with a size and height suitable for the physical characteristics and anthropometric dimensions of elderly users should be preferred and bedside tables should be placed on both sides of the bed for personal belongings such as telephone, medicine, etc.

In summary, for elderly users to be able to continue their lives in their own homes, their dwellings should be accessible and have functions that support comfortable and safe living by the needs of elderly users. New dwellings designed for this purpose should be designed by taking into account the design principles defined in this section and existing dwellings should be organized in this direction as much as possible.

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Enriching Empirical Thermal Comfort Assessment Methods with Fuzzy Logic

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Abstract

Building occupants spend approximately 90% of their lives indoors where they want to have indoor air quality, visual, acoustic, and thermal comfort (which is more dominant). Thermal comfort is assessed by physical factors such as operative air temperature, relative humidity, and air velocity. People's activity level and clothing level are also effective. Related regulations and standards like ISOEN7730 and EN15251 aim to provide a unified understanding of the matter. Since these studies rely on experimental methods, there are instances where certain scenarios lack experimental support, leading to gaps in the results. Those gaps can be filled with the Fuzzy Logic Method, which evaluates with "degrees of truth" instead of "true or false". With this study, the level of knowledge on providing thermal comfort can be increased by filling the gaps in the empirical studies and the damage caused by heating-cooling energy to the environment can be reduced with further studies.

Keywords: *Architectural comfort parameters, thermal comfort assessment, Fuzzy Logic, PMV.*

Ampirik Termal Konfor Değerlendirme Yöntemlerinin Bulanık Mantıkla Zenginleştirilmesi

Öz

Yapı kullanıcıları zamanlarının yaklaşık %90'ını iç hava kalitesi, görsel konfor, akustik konfor ve ısıl konfor (diğerlerine göre daha baskın olmak üzere) aradıkları iç mekanlarda geçirmektedirler. Isıl konfor; hava sıcaklığı, hava hızı ve bağıl nem gibi fiziksel parametreler üzerinden incelenmekte ve insanların aktivite seviyesi ve giyim seviyesi de ısıl konforun düzeyinde etkili olmaktadır. ISOEN7730 ve EN15251 gibi ilgili yönetmelikler ve standartlar, konunun profesyonellerce benzer şekilde anlaşılmasını sağlamayı amaçlamaktadır. Bu çalışmalar deneysel yöntemlere dayandığından, bir deneyle desteklenmeyen durumlar için literatürde yer alan sonuçlarda boşluklar vardır. Bu boşluklar "doğru-yanlış" yerine "doğruluk dereceleri" ile değerlendirme yapan Bulanık Mantık Yöntemi ile doldurulabilmektedir. Bu çalışma ile ampirik çalışmalarda yer alan sonuçlardaki boşluklar doldurularak ısıl konforun sağlanması konusundaki bilgi düzeyi artırılabilir ve ileriki çalışmalarla ısıtma-soğutma için harcanan enerjinin çevreye verdiği zarar azaltılabilir.

Anahtar kelimeler: *Mimari konfor parametreleri, ısıl konfor değerlendirmesi, bulanık mantık, PMV.*

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1. Introduction

Energy consumption, which is the main source of global warming-based concerns, has been the subject of many studies, especially in the last half of this century. Buildings constitute 40% of the said global energy consumption and providing the optimum thermal well-being in buildings is a large part of this (Costa, Keane, Torrens & Corry, 2013; Yang, Yan & Lam, 2014). With the increase in building stock brought by globalization and modernization, the common use of mechanical methods in building cooling/heating systems, it is possible to provide thermal comfort in buildings by artificial means such as HVAC systems (Taleghani, Tenpierik, Kurvers & Van Den Dobbelsteen, 2013). The use of HVAC systems corresponds to nearly 50% of the energy consumption in non-residential buildings (D'Ambrosio Alfano, Olesen, Palella & Riccio, 2014; Wong & Khoo, 2003). According to Taleghani et al. (2013) thermal comfort in buildings has been discussed since 1930s and is one of the increasingly popular issues to be addressed in the building design phase, as it is directly related to people's health, well-being, as well as the energy performance and efficiency of a building (D'Ambrosio Alfano et al., 2014; Taleghani et al., 2013).

1.1. Thermal Comfort

Thermal comfort can be defined as a person's satisfaction with the thermal environment around him/her and is examined over physical elements such as operative air temperature, relative humidity and air velocity. Apart from these, people's activity and clothing level are also effective. The related studies, regulations, and standards (Figure 1) like ISO EN 7730 and EN 15251 aim to provide a similar sense of the matter (Olesen & Parsons, 2002).

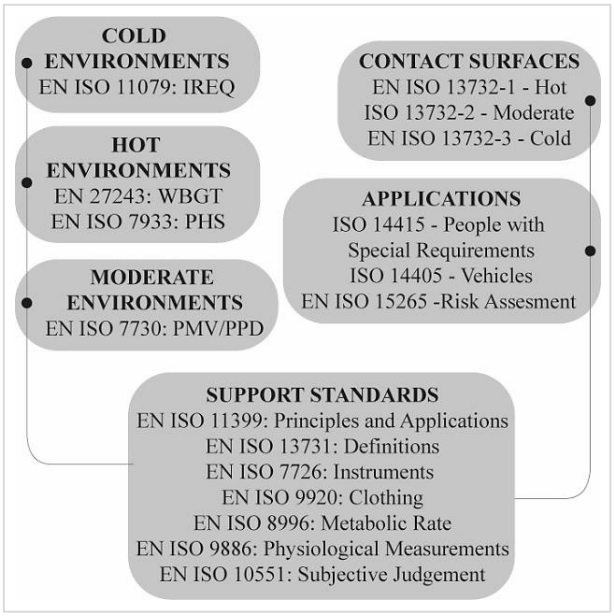

Figure 1. The main CEN and ISO standards regarding thermal comfort (D'Ambrosio Alfano et al., 2014)

The issue of thermal comfort is important for three reasons in particular (Nicol, 1993; Taleghani et al., 2013):

- to provide a satisfying thermal environment for building occupants,
- to control excess energy consumption while doing so (Omer, 2008; Sayigh & Marafia, 1998) and
- to set standards and create common sense.

Additionally, according to Raw & Oseland (1994), the benefits of improving knowledge about thermal comfort can be exemplified as: achieving improved indoor-air quality (Chen & Chang, 2012; Khodakarami & Nasrollahi, 2012; Ormandy & Ezratty, 2012) and energy savings, controlling environmental conditions indoors, reducing CO_2 emissions and the harm on the environment, increasing the work efficiency of building occupants (Kottek, Grieser, Beck, Rudolf & Rubel, 2006) and improving and developing standards while doing so (Raw & Oseland, 1994). Moreover, many studies

on indoor comfort conditions have shown that thermal comfort is the most effective on building occupants compared to other comfort parameters which are indoor air quality, visual comfort, and acoustic comfort (Frontczak & Wargocki, 2011).

Thermal comfort can be evaluated by two different methods (Taleghani et al., 2013):

• Climate-chamber studies which take place in chambers where different climatic environments can be created while personal variables like the metabolic rate and the clothing insulation can be determined and varying parameters such as air temperature, humidity and air velocity can be controlled.

• Field studies which yield real-world results obtained by observing an indoor space without interfering with any of the environmental data while recording the clothing insulation and the metabolic rate values of the test subjects.

While both climate and personal variables can be intervened in experiments performed in climate-chambers, in field studies only controlled changes in personal variables can be made. Accordingly, climate-chamber studies can be used for a more specific condition anywhere in the world, while field studies can reflect more realistic conditions. However, the data obtained from climate-chamber studies or field studies are carried out under certain conditions or measured data in specific occasions. Perceiving these data as universal values can also lead to confusion about thermal comfort evaluation and is compounded by the fact that only a few of the many parameters included in the standards are considered during the building application process (D'Ambrosio Alfano et al., 2014). Some gaps may arise in the literature in applying these results to real life as they were obtained in these standards, which were created under certain specific conditions.

1.2. Aristotelian Logic

According to Aristotelian Logic (also referred to as classical or traditional logic and is a formal logic system that originated from the ancient Greek philosopher Aristotle), a proposition is either completely true or completely false; there is no gray area. It is regarded as one of the earliest and most influential logic systems in Western philosophy and has had a considerable influence on the evolution of logic and philosophy throughout history. Aristotelian logic is grounded in a core set of elementary principles and concepts, comprising (Groarke, n.d.):

i. The Law of Non-Contradiction dictates that contradictory statements cannot simultaneously be true in the same manner at the same moment. Therefore, if a statement is true, its negation must be false.
ii. The Law of Excluded Middle dictates that any statement is either true or false, with no middle or third option. It is commonly stated as "either A is true, or not-A is true."
iii. Categorical Propositions: Aristotle's logic mainly pertains to categorical propositions, which state a connection between two categories or classes of objects. These propositions can be categorized into four fundamental forms, each having a specific structure:
    - All S is P (Universal Affirmative)
    - No S is P (Universal Negative)
    - Some S is P (Particular Affirmative)
    - Some S is not P (Particular Negative)
iv. Syllogisms: Aristotle's logic is renowned for its emphasis on syllogisms, which constitute deductive reasoning comprising of three propositions: two premises and a conclusion. Syllogisms follow a logical structure, where the conclusion must be true if the premises are true. An instance of a syllogism in Aristotelian logic is the following:
    - All humans are mortal (major premise)
    - Socrates is a human (minor premise)
    - Hence Socrates is mortal (conclusion)

However, in real life, reconcilable values are needed when there are no parameters to fully meet the right or wrong in some situations. While the results of the experiments mentioned above are valid only in certain mathematically expressed conditions, Fuzzy Logic can be used to answer the question of what will happen in another situation that is very close but slightly different.

1.3. Fuzzy Logic

The term Fuzzy Logic has started to be discussed with the proposal of Fuzzy Set Theory introduced by Iranian-Azerbaijani mathematician Lotfi Zadeh in 1965. Fuzzy sets are mathematical tools that represent uncertainties and indefinite information. With these models, imprecise information and data can be represented, designed, recognized, interpreted, and used. Fuzzy Logic method can be used where different cases can take truth values - any real number between 0 and 1. The aim with Fuzzy Logic is to evaluate partial truth in the field where the truth value can vary from completely true to completely false whereas according to Boolean/Aristotelian Logic, the truth values of the variables can only be 0 or 1. This allows Fuzzy Logic to be used in solutions to be produced for all situations encountered in life that cannot be explained by absolute truth or absolute false (Cintula, Fermüller & Noguera, 2016; Wesley Chai, 2021).

Using Fuzzy Logic can sometimes be the only solution method for problems that require being able to draw conclusions consistent with imprecise, relative, or verbal information (Pakdamar & Güler, 2012). Fuzzy Logic is used in areas such as the construction and operation of technological devices, transportation, company operation, agriculture, health, artificial intelligence modeling, as well as almost every engineering/architectural subject and technological studies (Ödük, 2019). Studies carried out with the Fuzzy Logic method in the field of architecture vary and are used for problem solving in many technical problems of architectural design, structural engineering and building physics.

Baran Ergül, Varol Malkoçoğlu & Acun Özgünler (2022) compared the advantages and disadvantages of traditional design methods and decision support methods using information and communication technologies including fuzzy logic. Examining the studies in which fuzzy logic was used, they classified the concept of design under the headings of conceptual, structural, building element design, space design, product development, material selection and project management. Pakdamar & Tuğrul Okbaz (2018) used Fuzzy Logic Method as a decision-making method in high-rise buildings considering the amount of land, land unit price, registered building density and population density in the environment as inputs. Çekmiş (2016) used Fuzzy Logic as a decision-making method on an architectural site plan design and to find the optimum settlement using distance from the beach and market, the neighborhood, and the view as input parameters. Another study on building physics evaluated indoor air quality, thermal comfort and visual comfort in buildings with Fuzzy Logic method and use MATLAB/Simulink to present the data (Kolokotsa, Tsiavos, Stavrakakis, Kalaitzakis & Antonidakis, 2001). Kolokotsa (2007) also focused on applications concerned with regulating and modelling indoor thermal comfort, visual comfort, indoor air quality and examined the studies on this subject using the Fuzzy Logic method. In the studies examined, it has been observed that energy savings can be achieved when using the HVAC system, thanks to the provision of thermal comfort with the fuzzy logic method (Kolokotsa, 2007).

In this context, it is decided to use the Fuzzy Logic method has been implemented in this paper to evaluate the thermal comfort conditions and to fill the existing gaps in the literature that were not included in the experimental studies.

1.4. The Aim and Scope of the Study

The aim of the study is to generate a Fuzzy Logic-based model to complete the gap in the data set formed by the empirical information obtained from numerous climate-chamber studies and standards on thermal comfort. The mathematical-based Fuzzy Logic system, which was obtained with a limited amount of data for this article, can be further developed with more data in future studies. Although this study was expressed on providing thermal comfort, it also represents a method that can be used for other comfort parameters such as indoor air quality, visual comfort, and acoustic comfort. The generated Fuzzy Logic model of thermal comfort is limited to 6 inputs and 26 membership functions

of these inputs. Although this situation varies according to the number of comfort parameters and the available data, the model will work effectively even if the number of the inputs are increased or decreased.

The material and the methodology of the study will be given respectively in Section 2. Following these, in Section 3, the Fuzzy Logic model will be explained and the Fuzzy Logic Model ΔPMV results and a comparative discussion with current literature will be presented. If finally in Section 4, the conclusions and recommendations regarding this article will be given.

2. Materials and Methods

In this article, the information in the standards and regulations related to thermal comfort assessment based on experimental methods has been enriched by using the Fuzzy Logic model and it is aimed to increase the level of knowledge on the subject. In this section, the thermal comfort evaluation system and the Fuzzy Logic methodology used in the study are explained respectively.

2.1. Thermal Comfort Evaluation

Thermal comfort can be evaluated with two main models: climate chamber studies and field studies. Climate chamber studies consist of information obtained from a series of experiments carried out under certain conditions in climate chambers, whereas field studies usually consist of information from real-life measurements (D'Ambrosio Alfano et al., 2014). Detailed analysis of thermal comfort evaluation methods and their comparison can be accessed in references (Brager & de Dear, 1998; Djongyang, Tchinda & Njomo, 2010; Taleghani et al., 2013) Whether a particular thermal condition is acceptable to a large group of people can be estimated by the PMV (predicted mean vote) index Metin girmek için buraya tıklayın veya dokunun.(Yang et al., 2014).

PMV has been formulated based on numerous tests on people under specific conditions by ISO 7730 standard in thermally controlled climate chambers. It is affected by parameters such as air temperature, humidity, air velocity, clothing insulation, activity level and works with an ASHRAE 7-points sensation scale (Olesen & Parsons, 2002) (+3.0 for hot sensation, +2.0 for warm sensation, +1.0 for moderately warm sensation, 0.0 for neutral sensation, -1.0 for moderately cool sensation, -2.0 for cool sensation and -3.0 for cold sensation). The parameters have ranges of application such as: air temperature between 10 degrees Celsius to 30 degrees Celsius, air velocity between 0.0 to 1.0 m/s, metabolic rate between 0.8 to 4.0 met (one metabolic equivalent=the amount of oxygen consumed while doing any activity, 1 met = 58,2 W/m2 (Öz, Korcan & Bulduk, 2018)), clothing insulation between 0.0 to 2.0 clo (thermal resistance of clothing, 1 clo equals to 0.155 m^2/W (Öz et al., 2018)) and PMV rates between -3.0 to +3.0 (Olesen, 2012; Yang et al., 2014). People's expectancy level also plays role as in how they perceive the matter according to their psychological evaluation of thermal comfort state in Categories I to IV. When people have a high level of thermal expectation, it is classified as Category I according to EN 15251 and ISO 7730 Standards (Olesen, 2012; Olesen & Parsons, 2002; Yang et al., 2014). That category includes very fragile, sensitive, handicapped, sick or elderly people and young children. Category II covers the cases of new buildings or buildings that are being renovated and means a normal level of thermal expectation. Category III covers the cases for existing buildings and means a mildly acceptable or moderate level of thermal expectation. And lastly Category IV covers the cases that have values outside the other categories and can be valid for a certain time for the year. For this reason, situations that are or may be classified in this category are excluded from the climate chamber studies. According to current studies, PMV value examples for particular operative temperatures are specified in EN 15251 Standard. In Table 1 (Olesen, 2012; Yang et al., 2014) the design value examples for specific thermal comfort parameters can be seen. Type A stands for "Landscaped office building (1.2 met)", Type B stands for "Kindergarten (1.4 met)", Type C stands for "Department store (1.6 met)"; "Icl,dyn is 0.5 clo (summer) and 1.0 clo (winter); categories on people's expectation level (I,II and III) are as described above (IV excluded). V_a stands for air velocity, RH stands for relative humidity, t_0 stands for minimum temperature in summer or winter for the specific climate chamber condition.

Table 1. Design value PMV examples for the operative temperature according to EN 15251 Standard (Olesen, 2012; Olesen & Parsons, 2002; Yang et al., 2014)

Type	Category	$t_{o,min,winter}$(°C)	V_a= 0.05 m/s		V_a= 0.10 m/s		V_a= 0.15 m/s	
			RH=40%	RH=60%	RH=40%	RH=60%	RH=40%	RH=60%
A	I	21.00	-0.20	-0.10	-0.30	-0.20	-0.40	-0.30
	II	20.00	-0.40	-0.30	-0.50	-0.40	-0.60	-0.50
	III	19.00	-0.60	-0.50	-0.80	-0.70	-0.80	-0.70
B	I	19.00	-0.30	-0.30	-0.40	-0.30	-0.50	-0.40
	II	17.50	-0.60	-0.50	-0.70	-0.60	-0.80	-0.70
	III	16.50	-0.80	-0.70	-0.90	-0.80	-1.00	-0.90
C	I	17.50	-0.40	-0.30	-0.40	-0.30	-0.40	-0.40
	II	16.00	-0.60	-0.50	-0.70	-0.60	-0.70	-0.60
	III	15.00	-0.80	-0.70	-0.80	-0.80	-0.90	-0.80
Type	**Class**	**$t_{o,min,summer}$(°C)**	**V_a= 0.05 m/s**		**V_a= 0.10 m/s**		**V_a= 0.15 m/s**	
			RH=40%	**RH=60%**	**RH=40%**	**RH=60%**	**RH=40%**	**RH=60%**
A	I	25.50	0.10	0.30	0.00	0.10	-0.10	0.00
	II	26.00	0.30	0.43	0.20	0.30	0.10	0.20
	III	27.00	0.60	0.70	0.50	0.60	0.40	0.60
B	I	24.50	0.10	0.20	-0.00	0.10	-0.10	0.00
	II	25.50	0.30	0.50	0.30	0.40	0.20	0.30
	III	26.00	0.50	0.60	0.40	0.50	0.30	0.50
C	I	24.00	0.10	0.30	0.10	0.20	0.00	0.10
	II	25.00	0.40	0.50	0.30	0.40	0.30	0.40
	III	26.00	0.60	0.80	0.60	0.70	0.50	0.70

According to Yang et al. (2014) this data can only be valid under the specific test conditions assumed for specific temperature, air velocity, activity level, clothing level and humidity. However, in the real-world, situations other than these specific experimental conditions can also be encountered. In such conditions, analysis methods such as Fuzzy Logic can be useful.

2.2. Fuzzy Logic Method

The Fuzzy Logic working principle can be summarized as follows:

- Firstly, sharply expressed input and output parameters of the problem, which can be verbal, are determined by the Aristotelian Logic.
- Secondly, the fuzzification process -which is the process to define a membership function for the input parameters- is performed.
- Thirdly, the logical relationships between the input parameters and output parameters are determined to form a rule base with IF-THEN statements. The rule base determination process can be verbal or numerical and the form of knowledge can be empirical, observatory, experienced or foresighted. Fuzzy Logic is a flexible system where all these knowledge and data types can be modeled and digitized.
- After the Fuzzy rule base is applied to the model, the Fuzzy inference system becomes available in the Fuzzy Logic operator. Thus, the resulting data obtained is fuzzified. To be understandable in machine language, sharp (Aristotelian) output data is obtained by applying defuzzification process (Pakdamar & Güler, 2012).

Steps followed in this study when creating the Fuzzy Logic model are shown in Figure 2. As seen in the chart, firstly, the available existing information in the literature and standards on the subject was obtained. To produce a model that can measure thermal comfort, six inputs and their membership functions given according to EN 15251 standard (Olesen, 2012; Olesen & Parsons, 2002; Yang et al.,

2014) specified in Table 1 are determined. With If-Then rule sets, ΔPMV values in the literature are defined in the model. With the fuzzification and defuzzification process through the MATLAB program Fuzzy Logic Toolbox application, defuzzification can be done with five built-in methods and a single and clear output can be obtained from Fuzzy sets. These methods are called middle of maximum, smallest of maximum, largest of maximum, bisector, and centroid. In this study, "centroid method" was used as the defuzzification method. Centroid defuzzification considers the center of gravity of the Fuzzy set along the x-axis (The MathWorks Inc., 2023) and results with real numbers obtained as a result of defuzzification. In this wise, enriched ΔPMV values were obtained. These new values could be derived by querying the system of intermediate values that are not found in the existing literature. Detailed information on the generation of the Fuzzy Logic model in the MATLAB program is given in Section 3.

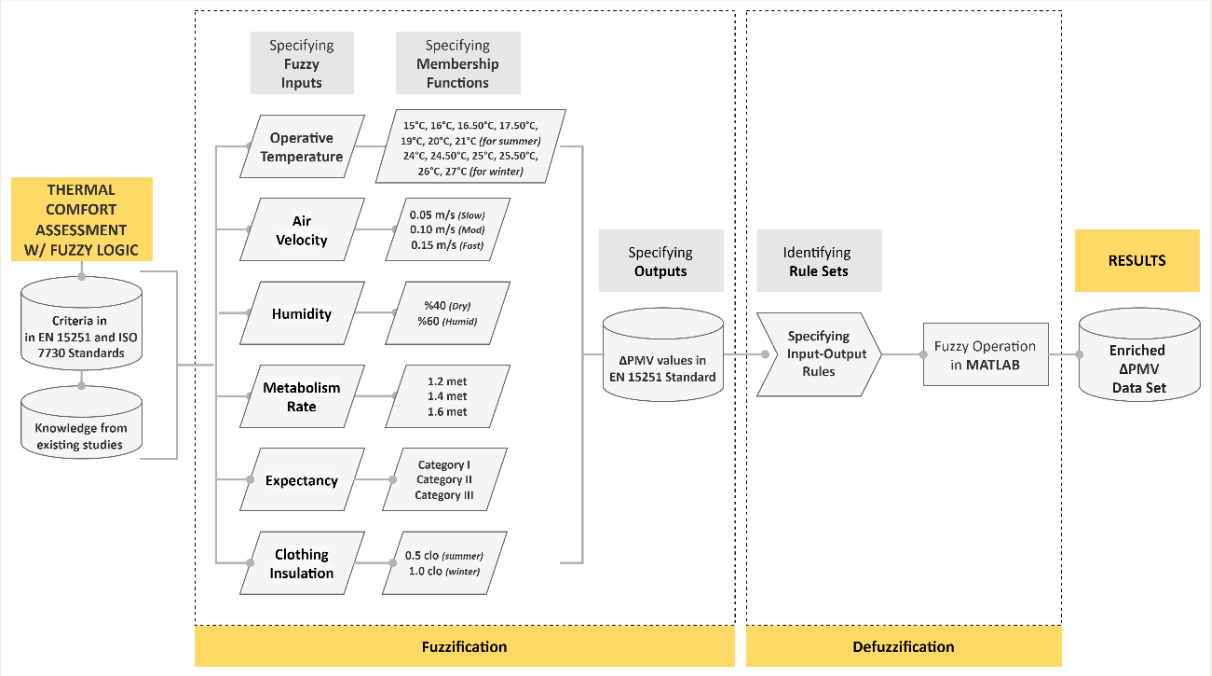

Figure 2. Chart describing the methodology of the study and fuzzification/defuzzification process

3. Results and Discussion

3.1. Creation of the Fuzzy Logic Model

To create the Fuzzy Logic model of thermal comfort in line with the existing information obtained; inputs, membership functions, outputs and relations between them are determined and to express the model visually, the MATLAB (R2022b) program and its Fuzzy Logic Designer plug-in have been used.

6 inputs (operative air temperature, relative humidity, air velocity, metabolism rate, expectancy rate and clothing insulation), 26 membership functions (13 for operative temperature, 3 for air velocity, 2 for humidity, 3 for metabolic rate, 3 for expectancy and 2 for clothing insulation – 26 in total) and 1 output (ΔPMV) are as seen in Table 2.

Table 2. The inputs, membership functions and outputs of the model

Inputs	Membership functions	Output
Operative temperature	15°C, 16°C, 16.50°C, 17.50°C, 19°C, 20°C, 21°C (for winter) 24°C, 24.50°C, 25°C, 25.50°C, 26°C, 27°C (for summer)	ΔPMV design values in EN 15251 Standard
Air velocity	0.05 m/s; 0.10 m/s and 0.15 m/s	
Humidity	40% and 60%	
Metabolism rate	1.2 (A); 1.4 (B); 1.6 (C) met	
Expectancy	Categories I-II and III	
Clothing insulation	0.5 clo (for summer) and 1.0 clo (for winter)	

After the inputs, the rule sets (Table 3), the membership degrees of the inputs (Figure 3) and the membership degrees of the outputs (Figure 4) were determined, and they were entered into the Fuzzy Logic model respectively. Each of these diagrams represent the degree of truth of the input in specific conditions.

Table 3. Example rule sets in the Fuzzy model (6 out of 108 are given) (Olesen, 2012; Olesen & Parsons, 2002; Yang et al., 2014)

Rule Sets
Rule No.1: IF temperature is 21°C and air velocity is 0.05 m/s and metabolism rate is 1.2 met (office) and relative humidity is 40% and expectation level is I (high) and clothing insulation is 1.0 clo THEN ΔPMV is -0.2.
Rule No.2: IF temperature is 20°C and air velocity is 0.05 m/s and metabolism rate is 1.2 met (office) and relative humidity is 40% expectation level is II (med) and clothing insulation is 1.0 clo THEN ΔPMV is -0.4.
Rule No.3: IF temperature is 19°C and air velocity is 0.05 m/s and metabolism rate is 1.2 met (office) and relative humidity is 40% expectation level is III (low) and clothing insulation is 1.0 clo THEN ΔPMV is -0.6.
Rule No.4: IF temperature is 19°C and air velocity is 0.05 m/s and metabolism rate is 1.4 met (kindergarten) and relative humidity is 40% and expectation level is I (high) and clothing insulation is 1.0 clo THEN ΔPMV is -0.3.
Rule No.5: IF temperature is 17.5°C and air velocity is 0.05 m/s and metabolism rate is 1.4 met (kindergarten) and relative humidity is 40% and expectation level is II (med) and clothing insulation is 1.0 clo THEN ΔPMV is -0.6.
Rule No.108: IF temperature is 26°C and air velocity is 0.15 m/s and metabolism rate is 1.6 met (department store) and relative humidity is 60% and expectation level is III (low) and clothing insulation is 0.5 clo THEN ΔPMV is 0.7.

As stated above the operative temperature levels vary between 14-28°C, the air velocity levels are standardized as 0.05 m/s (slow air flow), 0.10 m/s (moderate air flow) and 0.15 m/s (rapid air flow) and relative humidity can differ between 40-60%. The metabolism rate for specific space and activity conditions for this study is limited to three examples as Type A stands for "Landscaped office building (1.2 met)", Type B stands for "Kindergarten (1.4 met)", Type C stands for "Department store (1.6 met)"; "$I_{cl,dyn}$ (dynamic clothing insulation) is 0.5 clo (for summer) and 1.0 clo (for winter); categories on people's expectation level (I,II and III) are as stated earlier. And lastly the clothing insulation level is accepted as 0.5 clo (lightweight clothing) for summer season and 1.0 clo (heavy clothing) for winter season. 108 rule sets were defined in the program and the example rule sentences can be seen in Table 3. In each rule, the inputs and their degrees of memberships are connected by the "and" conjunction and they reach a conclusion value. Thus, the changing input values cause the result values to change.

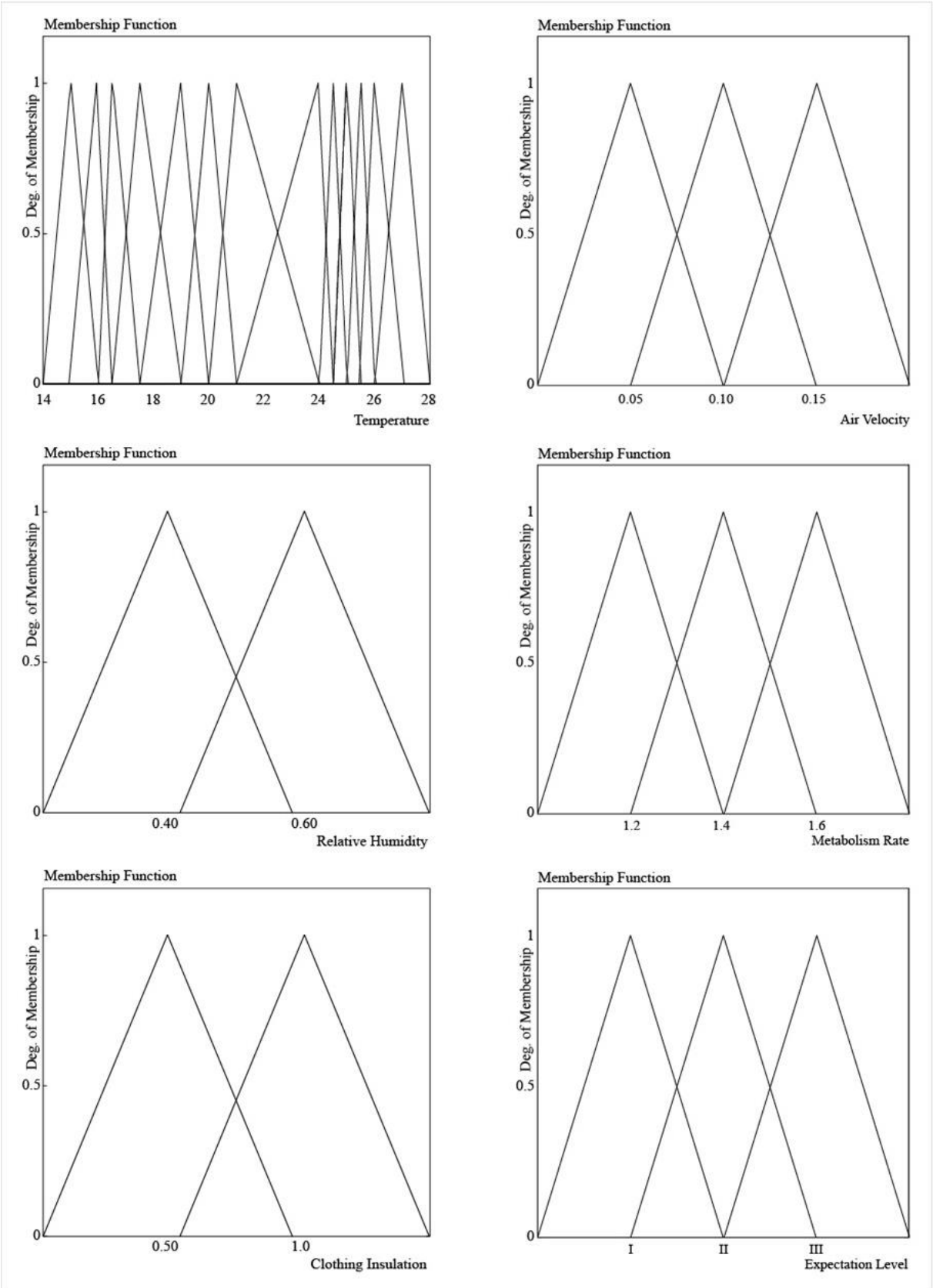

Figure 3. Degree of membership graphics of triangular membership functions of the inputs identified in the MATLAB program (operative air temperature, relative humidity, air velocity, metabolism rate, clothing insulation and expectation level)

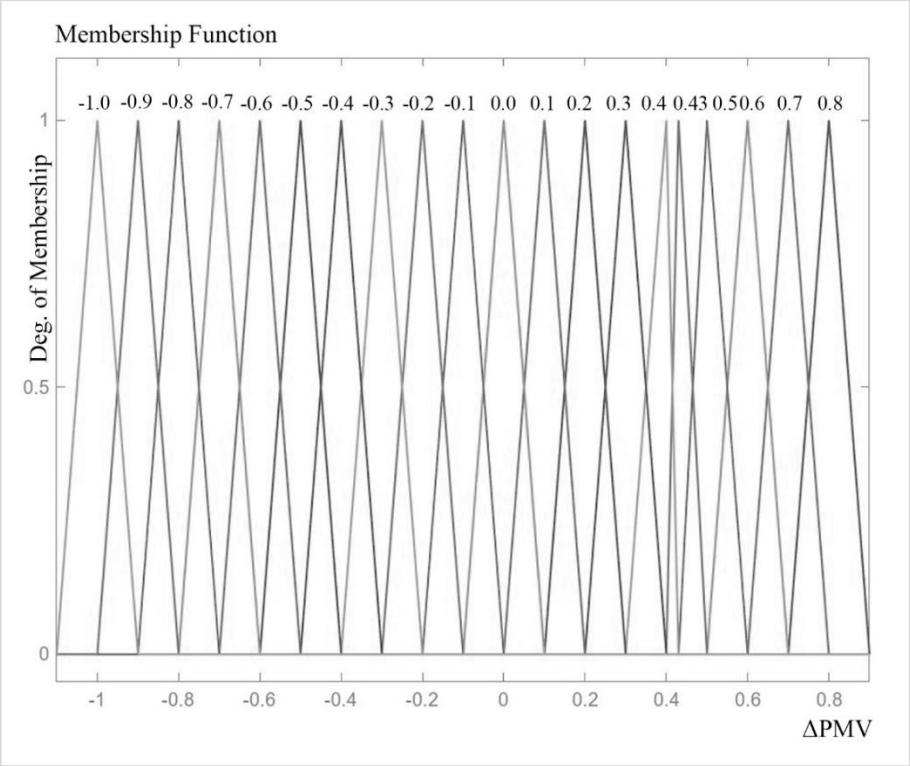

Figure 4. Degree of membership graphic of the outputs identified in the MATLAB program

3.2. Fuzzy Logic Model ΔPMV Results

In this part of the article, the ΔPMV results obtained with the created Fuzzy Logic model are examined. The figures below show the ΔPMV results for six known inputs as an example. In Figure 5, the temperature is 21°C, the metabolism rate is 1.2 met (office), the air velocity is 0.05 m/s, the relative humidity is 40%, expectation level is I (high) and clothing insulation is 1.0 clo. As a result of these input values, the ΔPMV is -0.2 as stated in Rule No.1. In Figure 6, the temperature is 20°C, the relative humidity is 40%, the air velocity is 0.05 m/s, the metabolism rate is 1.2 met (office), the expectation level is II (med) and the clothing insulation is 1.0 clo. As a result of these input values, the ΔPMV is -0.4 as stated in Rule No. 2. In Figure 7, the temperature is 19°C, the relative humidity is 40%, the air velocity is 0.05 m/s, the metabolism rate is 1.2 met (office), the expectation level is III (low) and the clothing insulation is 1.0 clo. As a result of these input values, the ΔPMV is -0.6 as stated in Rule No. 3. In Figure 8, the temperature is 19°C, the relative humidity is 40%, the air velocity is 0.05 m/s, the metabolism rate is 1.4 met (kindergarten), the expectation level is I (high) and the clothing insulation is 1.0 clo. As a result of these input values, the ΔPMV is -0.3 as stated in Rule No. 4 earlier. In Figure 9, the temperature is 17.5°C, the relative humidity is 40%, the air velocity is 0.05 m/s, the metabolism rate is 1.4 met (kindergarten), the expectation level is II (med) and the clothing insulation is 1.0 clo. As a result of these input values, the ΔPMV is -0.6 as stated in Rule No. 5. In Figure 10, the temperature is 26°C, the relative humidity is 60%, the air velocity is 0.15 m/s, the metabolism rate is 1.6 met (department store), the expectation level is III (low) and the clothing insulation is 0.5 clo. As a result of these input values, the ΔPMV is -0.7 as stated in Rule No. 108 earlier. Since all 108 of the rules do not fit in the images, only the rules triggered by the input values are shown in Figures 5-12. As a result of the inputs determined in the rules, the weights of the ΔPMV outputs obtained according to the centroid method (center of gravity of the Fuzzy set along the x-axis) are given in the lower right corner of the figures.

Looking at these examples, it is seen that the model created gives the correct and precise ΔPMV values for certain conditions, as in the standards, over the data entered before. Additionally, and more importantly, the Fuzzy Logic model can also give ΔPMV values for conditions that are not strictly defined (as mentioned in the examples above). In Figure 11, one of the inputs of Rule No. 1 – the air velocity is changed from 0.05 to 0.08 – the Fuzzy Logic model can still give an answer about ΔPMV as -0.258. Or in Figure 12, three of the inputs of Rule No. 1 – the air velocity is changed from 0.05 to 0.09,

the relative humidity is changed from 40% to 45% and the metabolism rate is changed from 1.2 to 1.3; the Fuzzy Logic model gives the ΔPMV value as -0.231. In this wise, the Fuzzy Logic model can produce new results for values between the existing data, and thus the model can better respond to situations encountered in real life.

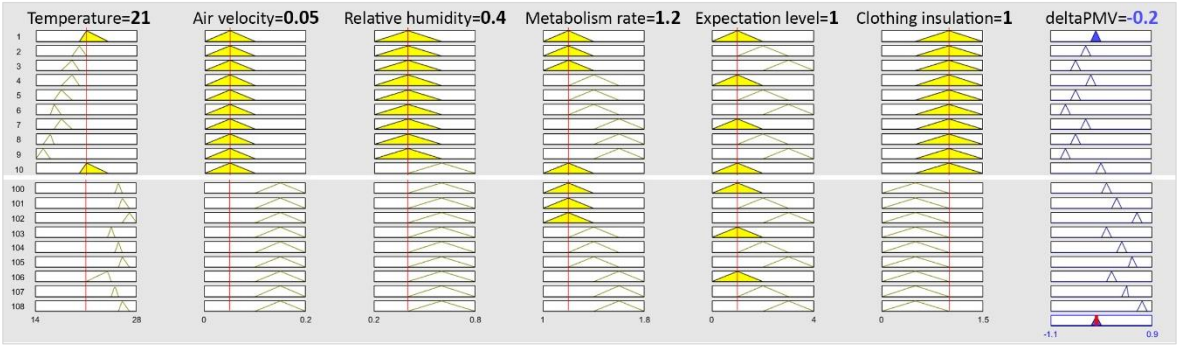

Figure 5. Rule Inference and the ΔPMV output for Rule No. 1 (ΔPMV = -0.2)

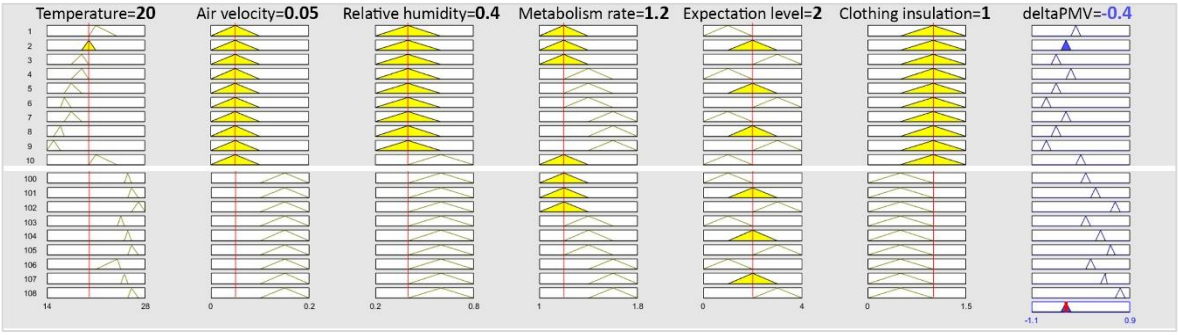

Figure 6. Rule Inference and the ΔPMV output for Rule No. 2 (ΔPMV = -0.4)

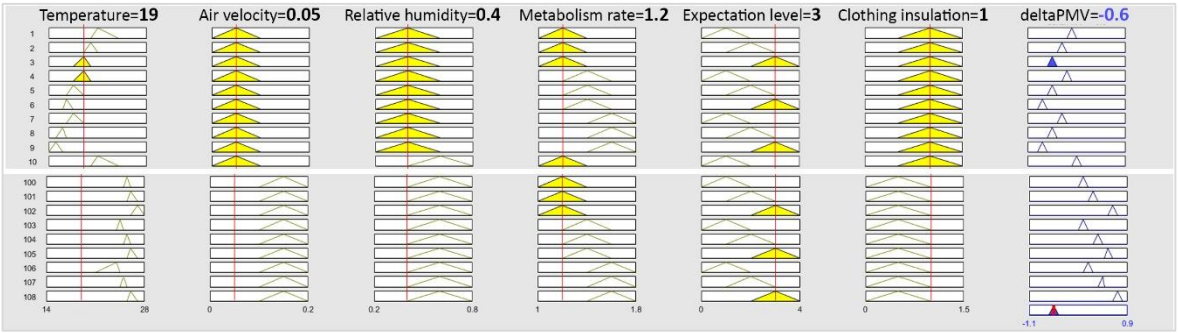

Figure 7. Rule Inference and the ΔPMV output for Rule No. 3 (ΔPMV = -0.6)

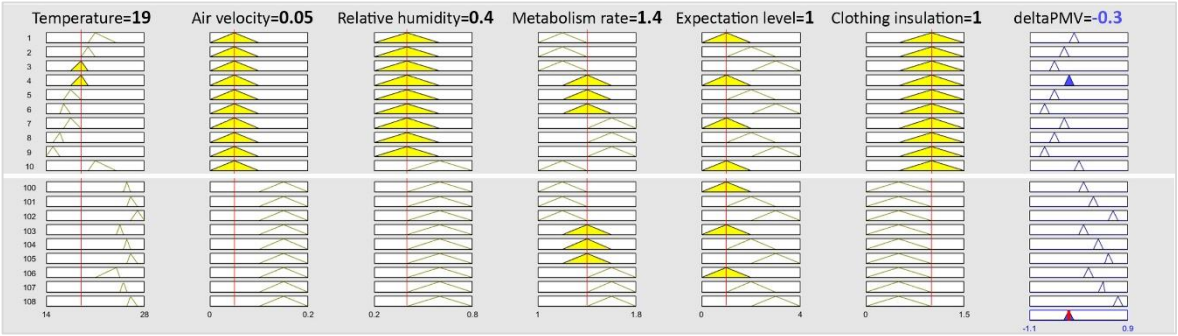

Figure 8. Rule Inference and the ΔPMV output for Rule No. 4 (ΔPMV =-0.3)

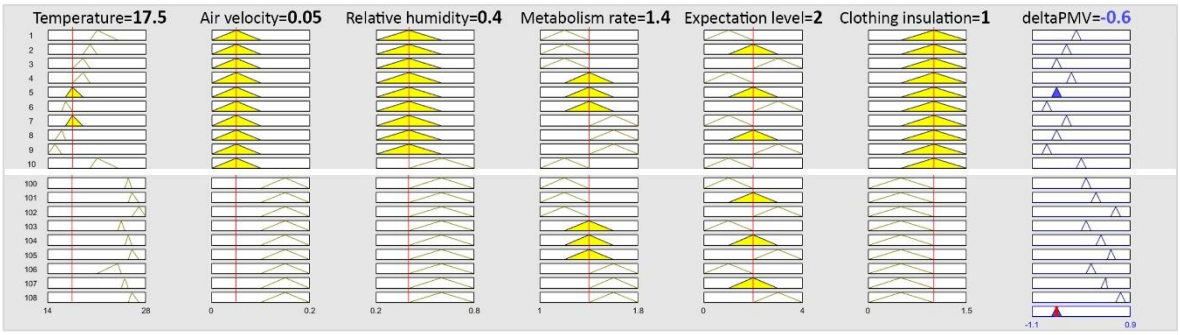

Figure 9. Rule Inference and the ΔPMV output for Rule No. 5 (ΔPMV =-0.6)

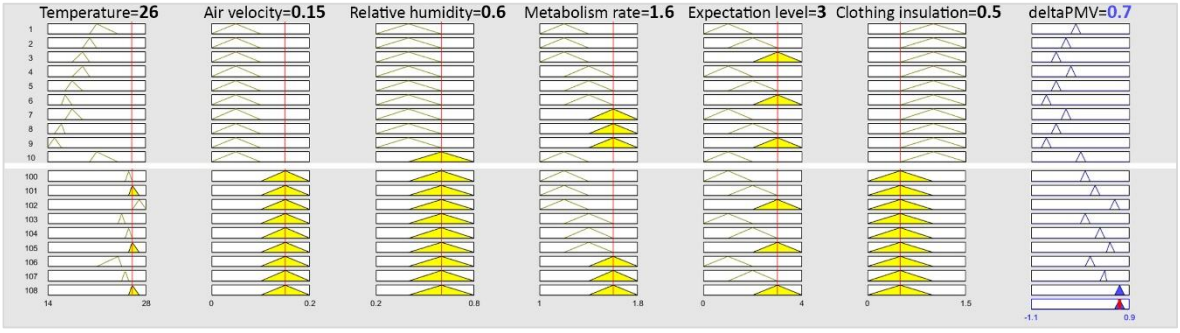

Figure 10. Rule Inference and the ΔPMV output for Rule No. 108 (ΔPMV =-0.7)

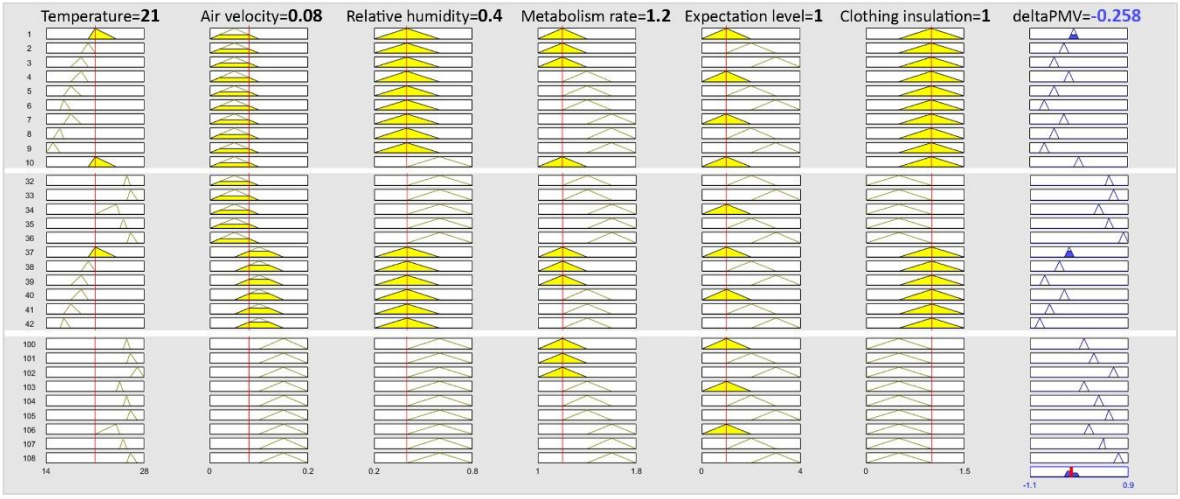

Figure 11. Rule Inference and the ΔPMV output by changing the air velocity value of Rule No. 1 (ΔPMV =-0.258)

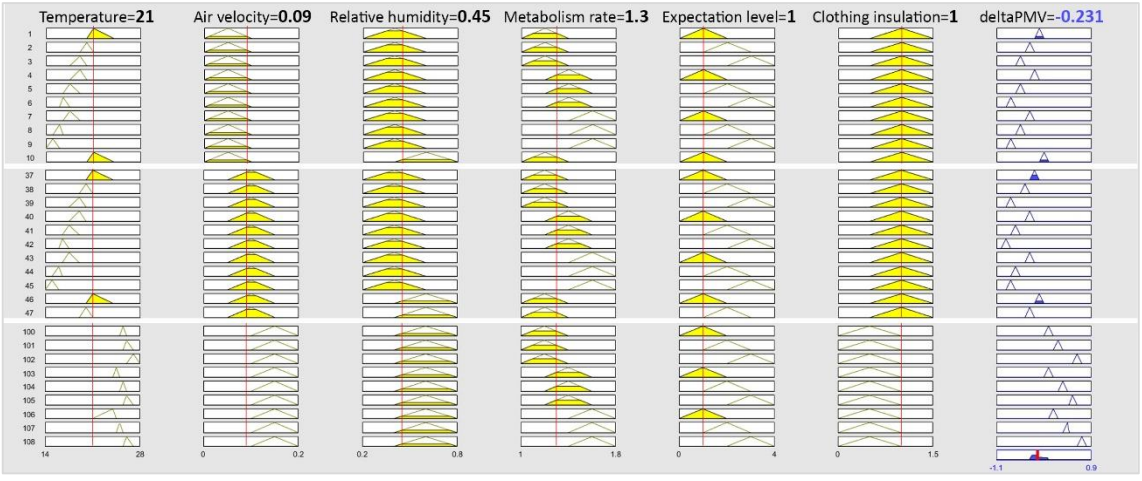

Figure 12. Rule Inference and the ΔPMV output by changing the air velocity, relative humidity and metabolism rate values of Rule No. 1 (ΔPMV = -0.231)

3.3. Comparison of the Findings with the Relevant Literature

In this article, a Fuzzy Logic model was created by using the results obtained from experimental studies as input. The model, which was created with 6 inputs, 26 membership functions and 108 rules, and yielded successful results for reconcilable values as well. The studies examined in the literature vary in terms of the number and quality of inputs they use. From this, the performance and capacity of the produced model are also affected.

While Pakdamar & Tuğrul Okbaz (2018) created the model with 4 verbal inputs (the amount of land, land unit price, registered building density and population density in the environment) and 16 rules, Çekmiş (2016) implemented Fuzzy Logic with 3 verbal inputs (distance from the beach and market, the neighborhood, and the view) and 36 rules. In both studies, the membership functions of the inputs were determined intuitively as “less-moderate-many” and it was stated that the number of inputs could be increased in future studies and the precision of the findings may be enhanced (Çekmiş, 2016; Pakdamar & Tuğrul Okbaz, 2018).

Furthermore, Baran Ergül et al. stated that creating models using Fuzzy Logic may result in time-consuming processes due to the use of a trial-and-error method for determining membership function selections (Baran Ergül et al., 2022).

Accordingly, in this article, it is thought that the fact that the inputs are based on an objective and experimental basis and that the number of inputs is enough and many, causes the accuracy of the results to increase comparing to the studies mentioned above. In addition, since the membership functions of the inputs were determined experimentally, the model could be produced quickly and not by trial-and-error method. It is thought that the study conducted in this article differs positively from the others with these aspects.

4. Conclusion and Recommendations

In today's world, building occupants spend a large part of their life indoors where they seek comfort and numerous studies have shown that people care most about thermal comfort when it comes to indoor comfort conditions. Thermal comfort can be defined as the satisfaction with the thermal environment around a person and is examined over physical parameters such as operative air temperature, relative humidity and air velocity. Apart from these, people’s activity and clothing level are also effective. The related studies, regulations, and standards like ISO EN 7730 and EN 15251 aim to provide a similar understanding of the matter.

Since these studies are based on experimental methods which can cover limited cases, there are gaps in the results for cases not supported by an experiment. The gaps mentioned in the literature can be filled with the Fuzzy Logic Method, which is a method that evaluates with “degrees of truth (between 0 to 1)” instead of “true or false (1 or 0)”.

Filling the literature gaps in empirical studies and expanding the level of knowledge on thermal comfort by fuzzification method are the main goals of this study. Based on this article, optimum thermal conditions can be more easily achieved for different conditions, less energy compared to today can be used to provide thermal comfort with artificial systems in buildings (like HVAC) and negative effects on the environment can be reduced with future studies.

Firstly, to generate the Fuzzy Logic Model of the thermal comfort, parameters (inputs) affecting thermal comfort; sub-functions (membership functions) and obtained results (outputs) of these parameters were determined. Then, using the MATLAB program and Fuzzy Logic Designer plug-in, pre-existing data was identified into the program and after the fuzzification and defuzzification processes the thermal comfort model was simulated.

As a result of applying the Fuzzy Logic Method, it has been seen that the program can both correctly detect the data entered into the system and reach the result and successfully complete the missing data with its own processing system. The rules below were verified by querying the same values in the system and the ΔPMV values emerged as the same:

- The Rule No. 1 (Figure 5), "IF temperature is 21°C and air velocity is 0.05 m/s and metabolism rate is 1.2 met (office) and relative humidity is 40% and expectation level is I (high) and clothing insulation is 1.0 clo THEN ΔPMV is -0.2."
- The Rule No. 2 (Figure 6), "IF temperature is 20°C and air velocity is 0.05 m/s and metabolism rate is 1.2 met (office) and relative humidity is 40% expectation level is II (med) and clothing insulation is 1.0 clo THEN ΔPMV is -0.4."
- The Rule No. 3 (Figure 7) "IF temperature is 19°C and air velocity is 0.05 m/s and metabolism rate is 1.2 met (office) and relative humidity is 40% expectation level is III (low) and clothing insulation is 1.0 clo THEN ΔPMV is -0.6."
- The Rule No. 4 (Figure 8) "IF temperature is 19°C and air velocity is 0.05 m/s and metabolism rate is 1.4 met (kindergarten) and relative humidity is 40% and expectation level is I (high) and clothing insulation is 1.0 clo THEN ΔPMV is -0.3."
- The Rule No. 5 (Figure 9) "IF temperature is 17.5°C and air velocity is 0.05 m/s and metabolism rate is 1.4 met (kindergarten) and relative humidity is 40% and expectation level is II (med) and clothing insulation is 1.0 clo THEN ΔPMV is -0.6."
- The Rule No. 108 (Figure 10) "IF temperature is 26°C and air velocity is 0.15 m/s and metabolism rate is 1.6 met (department store) and relative humidity is 60% and expectation level is III (low) and clothing insulation is 0.5 clo THEN ΔPMV is 0.7."
- Afterwards, by changing the air velocity value of Rule No.1 from 0.05 to 0.08, the Fuzzy Logic model can give the output ΔPMV as -0.258 (Figure 11).
- Also in another example, by changing the air velocity, relative humidity and metabolism rate values of Rule No.1 – the air velocity is changed from 0.05 to 0.09, the relative humidity is changed from 40% to 45% and the metabolism rate is changed from 1.2 to 1.3; the Fuzzy Logic model gave the ΔPMV value as -0.231 (Figure 12).

By employing this approach, the generated Fuzzy Logic model was able to give results for diverse conditions related to thermal comfort that were not previously covered in the existing literature, which relied on experimental studies. These changes made in the rules can be very diversified within the scope of 6 inputs and 26 membership functions for 108 rules. Consequently, the potential to obtain an expanded number of results can be obtained according to specific requirements or topics.

As mentioned before, the Fuzzy Logic method has been experienced in different areas of architecture and has been used to increase the level of knowledge previously obtained in different design/application issues. It is thought that this study also makes a unique contribution by providing benefit in increasing the level of knowledge about thermal comfort in architectural structures for intermediate values that do not have experimental output data.

In this way, it has been demonstrated that the Fuzzy Logic method can be used in architectural applications to process information and expand the data network. It is hoped that this method will be a useful model for similar architectural issues in future studies.

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The article complies with national and international research and publication ethics. Ethics Committee approval was not required for the study.

Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to the article. There is no conflict of interest.

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Determination of Landscape Use Opportunities of Some Taxa from Şanlıurfa (Türkiye) Wetland Flora

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Abstract

The aim of this study is to determine the landscape use opportunities of natural plants of wetland habitats (river, stream, rill, moist meadows, etc.) within Şanlıurfa province. In this study, 58 plants were determined from wetland habitats that can be evaluated in terms of landscape use. The characteristics of these plants for their landscape use (life form, structure, flowering period, flower color, landscape value, color, and scent effect) were determined. The obtained data were evaluated using PAST 4.03 data analysis software and Principal Component Analysis (PCA). In addition, cluster analysis was performed to examine the distribution of these plants according to the determined landscape use parameters. With the classification practices, plants were defined in 4 different groups, and it was observed that the parameters were effective in the classification of the species. It was concluded that PC1 and PC2 heavily determined the grouping with parameters such as life form, flowering period, color effect and flower color.

Keywords: *Flora, landscape, wetland, landscape management, environmental sustainability.*

Şanlıurfa (Türkiye) Sulak Alan Florasındaki Bazı Taksonların Peyzaj Kullanım Olanaklarının Belirlenmesi

Öz

Bu çalışmanın amacı, Şanlıurfa il sınırları içerisindeki sulak alan habitatlarındaki (nehir, dere, nemli çayırlar vb.) doğal bitkilerinin peyzaj kullanım olanaklarının belirlenmesidir. Çalışmada sulak alan habitatlarından peyzaj kullanımı açısından değerlendirilebilecek 58 bitki tespit edilmiştir. Bu bitkilerin peyzaj kullanımına yönelik özellikleri (yaşam formu, yapısı, çiçeklenme dönemi, çiçek rengi, peyzaj değeri, rengi ve koku etkisi) belirlenmiştir. Elde edilen veriler, PAST 4.03 veri analiz yazılımı ve Temel Bileşen Analizi (PCA) kullanılarak değerlendirilmiştir. Ayrıca bu bitkilerin belirlenen peyzaj kullanım parametrelerine göre dağılımını incelemek için küme analizi yapılmıştır. Sınıflandırma uygulamaları ile bitkiler 4 farklı grupta tanımlanmış, parametrelerin türlerin sınıflandırılmasında etkili olduğu gözlemlenmiştir. PC1 ve PC2'nin yoğun olarak yaşam formu, çiçeklenme dönemi, renk etkisi ve çiçek rengi gibi parametreler ile gruplandırmayı belirlediği sonucuna ulaşılmıştır.

Anahtar kelimeler: *Flora, peyzaj, sulak alan, peyzaj yönetimi, çevresel sürdürülebilirlik.*

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1. Introduction

Landscape design involves planning processes that prioritize the relationship between human beings, flora and fauna in line with legal frameworks, taking into account aspects such as natural, socio-cultural, environmental, ecological, economic, technological aspects, compatibility with the land structure, relations with the immediate surroundings as well as vegetative, geographical, innovative aspects and sustainability (Yerli & Kaya, 2018). The landscape areas so designed are regarded as one of the key elements of the cities thanks to the benefits they offer, such as supply of fresh air, wind screening, noise reduction, and creating recreational areas for the urban residents by establishing nature reserves for the cities. Open and green spaces, which are important for the Landscape Architecture discipline, play a major role in the improvement and development of the urban ecosystem, such as reducing the urban heat island effect, carbon capture and storage (Tuğluer & Gül, 2018). Such areas incorporate elements that minimize the negative impact of urbanization on the environment, accessible by people from all segments of the society to benefit therefrom, and improve the living standards. Using natural plant species for landscaping helps to conserve water and maintain the quality of water while preserving the existing natural vegetation (Aksoy & Erken, 2022). It is known that plant material, which is the basic element of urban open and green spaces, provides many benefits to the city. However, in order for plants to provide the expected benefits from them, while being used in landscape architecture studies, along with the design principles, their dendrological characteristics and ecological demands should be taken into consideration (Ekren & Çorbacı, 2022).

Water garden designs stand out as one of the most conspicuous elements in landscape planning efforts. In addition acting as the highlight of the landscaping effort, the water garden is also used for generating sounds and for cooling the ambiance. Wetlands are generally known as areas with dominant water saturation, which soil improvement, plant species and animal communities. Considered as areas of great importance due to the biological diversity they feature, the wetlands represent key ecosystems of the earth with natural functions and economic values (Wescoat, 2012; Bhikha, 2013; Haynes, 2015).

The concept of ‘water garden’ is first mentioned in conjunction with the garden art in Ancient Egypt and Far East (Düzenli et al., 2019). The water garden concept can be defined as an architectural space designed to house, exhibit or reproduce certain species or a variety of aquatic plants. When designed and planned with compatible plants, the water gardens compose structures that support sustainable water quality and clarity. Furthermore, aesthetic and functional benefits can also be achieved by planting combined with architectural elements such as fountains, sculptures, waterfalls, rocks, etc.

Giving preference to the plants adapted to local ecological conditions in the design of the water garden shall mitigate the economic risks in landscape design and planning aspects (Cirik, 1993; Gülgün et al., 2010). Such plants shall be used for purposes such as exhibiting the local flora in urban green areas, soil stabilization, as well as their functional features such as shading, guidance, axle and highlighting. Moreover, such natural flora have already adapted to the climatic conditions of their respective region, and once planted, they scarcely require resources for protection and do not require any chemical fertilizers or any chemical pesticides. This also offers an advantage in terms of cost-effectiveness (Aksoy & Erken, 2022). Morphological and aesthetic features of taxa gain importance when evaluating plants (Sarı & Acar, 2015). While choosing plants, even if they belong to a theme, their ecological demands and functional uses are taken into consideration as well as their aesthetic appearance. The color, shape and arrangement of the leaves, flowers, fruits, branches and bark of the plants determine the areas of use in designs and enable effective compositions to be created (Dönmez et al., 2016).

It is important to use local plants adapted to the climatic conditions of the region in order to ensure sustainability of the recreation areas that feature water garden designs in cities such as Şanlıurfa, where semi-arid climatic conditions prevail. Landscape use opportunities of plant taxa from the wetlands that can be used in water garden designs in the natural flora of Şanlıurfa province were identified under this study. In our cities, which are increasingly uniform in terms of using our natural resources and species diversity, studies on the use of natural plant species in plant designs should gain importance. In this context, a classification has been made regarding the qualitative and quantitative

use of wetland plants according to the characteristics that determine their use in the landscape, such as landscape value, color, and odor effect. Suggestions for its use in landscape design studies have been developed.

2. Material and Method

The survey area is the province of Şanlıurfa located in the Southeastern Anatolia Region of Turkey; surrounded by Syria in the south, Gaziantep in the west, Mardin in the east, Diyarbakır and Adıyaman in the northeast and northwest, the topography of Şanlıurfa vary across its northern and southern sections. Despite the mountain ranges in the north, the southern parts are rather flat. The volcanic Karacadağ (1957 m) located in the borders of Siverek is the highest altitude in the province (GPDEF, 2006). Şanlıurfa is located in the region far from the maritime exposure, and predominantly semi-arid climate prevails the survey area. The measurements by the Turkish State Meteorological Service (Turkish State Meteorological Service, 2022) throughout the province Şanlıurfa in the last 50 years indicate that the highest temperature measured is 46.8°C (in July) while the lowest temperature measured is -12.4°C (in February). The highest precipitation, 181 mm, is measured in January, February and December. Annual precipitation is measured to be 379 mm in Şanlıurfa province. The plant taxa from the wetlands of Şanlıurfa constitutes the primary material of the survey. The studies by Davis (1965-1985), Davis et al. (1988), Güner et al. (2000), and Kaya & Bozancı (2022) were used as references for identification of the plants. The list of plant taxa was created in alphabetical order. The author and abbreviation of the taxa is checked using the study by Brumitt & Powell (1992).

The guiding principles for using plant materials in landscape design are based on features such as texture, color and decorativeness as established by Tanrıverdi (1987), Gültekin (1988) and Brickell (1996). Therefore, 7 features (life form, structure, flowering period, flower color, landscape value, color effect, and scent effect) that have an impact on choice of plant taxa by the landscape designer, which will be statistically correlated, were evaluated. The life forms were identified according to Raunkiaer (1934) in order to interpret where the plants can be used in the water garden (as immersed in the water/planted at the edge). Accordingly, the chart that contains the criteria on landscape use of 58 taxa considered to be suitable for landscape use in Şanlıurfa flora was created.

PAST 4.03 data analysis software was utilized at this stage in order to analyze the data. In the first step, the criteria so identified were digitized and tabulated by assigning distinct values thereto in order to interpret the 7 different features that would determine the landscape use of taxa. The Principal Component Analysis (PCA) has been applied contemplating that it may assist in avoiding mutual interactions between single assessment indicators, to render the assessment indicator system simple and effective, to produce strictly linked cases for research objects, and to improve objectivity of the assessment results (Yang & Wang, 2020). The Principal Component Analysis (PCA) was conducted in order to downscale large amount of data designating the characteristics that make taxa preferred in landscape design into meaningful components, to determine the preference size and to comprehend such components are grouped (Hammer et al., 2001). The cluster analysis (dendrogram) was conducted to analyze distribution of 58 taxa on the basis of 7 parameters to analyze the distribution of the groups for the second time. The dominant characteristics of the plant taxa in the groups were reviewed in the cluster analysis (PCA) in order to denominate the parameters as effective factors, and the graphs were generated accordingly.

3. Findings and Discussion

The information on 7 distinct features for each taxon that shall improve preference for landscape use is provided in Table 1 hereunder. Of the 58 plants with identified value in terms of landscape use, 50 are herbaceous and 7 are woody in nature. When assessed in terms of life forms (Raunkiaer, 1934), 28 of such plants are hemicryptophytes, 14 are cryptophytes (geophytes, helophytes, hydrophytes), 9 are therophytes and 7 are phanerophytes. When we review the flowering period of such plants, of 58 plant species, 25 are identified to flower in summer, 15 in spring, 10 in autumn and 1 in winter, except for Equisetum arvense L. species. When assessed in terms of flower colors, it is observed the purple(11 taxa), pink (8 taxa), white (7 taxa) and yellow (5 taxa) colors are dominant among the plants. Furthermore, the flowers of 12 taxa are considered to be ineffective in terms of aesthetics. The survey

further revealed that 87% of the plants had no scent effect, while the flowers or leaves of 6 taxa are not scented. 24 plant taxa featured landscaping value with their flowers, while 18 taxa with their forms and 3 taxa with their leaves.

The clusters generated by classification of the taxa based on the landscaping characteristics data acquired from the PCA are illustrated in Figure 1. Accordingly, one can observe that the plant groups classified by the PAST program are vividly distinguishable and present clear pattern of dissociation in the coordination planes. The plant taxa are distributed along the axes PC1 and PC2 in this plane. The eigenvalues for both axes are 0.495 and 0.375, respectively. Statistically, it was concluded that the classification was identified using parameters such as life form, flowering period, color effect and flower color. As illustrated in Figure 1, while the life form and flowering period parameters are more effective in axis PC1, the scent effect and structure parameters contributed less to the distribution in PC1 compared to other features. The most prominent feature in axis PC2 was observed to be the flower color. Accordingly, the plant taxa are subdivided into 4 distinct groups;

Group 1 – *Ceratophyllum demersum*, *Eleocharis palustris* subsp. *palustris*, *Geranium dissectum*, *Groenlandia densa*, *Lemna minor*, *Myriophyllum spicatum*, *Orchis coriophora* subsp. *coriophora*, *Populus euphratica*, *Potamogeton nodosus*, *Rubus sanctus*, *Salix acmophylla*, *Salix alba* subsp. *alba*, *Tamarix smyrnensis*, *Trifolium resupinatum* var. *resupinatum*, *Vitex agnus-castus*

Group 2 – *Bolboschoenus maritimus* var. *maritimus*, *Butomus umbellatus*, *Cionura erecta*, *Cyperus fuscus*, *Euphorbia chamaesyce*, *Iris pseudacorus*, *Ranunculus sphaerospermus*, *Schoenoplectus tabernaemontani*, *Scirpoides holoschoenus*, *Typha domingensis*

Group 3 – *Alisma lanceolatum*, *Althaea cannabina*, *Anagallis arvensis* var. *caerulea, Arundo donax*, *Bellis perennis*, *Centaurium erythraea* subsp. *erythraea*, *Cyperus longus* subsp. *longus*, *Epilobium hirsutum*, *Equisetum arvense*, *Galega officinalis*, *Imperata cylindrica*, *Lythrum salicaria*, *Phragmites australis*, *Potentilla reptans, Saccharum ravennae*, *Sanguisorba minor* subsp. *lasiocarpa*, *Scutellaria galericulata*, *Veronica anagallis-aquatica*

Group 4 – *Anagallis arvensis* var. *arvensis, Catabrosa aquatica, Eclipta prostrata, Blackstonia perfoliata* subsp. *perfoliata, Nasturtium officinale, Lycopus europaeus, Pulicaria dysenterica* subsp. *dysenterica, Inula britannica, Mentha longifolia* subsp. *typhoides, Calystegia sepium* subsp. *sepium, Campanula sclerotricha, Juncus articulatus* subsp. *articulatus, Juncus effusus* subsp. *effusus, Trifolium repens* var. *repens*, *Verbena officinalis* var. *officinalis*

These plant groups formed based on the analysis results indicate the taxa that present equivalent landscape characteristics. The ability of the spaces established in the water garden to maintain their effect during certain periods of the year shall be ascertained by choosing plants from distinct groups so identified. The groups established in this context shall ensure that the landscape characteristics of the taxa serve the desired functions.

The dendrogram graph plotted by evaluating seven parameters identified in terms of landscape design with respect to the plant species is illustrated in Figure 2. 4 groups determined by the PCA and the degree of affinity in the dendrogram are coherent in general.

The taxa included in the same group on the graph (Figure 1) created to identify any similarities and distinctiveness in terms of landscape use characteristics of different plant taxa and located closely in the dendrogram (Figure 2) feature similar characteristics in general. For example, although the taxa in the same group differ from each other in terms of general characteristics, such plants demonstrate similar characteristics when evaluated in terms of landscape characteristic parameters.

Yılmaz & Yılmaz (2009) evaluated the landscaping possibilities of *Campaluna*, *Epilobium*, *Equisetuma*, *Euphorbia*, *Geranium*, *Iris*, *Juncus*, *Mentha*, *Orchis*, *Potentilla*, *Ranunculus*, *Sanguisorba*, *Trifolium*, and *Vitex* genera, some of which some of which were examined in our study. They stated that the species belonging to these genera can be used in landscape restoration and conservation in urban areas, water gardens, rock gardens and roof-terrace gardens.

Sarı & Acar (2015) examined different species belonging to the genera *Campaluna*, *Geranium*, *Orchis*, *Potentilla*, *Ranunculus*, *Rubus*, *Trifolium*, and *Veronica*. They examined the functional and aesthetic values of the taxa belonging to these genera.For example, the combination of taxa with contrasting color and form features in rocky areas can be considered as a factor that increases visual appeal. Some genres can be used as focus/emphasis (Sarı & Acar, 2015). In this context, the plants within the scope of the study can be used in the rock garden designed in the park design. Two studies (Yılmaz & Yılmazi 2009; Sarı & Acar, 2015) were conducted at high altitudes. Considering the semi-arid climatic conditions prevailing in Şanlıurfa, non-uniform water garden design that is active in all seasons As mentioned above, when designing the water garden landscape, the best yield of the year can be obtained by choosing plants from different groups.

Çimen & Ulus (2020) stated that *Lythrum salicaria* and *Epilobium hirsutum* species can be used in flower beds and borders in landscape areas and rock gardens. They also stated that different species of *Inula*, *Geranium*, and *Scutellaria* can be used in areas with limited maintenance conditions. In this direction, it was considered to evaluate other plants examined on the basis of the research.

In the past, plants that were not found in our country's flora were used extensively in the open-green areas of cities (Çimen & Ulus, 2020). Even if the upper vegetation starts to disappear due to the drought that may occur due to global climate change, together with the studies carried out with the plants used in the country flora, natural species that can protect the green cover after these plants should be used in the designs. For this reason, it is recommended that the species determined in the study be used in landscape areas by providing these effects. In this context, in addition to flowers, leaves and life forms, species that are effective in terms of some characteristics of the plant were also determined. Thus, plants that stand out with their fruit and form characteristics after flowering will be directed to more use in urban open-green areas.

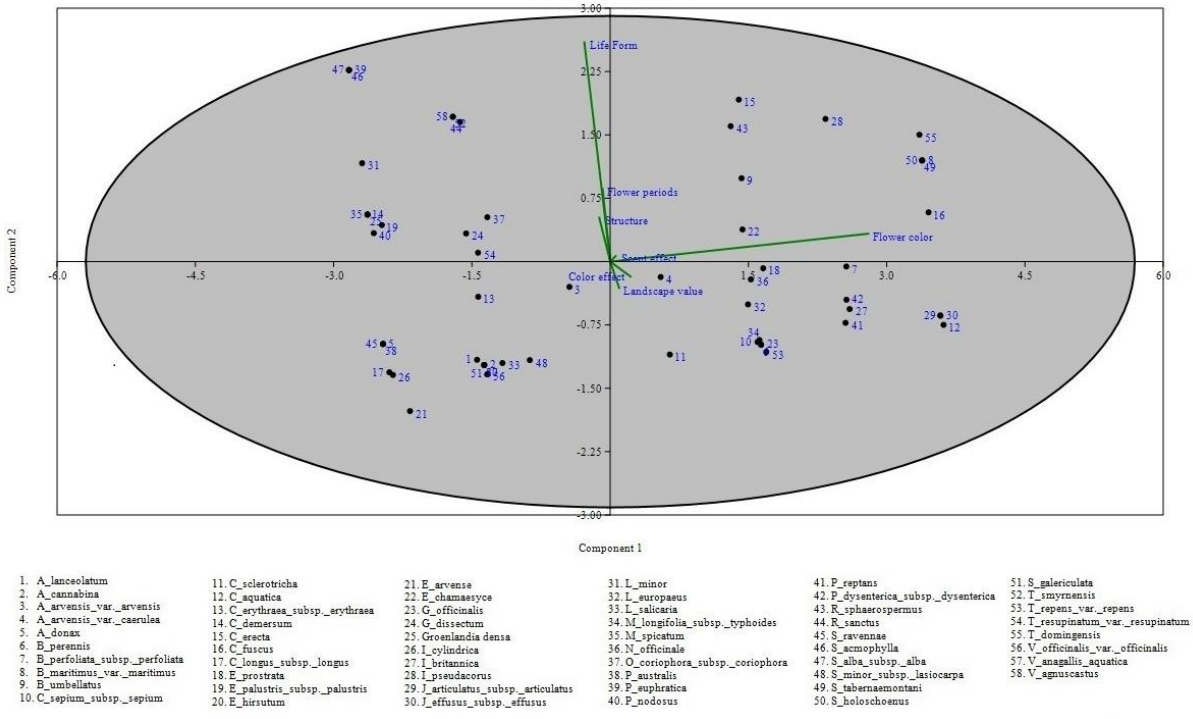

Figure 1. PCA ordination showing the grouping of taxa with Landscape features obtained from the PAST program (58 taxa x 7 landscape features)

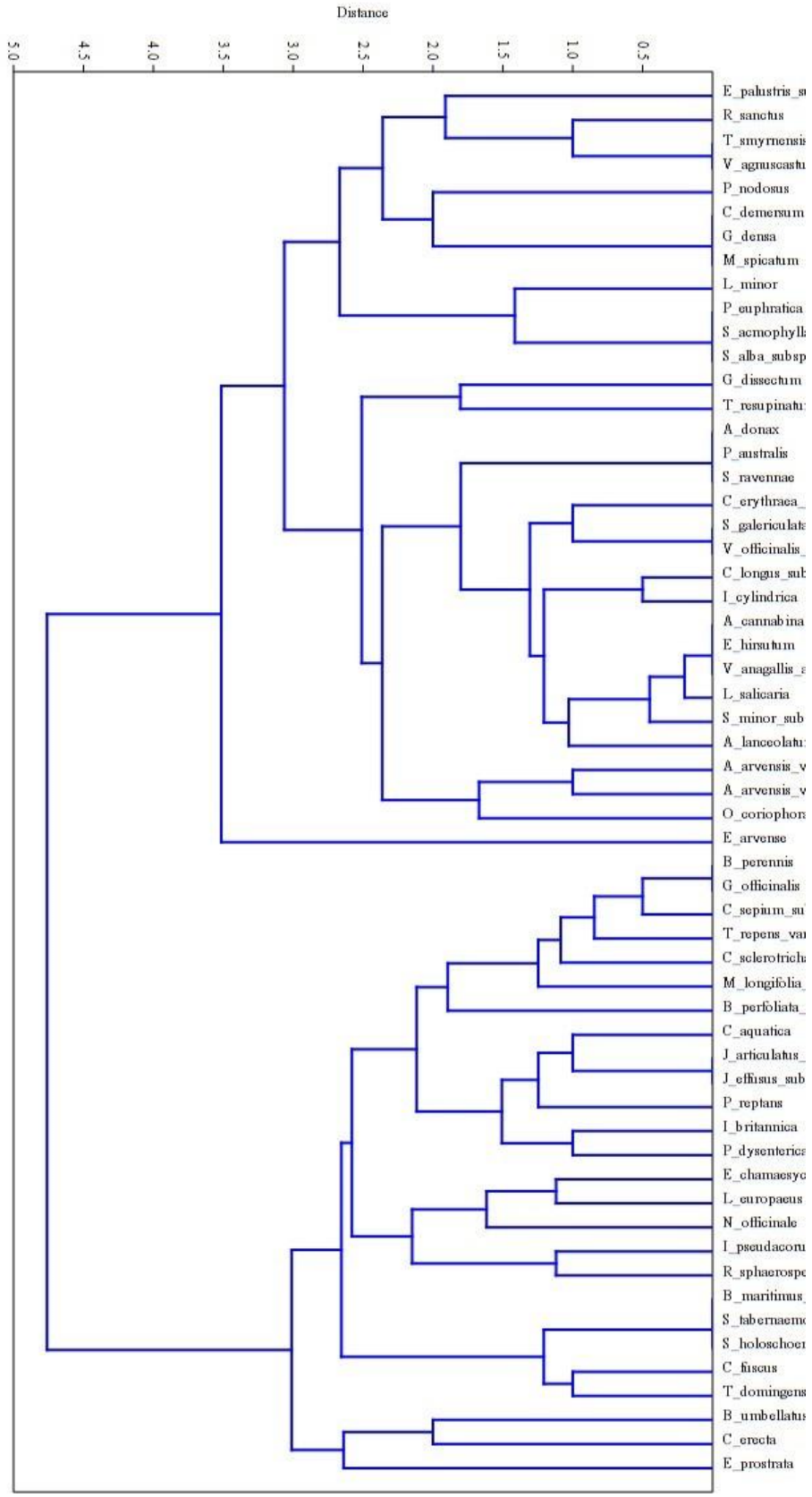

Figure 2. Clusters resulting from the classification of Landscape features and taxa (58 taxa x 7 landscape features) obtained from the PAST program

Table 1. Attributes of 58 taxa identified based on 7 parameters

Taxon	Life form (Raunkiaer, 1934)	Structure	Flower periods	Flower color	Landscape value	Color effect	Scent effect
***Alisma lanceolatum* With.**	Hemicryptophyte	Herbaceous	4-9	Pink/Lilac/ White	Form	Leaf	-
***Althaea cannabina* L.**	Hemicryptophyte	Herbaceous	6-8	Pink	Form	Flower	-
Anagallis arvensis* L. var. *arvensis	Therophyte	Herbaceous	4-9	Orange/Red	Flower	Flower	-
***Anagallis arvensis* L. var. *caerulea* (L.) Gouan**	Therophyte	Herbaceous	3-8	Blue	Flower	Flower	-
***Arundo donax* L.**	Hemicryptophyte	Herbaceous	10	Noneffective	Form	Leaf	-
***Bellis perennis* L.**	Hemicryptophyte	Herbaceous	3-8	White	Flower	Flower	-
Blackstonia perfoliata* (L.) Huds. subsp. *perfoliata	Therophyte	Herbaceous	4-8	Yellow	Leaf	Flower	-
Bolboschoenus maritimus* (L.) Palla var.*maritimus	Cryptophyte (Helophyte)	Herbaceous	5-9	Brown	Form	Flower	-
***Butomus umbellatus* L.**	Cryptophyte (Geophyte)	Herbaceous	5-9	White (with purplish veins)	Form	Flower	Flower
Calystegia sepium* (L.) R.Br. subsp. *sepium	Hemicryptophyte	Herbaceous (rhizomatous)	5-9	White	Flower	Flower/ Leaf	-
***Campanula sclerotricha* Boiss.**	Hemicryptophyte	Herbaceous	7-8	Violet/Blue	Flower	Flower	-
***Catabrosa aquatica* (L) P. Beauv.**	Hemicryptophyte	Herbaceous	5-8	Greenish/Yellowish-brown/Brownish-violet	Flower	Flower	-
Centaurium erythraea* Rafn. subsp. *erythraea	Therophyte	Herbaceous	5-7	Pink/Purple	Flower	Flower	-
***Ceratophyllum demersum* L.**	Cryptophyte (Hydrophyte)	Herbaceous	7-9	Noneffective	Form	Leaf	-
***Cionura erecta* (L.) Griseb.**	Phanerophyte	Woody	4-9	White	Flower	Flower/ Fruit	Flower
***Cyperus fuscus* L.**	Therophyte	Herbaceous	7-10	Brown	Form	Flower	-
Cyperus longus* L. subsp. *longus	Hemicryptophyte	Herbaceous	5-9	Noneffective	Form	Flower/ Leaf	-
***Eclipta prostrata* (L.) L.**	Therophyte	Herbaceous	7-8	White	Form	Flower/ Stem	-
Eleocharis palustris*(L.) Roem.&Schult. subsp. *palustris	Cryptophyte (Helophyte)	Herbaceous	3-9	Noneffective	Form	Fruit	-
***Epilobium hirsutum* L.**	Hemicryptophyte	Herbaceous	7-9	Pinkish-Purple	Form	Flower	-
***Equisetum arvense* L.**	Hemicryptophyte	Herbaceous (rhizomatous)	-	Noneffective	Form	Stem	-
***Euphorbia chamaesyce* L.**	Therophyte	Herbaceous	5-10	White/Pinkish	Form	Flower/ Leaf	-
***Galega officinalis* L.**	Hemicryptophyte	Herbaceous	6-9	White/Lilac/ Purple	Flower	Flower	-
***Geranium dissectum* L.**	Therophyte	Herbaceous	4-5	Carmine/Purple	Form	Flower/ Leaf	-
***Groenlandia densa* (L.) Fourr.**	Cryptophyte (Hydrophyte)	Herbaceous	5-9	Noneffective	Form	Leaf	-
***Imperata cylindrica* (L.) Raeusch.**	Hemicryptophyte	Herbaceous	4-7	Noneffective	Form	Flower	-
***Inula britannica* L.**	Hemicryptophyte	Herbaceous	6-10	Yellow	Flower	Flower	-
***Iris pseudacorus* L.**	Cryptophyte (Geophyte)	Herbaceous	4-5	Yellow	Form	Flower	-
Juncus articulatus* L. subsp. *articulatus	Hemicryptophyte	Herbaceous	4-8	Brown	Form	Flower	-

Juncus effusus* L. subsp. *Effuses	Hemicryptophyte	Herbaceous	4-7	Brown	Form	Flower	-
***Lemna minor* L.**	Cryptophyte (Hydrophyte)	Herbaceous	7	Noneffective	Form	Leaf	-
***Lycopus europaeus* L.**	Hemicryptophyte	Herbaceous	6-10	White (with small dark purple spots)	Form	Leaf	-
***Lythrum salicaria* L.**	Hemicryptophyte	Herbaceous	6-8	Purple	Form	Flower	-
***Mentha longifolia* subsp. *Typhoides* (Briq.) Harley**	Hemicryptophyte	Herbaceous	7-9	Lilac/White	Flower	Flower/ Leaf	Leaf
***Myriophyllum spicatum* L.**	Cryptophyte (Hydrophyte)	Herbaceous	5-7	Noneffective	Form	Leaf	-
***Nasturtium officinale* (L.) R.Br.**	Hemicryptophyte	Herbaceous (rhizomatous)	3-7	White	Form	Flower/ Leaf	Flower
Orchis coriophora* L. subsp. *coriophora	Cryptophyte (Geophyte)	Herbaceous	4-6	Dark purple/Brownish-red/Greenish-red	Flower	Flower	-
***Phragmites australis*(Cav.) Steud.**	Hemicryptophyte	Herbaceous	8-10	Noneffective	Form	Leaf	-
***Populus euphratica* Olivier**	Phanerophyte	Woody	4	Noneffective	Form	Leaf	-
***Potamogeton nodosus* Poir.**	Cryptophyte (Hydrophyte)	Herbaceous	4-8	Noneffective	Leaf	Leaf	-
***Potentilla reptans* L.**	Hemicryptophyte	Herbaceous	5-8	Yellow	Form	Flower/ Leaf	-
Pulicaria dysenterica* (L.) Bernh. subsp. *Dysenterica	Hemicryptophyte	Herbaceous	6-10	Yellow	Form	Flower	-
***Ranunculus sphaerospermus* Boiss.& C.I.Blanche**	Cryptophyte (Helophyte)	Herbaceous	1-9	White	Form	Flower/ Leaf	-
***Rubus sanctus* Schreb.**	Phanerophyte	Woody	6-8	Pink	Form	Flower/ Fruit	-
***Saccharum ravennae* (L.) L.**	Hemicryptophyte		9-10	Noneffective	Form	Leaf	-
***Salix acmophylla* Boiss.**	Phanerophyte	Woody	2-3	Noneffective	Form	Leaf	-
Salix alba* L. subsp. *alba	Phanerophyte	Woody	4-5	Noneffective	Form	Leaf	-
***Sanguisorba minor* Scop. subsp. *lasiocarpa* (Boiss. & Hausskn.) Nordb.**	Hemicryptophyte	Herbaceous	7-9	Green (with whitish or pinkish margins)	Form	Flower	-
***Schoenoplectus tabernaemontani* (C.C.Gmel.) Palla**	Cryptophyte (Helophyte)	Herbaceous	4-8	Brown	Form	Flower	-
***Scirpoides holoschoenus* (L.) Sojak**	Cryptophyte (Helophyte)	Herbaceous	4-8	Brown	Form	Flower	-
***Scutellaria galericulata* L.**	Hemicryptophyte	Herbaceous	6-8	Lavender/ Lilac-blue	Flower	Flower	-
***Tamarix smyrnensis* Bunge**	Phanerophyte	Woody	4-8	Pink	Form	Flower	-
Trifolium repens* L. var. *repens	Hemicryptophyte	Herbaceous	3-9	White	Flower/ Leaf	Flower/ Leaf	-
Trifolium resupinatum* L. var. *resupinatum	Therophyte	Herbaceous	5	Pink	Flower/ Leaf	Flower/ Leaf	-
***Typha domingensis* (Pers.) Steud.**	Cryptophyte (Helophyte)	Herbaceous	6-11	Brown	Form	Flower	-
Verbena officinalis* L. var. *officinalis	Hemicryptophyte	Herbaceous	6-8	Pale lilac	Flower	Flower	-
***Veronica anagallis-aquatica* L.**	Hemicryptophyte	Herbaceous	3-9	Lavender/Pale blue/Pale lilac	Form	Flower	-
***Vitex agnus-castus* L.**	Phanerophyte	Woody	6-9	Pale lilac/Blue	Form	Flower	-

4. Conclusion and Suggestions

This study investigates the landscape use criteria of the plant taxa from the wetland flora of the region that can be used in water gardens, an important aspect of urban green space systems, in regions far from sea where semi-arid conditions prevail, as is the case in Şanlıurfa. The life forms, structures, flowering times, flower colors, scent and color effects and landscape values of the plant taxa addressed in the study were identified. The plants with intense similar characteristics were grouped together in line with the statistical evaluations.

Majority of the woody plant materials used in outdoor-green areas in Şanlıurfa and other cities with similar ecological conditions is of exotic origin. In general, such species are used for aesthetic intentions. Out of the taxa evaluated under this study, the taxa *Populus euphratica*, *Salix acmophylla*, *Salix alba* subsp. *alba* and *Tamarix smyrnensis* can also be considered in this context.

Majority of the plants used in urban landscape areas also represent sources of various raw materials. However, such plants are not utilized based on the functional properties thereof, since such plants are rather used for their aesthetic properties in the urban areas. An example for such plant species is *Rubus sanctus* as evaluated under this study.

Only 3 plants out of all plants identified under the study (*Butomus umbellatus, Mentha longifolia* subsp. *typhoides* and *Nasturtium officinale*) were observed to have an intense and pleasant scent effect. Therefore, one can see that use of at least one of such species in landscape design can contribute to the aromatic plant diversity at outdoor and green areas by introducing scent effect in the water garden. It is of great importance to encourage use of fragrant plants at levels that shall not disturb the users in landscape design efforts.

Another key aspect in the landscape design efforts is the color effects by the plant materials to be planted. It is determined that the majority of the plant taxa evaluated under the study created color effect with their organs such as flowers and leaves, etc. The fact that such plant taxa feature flowers in various colors such as pink, purple, orange, blue, white, yellow and brown, etc., stands out as an important factor in terms of color effect.

Based on the outcomes from the study, it would be possible to create an enduring landscape composition by securing perpetuity of the flower effect by taking into account other characteristics of the plants that bloom in different periods. Designs wherein taxa such as *Althaea cannabina, Campanula sclerotricha, Potentilla reptans*, and *Scutellaria galleryculata,* which bloom in different periods and feature various flower colors, are used in combination shall ensure sustainability of the aesthetic appearance at the water garden during different periods.

In conclusion, this study evaluated the parameters of natural wetland plant taxa that are suitable for creating striking visual compositions in outdoor garden landscapes of the buildings such as residences, restaurants, hotels, complexes, campuses, etc., in particular at the parks and gardens. Accordingly, the wetland plants from the natural flora of Şanlıurfa were classified based on their landscape values.

The fact that the examined natural plant taxa are in a semi-arid climate, such as the Southeastern Anatolia Region, will provide support in terms of their use as ornamental plants, and in terms of bringing in the drought-resistant species that are likely to be experienced in the zone where Turkiye is located due to global climate change. In cities such as Şanlıurfa, where semi-arid climatic conditions prevail, preferring use of local natural plants adapted to ecological conditions rather than exotic plants shall not only eliminate adaptation problems, but also be sustainable in the long run.

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The paper complies with national and international research and publication ethics. Ethics committee approval was not required for this manuscript.

Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to this manuscript. There is no conflict of interest.

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Conservation Initiatives/Assessments in Rock-Carved Churches Specific to the Göreme Saklı Church

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Abstract

Cappadocia contains historical, documentary, aesthetic, artistic, symbolic, social, economic, religious and spiritual values. Many structures and places produced by the rock carving technique have been destroyed and/or are on the way to extinction because of intense destruction in the historical process. Rock-carved churches, unique in their religious, artistic, and cultural values, are among the most affected. In this study, the current status of the Saklı Church, the examination of its historical development, the architectural documentation studies with the monasteries in its immediate vicinity, the structural deterioration, and the reasons for the preservation of the rock-hewn churches in the Göreme Valley, and the current conservation strategies and practices in the rock churches were evaluated. Preservation proposals have been developed so that the cultural heritage can be safely transferred to the future. As a result, the status and deterioration of the Saklı Church have been documented with various architectural representation methods, and conservation proposals have been developed.

Keywords: *Cappadocia, Göreme, Saklı Church, conservation.*

Göreme Saklı Kilise Özelinde Kaya Oyma Kiliselerinde Koruma Girişimleri/Değerlendirmeleri

Öz

Kapadokya, tarihsel, belgesel, estetik, sanatsal, simgesel, sosyal, ekonomik, dini ve manevi değerler içermektedir. Kaya oyma tekniği ile üretilen birçok yapı ve mekân tarihsel süreç içerisindeki yoğun tahribatlar neticesinde yok olmuşlar ve/veya yok olma yolunda ilerlemektedirler. Bunlardan dinsel, sanatsal, kültürel değerleri bakımından eşsiz olan kaya oyma kiliseler en çok etkilenenlerdendir. Bu çalışmada, Göreme Vadisi'ndeki kaya oyma kiliselerin korunma durumu ile birlikte Saklı Kilise'nin güncel durumu, tarihsel gelişiminin incelenmesi, yakın çevresinde bulunan manastır mekânları ile birlikte mimari belgeleme çalışmaları, yapısal bozulmaları ve nedenlerinin araştırılarak kaya kiliselerinde mevcut koruma stratejileri ve uygulamaları değerlendirilerek bu kültürel mirasın geleceğe güvenle aktarılabilmeleri için korunma önerileri geliştirilmiştir. Sonuç olarak Saklı Kilise'nin güncel durumu, bozulmaları çeşitli mimari gösterim yöntemleriyle belgelenmiş ve geleceğe aktarılabilmeleri için koruma önerileri geliştirilmiştir.

Anahtar kelimeler: *Kapadokya, Göreme, Saklı Kilise, mimari koruma.*

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1. Introduction

Göreme, which is 10 km away from Nevşehir, lies on the borders of Nevşehir province and Ürgüp and Avanos districts in an area surrounded by valleys. The town, located 500 m west of the center of Göreme rock churches, has an area of approximately 5 km². Göreme and its surroundings have the same topographic structure as Cappadocia. Rocks, composed of soft tuffs, have obtained different surface shapes with the erosion effect of harsh climatic conditions (Figure 1).

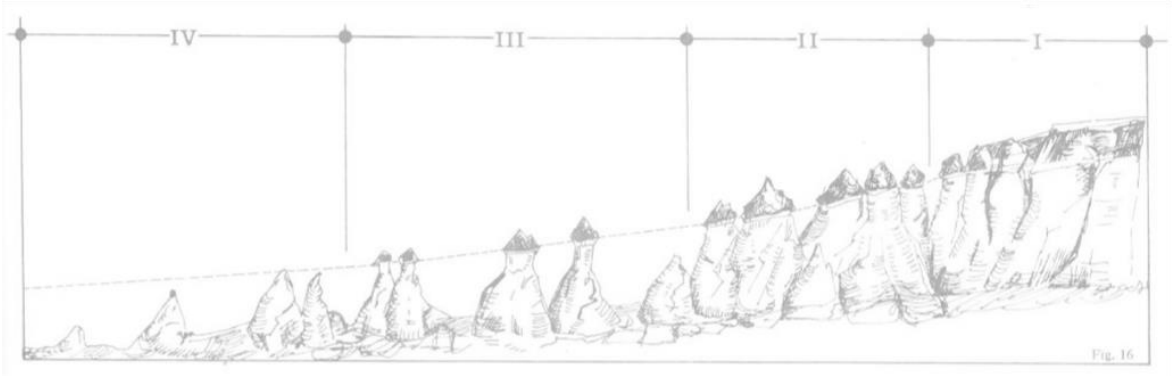

Figure 1. Formation of fairy chimneys in Göreme Valley (Giovannini, 1971, p.61)

Volcanic tremors and erosion formed the general structure of Göreme Valley. The surface shape and narrow valleys form "fairy chimneys," a particular form of erosion of the flood beds (Ötüken, 1987, p.7). They are natural structures that significantly impact the region's architecture. Many rock-carved monasteries, churches, and chapels exist in the Göreme Valley. In the Cappadocia Region, the settlement is usually made by carving into the valley slopes or carving a rock mass in harmony with the terrain.

Today, there are building groups with many religious functions in the "upper valley," called the Göreme Open Air Museum, which contains many important religious buildings for the region, and in the "lower valley" to the east of Göreme Town. The Saklı Church, the present study's subject, is 500 meters from the Göreme Open Air Museum. It is located on the slope of the mountain, which is in the lower valley to the west, overlooking the Zemi Valley.

2. Material and Method

The Göreme Valley is one of the areas where early Christian individuals and communities in Anatolia settled. Mitchell states this is because church fathers, such as St. Basilios, Gregorius of Caesarea, and Gregorios of Nazianzus, were active in the region (Mitchell, 1993). Basil of Caesarea (329-379 AD), known as the father of the church whose writings built the Christian doctrine of Eastern Rome, his brother Gregorius (335-394 AD), and his close friend Gregorius of Nazianzus (330-389 AD) were the most important figures of Cappadocia at that time. They became Christian theologian (Vasiliev, 2017, p.145). In the first years of Christianity, people and clergy fleeing oppression built churches and monasteries in the valley where they could hide easily and worship in seclusion. There are various sections, such as the dining hall, monk rooms, cellar, kitchen, and chapel in the monastery structures carved into the rock. Written document sources such as endowments, inventory or letters related to the rock churches and monasteries are unknown. Therefore, churches in monasteries are dated with the help of architectural elements and stylistic and iconographic features of fresco decorations (Ötüken, 1987, p.13). It is thought that some of the churches in the Göreme Valley have a similar style or iconography to the wall paintings, and they form a group because the paintings contain symbolic scenes. The land structure in and around the Göreme Valley is the same as the Cappadocia region in general and the primary material of the monastic settlement is volcanic ignimbrite tuffs.

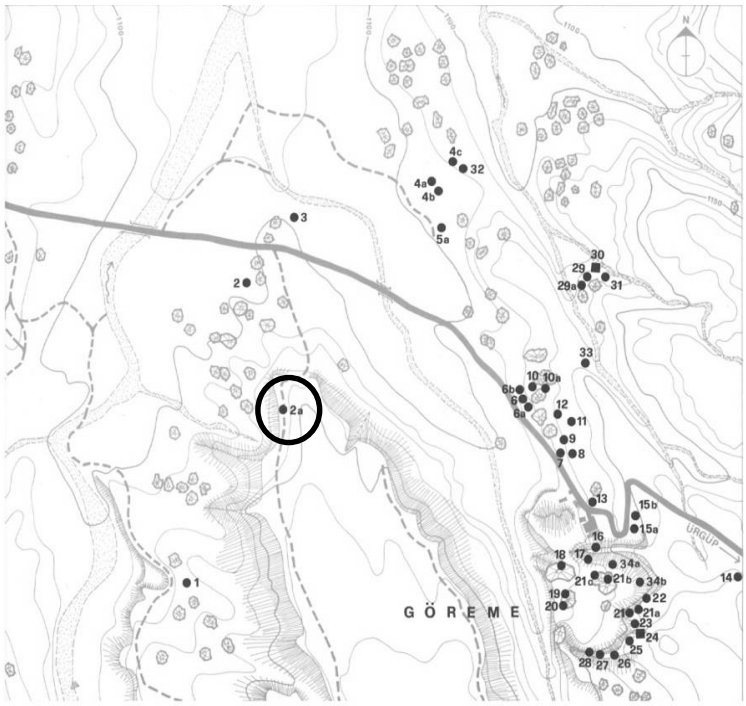

Figure 2. Göreme Valley and Saklı Church (Giovannini, 1971, p.203)

The region with the highest concentration of monastic formations in the Cappadocia Region is the Göreme Valley. None of the rock spaces in the valley can be defined as residences, making the living areas inside the valley structures suitable for monastic life (Figure 2). These monasteries are concentrated in two parts of the Göreme Valley. The structures inside are the Lower Valley, dating from the middle of the 9th and 10th centuries, and the Upper Valley, dating the 11th and 13th centuries (Teteriatnikov, 1997, p.30). The Lower Valley, generally dating from the 10th century, is located to the west of Göreme Open Air Museum. Ten churches, including the Saklı Church, the subject of the present article, are evaluated in the first group (Teteriatnikov, 1997, p.37). Researchers have tried to assess the monastic life and complexes in the region in terms of the history of the monasteries in the region. Cappadocia has been visited by many Western travelers traveling to the East and included in their travel notes, but related scientific research started in the late 19th century. British, German and French travelers and researchers who visited the region examined it according to its different characteristics and made transfers. Jerphanion, a French priest, collected his work, which began in 1912, in his *Les Eglises Rupestres de Cappadoce*. He is the researcher who conducted the first comprehensive study on the Cappadocia region with his archeology and art history research, in which he concentrated on the churches built on tuff rocks (Jerphanion, 1925). Restle, on the other hand, described his work in 1969 in his three-volume *Byzantine Wall Painting in Asia Minor*, consisting of one text, two paintings, plans, and drawings. The first part of the first volume i, included the dating of the researchers who worked on the churches in the region and evaluated the churches from a technical point of view (Restle, 1967). The art historian Rodley, a researcher in Türkiye and Greece, produced *The Cave Monasteries of Byzantine Cappadocia* The book's first part, comprising six chapters, presents the history and geography and features Cappadocia's rock architecture. In the second, third, fourth, and fifth chapters, the author describes the rock monasteries, and in the last chapter, he describes the chronological and typological evaluations of the buildings. The author, who divides the rock monasteries into two monasteries with courtyards and monasteries with refectories, evaluated monasteries and churches separately and compared the cafeterias of monasteries (Rodley, 1985). Many researchers such as Catherine Jolivet-Levy, Mazhar Şevket İpşiroğlu, Sabahattin Eyüboğlu, Ludwig Budde, Sue-Anne Wallace, S. Yıldız Ötüken, Gürsel Korat have examined the Saklı Church and its surroundings (Ertürk, 2020).

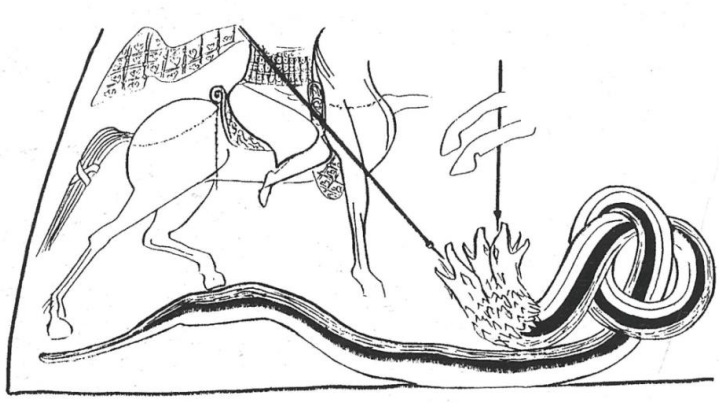

Figure 3. The Saklı Church, (St. George and St. Theodore) Drawing (Thierry, 2002)

Researchers have different ideas about the Göreme Valley and date the churches from various periods. According to Epstein (1975a, p.24-26), dating for the murals of the churches is also controversial since there are no 10th-century inscriptions. Restle introduced the churches in the Cappadocia region with their numbers and names in his book and came up with dates by comparing the wall paintings and manuscripts (Restle, 1967). Byzantine Researcher Thierry, published in 2002 *La Cappadoca De L'antiquite Au Moyen Age IV*. In the volume, he gave information about the churches in Göreme and the Saklı Church (Thierry, 2002). Explaining the location, plan features, and painting programs of the churches in Göreme Valley, the author briefly mentioned the location of the Saklı Church and related publications, included fresco drawings and photographs of the church, and dated the iconographic program of the church to the 11th century from the frescoes (Figure 3).

3. Findings and Discussion

It is seen that the Saklı Church and the monastic settlement around it were built using existing rock layers. The presence of arable land around the monastery shows that the land was specially chosen for the construction of the monastery. Numerous dining halls and their side spaces were built in the rocky texture of the northern wing of the Saklı Church. The Saklı Church, its side space, the dining halls numbered 2E, 2F, 2G, 2H, and its side spaces around it were carved into the slope of the same rock mass. The elevations of the spaces, which are placed in harmony with the natural structure of the topography, also show differences (Figure 4). Other monastic spaces such as churches, chapels, washrooms, and workshops are located within the monoliths as close to each other as the natural texture allows (Ertürk, 2020).

Figure 4. The Saklı Church and monastery structures layout plan (Ertürk, 2020, p.77)

There are no definite rules for the monastic plan type in the region where the Saklı Church is located; the church is centered and other places are around it. Plan schemes were created according to the needs of the region and land characteristics (Koch, 2007, p.96).

Also known as Göreme 2a, St. John the Baptist Church, and Hagios Ioannes Church, the Saklı Church is located to the northeast of El Nazar Church, on the slope of the rock mass between Göreme and Ortahisar, facing Uçhisar. The entrance of the Saklı Church, which took its name when it was discovered in 1957, was closed years ago due to the landslides caused by the flood waters (İpşiroğlu & Eyüboğlu, 1958, p.6). Transportation is by car from Ortahisar using a dirt road. It is 250-300 m upwards from the path between the rocks south of the Göreme - Maçan road. Access is also possible by climbing (Figure 5, 6).

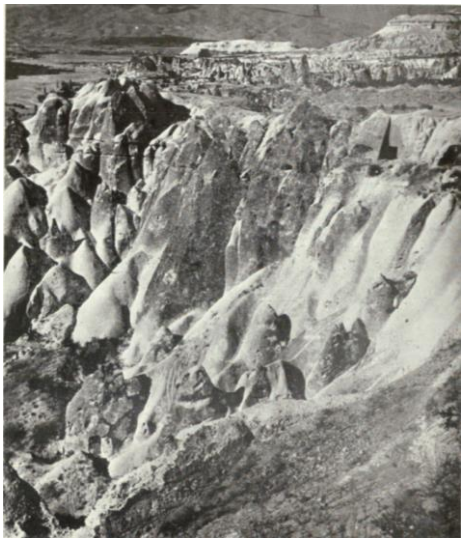

Figure 5. The Saklı Church exterior (İpşiroğlu & Eyüboğlu, 1958, p.8)

Figure 6. The Saklı Church exterior (Ertürk, 2020, p.79)

On the slope view of the rock mass where the Saklı Church, taken in 1958, is located, a tuff ladder made roughly by shaping the rock can be seen. Access to the church is provided by the cut stone steps placed on the top of the tuff block in which the church is located. In addition, there are small pits on the rock surface in front of the terrace of the church and under the northern entrance door of the S1 side room, roughly carved into the rock to provide access to the church from the lower level of the slope (Ertürk, 2020).

Consisting of a narthex and a naos, the rock-carved Saklı Church with a single nave was built as a rectangular lattice plan and three apses, coming from Mesopotamia (İpşiroğlu & Eyüboğlu, 1958: 6). The naos and the narthex are divided into two-by-two columns and three arches. The church is approximately 5 m long and 7 m wide (Figure 7,8). The church's narthex entered through the door on the west wall, is reached by descending three rock-carved steps. The long side of the naos is arranged as an apse. The middle apse is wider than the side apse. (Figure 9, 10). The west of the nave is a flat ceiling, and the east is vaulted. There are crosses and geometric ornaments on the flat ceiling.

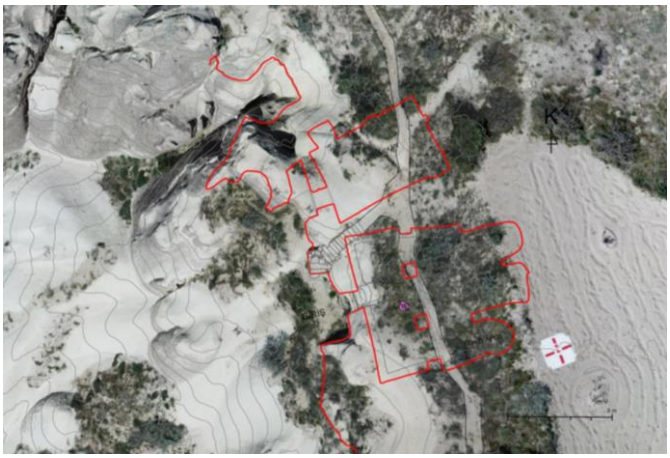

Figure 7. The Saklı Church plan rock settlement (Ertürk, 2020, p.80)

Figure 8. The Saklı Church (Ertürk, 2020, p.81)

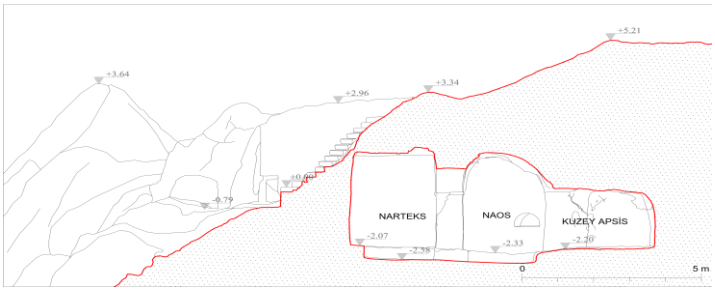

Figure 9. The Saklı Church section A-A (Ertürk, 2020, p.81)

Figure 10. The Saklı Church section perspective A-A (Ertürk, 2020, p.82)

The Saklı Church and other monastic structures are situated in different locations in the rocky area. The volcanic rocks in the area where Saklı Church and other monastic structures are in Göreme are the products of active volcanism in the Upper Miocene. The cone-shaped fairy chimneys on the valley's slope and the spaces placed on the valley slope have been destroyed by falling snow, rain, and water leaks. Damages are increasing gradually due to the inability to drain the water in the area where the buildings are located and the lack of drainage lines. It is seen that the reasons for the deterioration of the Saklı Church and monastery structures are similar when these evaluations are considered. The causes of deterioration of tuffs vary according to their chemical, physical, and biological contents. For example, the color changes observed on the rock tuffs are caused by the reactive components of different metals in the tuffs. In addition, water's freezing and dissolution effect causes the tuff's volcanic glass particles to decompose and turn the tuff into smectite clay (Topal & Doyuran, 1998, p.9-10). The layer thicknesses change and swell due to water and organic liquid entering between the layers that make up the smectite group clays. These clays contain magnesium, calcium, iron, and sodium (Çokça, 2012, p.91-122). Changes and deteriorations are observed in the rock material whose physical and mechanical properties change.

Tuff, the primary material of the buildings, is heavily affected by weather-related deterioration with its soft textured, porous, and granular structure. Factors such as sunlight, temperature and humidity changes, soluble and insoluble salts, water, and wind disrupt the material's texture forming the structure. If the structures, which have been under the effects of nature for many years, are not maintained continuously, irreversible damage occurs. Water, which creates an expansion and contraction effect in the material according to seasonal differences, causes deformation, cracking, crusting on the surface, and color changes. In the lower parts of the fairy chimneys, scours called heel wear are observed with the effect of surface waters. Water entering through cracks on the rock's surface causes blooms, and freezing and thawing events cause larger cracks and fragmentation. Water entering through cracks on the rock surface or rising from the foundation with precipitation causes an increase in humidity in the structure and deterioration caused by the progression of salt and different minerals carried by water in the material. Dust and stone chips moving with the wind's effect also erode the loosely textured rock surface (Ahunbay, 1996, p.45-47; Zakar & Eyüpgiller, 2018, p.47-49).

Figure 11. The Saklı Church appearance (Ertürk, 2020, p.100)

Color changes, ruptures, and cracks in the rock material in the region's rock formations are also seen in other monastic spaces within the rock mass where the Saklı Church is located (Figure 11). There are

abrasions and ruptures on the floor, terrace, and staircase surfaces of the Saklı Church. The water coming from the slope erodes the tuff surface of the structure, and the surface affected by moisture and salt has deteriorated (Figure 12, 13). As a result of the snow falling on the building for a long time in the winter season, ruptures and separations are observed in the ceiling of the building. In addition, when the church was discovered in 1957, there were losses in the wall paintings in the areas touched by the soil heap.

Figure 12. The Saklı Church western murals distortion detail (Ertürk, 2020, p.151)

Figure 13. The Saklı Church, abscess distortion detail (Ertürk, 2020, p.151)

Figure 14. The Saklı Church entry door distortion detail (Ertürk, 2020, p.145)

Figure 15. The Saklı Church, ladder distortion detail (Ertürk, 2020, p.145)

The Saklı Church and the structures in the monastery settlement are of great importance to Christians and are included in the scope of cultural assets that need to be protected today. Other churches and monasteries in the Cappadocia region, such as the Saklı Church, have been abandoned since the Middle Ages. Most churches are subject to natural damage and vandalism (Figure 16, 17).

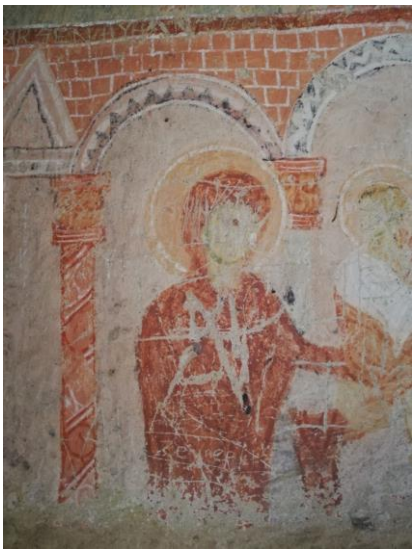

Figure 16. The Saklı Church northern wall paintings vandalism detail (Ertürk, 2020, p.145)

Figure 17. The Saklı Church, north murals deterioration detail (Ertürk, 2020, p.145)

In the proposed restoration work, it seems more appropriate to deal with an interdisciplinary architectural intervention project with the cooperation of expert teams from construction, geophysics, and geology for material and structural consolidation studies. It is recommended to carry out consolidation works to prevent damage to the structure and surrounding monastic structures. Likewise, it is recommended to examine other rock structures in the region where the repairs were made and to evaluate the processes they underwent after the repair together (Table 1).

Table 1. Causes of destruction in the Saklı Church and suggestions for conservation

Causes of Destruction	Protection Advice
Discontinuities in the rock, distortions due to cracks.	Necessary consolidation works of the building should be carried out, the causes of discontinuity should be determined, and precautions should be taken.
Distortions are caused by the position of the rock in which the place was carved.	Abrasions and soil heaps at the place' entrance should be removed from the building.
Deterioration is caused by the swelling of the material due to precipitation by taking water.	Abrasions and soil heaps at the entrance of the place should be removed from the building
Deterioration of the strength of the rock because of the use of cement.	A material that does not harm the structure should be preferred instead of the material used due to bad repairs.
Disturbances are caused by surface waters flowing over the surface of rock structures.	Protection top covers should be made to prevent abrasions on the surface of the rock.
Deterioration is caused by leaving the church idle.	Necessary interventions to the building should be carried out quickly and periodic controls should be made.
Deterioration vandalism because of the church.	Controlled entrances should be ensured during visits, and destruction should be prevented.

In the churches in the Göreme Valley, processes were carried out to cover the primary material in the conservation interventions. The worn parts were coated and, in the repair, and application projects of El Nazar Church and St. Barbara Church, and imitation plaster was applied to the coating (Figure 18, 19). However, it was determined that the plaster was poured on all surfaces, with gaps under it. The cut stones on which the imitation plaster was poured due to frost during winter revealed an image incompatible with the rock texture. (Figure 20, 21). Cracks and crevices formed in the plaster on the

west, north, and south walls of the Elmalı Church, located in the same rock as the St. Barbara Church. The protection process should be regularly maintained and re-applied every year (Figure 22, 23, 24, and 25).

Figure 18. El Nazar Church entrance (Ertürk, 2019, p.170)

Figure 19. El Nazar Church abscess (Ertürk, 2020, p.170)

Figure 20. St. Barbara's Church (Ertürk, 2019, p.170)

Figure 21. St. Barbara's Church (Ertürk, 2020, p.170)

Figure 22. Elmalı Church North Entrance (Ertürk, 2019, p.171)

Figure 23. Elmalı Church North Entrance (Ertürk, 2020, p.171)

Figure 24. Elmalı Church west entrance (Ertürk, 2019, p.171)

Figure 25. Elmalı Church west entrance (Ertürk, 2020, p.171)

In the Göreme Open Air Museum, visitors are provided with security-controlled entrances to churches and other monasteries, and visits are made under surveillance by cameras and staff. Wooden walking platforms have been placed in the spaces to prevent floor abrasions and to prevent visitors from touching the rock surfaces (Figure 26, 27, 28, and 29). Conservation projects were carried out to stop and repair the damage to the church wall paintings.

Figure 26. Karanlık Church refectory (Ertürk, 2020, p.171)

Figure 27. Karanlık Church refectory (Ertürk, 2019, p.171)

Figure 28. Çarıklı Church refectory (Ertürk, 2020, p.172)

Figure 29. Çarıklı Church refectory (Ertürk, 2019, p.172)

Figure 30. The Saklı Church dirt road (Ertürk, 2022)

Figure 31. The Saklı Church new vehicle road (Ertürk, 2022)

Landscaping Projects and transportation planning studies have started in the lower valley of the Saklı Church (Figure 30, 31). The existing 2,8 km road between Göreme and Ortahisar passes in front of the registered cultural assets and churches in the Göreme Open Air Museum. The road in question damages Tokalı Church, Kızlar Monastery, Elmalı Church, Yılanlı Church, and Dark Church due to vibration and atmospheric gases. It is seen that the road, which has heavy vehicle traffic during the tourism seasons, is not sustainable and negatively affects natural and cultural assets. Route and archaeological georadar studies were carried out to create an alternative route, and the slope of the mountain where the Saklı Church is located was selected. It is on a cadastral road line with a length of 2,2 km and a width of 5 to 7 meters (Figure 32).

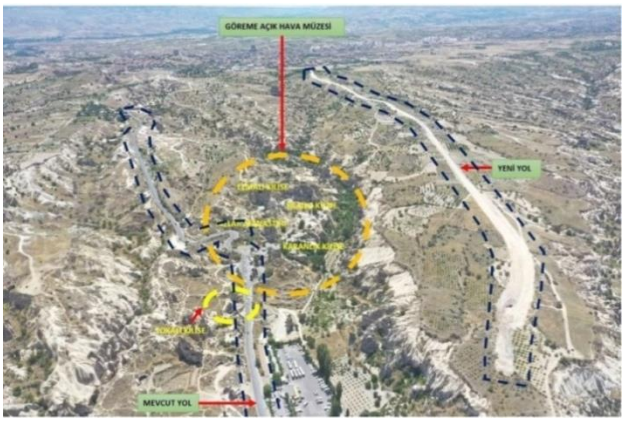

Figure 32. Current- proposal road comparison (Turizm Günlüğü Turizm ve Seyahat Gazetesi, 2022)

4. Conclusion and Suggestions

Considering the conservation practices made in rock-carved spaces in the Cappadocia Region, it is seen that the wall paintings benefit from delicate and detailed conservation. However, most of the rock carving places, which are not considered holistically, are disappearing due to the increasing destruction. In the examples of El Nazar Church and Barbara Church in Göreme, coatings, and completions were made on the rock surfaces, but it is seen that no other precautions were taken apart from simple measures for the protection of other structures in the monastery complexes. In applications based on a single structure, there is no intervention other than the iron doors that are simply installed as a security measure and a wooden visitor walking platform in the applications whose conservation is ongoing or completed.

The Saklı Church in the Lower Valley and the monastic structures around it are used as warehouses and barns according to the needs of the surrounding businesses and are quickly destroyed. However, the water entering through the cracks formed on the surface of the rock causes significant damage to the structure. With the increase of uncontrolled entrances to the area, the tremors caused by the vehicles passing by, and the gases released, irreversible damage will occur to the monastery structures

and their surroundings. In addition, with the alternative road passing over the slope where the Saklı Church is located, the damage to the cultural assets in the valley will increase.

However, in recent years, practices regarding the holistic protection of areas such as Göreme Open Air Museum, Paşabağları Ruins, and Zelve Archaeological Sites, measures have been started to be taken to protect them with controlled entrances ensuring their security. However, in the valley where the Saklı Church is located, protection strategies for the refectory, other side spaces, and chapels could not be developed, except for the iron-barred door of the Saklı Church.

When we look at the region in general, short-term solutions are produced with only small-scale emergency protection measures, but they are long-term sustainable. Many cultural heritage sites worldwide are evaluated within the scope of larger-scale archeoparks. Direct access to the protected areas is restricted and controlled from outside the area, public or private; for example, buses and open-air vehicles can provide access to the site.

It is suggested that in areas with dense cultural and historical settlements such as Göreme within the Cappadocia region, an area management unit should be established accordingly, and necessary sustainable policies should be developed.

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Author Contribution and Conflict of Interest Disclosure Information

All authors contributed equally to the article.

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Analysis of Deterioration on Stone Surfaces: The Case of Kasimiye Madrasah

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Abstract

The durability of stone is important for traditional buildings to survive today. However, as a result of environmental and atmospheric factors, physical, chemical, biological and anthropogenic degradation occurs on stone surfaces. Detecting, classifying and taking appropriate measures against these degradations on stone surfaces is one of the factors that play a role in the survival of stone structures for a longer period. In this study, the deterioration of the facades of Kasımiye Madrasah in Mardin was analyzed. The deterioration of the building was classified and analyzed. Visual, mapping, and X-Ray Fluorescence Spectroscopy (XRF chemical analysis method) were used as analysis methods. The deterioration of the building was analyzed and classified by visual analysis. The type of deterioration and its ratio to the façade were examined using the mapping method. With the XRF analysis method on the deteriorated stone surfaces, the chemical components on the stone surface were examined and the effect causing the deterioration was examined. The study aims to determine the types and causes of deterioration in the building, to offer solutions, and to ensure that the building is transferred to future generations without losing its originality for many years in the light of this information.

Keywords: *Kasımiye Madrasah, stone deterioration, XRF chemical analysis method.*

Taş Yüzeylerinde Görülen Bozunmaların Analizi: Kasımiye Medresesi Örneğinde

Öz

Geleneksel yapıların günümüze kadar ulaşmasında taşın dayanıklılığı önemlidir. Ancak çevresel ve atmosferik etkenler sonucunda taş yüzeylerinde fiziksel, kimyasal, biyolojik ve antropojenik bozunmalar meydana gelmektedir. Taş yüzeylerde meydana gelen bu bozunmaların tespiti, sınıflandırılması ve bozunmalara karşı uygun önlemlerin alınması taş yapıların daha uzun süre ayakta kalmasında rol oynayan etkenlerden biridir. Bu çalışmada Mardin'de yer alan Kasımiye Medresesi'nin cephelerinde meydana gelen bozunmalar irdelenmiştir. Yapıda oluşan bozunmalar sınıflandırılmış ve analiz edilmiştir. Analiz yöntemi olarak görsel, haritalama ve X-Işınları Floresan Spektroskopisi (XRF kimyasal analiz yöntemi) yöntemi kullanılmıştır. Yapıda meydana gelen bozunmalar görsel analiz ile incelenmiş ve sınıflandırılmıştır. Bozunma türü ve cepheye oranı haritalama yöntemi kullanılarak incelenmiştir. Bozunma olan taş yüzeylerde yapılan XRF analiz yöntemi ile taş yüzeydeki kimyasal bileşenler incelenmiş ve bozunmaya neden olan etki irdelenmiştir. Çalışmanın amacı; yapıda meydana gelen bozunma türlerini ve nedenlerini tespit etmek, çözüm önerileri sunmak ve bu bilgiler ışığında yapının uzun yıllar boyunca özgünlüğünü kaybetmeden gelecek nesillere aktarılmasını sağlamaktır.

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1. Introduction

Due to its geographical location, Mardin has been home to many civilizations and civilizations, and throughout history, representatives of different cultures, civilizations, peoples, languages, and religions have lived together in peace (Alioğlu, 1989).

These civilizations that ruled in Mardin built structures with different functions. Madrasa buildings, one of these structures built in the city, have been used for educational and cultural purposes throughout history (Yardımlı, 2018). Limestone, one of the natural stones, was used in cultural heritage buildings in Mardin. When natural stones are exposed to internal and external factors such as adverse climatic conditions, user error, and traffic density, deterioration occurs on stone surfaces (Öcal, 2010; Dal & Öcal, 2013a; Dal & Öcal, 2013b). These deteriorations that occur on stone surfaces over time cause the durability and strength values of the stone to decrease (Semerci, 2017). The decrease in durability and strength values shortens the survival time of the structures for a long time. Taking measures to minimize deterioration and reduce damage is important for the life of structures (Douglas, Hughes, Jones, & Yarrow, 2016). The measures to be taken for these types of deterioration in buildings vary according to the types of deterioration and are different from each other (Dal & Öcal, 2017). It is important to correctly identify the deterioration that occurs in buildings, to classify the deterioration and to take precautions in order to deal with the deterioration separately (Arpacıoğlu, 2016). In some cases, the deterioration of the structures paves the way for the formation of another deterioration. In addition, regular inspection of the structures, selection of suitable stones, cleaning the structure and taking measures to increase its durability play an effective role in carrying the structure to the next years (Doehne & Price, 2010; Karkaş & Acun Özgünler, 2022).

The study aims to examine and identify the stone deterioration observed on the facades of Kasımiye Madrasah in Mardin and to ensure that the building survives longer by taking measures against deterioration. In this context, the stone deterioration observed in Kasımiye Madrasah was analysed in three stages. Firstly, it was visually examined and deterioration was systematically analysed as physical, chemical, biological and anthropogenic deterioration. In the second stage, after identifying the deterioration on the facades, the mapping method was used to determine the types of deterioration and their ratios in relation to all facades. The mapping method relied on software programmes (Autocad 2018 and Adobe Photoshop CS6). In the third stage, the chemical content of the stone was determined using the X-Ray Fluorescence Spectroscopy (XRF chemical analysis method). In light of the data obtained from the study, the aim is to form the basis for conservation projects to be carried out in the upcoming years (Biçen Çelik, 2021).

2. Material and Method

Natural stones have been used for different purposes and functions from the past to the present. The fact that it can be used without the need for binding materials has caused it to be preferred more than other main construction materials. The most important factor in the survival of traditional buildings, which are cultural heritage, is the high durability and strength values of the stone used in the building. When natural stones are faced with environmental and climatic factors, deterioration occurs on the surfaces of the stone (Ay et al., 2023a; Biçen Çelik et al., 2023; Umaroğuları & Kartal, 2021). In this study, natural stone deterioration in the Kasımiye Madrasah in Mardin is discussed. The deterioration on the stone surfaces of the building was analyzed, and the types and rates of deterioration, their diversity and causes were determined. The study includes the analysis of the deteriorated surfaces on the east, west and south facades of the building and the inner courtyard facades facing west and south as a result of environmental conditions.

Different methods were used to determine the types of deterioration that occurred in the Kasımiye Madrasah. The mapping method, which is one of the methods used, is an internationally recognized method and deterioration was detected and classified with these methods (Fitzner, Heinriches, & Kownatzki, 1997). After the deterioration of the building facades was visually detected, they were processed on the facades through AutoCAD 2018 and Adobe Photoshop CS6 programs and thus a mapping method was created. According to the data obtained, the types of deterioration on the facades and the ratio of deterioration to the entire facade were determined. In the study, the

deteriorations were grouped as physical, chemical, biological and anthropogenic deteriorations. As a result of the classification, deterioration was handled separately. In addition to visual detection and mapping methods, chemical analysis method was also used. Among the chemical methods, X-Ray Fluorescence Spectroscopy (XRF chemical analysis method) was preferred. With this method, it was aimed to determine the chemical content of the degraded stone. SPECTRO xSORT / Portable Metal Spectrometer model device was used for XRF chemical analysis method. According to the XRF chemical analysis method, the ratios of CaO, SiO_2, Al_2O_3, SO_3, Fe_2O_3 and P_2O_5 compounds in the stone were determined, evaluated and analyzed with tables and graphs. As a result of the data obtained, the relationship between the deterioration and the components in the stone was determined. This study aims to form an important basis for the interventions to be made to the Kasımiye Madrasah.

2.1. Study Area Features

2.1.1. History of Mardin Province

The historian Ammianus Marcellinus first mentioned the name Mardin as "Maride" (Gabriel, 1940). The name Mardin was also referred to as Mâridin and Mârdê by different ethnicities (Noyan, 2008; Yousif, 2011). Mardin has been home to various cultures and ethnic origins throughout history due to its location on an important trade route (Silk Road) and its geographical and topographical defensibility (Alioğlu, 2000).

The first settlements in Mardin have artifacts dating back to 3000 BC (Aydın, Emiroğlu, Özel & Ünsal, 1999). In later years, different civilisations (Yıldız, 2007) and states (Aliveya, 2007; Biçen Çelik, 2021). It can be said that the Artuqids in the XIIth century had an impact on determining Mardin's identity (Dal & Öcal, 2017). After the Artuqids, Mardin came under the rule of Akkoyuncu, Karakoyunlu, Safavids and Ottomans, and there are traces of all civilisations in Mardin (Çağlayan, 2018; Dolapönü, 1972). Kasımiye Madrasah was built in the XIVth century and is among the religious buildings until today (Alioğlu, 2000). The satellite image of Mardin province was taken and processed on Google Earth and the location of Kasımiye Madrasah was marked and given in Figure 1.

Figure 1. Satellite image of Mardin (processed from Google Earth)

2.1.2. Geographical features of Mardin Province

Mardin is located in the Southeastern Anatolia Region of Turkey, neighboring Syria together with the provinces of Şanlıurfa, Diyarbakır, Batman, Şırnak and Siirt. Mardin Castle is located at the top of the city. The first settlements of the city were around the castle and then settlements started outside the castle on the high plateaus overlooking the Mesopotamian plain (Karataş, 2018) (Figure 2). In this region where the settlement is located, the buildings were built on sloping land. Access to the buildings is provided by steep ramps and stairs (Bekleyen, Dalkılıç & Özen, 2014).

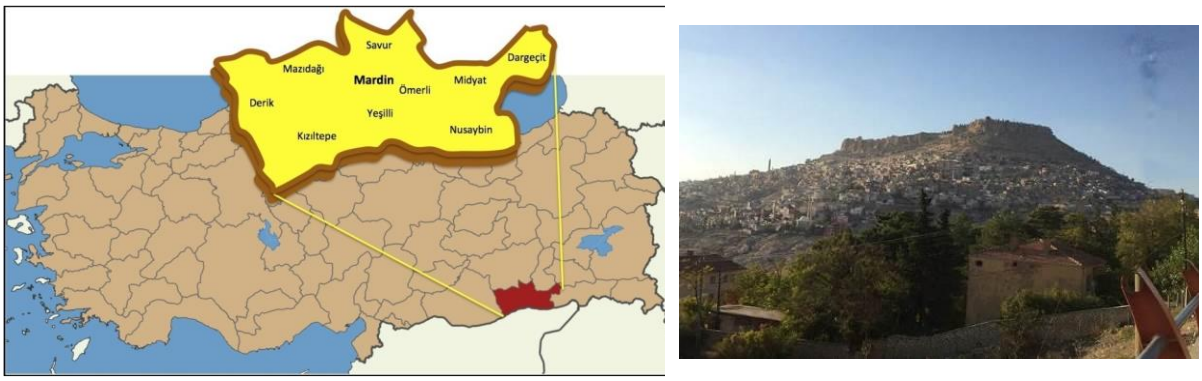


Figure 2. Mardin's location in Turkey (Dal & Öcal, 2017) and Mardin view (Biçen Çelik, 2019)

When the climate of Mardin province is examined, continental climate is observed in the center and Mediterranean climate is observed in the districts. Winter months are cold. In the summer season, it is dry and hot due to the effect of the pressure and wind coming from the desert. Looking at the annual average temperature values of the province, it is seen that the highest temperature value is 29.8 °C in July and the lowest temperature value is 3.0 °C in January (Table 1). When the climatic data of Mardin province between 1941 and 2022 are analysed, it is seen that the maximum average sunshine duration is 12.4 hours in July and the minimum sunshine duration is 4.5 hours in December. Due to the climatic characteristics of Mardin province, stone deterioration is frequently encountered (Karataş, 20018).

Table 1. Meteorological data evaluation of Mardin province (Measurement Period, 1941-2022) (General Directorate of Meteorology, 2023)

MARDİN	Average Temperature (°C)	Average Highest Temperature (°C)	Average Lowest Temperature (°C)	Average Sunbathing Time (hours)	Average Number of Rainy Days	Average Monthly Precipitation (mm)
January	3.0	5.8	0.6	4.5	12.11	115.9
February	4.2	7.4	1.4	5.1	10.61	103.2
March	7.9	11.6	4.6	5.9	11.70	97.7
April	13.5	17.4	9.8	7.3	10.28	81.1
May	19.5	24.0	15.1	9.7	7.35	47.3
June	25.6	30.6	20.3	12.1	1.54	6.5
July	29.8	35.0	24.6	12.4	0.48	3.2
August	29.6	34.7	24.7	11.4	0.24	2.3
September	25.3	30.1	20.8	10.3	0.70	4.0
October	18.6	22.9	14.7	7.7	5.12	33.8
November	11.1	14.5	8.1	5.9	7.66	71.9
December	5.4	8.2	2.9	4.4	10.80	108.7
Annual	16.1	20.2	12.3	8.1	78.6	675.6

2.1.3. Architectural features of Kasımiye Madrasah

Kasımiye Madrasah is located on the hill on the southwest side of Mardin. The construction date of the building is not known exactly. Gabriel's ideas about the construction date of the building and the madrasah are generally accepted (Altun, 1971). It is estimated that the madrasah was started at the end of the Artuqid period and completed during the Akkoyunlu period. Due to the similarity of the architectural style of Kasımiye Madrasah and Zinciriye Madrasah, it is estimated that the two buildings were built in the same period (Artuqid period) and by the same architect. The resemblance of the building is similar to the decoration of Zinciriye Madrasah. There is a belt with muqarnas outside the door and corner columns and a three-slice arch inside (Semerci, 2017).

The main portal, which is one of the most important parts of the building, resembles the portal of Zinciriye Madrasah. Its stones and stone decorations are quite worn. Therefore, the portal is enclosed in a frame with muqarnas. The entrance to Kasımiye Madrasah, one of Mardin's two-storey madrasas with a single courtyard, is through the main portal. The building consists of a domed square space over the mosque and barrel vaulted rooms. Madrasah rooms are located at the back of the courtyard. The

ground floor of the building has a mausoleum, Hanafi masjid, Shafii masjid and 11 cells, while the first floor has 12 cells (Figure 3). To the left of the main entrance is the Hanafi masjid with onion slices and to the right is the tomb with a slice dome. The part of the entrance corridor opening to the courtyard is covered with a passion vault. When you enter the courtyard, there is an iwan with selsebil and cells with sliced domes located around the courtyard. The iwan in the courtyard is covered with a pointed vault. There is a mihrab in the centre of the southern part of the courtyard. On the left side of the mihrab is the tomb and on the right side is the Shafii masjid. The tops of the tomb and Shafii masjid are covered with a sliced trumpet dome. With the repair in 2007, the porch vaults on the ground floor were cut stone, but after the repair, the tops were plastered and turned into barrel vaults (Figure 3) (Çağlayan, 2018; Karataş & Peyker, 2023; Yeşilbaş, 2020). The building, which was restored in 1967, was allocated to the Governorship of Mardin in 1974 and started to be used as a museum. During the restoration of the madrasah in 2007, the stone surfaces were cleaned (Ergin, Biçen Çelik & Dal, 2019).

Kasımiye Madrasah has a total of seven facades, including four facades facing the inner courtyard, the south facade, which is the front facade, and the east and west facades, which are the side facades. Limestone was used as the main material of the building. Kabayonu stone was used on the eastern façade of the building and the western façade, except for the mosque part. The Hanafi masjid on the west façade and the south façade have cut stone (Figure 4).

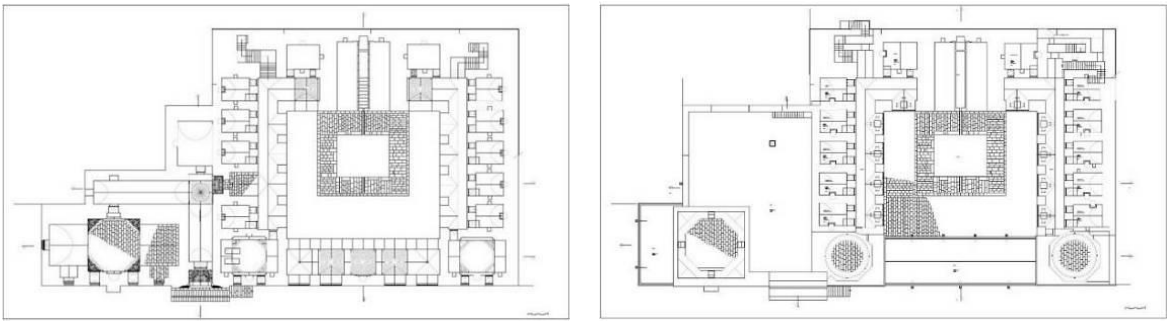


Figure 3. Floor plans of Kasımiye Madrasah

Figure 4. Facade photographs of Kasımiye Madrasah (Biçen Çelik, 2019)

3. Findings and Discussion

Determining the factors that cause stone deterioration is important for cultural heritage (Karataş & Peyker, 2023). Stone has been used and continues to be used in different forms and functions in the process until today (Tintin, 2012). Stone, which was used by the first people for defense purposes, was also used as a housing, decorative product and symbol in later periods, apart from giving messages and using gravestones (Sabbioni & Cassar, 2012).

Stone, which is preferred as a building material, degrades over time as a result of environmental and climatic factors such as pressure, temperature and wind (Dal, 2016). As a result of the deterioration, the structure and strength of the stone deteriorates significantly. In addition, these deteriorations sometimes prepare the environment for another deterioration and accelerate the process (Ergin, Biçen Çelik & Dal, 2020). If necessary precautions are not taken or incorrect applications are made, serious

damages and significant destruction occur in the structures (Doehne & Price, 2010; Torraca, 1976; Yardımlı, Hattap, Khooshroo & Javadi, 2017).

The deterioration occurring in buildings is handled in four groups physical, chemical, biological, and anthropogenic deterioration.

Physical deterioration is characterized as the surface loss that occurs on the surface of the stone as a result of mechanical effects on the surface of the stone. These can be exemplified as fracture, crack, piece breakage, deformation, abrasion, cut, honeycombing, joint discharges (Dal & Yardımlı, 2021).

Chemical deterioration is the type of deterioration on the surface of the stone as a result of atmospheric events. Examples such as colour change, salting, crystallisation (blooming), crusting, blistering, sugaring and foliation are examples of chemical deterioration (Öcal & Dal, 2012).

Biodeterioration is the type of deterioration of organic substances caused by stone. Algae formation, plant formation, and bioaccumulation are examples of biodeterioration (Rivera, Ramos, Sánchez, & Serrano, 2018; Dal, Zülfikar & Dolar, 2020; Dolar & Yardımlı, 2017).

Anthropogenic deterioration is the deterioration caused by human destruction. Improper application, misuse and periodic wear can be given as examples of anthropogenic deterioration (Ay et. al, 2023b; Hattap, 2002).

In this study, the deterioration of Kasımiye Madrasah was examined under three different headings: visual examination, examination using the mapping method and examination using XRF chemical analysis method.

3.1. Visual Investigation of the Deterioration Occurring in Kasımiye Madrasah

The deterioration of Kasımiye Madrasah was analysed in four groups physical, chemical, biological, and anthropogenic deterioration. The physical deterioration of Kasımiye Madrasah as a result of environmental and climatic factors is shown in Figure 5. As a result of climatic factors, capillary cracks in the walls (Figure 5a), fragment breaks in the window openings (Figure 5b), fragment breaks in the inner courtyard (Figures 5c and 5d), abrasion caused by wind-borne dust on the south façade (Figures 5e and 5f), fragment breaks, capillary cracks and joint discharges on the main portal and west façade of the building (Figures 5h and g), and abrasion on the entrance staircase due to visitor flow (Figure 5).

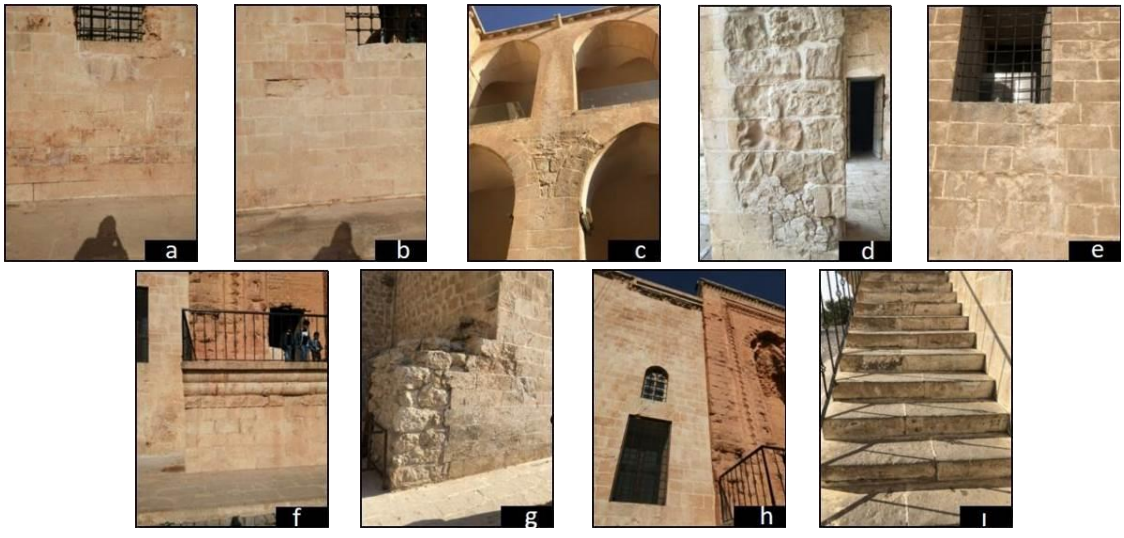


Figure 5. Physical deterioration of Kasımiye Madrasah (Biçen Çelik, 2019)

Salination and discoloration caused by climatic factors in Kasımiye Madrasah are shown in Figure 6. Salination is caused by the dissolution and evaporation of the salts in the limestone under the influence of humidity and temperature (Figure 6a, 6b and 6c) and discoloration is caused by the interaction of the minerals in the stones (Figure 6d, 6e and 6f) were observed.

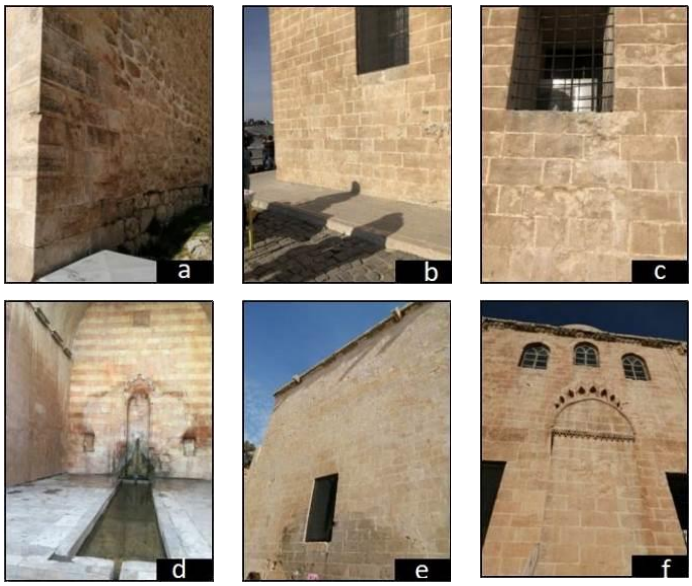


Figure 6. Chemical deterioration in Kasımiye Madrasah (Biçen Çelik, 2019)

Biological deterioration occurring in Kasımiye Madrasah is shown in Figure 7. Plant formations are observed as a result of the interaction of the seeds that settle inside the capillary cracks with water (Dal &Yardımlı, 2019). Plant formations were observed on the south façade (Figure 7a) and east façade (Figure 7e) of the building, biochemical deterioration caused by bacteria settled on the stone surfaces (Figures 7b and 7c), deterioration caused by bird droppings (Figure 7d) and moss formations in the selsebilli iwan (Figure 7e).

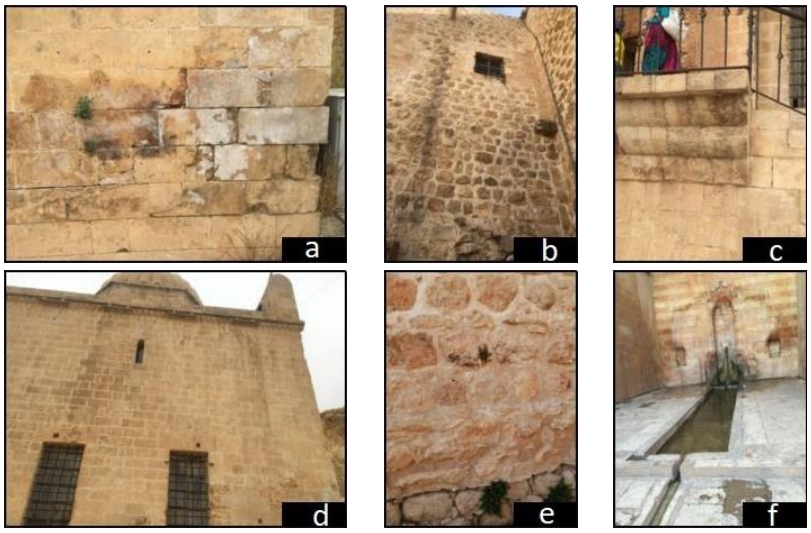


Figure 7. Biological deterioration in Kasımiye Madrasah (Biçen Çelik, 2019)

The deterioration of Kasımiye Madrasah as a result of anthropogenic impacts is shown in Figure 8. As a result of the damage caused to the building by unconscious users with sharp tools, deterioration was observed on different facades (Figure 8a, 8b and 8c).

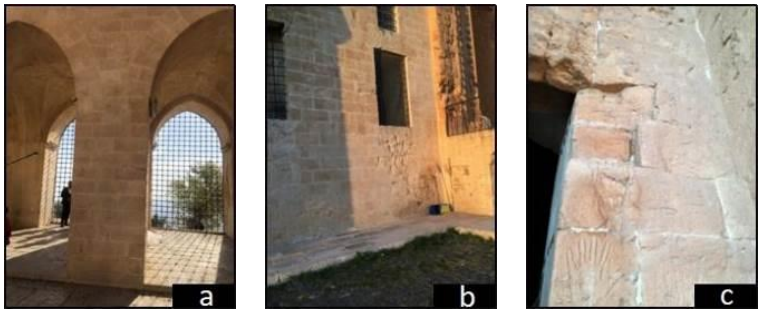


Figure 8. Anthropogenic deterioration of the Kasımiye Madrasah (Biçen Çelik, 2019)

3.2. Investigation of the Deterioration of the Kasımiye Madrasa by Using the Mapping Method

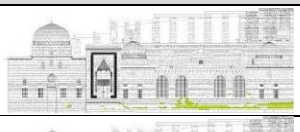
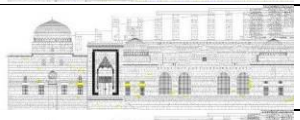
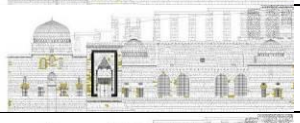
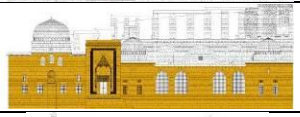
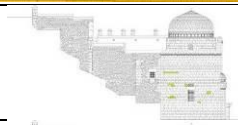
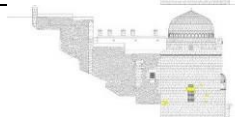
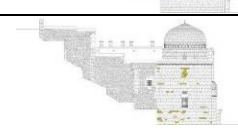
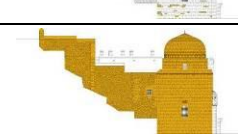
The deterioration of Kasımiye Madrasah is shown in the charts by mapping method. The façades of the building facing the south, east, west and inner courtyard, as well as the façades with the selsebil, were analysed. After observational analyses were made on the selected facades, the facades were photographed.

The types of physical deterioration that occurred in Kasımiye Madrasah are shown in Table 2. The types of deterioration such as joint discharge, fragment rupture, hairline cracks and surface loss were observed. When the facades are analysed separately, surface abrasion was the most common type of deterioration on all south, west and east facades, and on the facades facing south and west (83% and 20% respectively). The least common types of deterioration were capillary cracks on the south and west facades, joint discharge on the east facade, and capillary cracks on the courtyard facades facing south and west. When all facades were considered together, surface abrasion was the most common type of deterioration while capillary cracks were the least common.

The chemical deterioration of the building is shown in Table 3. Discoloration and salination were observed on all facades (100%). Bacteria formation was observed on the south façade at a rate of 5.6%, on the east façade at a rate of 18%, on the west façade at a rate of 7.9% and on the west-facing courtyard façade at a rate of 47% and was the least observed type of chemical deterioration in the building.

The types of biological deterioration observed in Kasımiye Madrasah are shown in Table 4. Plant formations are observed on the south and east facades of the building and mossing is observed on the facade facing the inner courtyard. Plant formations occupy 0.2% of the south façade and 0.1% of the east façade. Moss formation was observed at a rate of 1.8% on the south-facing courtyard façade.

Table 2. Physical deterioration of Kasımiye Madrasah

	Physical Deterioration Type	Facade Deterioration Ratio	Rate (%)
SOUTH FACADE	Joint Discharge		6.6
	Capillary Crack		1.9
	Fragment Breakage		8
	Surface Abrasion		100
WEST FACADE	Joint Discharge		0.9
	Capillary Crack		0.6
	Fragment Breakage		2.5
	Surface Abrasion		100

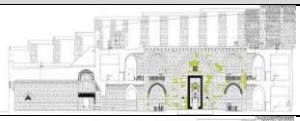
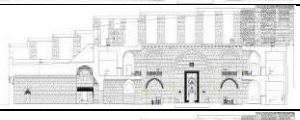
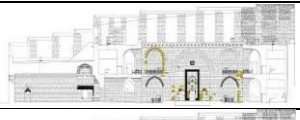
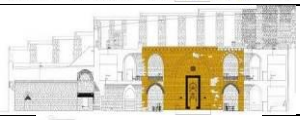
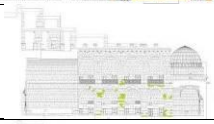
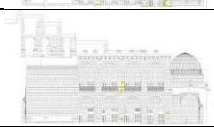
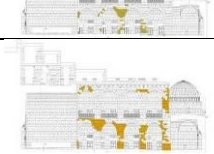
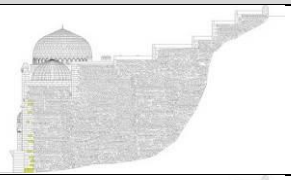
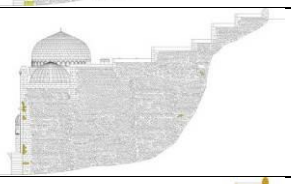
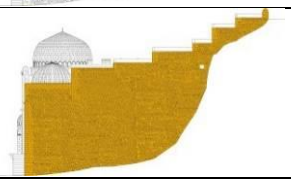
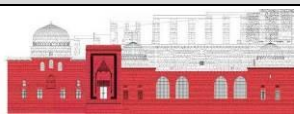
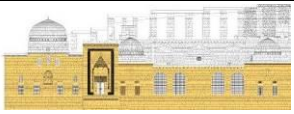
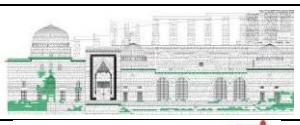
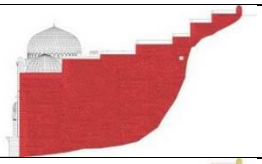
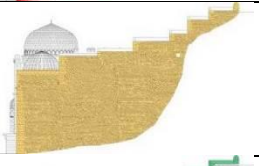
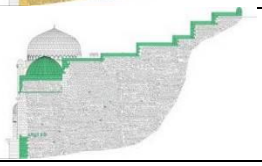
	Physical Deterioration Type	Facade Deterioration Ratio	Rate (%)
SOUTH FACING COURTYARD FACADE	Joint Discharge		11
	Capillary Crack		1.2
	Fragment Breakage		10
	Surface Abrasion		83
WEST FACING COURTYARD FACADE	Joint Discharge		8.1
	Capillary Crack		1.2
	Fragment Breakage		13
	Surface Abrasion		20

Table 2. Physical deterioration of Kasımiye Madrasah (contiuned)

	Physical Deterioration Type	Facade Deterioration Ratio	Rate (%)
EAST FACADE	Joint Discharge		0.5
	Fragment Breakage		0.7
	Surface Abrasion		100

The deterioration of Kasımiye Madrasah as a result of anthropogenic impacts is shown in Table 5. The use of sharp tools on the south, south-facing courtyard façade and west-facing courtyard façades and the use of paint on the south façade were observed. The use of sharp tools was 0.4 percent on the south facade, 0.9 percent on the south-facing courtyard facade and 1.6 percent on the west-facing courtyard facade. The rate of paint use observed on the south façade is 0.1%.

Table 3. Chemical deterioration of Kasımiye Madrasah

	Chemical Deterioration Type	Facade Deterioration Ratio	Rate (%)
SOUTH FACADE	Colour Variation		100
	Salitisation		100
	Bacteria Formation		5.6
EAST FACADE	Colour Variation		100
	Salitisation		100
	Bacteria Formation		18

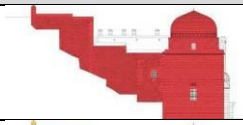
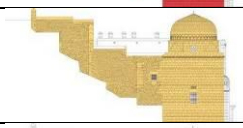
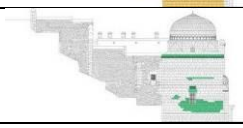
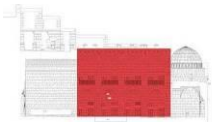
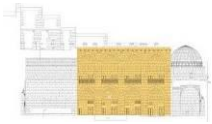
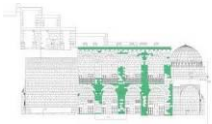
	Chemical Deterioration Type	Facade Deterioration Ratio	Rate (%)
WEST FACADE	Colour Variation		100
	Salitisation		100
	Bacteria Formation		7.9
WEST FACING COURTYARD FACADE	Colour Variation		100
	Salitisation		100
	Bacteria Formation		47

Table 4. Biological deterioration of Kasımiye Madrasah

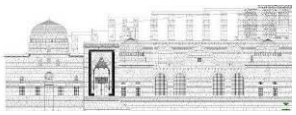
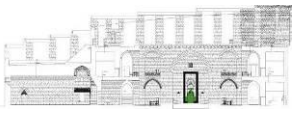
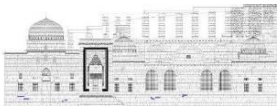
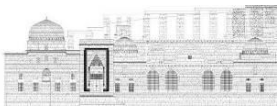
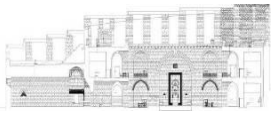
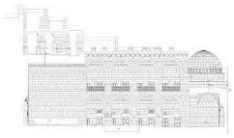
	Biological Deterioration Type	Facade Deterioration Ratio	Rate (%)
SOUTH FACADE	Plant Formation		0.2
EAST FACADE	Plant Formation		0.1
SOUTH FACING COURTYARD FACADE	Moss Formation		1.8

Table 5. Anthropogenic deterioration of the Kasımiye Madrasah

	Antropogenic Deterioration Type	Facade Deterioration Ratio	Rate (%)
SOUTH FACADE	Sharp Instrument Use		0.4
	Paint Usage		0.1
SOUTH FACING COURTYARD	Sharp Instrument Use		0.9
WEST FACING COURTYARD	Sharp Instrument Use		1.6

3.3. Investigation of the Deterioration of the Kasımiye Madrasah Using XRF Chemical Analysis Method

All types of deterioration occurring in the Kasımiye Madrasah were analysed with the codes determined by X-Ray Fluorescence Spectroscopy (XRF chemical analysis method). The codes determined (Table 6), the representations of the selected stones on the plan (Figure 9) and on the facade (Figure 10) are given below. The main purpose of analysing the materials of historical buildings is to obtain information about the production technology as well as the physical and chemical composition of the materials (Karataş, Alptekin & Yakar, 2022).

Table 6. Stones selected for the use of XRF chemical method for the deterioration of the Kasımiye Madrasah

Stone Code	Type of Deterıoratıon	
A0	Clean Stone	
A1a	Abrasion	Physical Deterioration
A1b	Capillary Crack	
A1c	Joint Discharge	
A1d	Fragment Breakage	
A2a1	Colour Variation	Chemical Deterioration
A2a2	Salitisation	
A2b	Bacteria Formation	
A2c	Microorganism Formation	Biological Deterioration
A3a	Sharp Instrument Use	Anthropogenic Deterioration

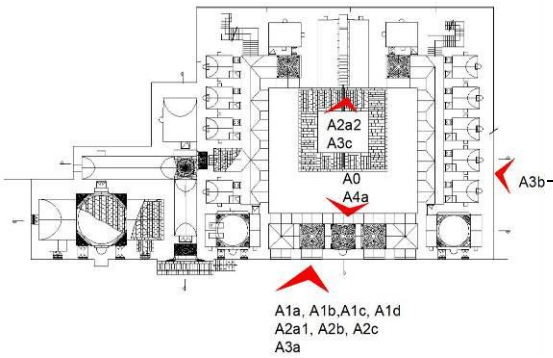
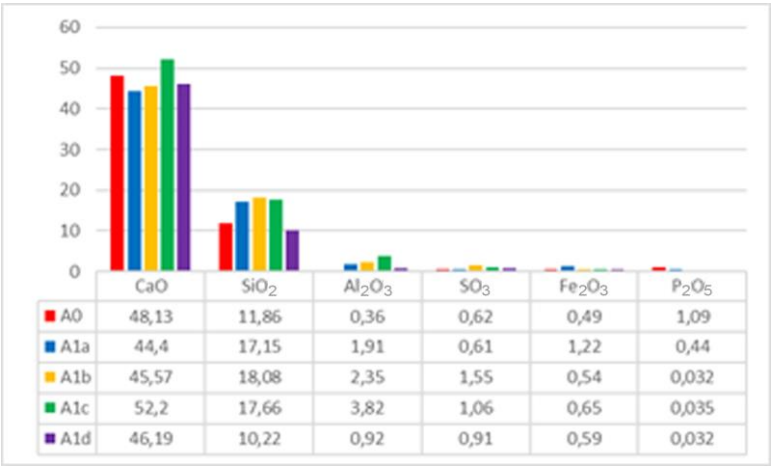


Figure 9. The plan representation of the stones selected for the use of XRF chemical method for the deterioration of the Kasımiye Madrasah

Figure 10. Demonstration of the stones selected for the use of XRF chemical method for the deterioration of Hatuniye Madrasah on the facade

The results of the analysis of the physical deterioration in Kasımiye Madrasah according to XRF analysis method are given in Table 7. According to the analysis results, changes in SO_3, SiO_2 and CaO ratios are remarkable. An increase in SO_3 occurred in A1b stone. The increase in SO_3 ratio is due to the air pollution of the stone. It can be said that the strength of the stone increases with the increase in SiO_2 ratio. While the SiO_2 ratio was 11.86% in A0 stone, this ratio was 18.08% in A1b stone. The clays decomposed on the stone surface cause the SiO_2 ratio to increase. Changes are observed in the stones due to daily and annual temperature differences and different minerals in the stones. Physical deterioration such as capillary cracks, surface abrasions and fragment fractures were observed in Kasımiye Madrasah (Karataş, Alptekin & Yakar, 2023).

Table 7. XRF chemical analysis results of physical deterioration observed on the facades of Kasımiye Madrasah

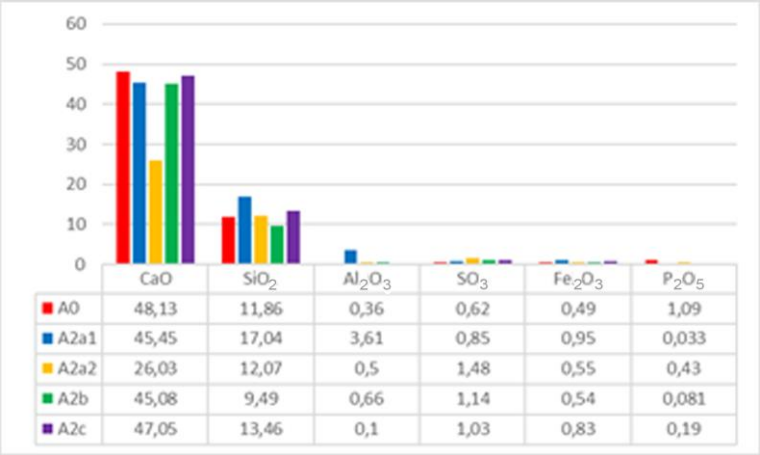


	CaO	SiO_2	Al_2O_3	SO_3	Fe_2O_3	P_2O_5
A0	48,13	11,86	0,36	0,62	0,49	1,09
A1a	44,4	17,15	1,91	0,61	1,22	0,44
A1b	45,57	18,08	2,35	1,55	0,54	0,032
A1c	52,2	17,66	3,82	1,06	0,65	0,035
A1d	46,19	10,22	0,92	0,91	0,59	0,032

The results of XRF chemical analyses of the chemical deterioration in Kasımiye Madrasah are shown in Table 8. According to the results obtained, it is seen that the CaO ratio decreased in stone A0 compared to other stones. Since the SO_3 ratios in A2a2 and A2b stones are high, it can be said that they are affected by air pollution. While the SiO_2 ratio was 11.86% in A0 stone, this ratio increased to 17.04% in A2a1 stone. This increase is due to the carbonated silica and marl (clayey limestone) content in the structure of the stone. When other compounds are examined, it is seen that there are no serious changes (Table 8).

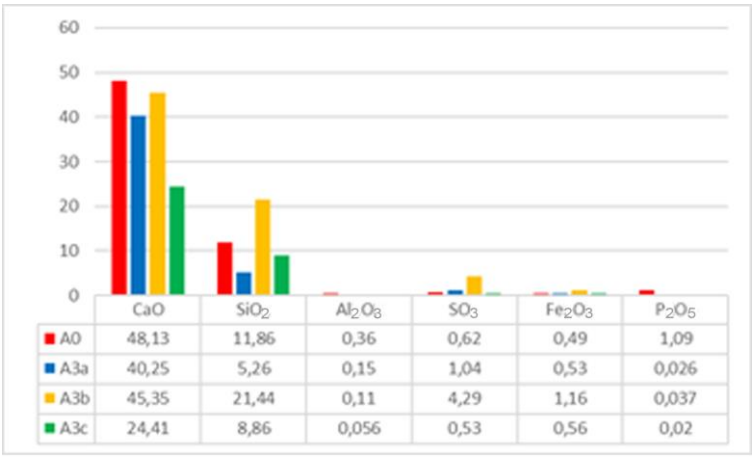
The results of the analysis of biodeterioration in Kasımiye Madrasah are given in Table 9. According to the analysis results, a decrease in CaO ratio was observed. It can be said that the reason for the decrease in CaO ratio in stone A3c is the interaction of acids secreted by bacteria. The change in the SiO_2 ratio in stone A3b draws attention. While this ratio was 11.86% in stone A0, it was measured as 21.44% in stone A3b. No significant changes were observed in other compounds (Table 9).

Table 8. XRF chemical analysis results of chemical deterioration observed on the facades of Kasımiye Madrasah



	CaO	SiO_2	Al_2O_3	SO_3	Fe_2O_3	P_2O_5
A0	48,13	11,86	0,36	0,62	0,49	1,09
A2a1	45,45	17,04	3,61	0,85	0,95	0,033
A2a2	26,03	12,07	0,5	1,48	0,55	0,43
A2b	45,08	9,49	0,66	1,14	0,54	0,081
A2c	47,05	13,46	0,1	1,03	0,83	0,19

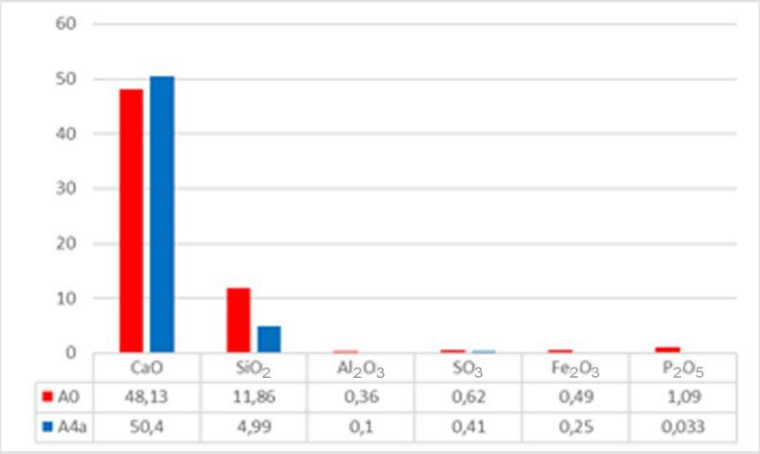
Table 9. XRF chemical analysis results of biological deterioration observed on the facades of Kasımiye Madrasah



	CaO	SiO_2	Al_2O_3	SO_3	Fe_2O_3	P_2O_5
A0	48,13	11,86	0,36	0,62	0,49	1,09
A3a	40,25	5,26	0,15	1,04	0,53	0,026
A3b	45,35	21,44	0,11	4,29	1,16	0,037
A3c	24,41	8,86	0,056	0,53	0,56	0,02

When the anthropogenic deterioration in Kasımiye Madrasah was analysed by XRF chemical analysis method, an increase in CaO ratio and a decrease in SiO_2 ratio were observed. While the SiO_2 ratio was 11.86% in stone A0, this ratio decreased to 4.99% in stone A4a. Clay deposits were observed from the degraded stone surfaces (Table 10).

Table 10. XRF chemical analysis results of anthropogenic deterioration observed on the facades of Kasımiye Madrasah



	CaO	SiO_2	Al_2O_3	SO_3	Fe_2O_3	P_2O_5
A0	48,13	11,86	0,36	0,62	0,49	1,09
A4a	50,4	4,99	0,1	0,41	0,25	0,033

4. Conclusion and Suggestions

Stone, which is used as a building material, takes place in every aspect of our lives in different forms and functions. When the historical buildings in Mardin are examined, it is seen that limestone is used as the main material of the building. Limestone is exposed to deterioration over time due to its structure. In this study, the stone deterioration of Kasımiye Madrasah was discussed and analysed. The deterioration was analysed by using visual analysis, mapping method and XRF analysis methods.

As a result of the investigations, it was observed that the rate of chemical deterioration in the structure was higher, while anthropogenic deterioration was the least. Capillary cracks, abrasion, joint discharge and fragment rupture were observed as physical deterioration. Discoloration and salination were observed as chemical deterioration; bacterial growth, plant growth and algae species were observed as biological deterioration. In anthropogenic deterioration, which is characterised as damage to the structure consciously or unconsciously by humans, sharp tools and paints were used in the structure.

Table 11. Deterioration on the facades of Kasımiye Madrasah

Kasımiye Madrasah	Physical Deteriorations				Chemical Deteriorations			Biological Deteriorations		Anthropogenic Deteriorations	
	Abrasion	Capillary Crack	Joint Emptying	Fragment Breakage	Colour Variation	Salitisation	Bacteria Formation	Plant Formation	Moss Formation	Sharp Instrument Use	Paint Usage
South Facade	+	+	+	+	+	+	+	+	-	+	+
East Facade	+	+	+	+	+	+	+	+	-	-	-
West Facade	+	+	+	+	+	+	+	-	-	-	-
South Facing Courtyard Facade	+	+	+	+	+	+	+	-	+	+	-
West Facing Courtyard Facade	+	+	+	+	+	+	+	-	-	+	+

When analysed on the basis of façade, capillary cracks, abrasion, joint discharges and fragment breakage, which are physical deterioration types, were observed on all façades. Apart from physical deterioration, chemical deterioration such as discoloration, salting and bacterial growth were also observed on all facades. Among the biological deterioration types, plant formation was observed on the south and east facades of the building, while moss formation was observed on the south-facing courtyard facade. The use of sharp tools and paint in anthropogenic deterioration types is observed on the south and west-facing courtyard facades of the building, while the use of sharp tools is observed on the south-facing courtyard facade (Table 11).

According to the results of XRF chemical analyses performed in Kasımiye Madrasah, chemical changes in selected stones were examined. According to the results obtained, the changes in CaO, SiO_2 and SO_3 values in the stones are remarkable. According to the results of the analyses, while the CaO ratio was 48.13% in the clean stone A0, this ratio decreased to 24.41% in the stone A3c. While the SiO_2 ratio was 11.86% in stone A0, this ratio increased to 21.44% in stone A3b. The increase is because the building stone is limestone with carbonated silica and marl content (Table 12).

Table 12. XRF chemical analysis results of the deterioration observed on the facades of Kasımiye Madrasah

Component	A0	A1a	A1b	A1c	A1d	A2a1	A2a2	A2b	A2c	A3a	A3b	A3c	A4a
CaO	48.13	44.4	45.57	52.2	46.19	45.45	26.03	45.08	47.05	40.25	45.35	24.41	50.4
SiO_2	11.86	17.15	18.08	17.66	10.22	17.04	12.07	9.49	13.46	5.26	21.44	8.86	4.99
Al_2O_3	0.36	1.91	2.35	3.82	0.92	3.61	0.5	0.66	0.1	0.15	0.11	0.056	0.1
SO_3	0.62	0.61	1.55	1.06	0.91	0.85	1.48	1.14	1.03	1.04	4.29	0.53	0.41
Fe_2O_3	0.49	1.22	0.54	0.65	0.59	0.95	0.55	0.54	0.83	0.53	1.16	0.56	0.25
P_2O_5	1.09	0.44	0.032	0.035	0.032	0.033	0.43	0.081	0.19	0.026	0.037	0.02	0.033

According to the data obtained as a result of the analyses, it was determined that physical and chemical deterioration were the most frequently observed types of deterioration in all facades of Kasımiye Madrasah. Capillary cracks, abrasion, joint discharge and fragment rupture among the physical deterioration types; discoloration, salting and bacterial formation among the chemical deterioration types were observed in all of the facades examined. When the XRF analysis results were analysed, it was observed that when the clay ratio increased, the deterioration also increased. There is an inverse relationship in silica ratios. As the amount of silica increases, deterioration decreases. When the overall structure is examined, the increase in clay and carbonate ratio caused an increase in the deterioration. As a result of the decomposition of the clay on the surface of the stone, an increase in the calcium and silica ratios in the structure of the stone was also observed.

As stated by Halaç and Akdağ (2018), in order for the building to survive for a longer period of time, deterioration should be accurately detected and measures should be taken against them. Detection of deterioration and taking measures for the protection of traditional buildings is an important phenomenon.

The results of the data and analyses obtained from this study should be used to provide effective solutions for building conservation projects planned to be carried out in the coming years. Taking early measures to reduce or stop the structural deterioration of the building is important for the building to survive for a longer period of time. It is important to accurately detect and evaluate the deterioration and develop improvement techniques in order to transfer the buildings to future generations.

Acknowledgements and Information Note

This article is derived from the Master's thesis titled "Investigation of Stone Deterioration on the Facades of Madrasah Buildings in Mardin Province and Analysis by XRF Spectrometry" completed at Dicle University, Institute of Science and Technology, Department of Architecture. The article complies with national and international research and publication ethics. Ethics committee permission was not required for the study.

Author Contribution and Conflict of Interest Disclosure Information

1st author 40%, 2nd author 20%, 3rd author 20% and 4th author 20% contributed. There is no conflict of interest.

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The Use of Waste Corn Cob as Aggregate in Geopolymer Mortar

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Abstract

This research aims to investigate the effects of waste corn cob aggregate on the properties of volcanic tuff-based geopolymer mortar. Nevşehir Pozzolan, which is produced as waste during the stone-cutting process, was used as an aluminosilicate source. The effect of alkali activator type, concentration, activator ratio, and sand-to-corn cob ratio on the properties was experimentally investigated. Study results revealed that waste Nevşehir Pozzolan was a suitable aluminosilicate for the production of geopolymer mortar. The optimum activator type, concentration, and activator ratios were sodium hydroxide with sodium silicate, 10 M, and 2.0, respectively, because they ensured the highest mechanical properties. Waste corn cob aggregate could be used instead of natural sand, and geopolymer mortar with various corn cob contents can meet the performance requirements of conventional wall materials.

Keywords: *Corn cob, waste aggregate, natural pozzolan, geopolymer mortar.*

Atık Mısır Koçanının Jeopolimer Harçta Agrega Olarak Kullanımı

Öz

Bu araştırmanın amacı volkanik tüf esaslı jeopolimer harcın özelikleri üzerinde atık mısır koçanı agregası kullanımının etkilerini araştırmaktır. Alüminosilikat kaynağı olarak taş kesim süreci sırasında üretilen atık halde Nevşehir Doğal Puzolanı kullanılmıştır. Alkali aktivatör türü, konsantrasyonu, aktivatör oranı ve kum/mısır koçanı oranının özelikler üzerindeki etkinliği deneysel olarak araştırılmıştır. Çalışma sonuçları Nevşehir Puzolanı'nın jeopolimer harç üretimi için alüminosilikat olarak uygun olduğunu göstermektedir. İdeal aktivatör türü, konsantrasyonu ve aktivatör oranı, en yüksek mekanik özelikleri sağlamasından dolayı, sırasıyla sodyum hidroksit ve sodyum silikat, 10 M ve 2.0'dır. Atık mısır koçanı agregası doğal kum yerine kullanılabilmektedir ve farklı mısır koçanı oranına sahip jeopolimer harçlar geleneksel duvar malzemelerinin performans gereksinimlerini karşılayabilmektedir.

Anahtar kelimeler: *Mısır koçanı, atık agrega, doğal puzolan, jeopolimer harç.*

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1. Introduction

The construction sector is among the main sectors that cause global carbon emissions due to its high energy consumption and waste generation. Efforts to "save energy and resources, reuse and recycle, appropriate management, and high consumption of waste products" in the context of seeking solutions to environmental problems have become the focal point of today's construction industry. However, more than 30 billion tons of natural aggregates are used in concrete production worldwide every year, and this amount increases by 5% annually (He et al., 2022). As a result, natural aggregate reserves decrease, and environmental damage occurs.

Globally, billions of tons of agricultural waste are produced each year. Storing these wastes in landfills creates a series of technical, social and environmental problems (Alaneme et al., 2023). The disposal of waste by incineration can cause adverse effects on the health of living things and the environment by releasing large amounts of polluting gasses and particulate matter into the atmosphere. In addition, incineration processes may adversely affect biodiversity and geomorphic processes in the soil, resulting in negative consequences for future agricultural practices (Aransiola et al., 2019; Memon et al., 2019). By using agricultural wastes instead of natural aggregates, natural raw material reserves can be protected, landfills can be reduced, and environmental pollution and carbon emissions can be reduced.

Corn Cob (CC) is an agricultural waste generated during corn harvest. Since about 18 kg of CC is obtained in 100 kg of corn production, there is a huge amount of waste CC around the world every year (Tsai et al., 2001). Unlike other crops, CC is nutrient-poor and only a certain portion is used for animal feed production or cultivated mushrooms. A large amount of corn cob is thrown into landfills or incinerated (Xu et al., 2021), resulting in the aforementioned problems for living things and the environment.

The composition of CC, which has a sponge-shaped porous microstructure, consists of cellulose, hemicellulose, and lignin (Takada et al., 2018). Therefore, CC is suitable for use as a building material because it has the same fiber components with wood (Khiari et al., 2010; Binici et al., 2016). Research shows that the ash obtained by burning CC contains more than 70% Al_2O_3 and SiO_2, that is, it has pozzolanic properties and can be used as a binder (Adesanya, 1996; Adesanya & Raheem, 2009; Memon et al., 2019). It was determined that with the use of 20% CC ash in concrete, embodied energy and CO_2 emissions were reduced by approximately 12% and 37%, respectively (Alsalman et al., 2021).

Pinto et al. (2011) evaluated the possibilities of CC as a thermal insulation material in buildings. According to the results of the research, the microstructures of the XPS thermal insulation material and CC were quite similar since both materials had a closed cellular microstructure and contained similar chemical components (oxygen, magnesium, aluminum, silicon, calcium, and iron). In another study, Faustino et al. (2012), investigated panel production possibilities by mixing CC aggregate with wood glue for impact sound insulation. It was determined that the produced material had positive acoustic properties. Pinto et al. (2012) produced Portland cement-based lightweight concrete using CC as aggregate. The unit weight (0.35-0.94 gr/cm^3), compressive strength (0.1-0.5 MPa), and thermal conductivity coefficient (1.99 W/mK) of this material were lower than those of the expanded clay-based specimen, and this material might be used for nonstructural applications. Binici et al. (2014) produced a thermal insulation material with a unit weight of 0.26-0.41 gr/cm^3, a water absorption ratio of 12-24%, and a thermal conductivity coefficient of 0.1-0.19 W/mK by mixing epoxy, gypsum, and cement with CC aggregate. Laborel-Préneron et al. (2018) investigated the thermal insulation properties of unfired soil-based building materials containing CC aggregates. As a result of the research, the thermal conductivity coefficient of the specimen containing 6% CC (0.35 W/mK) decreased by approximately 36% compared to the thermal conductivity coefficient of the soil-based specimen (0.57 W/mK). In another study, Shao et al., (2021) used CC aggregate as an alternative to river sand to produce cement-based paste. The use of CC aggregates increased the porosity and water absorption ratio and decreased the density, strength, and thermal conductivity coefficient. The optimum CC grain size was found to be 1-2 mm, and the ratio was 40%. Ramos et al. (2021) investigated the production possibilities of thermal insulation panels containing CC using polymer-based binders.

Choi et al. (2022) produced a composite panel by mixing ground CC with microencapsulated phase change material. The produced material increased the thermal performance of the building and reduced energy consumption. In another study, the use of CC aggregate enabled the production of gypsum-based partition wall elements with 34% lower thermal conductivity coefficient (Türk et al., 2022).

Literature studies provide significant data on the addition of CC in powder form or as aggregate into cement, gypsum, polymer-based binder, mortar, and concrete. However, research on the evaluation of CC as an aggregate in the production of geopolymer materials, which is more energy- and environmentally-efficient binder type compared to cement, is limited. Wang et al., (2023) incorporated CC aggregates into the geopolymer binder produced by activating the mineral powder with a mixture of NaOH and Na_2SiO_3 alkali activators. It was stated that materials with flexural and compressive strengths of 1.6 and 11.6 MPa, respectively, and thermal conductivity coefficient of 0.10-0.18 W/mK can be used as thermal insulation materials. However, the industrial waste used as a geopolymer raw material (aluminosilicate source) in this research is an artificial pozzolan. In the literature, there is no research in which waste natural pozzolan is used as an aluminosilicate source and reinforced with CC aggregate. On the other hand, since Anatolian geography is exposed to many volcanic activities, Turkey is very rich in terms of volcanic tuff reserves. According to the Mineral Research and Exploration Institute, when the visible reserve, possible reserve, and probable reserve data are taken into account, there are approximately 18 billion m^3 reserves, and Turkey has approximately 40% of the volcanic tuff reserves worldwide (Yaşar & Erdoğan, 2005).

Approximately 10-15% of the volcanic rocks extracted in our country are cut solidly and used in the construction sector, while the rest is used as filling material or stored as waste. These rocks, which have been physically crumbled and turned into dust, adversely affect the health of living things and the agricultural areas in the surrounding area and create visual pollution. Therefore, the aim of the current research is to investigate the effects of waste corn cob aggregate on the physical, mechanical, and thermal properties of geopolymer mortar produced from volcanic tuff, which is produced as waste during the stone-cutting process.

2. Material and Method

2.1. Raw Materials

Geopolymer binders are produced as a result of the reaction of an aluminosilicate source (natural or artificial pozzolans) containing a high percentage of alumina and silica with different alkali activators (Garcia-Lodeiro et al., 2015). These binders have two main components: (i) aluminosilicate source and (ii) alkali activator. The type of these components, their physical, chemical, and mineralogical properties, the type of aggregate and its properties, mixing ratios, mortar mixing, pre-curing, and curing conditions are very effective parameters for the properties of geopolymer mortars.

Because of eruptions of volcanoes, which are known to be active in geological periods such as Erciyes, Hasandağı, Melendiz, and Güllüdağ in the Cappadocia Region of Turkey, the lava coming out of the volcanoes have formed a 100-150 m thick tuff layer on the plateau, lakes, and streams. More than 1.5 billion m^3 of volcanic tuff reserves have been identified in this region (Yaşar & Erdoğan, 2005).

The natural Nevşehir Pozzolan (NP) used as an aluminosilicate source in this study was obtained from the waste storage area of the volcanic tuff quarry in the region (Figure 1a).

The specific surface area of the NP determined according to the TS EN 196-6 (2010) is 6542.16 cm^2/gr and its specific gravity is 2.45 gr/cm^3. XRF analysis results of NP are shown in Table 1.

The total SiO_2+Al_2O_3+Fe_2O_3 and the maximum SO_3 and MgO content in the composition of NP meet the criteria required to be used as a binder material according to TS 25 (2008) (Table 2). In addition, the flexural and compressive strengths performed in accordance with the pozzolanic activity test (TS 25, 2008) also reveal that NP is a binding material.

Table 1. Chemical composition of NP

Composition	NP
SiO_2	77.29
Al_2O_3	18.98
Fe_2O_3	1.71
CaO	0.33
MgO	1.29
K_2O	0.30
SO_3	0.10
Total	100

Table 2. Main requirements that a natural pozzolan should have

Requirements (TS 25, 2008)		NP
SiO_2+ Al_2O_3+ Fe_2O_3 (%)	≥ 70.0	97.98
SO_3 (%)	≤ 3.0	0.10
MgO (%)	≤ 5.0	1.29
Flexural Strength (MPa)	≥ 1.0	1.86
Compressive Strength (MPa)	≥ 4.0	6.81

The alkali activator, which is one of the two main components of the geopolymer binder, increases the pH of the reaction medium and ensures the dissolution of the aluminosilicate source (Firdous et al., 2018). In the current research, sodium hydroxide (NaOH) solution with 8, 10, and 12 molar concentrations (M) (Figure 1b) and liquid sodium silicate (Na_2SiO_3=SS) with silica modulus (SiO_2/Na_2O) 3.2 (Figure 1c) were used as alkali activators.

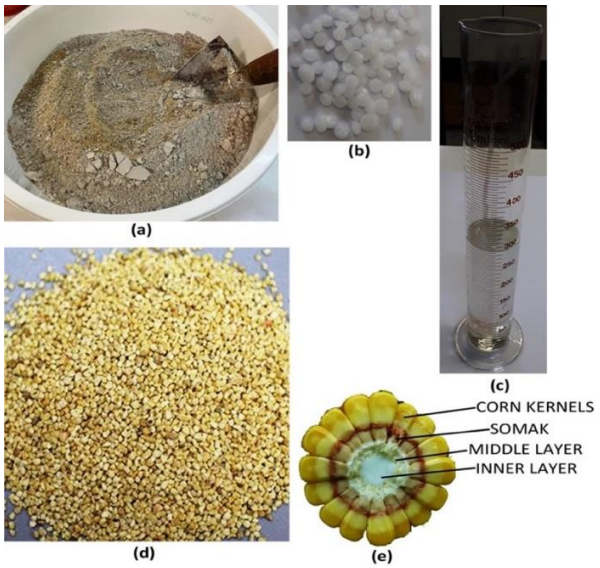

Figure 1. Raw materials used in the current study: (a) NP; (b) NaOH; (c) SS; (d) CC; (e) the cross-section of the CC

CEN Standard Sand (S) with a specific gravity of 2.56 gr/cm^3 according to TS EN 196-1 (2009) was used for the production of geopolymer mortar. The particle size distributions of NP and S is shown in Figure 2.

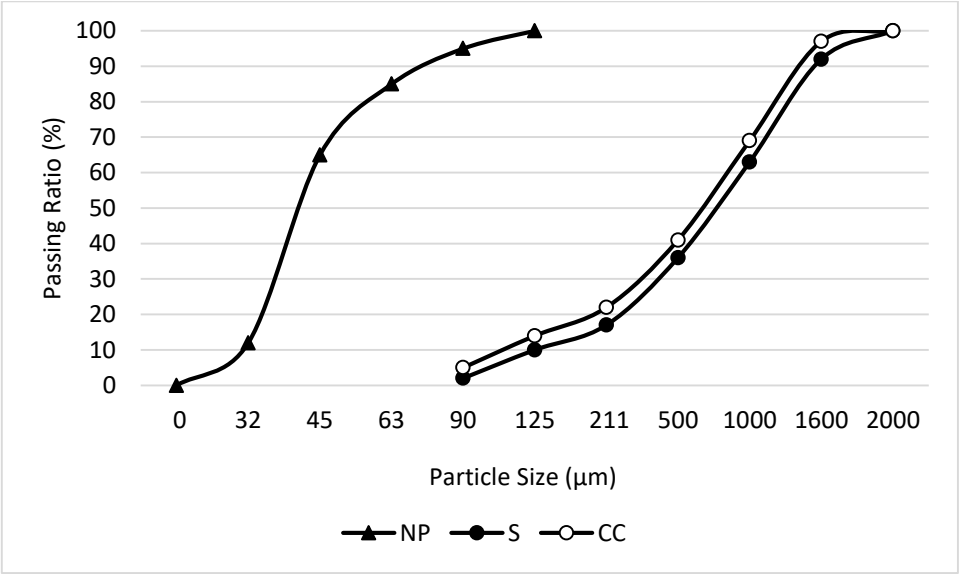

Figure 2. The particle size distributions of NP, S, and CC

CC was obtained from agricultural lands in the Black Sea Region (Ordu, Turkey) and dried at 100 °C for 48 h. Then, the weight, length, and maximum diameter of 50 randomly selected CCs were measured, and the coefficient of variation (CV) was calculated (Table 3). CC consists of cellulose, hemicellulose, pectin, lignin, and waxes (Shao et al., 2021). When the CC was cross-sectioned, a macro-structure of three concentric circles with different colors and densities appeared (Figure 1e). The innermost layer is the core layer, which is soft and easily compressible. The middle layer is darker, harder and has a wood-like texture. The outermost layer carries corn kernels and shows a soft structure (Bovo et al., 2022).

Table 3. The weight and dimensions of dried corn cobs

	Dried Weight (gr)		Length (mm)		Diameter (mm)	
CC	**Average (gr)**	**CV (%)**	**Average (mm)**	**CV (%)**	**Average (mm)**	**CV (%)**
	35.2	11.3	211	7.1	32	4.5

CV: Coefficient of variation

Since CC was used as a substitute for S, it was ground and sieved to provide the particle size distribution of S (Figure 2). Since CC does not have a regular shape, water absorption test was used to determine its density. First, the dry weight (m_{cc}) of the dried CC was recorded. Then an object of known volume (V_{object}) was attached to the CC to allow it to fully submerges in water. The CC and the object were placed in a water-filled glass container ($V_{control}$) of known volume. The volume of CC is calculated according to Equation 1:

$$\Delta V = V_{final} - V_{control} - V_{object} \quad \text{(Eq. 1)}$$

The calculated value of ΔV is the volume of CC (V_{cc}). Then the density of CC is calculated according to Equation 2:

$$d_{cc} = m_{cc} / V_{cc} \quad \text{(Eq. 2)}$$

The density (d_{cc}) of CC was calculated by taking the average of 10 specimens and was determined to be 2.51 gr/cm^3. This value is important in that it is close to the value found in another study (2.47 gr/cm^3) (Bovo et al., 2022).

2.2. Mixing Ratios and the Production Process

The effects of using CC aggregate instead of natural aggregate on the physical, mechanical, and thermal properties of waste volcanic tuff-based geopolymer binder were evaluated in this study. The experimental method consisted of three stages: (i) the effect of alkali activator type (NaOH and SS + NaOH); (ii) the effect of NaOH concentration (8, 10, 12 M) and activator ratio (SS:NaOH = 0.5, 1.0, 2.0); and (iii) the effect of the S:CC aggregate ratio (100:0, 70:30, 50:50, 30:70, 0:100). The optimum findings obtained in each stage were kept constant in the next stages.

Only S was used as aggregate in the first and second stages. S and CC aggregates were used in varying proportions in the third stage. As a result of the data in the first and second stages, the ideal alkali activator type (SS + NaOH), NaOH concentration (10 M), and activator ratio (2.0) were determined, and the specimen containing only S aggregate was selected as the "control specimen" in the third stage. Throughout the study the alkali activator: pozzolan and the pozzolan: aggregate ratios were kept constant at 3:10 and 1:2 by weight, respectively. The stages, specimen codes, and mixing ratios are given in Table 4.

Table 4. The stages, specimen codes, and mixing ratios

Stage	Specimen Code	Activator Type	NaOH Concentration (M)	Activator Ratio (wt %)	Activator: Pozzolan (wt %)	Pozzolan: Aggregate (wt %)
i	100S:0CC	NaOH	8	-	3:10	1:2
		SS+NaOH		0.5		
ii		SS+NaOH	8	0.5	3:10	1:2
				1.0		
				2.0		
			10	0.5		
				1.0		
				2.0		
			12	0.5		
				1.0		
				2.0		
iii	100S:0CC (Control)	SS+NaOH	10	2.0	3:10	1:2
	70S:30CC					
	50S:50CC					
	30S:70CC					
	0S:100CC					

Solid raw materials (NP, S, and CC) were mixed at 50 rpm for 5 min using a mortar mixer. Alkali activators and water were then added to this dry mixture and mixed for another 5 min at 70 rpm. The mixture was placed in steel molds of 40x40x160 mm, covered with polyethylene, and cured in a ventilated oven at 70 °C for 24 h. After the curing, the specimens were removed from the molds and kept in 22±2 °C and 55±5% RH for 28 days.

The produced specimens were coded in “aS:bCC” format. In this coding, “S” stands for standard sand, “a” stands for standard sand ratio by weight, “CC” stands for corn cob, and “b” stands for corn cob ratio by weight. While physical and mechanical tests were applied on the specimens with 40x40x160 mm, thermal conductivity coefficient, and water vapor permeability tests were carried out on circular specimens with a diameter of 100 mm and a thickness of 30 mm. Each test result was recorded by calculating the arithmetic mean of the results obtained from six specimens.

2.3. Applied Tests

The workability of the fresh binder was determined by the flow table test performed in accordance with TS EN 12350-5 (2019). In the first and second stages, the specimens were subjected to dynamic ultrasound velocity tests according to TS EN 14579 (2006) and flexural and compressive strength tests in accordance with TS EN 196-1 (2009). In the third stage, in addition to these tests, unit weight (TS EN 1015-10, 2001), water absorption ratio (TS EN 13755, 2009), and thermal conductivity coefficient (ASTM C518–17, 2021) tests were applied. The water vapor permeability of the specimens was determined according to TS EN 12086 (2013) by the dry cup method, which involved it being filled with silica gel. 90-day drying shrinkage was determined in accordance with TS ISO 1920-8 (2011). The length change of each specimen was measured on each of the following days: 1, 2, 3, 4, 5, 6, 7, 15, 22, 30, 40, 50, 60, 70, 80, and 90. The mechanical fracture behavior and toughness of the specimens were determined by drawing a flexural load-displacement diagram under flexural loads.

3. Results and Discussion

3.1. The Effect of Alkali Activator Type

The reaction mechanism of geopolymer materials is an exothermic process consisting of dissolution-agglomeration-polycondensation reactions. In the dissolution stage, the alkali solution with high pH dissolves the covalently bonded Si-O-Si and Al-O-Si groups in the aluminosilicate source. These dissolved groups transform into the colloidal phase in the second stage. Then, the dissolved phases react with each other to form an agglomerated structure, and a solidified structure is formed at the end of the polycondensation stage (Pacheco-Torgal et al., 2008).

The effect of alkali activator type on the mechanical properties of geopolymer mortar produced using NP aluminosilicate, S aggregate, and NaOH or SS + NaOH alkali activators is given in Figure 3.

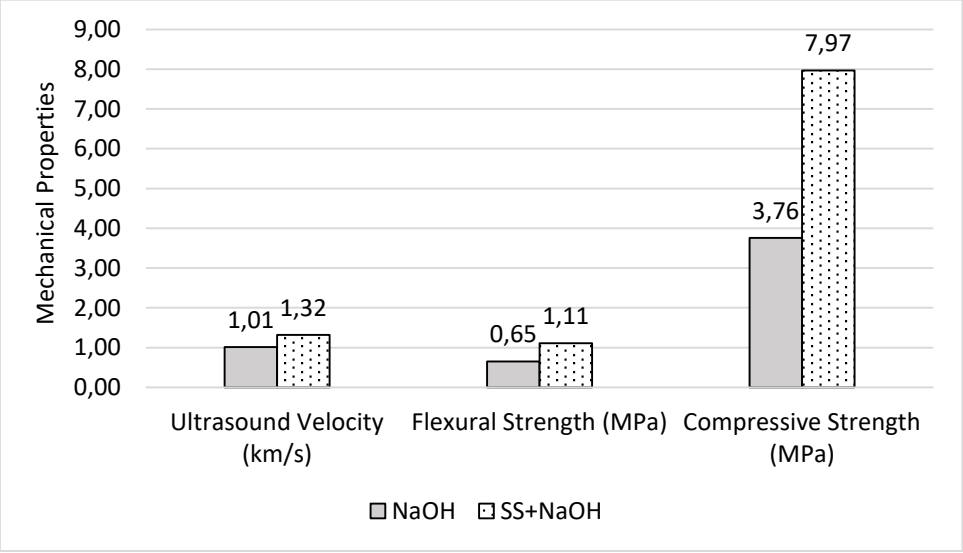

Figure 3. Effect of alkali activator type on the mechanical properties of NP-based geopolymer mortar

The ultrasound velocity of the mortar activated with SS + NaOH was 1.30 times higher than that of the mortar activated with only NaOH. Since ultrasound velocity, which is a nondestructive test method, is an indicator of the porosity of the material, it can be deduced that the geopolymer mortar body reached a more compact microstructure in the SS-containing specimens. In other words, the material structure developed to reach a more homogeneous structure, and cracks, voids, and irregularities that

would reduce the rate of absorption or dispersion of the sound passing through the material were reduced. In parallel with this change, the flexural and compressive strengths of specimens activated with SS + NaOH were 1.70 and 2.12 times higher, respectively, than those activated with only NaOH. This increasing trend in mechanical properties may be because SS increases the dissolution rate of Si and Al components in the aluminosilicate source (during the dissolution stage of geopolymerization). In addition, since the Al-O bonds in the aluminosilicate source are weaker than the Si-O bonds, Al ions dissolve easily and quickly in alkali solutions. If additional Si ions are present in the reaction medium before the raw material starts to dissolve, it becomes important to add SS to the mixture as the degree of geopolymerization will increase (Nadoushan & Ramezanianpour, 2016). In addition, the presence of SS in the mixture provides stronger ion pair formation during the polycondensation stage of geopolymerization and thus longer chain silicate oligomers are formed. The presence of longer chain silicate oligomers in the mortar facilitates the formation of geopolymer reaction products (NASH gel) (Xu & Van Deventer, 2000). Therefore, it is important to add SS to the geopolymer mix. This finding is also consistent with the results of another study (Barış, 2022) in which the positive effects of SS on the properties of Datça Pozzolan-based geopolymer binder were determined.

3.2. The Effect of Alkali Hydroxide Concentration

The effect of alkali hydroxide concentration on the mechanical properties of geopolymer mortar produced using NP aluminosilicate, S aggregate, and NaOH or SS + NaOH alkali activators is given in Figure 4.

The 10 M NaOH concentration was the limit at which mechanical properties were reversed. While the alkali activator ratio was constant, increasing the NaOH concentration from 8 M to 10 M resulted in an increase in ultrasound velocity and flexural and compressive strengths of the specimens. This finding indicated that the voids in the internal structure of the mortar decreased. The highest ultrasound velocity (3.07 km/s), flexural strength (2.09 MPa), and compressive strength (18.21 MPa) were obtained in the specimens activated with 10 M NaOH and with the highest activator ratio (2.0). This increasing trend may be explained by the fact that the higher OH^- ions in the reaction medium increase the dissolution rate of the aluminosilicate source (NP) (Kani & Allahverdi, 2009). Increasing dissolution positively affects microstructure development by increasing the dissolved Si and Al components required for the development of the next geopolymerization reaction stage, polycondensation (Panagiotopoulou et al., 2007). In other words, by activating the NP with 10 M NaOH, a higher degree of dissolution was achieved and the development of polycondensation reactions and thus the mechanical properties of the material were supported. However, it was determined that as a result of further increasing the NaOH concentration (12 M), a structural deformation occurred in the mortar structure and accordingly the mechanical properties decreased. Ultrasound velocity, flexural and compressive strengths of all specimens activated with 12 M SS + NaOH decreased by 0.72-0.78, 0.77-0.85, and 0.73-0.79 times, respectively, compared to the specimens activated with 10 M SS + NaOH. It can be deduced from this that increasing the alkali hydroxide concentration beyond its optimum value created an immature molecular structure in the mortar. Because the existence of an excessive number of OH^- ions in the reaction medium allowed the polycondensation reaction to start earlier than expected and to develop much faster. Thus, the development of the dissolution reaction, which was the first stage, was prevented, and the NP could not find enough time to be dissolved completely (Kani & Allahverdi, 2009). However, despite the detected reduction, the mechanical properties of the 12 M SS + NaOH activated mortars were still higher than those the of control specimen activated with 8 M SS + NaOH.

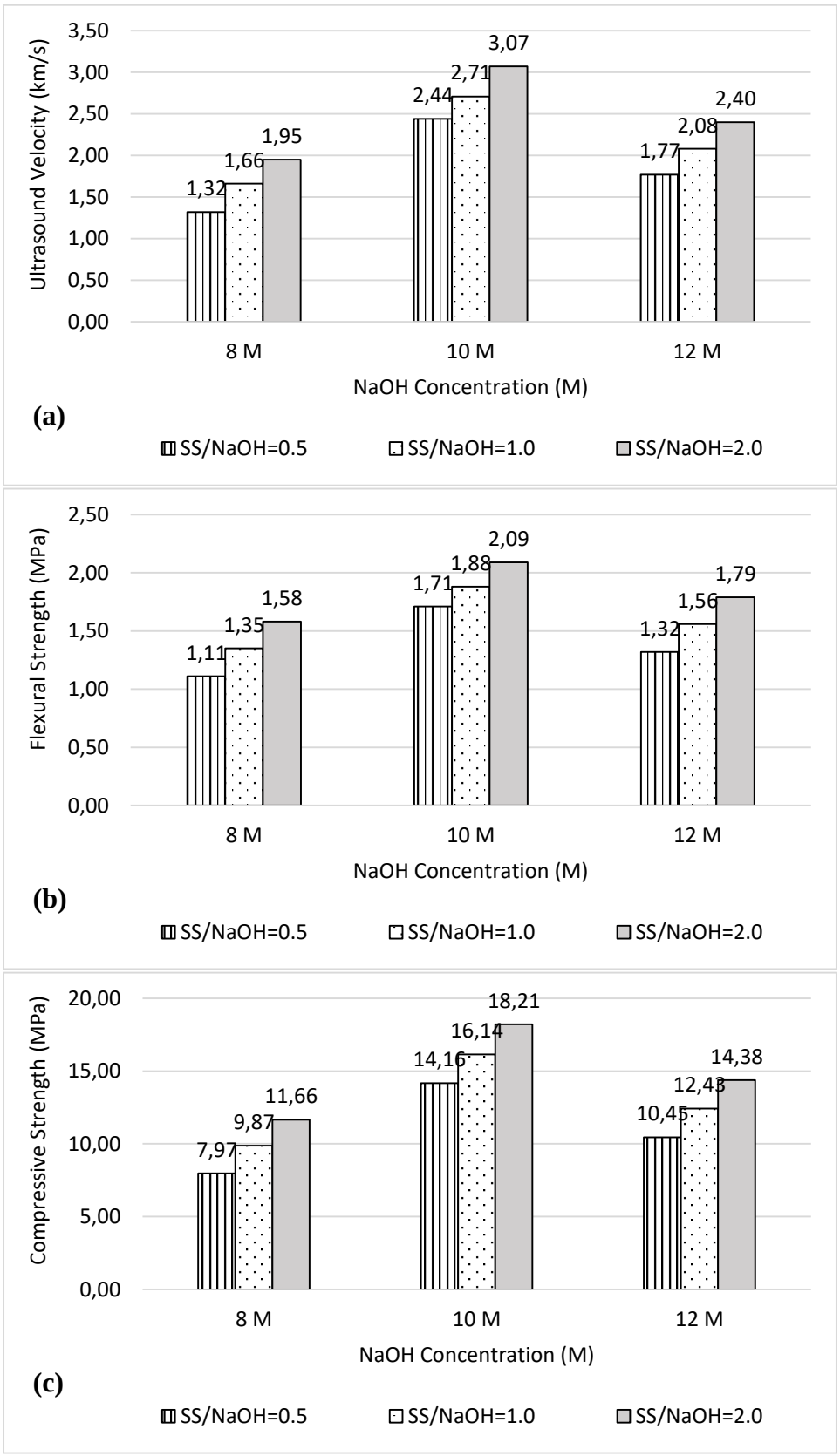

Figure 4. The effect of alkali hydroxide concentration on the mechanical properties of NP-based geopolymer mortar

3.3. The Effect of the Activator Ratio

The effect of the activator ratio (SS/NaOH) on the mechanical properties of geopolymer mortar produced using NP aluminosilicate source, S aggregate, and NaOH or SS + NaOH alkali activators is given in Figure 5.

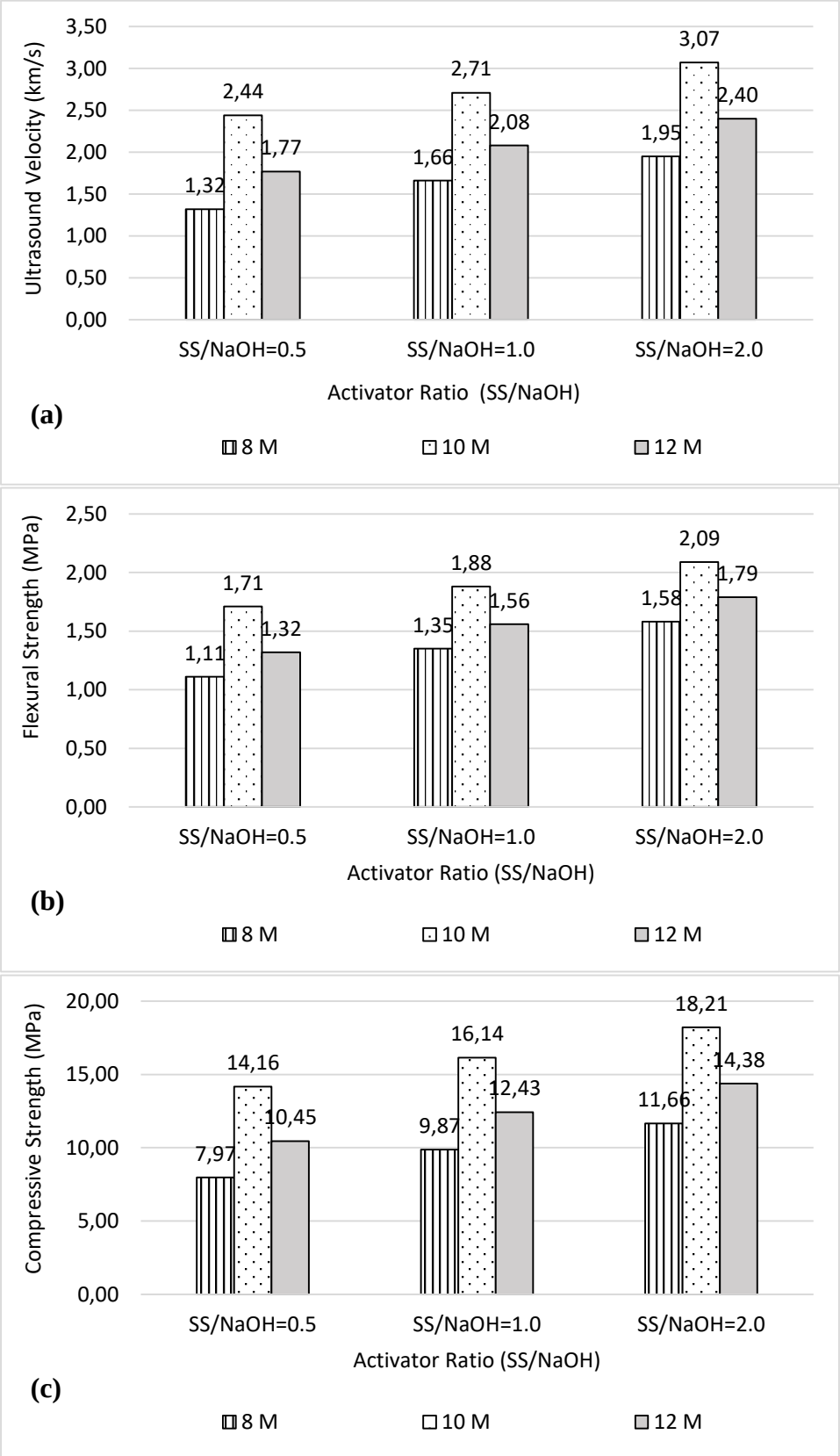

Figure 5. The effect of the activator ratio on the mechanical properties of NP-based geopolymer mortar

When the NaOH concentration was constant, increasing the activator ratio from 0.5 to 2.0 M increased the ultrasound velocity and flexural and compressive strengths of the specimens. The highest ultrasound velocity (3.07 km/s), flexural strength (2.09 MPa), and compressive strength (18.21 MPa) were obtained in the specimens with the highest activator ratio (2.0). The reason for this increasing trend was explained in the Section 3.1. However, the ideal activator ratio varies according to the type

of aluminosilicate raw material used. While the ideal activator ratio is 2.5 for Datça Pozzolan (Barış, 2022) and Pasuruan Pozzolan (Risdanareni et al., 2015), it is 2.0 for blast furnace slag-based geopolymer (Hadi et al., 2019) and 1.5 for fly ash-based geopolymer (Nath & Sarker, 2014) in the literature.

3.4. The Effect of Aggregate Mixing Ratio

3.4.1. The effect of aggregate mixing ratio on physical properties

The effect of the S:CC aggregate ratio on the workability and unit weight of NP-based geopolymer mortar is given in Figure 6.

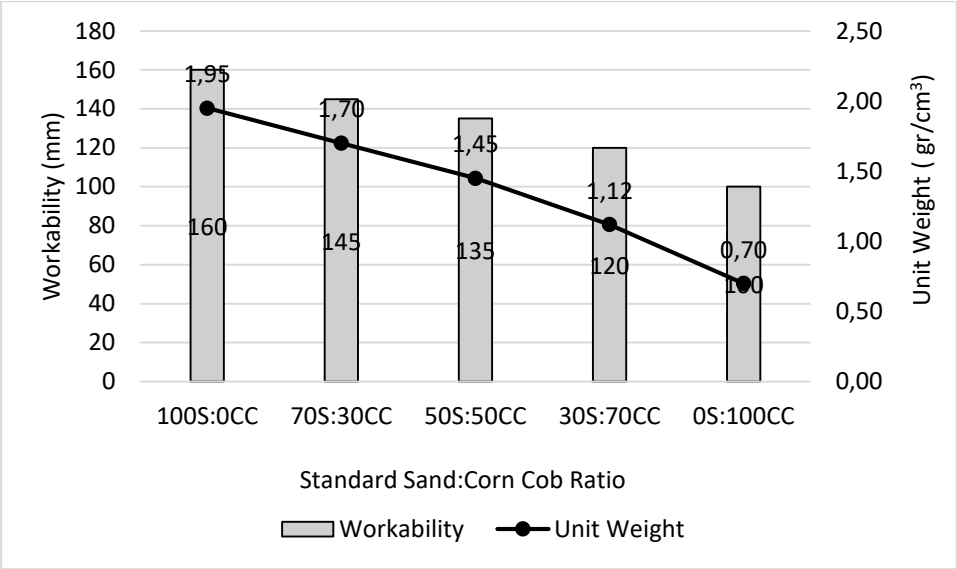

Figure 6. The effect of the S:CC ratio on the workability and unit weight relationship of NP-based geopolymer mortar

The control sample without CC (100S:0CC) had the highest workability (160 mm). With the addition of CC to the mortar mixture, the workability gradually decreased. The lowest workability (100 mm) was determined in the specimen with the code 0S:100CC. This decreasing trend was due to the decrease in the amount of mixing water because CC, which has porous structure and hydrophilic properties, absorbed the mixing water at a higher ratio than natural S. However, adding more water to the mixture to facilitate casting and molding processes would reduce the mechanical properties of the material, so, no more extra water was added to the mortar.

One of the most significant parameters affecting the physical and mechanical properties of materials is the unit weight (Shao et al., 2021). The unit weight of the mortar is significantly affected by the density and amount of the aggregate used. The unit weight of the geopolymer mortar varied between 0.70 and 1.95 gr/cm^3. The highest value (1.95 gr/cm^3) was obtained from the control specimen containing only S. The unit weight of all specimens containing CC was lower than that of the control specimen. Because CC is a material with a low unit weight due to its cellular and porous structure, the unit weight of the specimens containing 30%, 50%, 70%, and 100% CC decreased by 0.87, 0.74, 0.57, and 0.36 times, respectively, compared to that of the control mortar. Since the unit weight of all specimens included in the study is lower than 1.8 gr/cm^3, it meets the density requirement of lightweight mortar and wall materials (Corinaldesi et al., 2016). The unit weight of CC incorporated gypsum and cement-based mortar is 0.54-0.80 gr/cm^3 (Binici et al., 2016); the unit weight of only gypsum-based mortar is 0.85-1.20 gr/cm^3 (Türk et al., 2022); and the unit weight of cement-based mortar is 1.6-2.0 gr/cm^3 (Shao et al., 2021) in the literature. The values obtained in the current research are in agreement with unit weights in the literature.

The effect of the S:CC aggregate ratio on the porosity and water absorption ratio of NP-based geopolymer mortar is given in Figure 7. Accordingly, the porosity of mortars varied between 19.38-26.24%. The lowest value (19.38%) was obtained from the control specimen. Due to the porous

structure of CC, the porosity of the mortar containing 30%, 50%, 70%, and 100% CC increased approximately 1.09, 1.18, 1.27, and 1.35 times, respectively, compared to the control specimen. In addition, the water absorption ratio also showed results in parallel with the change in porosity. The lowest water absorption ratio (7.14%) was obtained from the control specimen, while the highest value (13.01%) was found in the 0S:100CC specimen containing 100% CC.

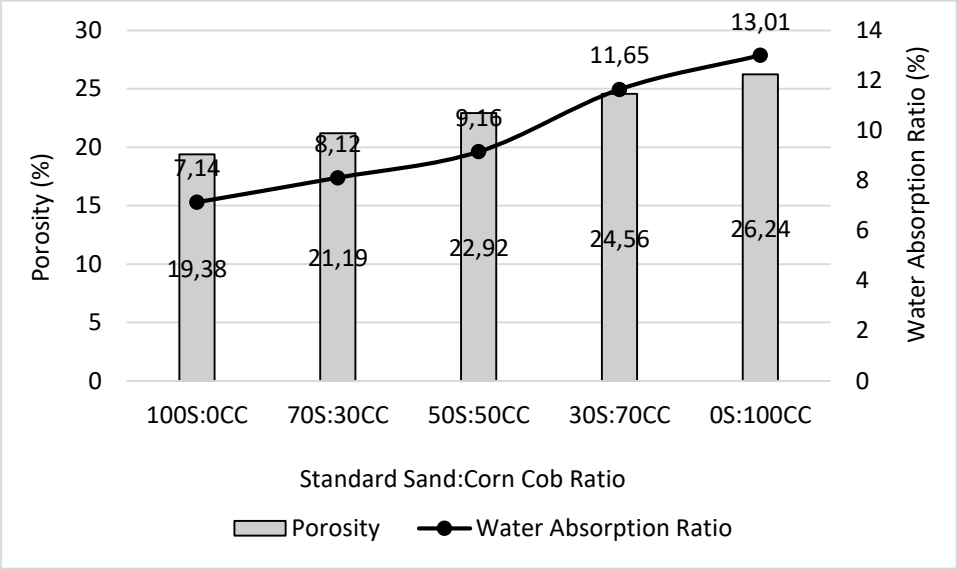

Figure 7. The effect of the S:CC ratio on the porosity and water absorption ratio relationship of NP-based geopolymer mortar

Unlike Portland cement, very little of the water used in the production of geopolymer-based binders is consumed in gel formation, and this water is called “structural water”. Water, known as "free water", is added to ensure the workability of the binder. When this free water evaporates from the binder structure in an uncontrolled way, drying shrinkage may occur (Azevedo et al., 2021). The effect of the S:CC ratio on the 90-day drying shrinkage of the NP-based geopolymer mortar is given in Figure 8.

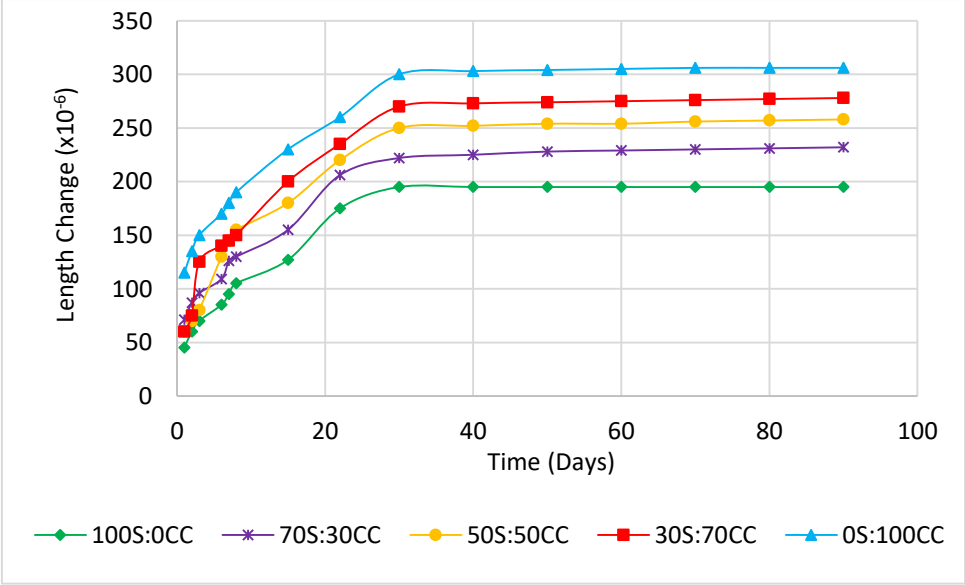

Figure 8. The effect of the S:CC ratio on the drying shrinkage of the NP-based geopolymer mortar

According to Figure 8, because of the higher free water content in all specimens in the early period, the shrinkage in the first 21 days was more effective. In the following period, the shrinkage value became constant. The lowest drying shrinkage (195x10-6) was obtained from the control specimen containing only S. The drying shrinkage of the specimens containing 30%, 50%, 70%, and 100% CC increased by 1.19, 1.32, 1.43, and 1.57 times, respectively, compared to the drying shrinkage of the control mortar. The main factor in this increase was that the modulus of elasticity (rigidity) of CC was

lower than that of S. Thus, the specimen with higher CC contents had a higher shrinkage ratio. On the other hand, S with higher rigidity was more successful in preventing drying shrinkage.

It is important to design building materials that allow the passage of water vapor to prevent condensation and related problems that may occur during the use of the material. The effect of the S:CC ratio on the water vapor permeability and porosity relationship of NP-based geopolymer mortar is given in Figure 9.

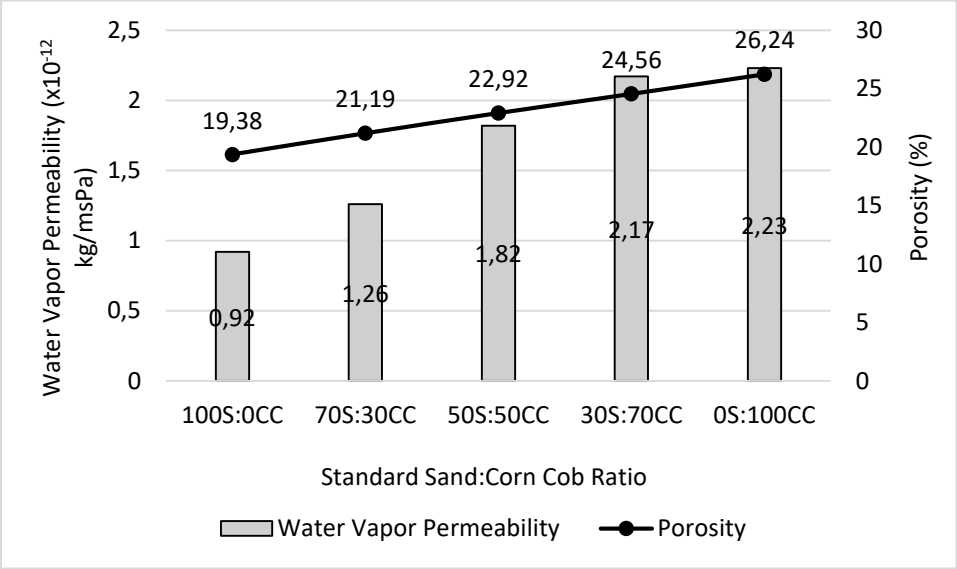

Figure 9. The effect of the S:CC ratio on the water vapor permeability and porosity relationship of NP-based geopolymer mortar

The lowest water vapor permeability ($0.92x10^{-12}$ kg/msPa) was obtained from the control specimen. The water vapor permeability increased as the ratio of the substitution of S by CC increased. The vapor permeability ($1.82x10^{-12}$ kg/msPa) of the specimen containing 50% CC (50S:50CC) was approximately 2 times that of the control specimen. Increasing the CC ratio to 70% and 100% increased the vapor permeability by 2.36 and 2.42 times, respectively, compared to the control specimen. In addition, the vapor permeability values were closely related to the porosity values. CC with porous structure allowed the vapor to pass through the material more easily, and consequently, the formation of condensation might be prevented.

3.4.2. The effect of aggregate mixing ratio on thermal properties

Since the thermal conductivity coefficient is an important indicator of the energy efficiency of a material, this property should be determined in an experimental study (Wang et al., 2023). As a waste material with a porous structure, CC has a good thermal insulation advantage with its low thermal conductivity coefficient (0.093 W/mK, Viel et al., 2018). The effect of the S:CC ratio on the thermal conductivity coefficient and unit weight relationship of the NP-based geopolymer mortar is given in Figure 10. The thermal conductivity coefficient of the produced geopolymer mortars varied between 0.28-0.96 W/mK. The highest value (0.96 W/mK) was obtained from the control specimen. The thermal conductivity coefficient of the specimens containing CC decreased gradually by 0.78, 0.52, 0.41, and 0.29 times, respectively, compared to the control mortar. This decrease in the thermal conductivity coefficient was related to the fact that CC increased the porosity and decreased the density of the geopolymer mortar. Furthermore, the thermal conductivity coefficients of the CC aggregate (0.093 W/mK) and the air in the voids of CC (0.026 W/mK) are lower than that of the matrix (0.96 W/mK).

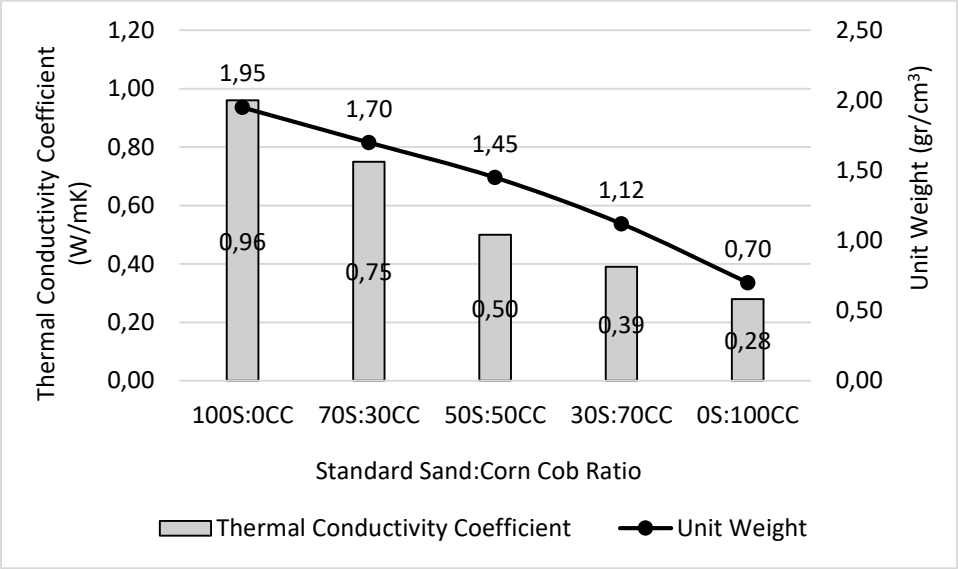

Figure 10. The effect of the S:CC ratio on thermal conductivity coefficient and unit weight relationship of NP-based geopolymer mortar

3.4.3. The effect of aggregate mixing ratio on mechanical properties

The effect of the S:CC ratio on ultrasound velocity, compressive, and flexural strengths of NP-based geopolymer mortar is given in Figure 11. Ultrasound velocity, compressive, and flexural strengths of geopolymer mortars varied between 1.74 and 3.07 km/s, 3.12 and 18.21 MPa, and 0.60 and 2.09 MPa, respectively. The highest values (3.07 km/h, 18.21 MPa, and 2.09 MPa, respectively) were obtained from the control specimen containing only S. The compressive strength of the specimens containing 30%, 50%, 70%, and 100% CC decreased by 0.56, 0.46, 0.31, and 0.17 times, respectively, compared to the compressive strength of the control mortar. The change in the S:CC ratio on flexural strength was also parallel to the change in compressive strength. This decrease in strength due to the addition of CC was related to the fact that CC increased the void ratio in the geopolymer matrix, and these voids created weak zones in the material. These porous structure and weak zones were also observed by digital images of the specimens determined after the flexural strength test, as can be seen in Figure 12. In addition, this situation coincides with the 0.57-0.82 times decrease in ultrasound velocity with the addition of CC compared to the control mortar. Furthermore, since the modulus of elasticity (rigidity) of CC was lower than that of S, stresses occurring in the specimen under pressure load led to an earlier fracture, and thus the strength decreased. However, the strength development of the mortars would be affected not only by the aggregate properties and mixing ratio but also by the properties of the interface between the matrix and the aggregate.

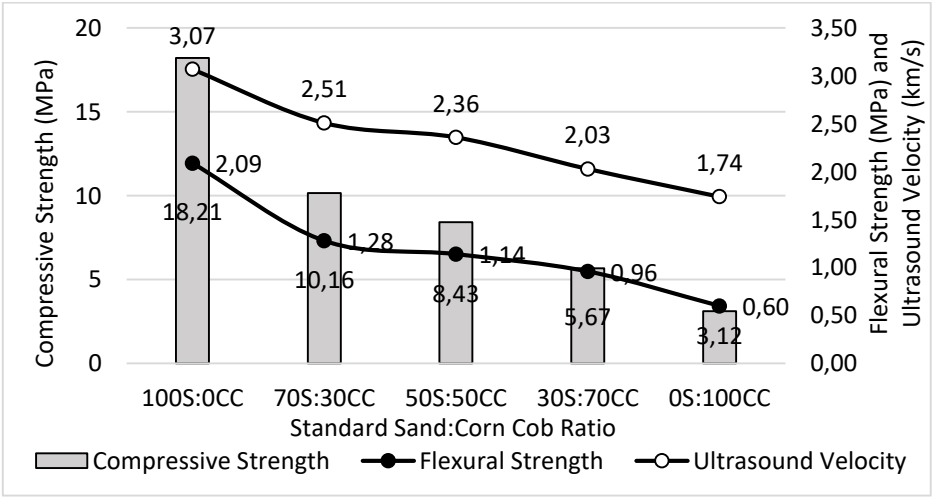

Figure 11. The effect of the S:CC ratio on ultrasound velocity, compressive and flexural strength relationship of NP-based geopolymer mortar

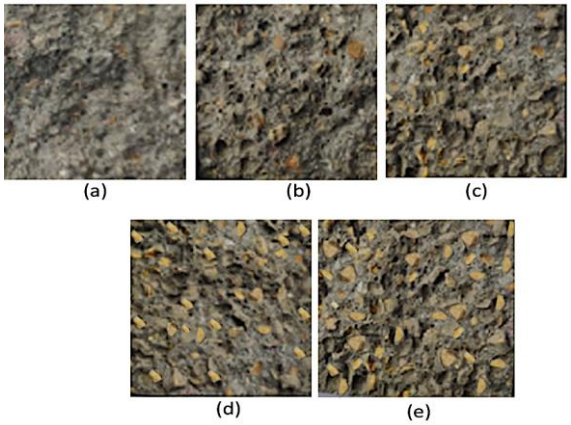

Figure 12. Digital images of the specimens after flexural strength test: 100S:0CC (a); 70S:30CC (b); 50S:50CC (c); 30S:70CC (d); 0S:100CC

The effect of the S:CC ratio on the flexural/compressive strength ratio of NP-based geopolymer mortar is given in Figure 13a. The flexural strength of conventional concrete is approximately 10-15% of its compressive strength (Wang et al., 2023). The flexural/compressive strength ratios calculated in this study were in the same range or higher than conventional concrete. In particular, the flexural/compressive strength ratios (0.17 and 0.19, respectively) of 30S:70CC and 0S:100CC specimens with higher CC contents were higher than the upper limit specified for concrete. This result might be attributed to the high elasticity of the CC aggregate and its fibrous internal structure, which increased its tensile property (Wang et al., 2023). Thus, the toughness of the material with high flexural/compressive strength was also high. As a matter of fact, this finding was also confirmed by the toughness diagram given in Figure 14. In Figure 13b, the correlation between the compressive and flexural strengths of all specimens produced in the study is expressed. Accordingly, the relationship between the compressive and flexural strengths of the NP-based geopolymer mortar was determined according to Equation 3:

$F_c=0.7152(F_f)^2 + 8.3351(F_f)-2.3984$ (Eq. 3)

F_c and F_f symbolize compressive and flexural strengths, respectively. Since the R^2 value in this relation was 98%, there was a high correlation between the compressive and flexural strengths of the specimens.

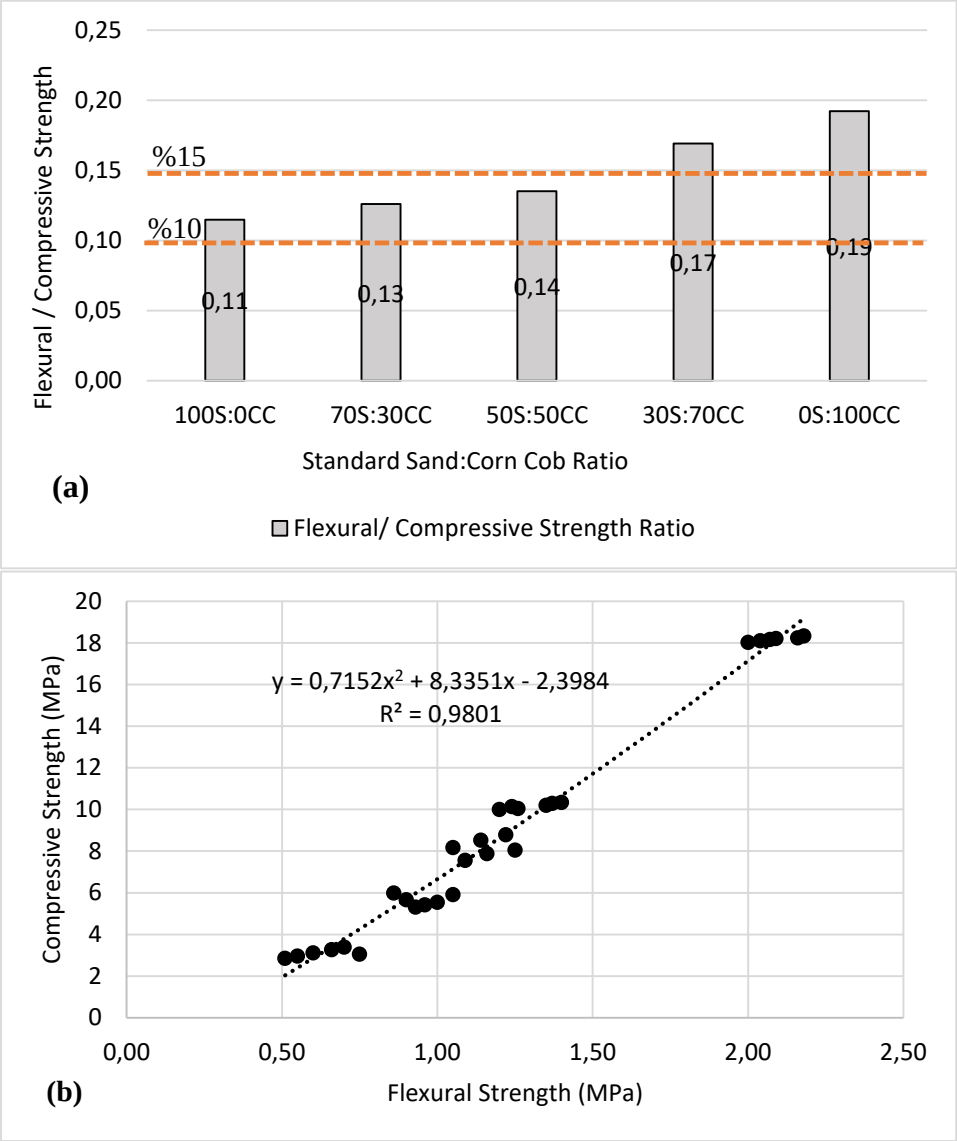

Figure 13. (a) The effect of the S:CC ratio on the flexural/compressive strength ratio of NP-based geopolymer mortar; (b) The correlation between compressive and flexural strength values

Toughness is the area under the stress-strain curve and is a measure of the ability of materials to absorb energy and withstand crack formation during plastic deformation under applied loads. The flexural load-displacement diagram of the NP-based geopolymer mortar is given in Figure 14. The amount of CC significantly affected how the geopolymer mortar was broken. Linear elastic deformation was observed during the initial loading period. As the load was increased, microcracks developed and the curve evolved into nonlinear deformation. The specimen with the highest peak point, i.e., the one that took the highest load, was the control specimen. However, the toughness of these specimens was low, as the area under the load-displacement curve was the lowest. When reaching the maximum load, the curve of the control specimen suddenly dropped, exhibiting a brittle fracture behavior. On the other hand, the fracture behavior of the CC-incorporated specimens was more ductile than that of the control specimen. In contrast to the control mortar, the specimens containing more CC had a higher energy-absorbing capacity (toughness).

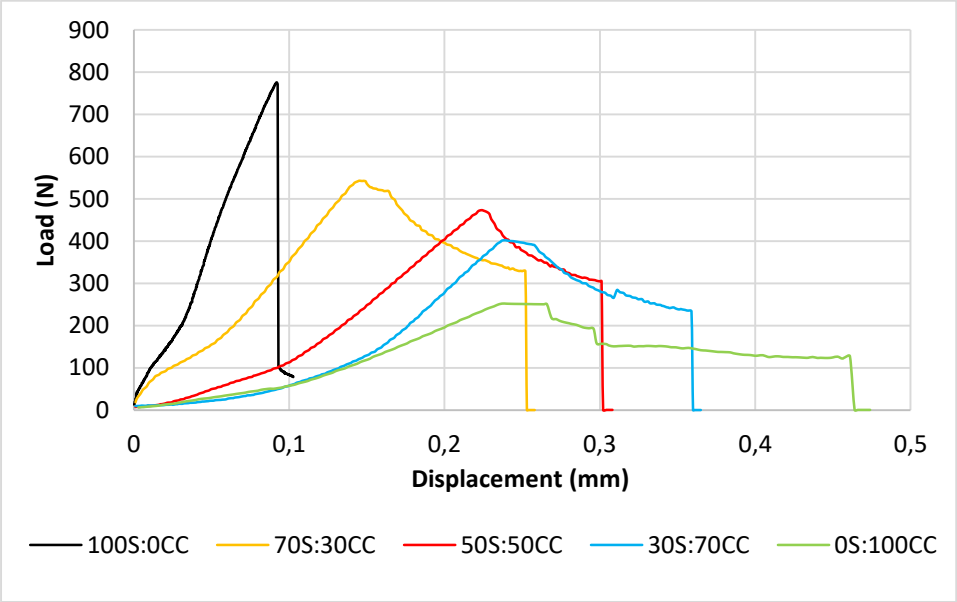

Figure 14. The effect of the S:CC ratio on the flexural load-displacement diagram of NP-based geopolymer mortar

3.5. Using Possibilities of The Produced Geopolymer as A Partition Wall Material

The unit weight, thermal conductivity coefficient, water absorption ratio, and compressive strength values of the NP-based geopolymer mortar were compared with various inorganic partition wall materials used in the construction industry (Table 5). According to this comparison, the unit weight, thermal conductivity coefficient, and water absorption ratio of the control (100S:0CC) and 30% and 50% CC-containing specimens (70S:30CC, 50S:50CC) complied with the requirements of lightweight aggregate concrete, vertically perforated fired clay, and lime-sandstone blocks. The compressive strength of these specimens was higher than that of lightweight aggregate concrete and was in a similar range to that of vertically perforated fired clay and lime-sandstone blocks. The properties of 30S:70CC specimen met the requirements of lightweight aggregate concrete, pumice blocks, and lime-sandstone blocks. The specimen containing 100% CC (0S:100CC), with the lowest unit weight and thermal conductivity coefficient, met the criteria for pumice blocks and aerated autoclaved concrete blocks. As a result of all this evaluation, it is promising that the geopolymer mortar with CC aggregate can serve as an alternative to the traditional partition wall materials widely used in the construction industry. However, the durability performance of the material under various agents should be determined by another experimental research. In addition, the developed mixture should be produced in the nominal size of the traditional inorganic partition wall materials compared here, and the influence of the size on the properties should be investigated.

Table 5. Comparison of NP-based geopolymer mortar properties with conventional partition wall materials

Material	Unit Weight (gr/cm³) (TS 825, 2013)	Thermal Conductivity Coefficient (W/mK) (TS 825, 2013)	Water Absorption Ratio (%)	Compressive Strength (MPa)
Lightweight Aggregate Concrete	0.8-2.0	0.39-1.60	-	1.5-7.5 (TS EN 771-3+A1, 2015)
Pumice Block	0.4-1.3	0.12-0.47	8-35 (Güzel, 1993)	3.0-7.5 (TS EN 771-3+A1, 2015)
Aerated Autoclaved Concrete	0.4-0.8	0.11-0.31	8-18 (Kocataşkın, 2000)	1.5-7.5 (TS EN 12602, 2016)

Fired Clay Brick (Vertically Perforated)		1.2-2.0	0.50-1.40	8-18 (Kocataşkın, 2000)	6-24 (TS EN 771-1+A1, 2015)
Fired Clay Brick (Horizontally Perforated)		0.6-1.0	0.33-0.45	8-18 (Kocataşkın, 2000)	2.5-7.5 (TS EN 771-1+A1, 2015)
Lime- Sandstone Block		0.7-2.2	0.35-1.30	-	5-30 (TS EN 771-2+A1, 2015)
The Current Research	100S:0CC	1.95	0.96	7.14	18.21
	70S:30CC	1.70	0.75	8.12	10.16
	50S:50CC	1.45	0.50	9.26	8.43
	30S:70CC	1.12	0.39	11.65	5.67
	0S:100CC	0.70	0.28	13.01	3.12

4. Conclusion and Suggestions

The conclusions from this research are as follows:

- Nevşehir Pozzolan (NP) as a waste material produced during the extraction and cutting of volcanic stones is a suitable source of aluminosilicate for the production of geopolymer mortar.
- By optimizing important parameters such as activator type and ratio, concentration, and aggregate mixing ratio, geopolymer mortar with a flexural strength of 2.09 MPa and compressive strength of 18.21 MPa can be produced.
- The optimum alkali activator type, NaOH concentration, and activator ratio for NP-based geopolymer mortar are SS + NaOH, 10 M, and 2.0, respectively, because they allow the production of geopolymers with the highest mechanical properties.
- NP-based geopolymer mortar is also suitable for production with corn cob (CC) aggregate, which is an agricultural waste. Thus, new building material is developed by using two different wastes together in this research. The effectiveness of the S:CC aggregate ratio on the physical, thermal, and mechanical properties of NP-based geopolymer mortar is so important that it cannot be ignored.
- Geopolymer materials containing 30% and 50% CC meet the performance requirements of lightweight aggregate concrete, vertically perforated fired clay brick, and lime-sandstone block, which are widely used as partition wall materials in the construction industry. Geopolymer material containing 70% CC meets the criteria for lightweight aggregate concrete, pumice block, and lime-sandstone block, and 100% CC meets the requirements for pumice block and aerated autoclaved concrete. Therefore, it is possible to produce a geopolymer material with desired purposes and properties, by changing the CC ratio, as an alternative to traditional partition wall materials. However, the size effect on the properties should be investigated in another research by producing the nominal dimensions of traditional wall materials.
- The durability of the developed NP-based geopolymer material during the usage period should be determined by further research.

Acknowledgements and Information Note

The article complies with national and international research and publication ethics. Ethics Committee approval was not required for the study.

Author Contribution and Conflict of Interest Declaration Information

The article has a single author and there is no conflict of interest.

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The Evaluation of New Settlements in Rural Areas: Kalecik Village in Tercan District of Erzincan Province

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Abstract

In rural areas where modern residences are rapidly spreading, the local fabric and culture can be relegated to a secondary position, leading to the loss of traditional structures, lifestyles, and authenticity when establishing new settlements. This study aims to determine whether the expectations of the residents living in the new settlement areas built by public institutions in Kalecik village of Tercan district in Erzincan province are met and to assess their satisfaction. In this context, a literature review was conducted, and new settlement areas and residences were examined through on-site observation. Face-to-face surveys were also conducted. The findings indicate that most users have made changes to their homes by adding structures such as oven houses and barns, enclosing open spaces like balconies, and preferring reinforced concrete construction systems. The results emphasize that when planning new rural settlements, the region's climate, culture, and architecture should be taken into account, and the demands of the local population should not be overlooked.

Keywords: *Rural settlement, disaster housing, resettlement housing, housing satisfaction.*

Kırsalda Yeni Yerleşimlerin Değerlendirilmesi: Erzincan İli Tercan İlçesi Kalecik Köyü

Öz

Modern konutların hızla yayıldığı kırsal alanlarda, yeni yerleşim yerleri oluşturulurken yerel doku ve kültür ikinci planda tutulabilmekte ve böylece geleneksel doku, yaşam biçimleri ve özgünlükler kaybolabilmektedir. Bu çalışmada; Erzincan ili Tercan ilçesi Kalecik köyünde kamu kurumları tarafından yapılan yeni yerleşim yerlerinde yaşayanların beklentilerinin karşılanıp karşılanmadığı ve memnuniyet durumlarının belirlenmesi amaçlanmıştır. Bu doğrultuda literatür araştırması yapılarak, yerinde gözlem yöntemiyle yeni yerleşim yerleri ve konutlar incelenmiş, yüz yüze anket yapılmıştır. Kullanıcıların çoğunun konutlarına tandır evi, ahır vb. yapılar ekledikleri, balkon gibi açık alanları kapatarak değişiklikler yaptıkları ve betonarme yapım sistemini tercih ettikleri bulgularına ulaşılmıştır. Sonuçlar, kırsal alanlarda yapılacak yeni yerleşimlerde bölgenin iklimi, kültürü ve mimarisinin dikkate alınarak yerel halkın taleplerinin göz ardı edilmemesi gerektiğini vurgulamaktadır.

Anahtar Kelimeler: *Kırsal yerleşim, afet konutu, iskân konutu, konut memnuniyeti.*

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1. Introduction

Due to the advancements in technology brought about by the Industrial Revolution and rapid population growth, uncontrolled urbanization has begun in cities. This unchecked urban sprawl has led to a decrease in the quality of life in cities, as inadequate infrastructure and disappearing social spaces have resulted in the degradation of natural structures and caused ecological harm. The natural and cultural characteristics of cities have begun to fade away.

In Erzincan province, especially in the last 10 years, urban development has increased, leading to the creation of new residential areas on the eastern and western ends of the city. The widespread urban transformation projects have led to the rapid disappearance of the once-prevalent single-story, spacious residential areas with large gardens throughout the city. Single-story houses with gardens have been replaced by three to four-story apartment buildings with minimal or virtually no green space. Additionally, many mass housing projects have been implemented under the leadership of the Housing Development Administration of Turkey (TOKİ). Although these projects incorporate green spaces, they often overlook the region's local fabric and encourage apartment living, which is detached from the city's culture.

Despite being a city rich in water resources and green areas, Erzincan is gradually losing its green texture today. Consequently, the city center is losing its natural and cultural values. These issues in the city center are also beginning to threaten rural settlements. The urbanization of rural settlements leads to the disappearance of their unique characteristics and traditional ways of life. However, rural settlements, by bringing together various beliefs and lifestyles, using local climate data and indigenous building materials, offer a rich architectural diversity (Özgünler, 2017).

In the past 30 years, it can be observed that the uncontrolled urbanization carried out in rural areas of Anatolia, disregarding settlement patterns, local architectural features, and the needs of the local population, is incompatible with the region and culture. This situation leads to the deterioration and disappearance of both natural and built environmental heritage. Furthermore, the proliferation of urban-focused lifestyles also negatively affects the quality of rural construction and housing patterns (Özgünler, 2017). This rural development is sometimes the result of individual efforts and sometimes occurs through public projects.

Erzincan province is located in a region with a very high risk of disasters, particularly earthquakes. The city is situated on a first-degree seismic belt and has experienced numerous earthquakes in the past. Two major earthquakes have occurred in Erzincan, particularly in the years 1939 and 1992, in terms of both magnitude and intensity. Due to earthquakes, landslides, rockfalls, and flood disasters, the government in Erzincan has implemented many projects. Within the scope of Law No. 7269, the Provincial Disaster and Emergency Management Directorate (AFAD) takes measures to prevent disasters while also establishing new settlement areas in cases where disasters cannot be prevented by relocating existing settlements. Additionally, not only AFAD but also the Provincial Directorate of Environment, Urbanization, and Climate Change (ÇŞİDM) plans new settlement areas in rural regions. While Law No. 5543 is applied to regulate physical settlement in villages, Law No. 6306, concerning the Transformation of Areas at Risk of Disasters, is used to determine risky structures and areas and to implement new settlement areas. However, some aspects of these state-implemented initiatives are found to be inadequate. These settlements are established without adequately analyzing the original character of the settlements, and as a result, they fail to meet the needs of the inhabitants. These new settlement areas established by the government do not align with the traditions, lifestyles, and cultural, economic, and sociological structure of the region's rural areas; they exhibit differences and offer a more modern way of life. Based on this, this article aims to determine the satisfaction of inhabitants in newly established settlement areas in rural Erzincan, created by the government, through surveys.

1.1 Literature Review

This study primarily focused on reviewing the literature on post-earthquake new housing developments and user satisfaction in both Turkey and abroad.

Kamacı-Karahan & Kemeç (2022) focused on the satisfaction of residents living in permanent houses built after the 2011 Van earthquake and their previous neighborhood experiences, with a focus on their beneficiary status. They examined the differences in physical and social environments between the residents' previous and current living areas in Sihke permanent houses after the earthquake. As a result, factors influencing residents' satisfaction with the permanent houses built after the earthquake were determined. The study's findings highlight that residents' previous neighborhood experiences and beneficiary status are significant factors affecting their satisfaction with the permanent houses built after the earthquake. Other factors identified included differences in physical and social environments, house size, layout of living spaces, post-earthquake housing experiences, social and cultural needs, adapting to new neighbors, housing allocation process, distance between the new and old residential areas, and transportation options to the new residential area (Kamacı-Karahan & Kemeç, 2022).

Kürüm Varolgüneş (2021) aimed to determine the factors that increase housing residents' satisfaction and provided information about permanent housing practices after the 2003 Bingöl earthquake in Turkey. Surveys were conducted in four different villages in Bingöl, evaluating housing residents' satisfaction, housing environment, and factors such as the physical, social, and economic features of housing. The study's results revealed significant deficiencies in the planning and implementation of permanent housing production processes. Factors contributing to residents' dissatisfaction included insufficient local community involvement in the planning and implementation process, constructing houses in unsuitable locations with regard to environmental factors, inadequate physical features, lack of consideration for social and economic features, inadequate quality and durability of construction materials, insufficient research into construction sites, and inadequate consideration of environmental factors. The study emphasized that the housing environment was the most crucial factor in increasing residents' satisfaction. Furthermore, housing constructed using local materials and post-disaster education resulted in better economic outcomes and more effective community involvement (Kürüm Varolgüneş, 2021).

In a study concerning post-disaster permanent housing in rural areas, Dikmen (2005) conducted research in Çankırı to investigate the satisfaction of beneficiaries of disaster housing, aiming to uncover reasons for satisfaction or dissatisfaction. By taking measurements and surveys of the disaster housing, changes and additions made to these houses were identified. Based on the evaluations of modifications and additions, a model and design guide was proposed for permanent disaster housing in rural areas. The study highlighted those traditional houses better met local needs. İnhabitants of post-disaster housing sought to adapt these houses to their lifestyles, changing the spatial arrangements, altering the functions of areas, and adding extra spaces. İnhabitants expressed dissatisfaction with elements such as heating, daylight, layout, location, and barns; however, they were satisfied with the cleanliness of the houses and bathrooms.

In their study, Khorshidian and Fayazi (2023) aimed to identify critical factors for the reconstruction of housing in Iran after earthquakes. They examined three different housing reconstruction projects and, as a result of their study, identified 39 critical factors for the success of housing reconstruction projects in Iran. These factors were categorized under four main themes: "risk reduction," "community participation," "organizational design and supply," and "housing design and implementation." It was emphasized that reconstruction designs should be customized to the needs and conditions of affected households, taking into account factors such as psychological healing, transparency, and facilitation. These factors were suggested to enhance community satisfaction and the long-term sustainability of housing reconstruction programs (Khorshidian & Fayazi, 2023).

Bouraoui & Lizarralde (2013) conducted a study in Tunisia to examine the impact of centralized decision-making in the post-disaster reconstruction process on user participation and satisfaction. According to the study's results, centralized decision-making negatively affected the participation and satisfaction of inhabitants in the reconstruction process. To increase user participation and satisfaction, a more participatory approach was recommended, and inhabitants were advised to be more involved in the decision-making process. The study also highlighted the importance of different

stakeholders communicating and collaborating better with each other for a more effective and sustainable reconstruction process (Bouraoui & Lizarralde, 2013).

In Turkey, most of the studies related to rural settlements in the field of architecture focus on the examination and preservation of rural settlements' traditional fabric and traditional housing (Yalçıner, 2022; Örs, 2022; Dilaver, 2022; Koçoğlu, 2022; Göğebakan, 2022; Diker, 2022; Pilevne, 2022; Karadeniz, 2022; Genç, 2019; Güler, 2016; Eres, 2008), as well as the sustainability of rural settlements and rural housing (Korkmaz, 2007; Gülümser, 2009; Bedur, 2011; İner, 2013; Çetin, 2021; Bartu, 2020; Durak, 2019). The Ministry of Public Works and Settlement, Technical Research and Application Directorate, Rural Areas Department, and Mimar Sinan Fine Arts University have conducted two projects under the scope of "Determination of Regional Architectural Features in Rural Areas, Creation of a Guidebook and Sample Projects." These projects were carried out in Kayseri province in 2008 and Balıkesir province in 2011, resulting in the creation of a guidebook. The aim of both projects was to define and document the traditional fabric characteristics and rural housing architecture features of the provinces. Additionally, the projects aimed to identify the effects of economic, cultural, and societal changes on the formation of rural housing architecture (Çorapçıoğlu et al., 2008; Çorapçıoğlu et al., 2011).

No academic study related to housing projects carried out by the Provincial Directorate of Environment, Urbanization, and Climate Change (ÇŞİDM) in Turkey was found. When examining studies related to disaster housing, it is generally observed that the focus is on temporary housing implemented after disasters (Songür, 2000; Baradan, 2002; Arslan, 2004; Yalaz, 2012; Ünal, 2017; Koleri, 2020). In studies concerning permanent disaster housing, multi-story buildings constructed using tunnel formwork methods in urban areas have been mostly examined, with a significant focus on applications in the Marmara region after the 1999 Marmara Earthquake.

There have been studies that have examined the characteristics and issues encountered in permanent housing constructed after disasters in Turkey, particularly the 17 August Gölcük earthquake and the 1999 Marmara earthquake. These studies focus on the features and problems related to permanent housing built after disasters in Turkey (Kaya, 2001). Additionally, there are studies that emphasize the necessity and importance of sustainability in these housing projects and provide recommendations in this field (Bedur 2011).

Considering that 96% of Turkey's territory is within earthquake zones, Korkmaz (2007) advocated for increasing earthquake resilience in rural housing. He suggested an economic intervention to reinforce existing rural houses.

In international studies related to the sustainability of rural areas, Li (2013) aimed to identify the concept of sustainable rural development in impoverished rural areas in southwestern China. It was noted that green building practices in China generally focus on housing and public buildings in urban areas. However, with approximately 50% of the population living in rural areas, the presence of numerous unsustainable rural structures poses a potential threat to China's sustainable development (Li, 2013). X. Zhang & Zhang (2021) conducted a study on the sustainability of rural housing, analyzing embodied carbon emissions, cost comparisons, and sensitivity analysis related to rural housing construction in China. The results indicated that timber construction systems typically have lower carbon emissions and lower costs, while reinforced concrete construction systems tend to have higher carbon emissions and higher costs (X. Zhang & Zhang, 2021).

The literature review also included studies that investigated thermal comfort in rural housing. J. Zhang et al. (2023) examined factors affecting thermal comfort in rural housing in China. Another study conducted in China explored thermal comfort in rural housing at different latitudes in the cold north-eastern regions of the country. The research found that young individuals had a higher demand for thermal comfort compared to the elderly and that women tended to feel colder than men at the same temperature (Shao & Jin, 2020). In a study on how the thermal environment in urban and rural housing in a cold region of China affected the health and comfort of the elderly, it was determined that residents of rural housing had a lower perception of thermal comfort compared to those living in urban housing (H. Zhang et al., 2019).

Zhao (2015) conducted a study on Yanxia village in Zhejiang province, China, which lacked adequate public services. Following the "Construction of a New Socialist Countryside" policy issued by the central Chinese authorities in 2006, it was decided to relocate the entire Yanxia village to a remote settlement. However, this policy resulted in the destruction of historical and local houses, disruption of social relationships among residents due to displacement, and the loss of cultural traditions.

Regarding the rural settlements of Erzincan province, there is only one study available in the literature. In 1993, Parsamanesh conducted a study selecting various villages in the Refahiye district of Erzincan province as a pilot region. Research, examination, surveys, and interviews were conducted regarding the socio-economic life of the villagers and their housing conditions. The survey drawings of 15 selected houses were prepared, and schematics were developed for planning and improving the structures (Parsamanesh, 1993).

The literature review conducted highlights the lack of studies on rural housing and settlements in Erzincan province for approximately 30 years, underscoring the significance of this study.

2. Material and Method

In the scope of the study, a literature review was conducted as a primary step. For data collection, on-site observation and face-to-face survey methods were employed. The study area was determined as Kalecik village in the Tercan district of Erzincan province, influenced by the establishment of two new settlements on different dates by both AFAD and ÇŞİDM. The new settlement areas in Kalecik village were examined, and a total of 52 inhabitants were interviewed and surveyed. The survey data were analyzed using the Statistical Package for the Social Sciences (SPSS) program. This aimed to understand the needs of the inhabitants, assess whether the new settlements established by the government meet these needs, determine housing satisfaction levels, and gather information on changes or additions made or desired by residents in their homes.

2.1. Study Area

Erzincan province, located in the Eastern Anatolia Region, covers an area of 11,903 km² (Karadeniz & Altınbilek, 2018). According to the data from the Turkish Statistical Institute (TÜİK) for the year 2022, Erzincan has a population of 239,223 people, with 166,181 residing in the city center (TÜİK, 2023a). Meteorological data from the General Directorate of State Meteorology (DMİ) for the years 1991-2021 were analysed for Erzincan. According to this data, the lowest average temperature is -1.9°C in January, the highest average temperature is 24.5°C in August, and the highest amount of precipitation is observed in May (DMİ, 2023).

Tercan district, located to the east of Erzincan, is approximately 100 km away from the city center. Kalecik village, situated within the Tercan district, is approximately 43 km away (Figure 1). According to the Address-Based Population Registration System (ADNKS) data for the year 2022, the population of Kalecik village is 333 people (TÜİK, 2023b). Satellite imagery in Figure 2 displays the former settlement of Kalecik village, the location of disaster housing constructed by the Disaster and Emergency Management Authority (AFAD), and the location of housing projects carried out by the Ministry of Environment, Urbanization, and Climate Change (ÇŞİDM).

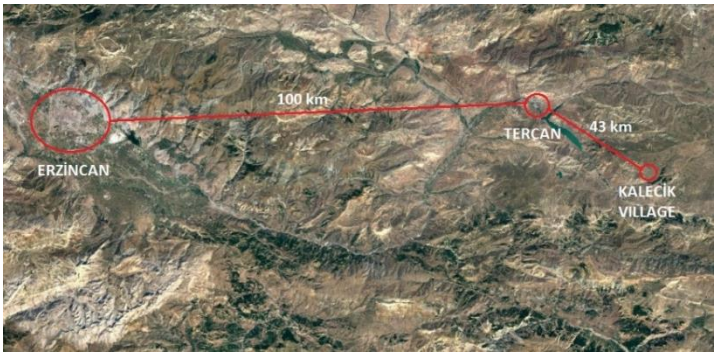

Figure 1. Erzincan-Tercan-Kalecik village satellite image (Modified by T. İnanç)

Figure 2. Kalecik village old and two new settlements satellite images (May 2022)

The old settlement area in Kalecik village was relocated due to rising groundwater and the potential threat of landslides. It was designated as a Disaster-Prone Area (Restricted for New Construction) and prohibited from habitation. Since the old settlement was abandoned for this reason, no one lived there, and most of the houses turned into ruins. Therefore, surveys could not be conducted in this area, and it was not possible to enter the houses. Only outdoor photography was carried out. Although the floor plans of these houses could not be obtained, observational inspections provided insights into the construction system and building materials. In the old settlement area of Kalecik village, houses were predominantly constructed using stone and wood as building materials with a masonry construction system (Figure 3).

Figure 3. Old settlement area of Kalecik village (T. İnanç photo archive)

According to the information obtained during the conversation with the village head of Kalecik village, all the village residents living in both the AFAD houses and the residential houses make their living through livestock farming and agriculture. Agricultural lands are mainly used for growing grass, wheat, and oats, primarily for livestock farming. The village is known for its traditional dishes; with soups, meat dishes, and bakery products being prominent. The villagers bake their bread in tandoors. Traditional family values and neighbourly relationships are highly important. Families generally have large structures, strong family bonds, and a strong sense of mutual assistance. The village adheres to the Islamic religion, with a mosque serving as a place of worship, which is an integral part of traditional life. The village hall, a service building in the village, is used for weddings and funerals. In the region with a continental climate, during the cold winter months, villagers with lower income levels use cow dung for heating due to its economic advantages (Yalçın, 2023).

2.1.1. Settlement area built by the Provincial Disaster and Emergency Management Directorate

Due to the dry streams in the upper part of Kalecik village turning into flowing streams during rainy seasons, the groundwater level rose in the lower part of the village (at elevations of 1950m to 1970m), affecting the houses. Considering that this situation could trigger the thick layer of soil over the basaltic ground, and due to the potential risks of landslide and rising groundwater levels, the decision was made to relocate the village. The new settlement area (Sırt Mevkii) was requested by the villagers who relied on agriculture and livestock breeding for their livelihoods. As a result of the study conducted in this area, it was determined that Sırt Mevkii was located at a higher elevation than the area declared vulnerable to disasters, thus eliminating the risks of rising groundwater levels, rockfall, flooding, and landslides. The area was found to be structurally sound, making it suitable for construction under the provisions of Law No. 7269. Consequently, disaster-resistant housing units were built in this area. The construction of 56 housing units was completed in 2008, and they were handed over to the eligible families. This project led to the creation of a new settlement area (Figure 4).

Figure 4. Kalecik village disaster housing settlement area (T. İnanç photo archive)

The site plan of the AFAD housing settlement area is provided in Figure 5, and unscaled floor plans are presented in Figure 6 (Erzincan Provincial Disaster and Emergency Management Directorate Archive, 2021). These houses were constructed using brick as the building material, employing a rubble construction system. They are single-story, uniform, with a gross area of 92 m^2, and consist of 3 bedrooms and 1 living room (Figure 6, 7). The new settlement area has an approximate slope of 10%, and the plot sizes vary between 588 and 637 m^2. Due to the continental climate prevailing in the region, the natural vegetation flourishes with spring rains and withers during the dry summer, consisting mainly of thorny shrubs, astragalus, and grasses.

Figure 5. Site plan of Kalecik village disaster housing location (Erzincan Provincial Disaster and Emergency Management Directorate Archive, 2021)

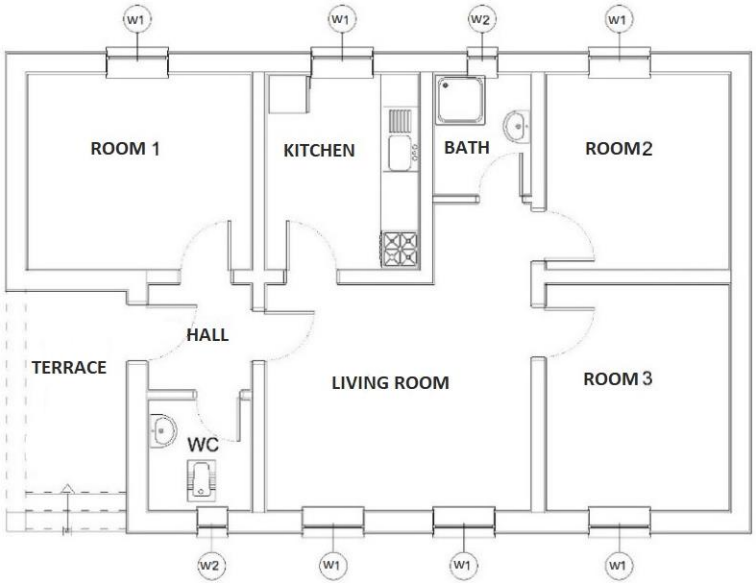

Figure 6. Kalecik village disaster housing (3+1) floor plan (Erzincan Provincial Disaster and Emergency Management Directorate Archive, 2021)

Figure 7. Kalecik village disaster housing (T. İnanç photo archive)

2.1.2. Settlement area built by the Directorate of Environment, Urbanization and Climate Change

To meet the housing needs of extended families accommodating their married children and for those who wish to return to their villages after migrating to big cities, as well as to consolidate Kalecik village and organize the physical settlement, a new settlement area (Figure 8) was established by the Ministry of Environment, Urbanization and Climate Change (Housing units) under the Law No. 5543 in a non-disaster risk area (with the opinion of AFAD) in accordance with the regulations. The construction of 33 single-story housing units and 33 single-story barns was completed in 2019. The layout plan of the settlement area for the housing units is shown in Figure 9, and the applied floor plan is provided in Figure 10 without scale (Erzincan Provincial Directorate of Environment, Urbanization, and Climate Change Archive, 2022). The houses and barns were built on plots ranging from 1017 to 1623 m2. The new settlement area has an approximate slope of 10%. The natural vegetation cover in this area has similar characteristics.

Figure 8. Settlement area of Kalecik village housing units (Photo Archive by T. İnanç)

Figure 9. Site layout plan of housing units and barns in Kalecik village (Erzincan Provincial Directorate of Environment, Urbanization, and Climate Change Archive, 2022)

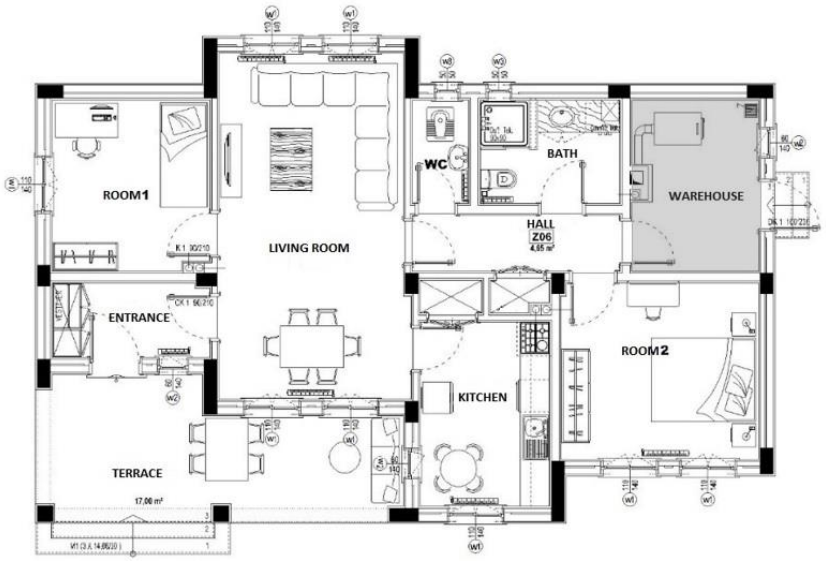

Figure 10. Floor plan of housing units (2+1) in Kalecik village (Erzincan Provincial Directorate of Environment, Urbanization, and Climate Change Archive, 2022)

The housing units were constructed using reinforced concrete construction system, standardized as 110 m^2 gross area, and designed as 2+1 layout. In the floor plan, the space originally intended for installing floor heating was designed as a storage area, but all inhabitants have converted it into a room for use. Therefore, the housing units can be considered as 3+1 layout.

Figure 11. Housing units in Kalecik village (T. İnanç photo archive)

3. Findings and Discussion

In the context of this study, observations were made in Kalecik village on the disaster and settlement housing units, and the following were determined:

- the terrace section was enclosed (Figure 12,13),
- additional structures were built in the garden, such as a woodshed/coal storage, oven house, storage room, poultry house, and garage (Figure 14, 15),
- a solar energy system was installed on the roof for hot water supply (Figure 12,14,15).

Figure 12. Examples of AFAD houses with enclosed terraces

Figure 13. Examples of enclosed terraces in resettlement houses

Figure 14. Examples of additional structures such as woodshed/coal storage, garage, tandoor house, etc. added to AFAD houses

Figure 15. Examples of additional structures such as woodshed/coal storage, garage, tandoor house, etc. added to resettlement houses

When examining the Google Earth satellite images of the resettlement area in Kalecik village carried out by AFAD for the years 2011 and 2022 (Figure 16), it can be observed that within the past 11 years, numerous additional structures have been constructed on the parcels by the residents of the houses.

Figure 16. AFAD housing complex satellite images (a) July 2011 (b) May 2022

Between July and September 2022, surveys were conducted with residents of 30 out of 56 disaster housing units in the AFAD settlement and 22 out of 33 housing units in the settlement area built by ÇŞİDM. Out of a total of 89 residents in both new settlements, 37 chose not to participate in the survey, and some were not available at home, resulting in interviews with a total of 52 participants. Survey data was entered into the SPSS program for analysis, and the results are presented below.

Descriptive statistics for gender, age, education, and occupation of the inhabitants who participated in the survey are given in Table 1 according to the type of housing. Among the 52 participants, 63.5% (33 individuals) were male, and 36.5% (19 individuals) were female. Regarding age distribution, it was observed that 4 individuals (7.7%) were between 18 and 30 years old, 18 individuals (34.6%) were between 31 and 45 years old, 17 individuals (32.7%) were between 46 and 60 years old, and 13

individuals (25%) were 61 years old and above. In terms of education, 55.8% of participants had completed primary school, while 28.8% had no formal education. Neither settlement area had individuals with a master's or doctoral degree. Among the 52 participants, 29 were farmers, and out of the 19 women, 17 were housewives.

Table 1. User characteristics according to housing type

User Characteristics		AFAD Housing	Resettlement Housing	Total	Percentage (%)
Gender	Man	18	15	33	63,5
	Woman	12	7	19	36,5
Age	18-30	3	1	4	7,7
	31-45	8	10	18	34,6
	46-60	7	10	17	32,7
	61 and above	12	1	13	25
Education	None	12	3	15	28,8
	Elementary	13	16	29	55,8
	Middle School	1	1	2	3,8
	High School	3	2	5	9,6
	University	1	0	1	1,9
	Master's and Doctoral Degrees	0	0	0	0
Occupation	Retired	2	0	2	3,8
	Housewive	11	6	17	32,7
	Farmer	15	14	29	55,8
	Livestock breeder	0	0	0	0
	Civil servant	0	0	0	0
	Other	2	2	4	7,7

The answers provided by the inhabitants to the question "What type of building material would you prefer for your house?" were examined according to the type of housing (Table 2). Among AFAD inhabitants, 60% prefer their houses to be made of reinforced concrete, while 40% prefer stone. All of the surveyed resettlement inhabitants expressed their preference for reinforced concrete as the building material for their houses.

Table 2. Participants' preference for building materials for housing

Building Material	AFAD Housing (n)	Resettlement Housing (n)
Reinforced Concrete	18 (%60)	22 (%100)
Stone	12 (%40)	0

According to the responses to the question "What changes have you made in your house?", out of 30 AFAD inhabitants, 28 have closed the terrace, and out of 22 inhabitants in the settlement area, 20 have closed the terrace (Table 3). In all AFAD houses, the terraces face the southwest direction (Figure 5), while in the resettlement housing, they face different directions (Figure 9). In the resettlement housing, eleven of the terraces face northwest, seven face southeast, seven face northeast, five face southwest, one faces north, and one faces south. According to the survey results, 26 of those who enclosed their terraces in AFAD houses did so to protect against the cold, one did so to protect against both the cold and the wind, and only one did it to gain extra space. Two inhabitants who wanted to enclose their terraces when possible also cited protection against the cold as the reason. In the resettlement houses, 19 inhabitants who enclosed their terraces did so to protect against the cold, one did it to protect against the wind, and one said they would enclose their terrace when possible to protect against the cold. When traditional houses were examined, it was observed that none of the houses had terraces.

Table 3. Distribution of inhabitants who have closed balconies/terraces in their houses according to housing type

	AFAD Housing (n)	Resettlement Houses (n)
Enclosed Balcony/Terrace	28	20
No enclosed Balcony/Terrace	2	2

When examining the answers given to the question "What changes would you like to make in your house?", it is observed that out of 52 inhabitants, only two AFAD inhabitants mentioned that they would like to shift the wall to enlarge the living room. Two AFAD inhabitants and one settlement housing user expressed their intention to close the terrace; seven AFAD inhabitants and three settlement inhabitants indicated they would like to renovate the plumbing of the kitchen, bathroom, and toilet; and 15 AFAD inhabitants mentioned their desire to install wooden parquet in the living room and bedrooms. 11 AFAD inhabitants expressed their intention to renovate the kitchen, 12 for the bathroom, and 11 for the toilet. Among the settlement inhabitants, three mentioned their intention to tile the bathroom and toilet with ceramic. Additionally, two AFAD inhabitants and three settlement inhabitants expressed their desire to change the bathroom tiles (Figure 17). Furthermore, one AFAD housing user mentioned building a garden wall, one user stated the intention to change the roof to metal sheets, three expressed their intention to renew kitchen cabinets, and two wanted to add a room to the house. Among the settlement inhabitants, one mentioned the intention to enlarge Room 1 (Figure 18).

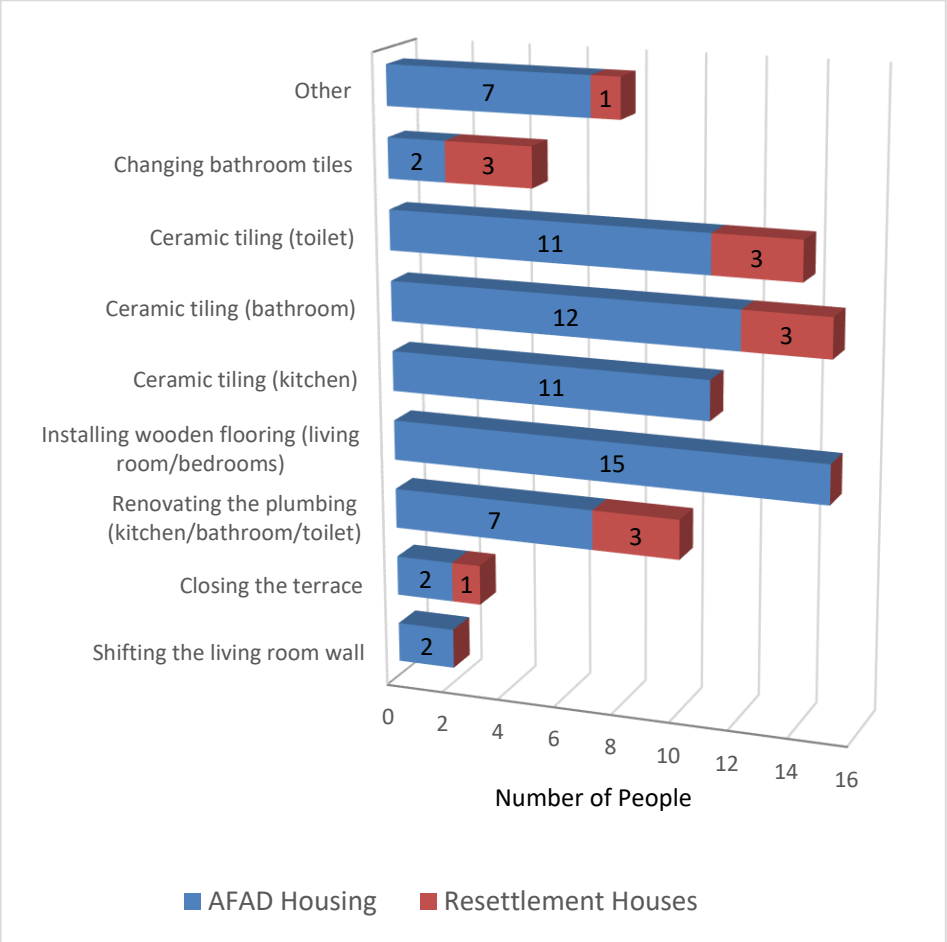

Figure 17. Distribution of changes residents want to make in their homes

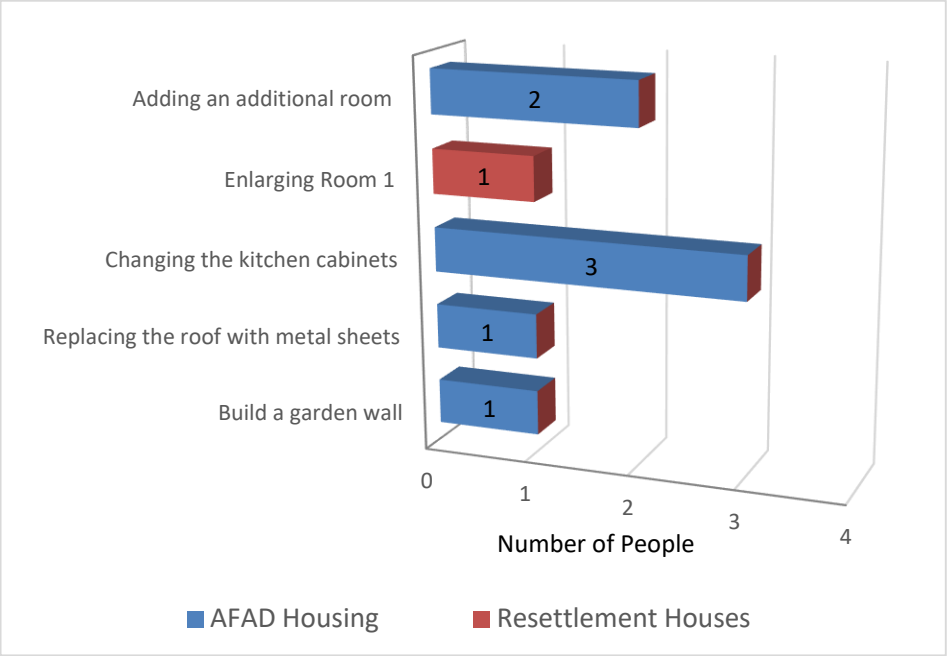

Figure 18. The distribution of changes that users who selected the "other" response wish to make in their residences

Both in AFAD housing and settlement housing, it has been determined that the majority of inhabitants have built additional structures in their gardens. These additional structures have been constructed either as standalone units in the garden or attached to the house/barn. Information about these structures in the gardens is provided in Figure 19 below.

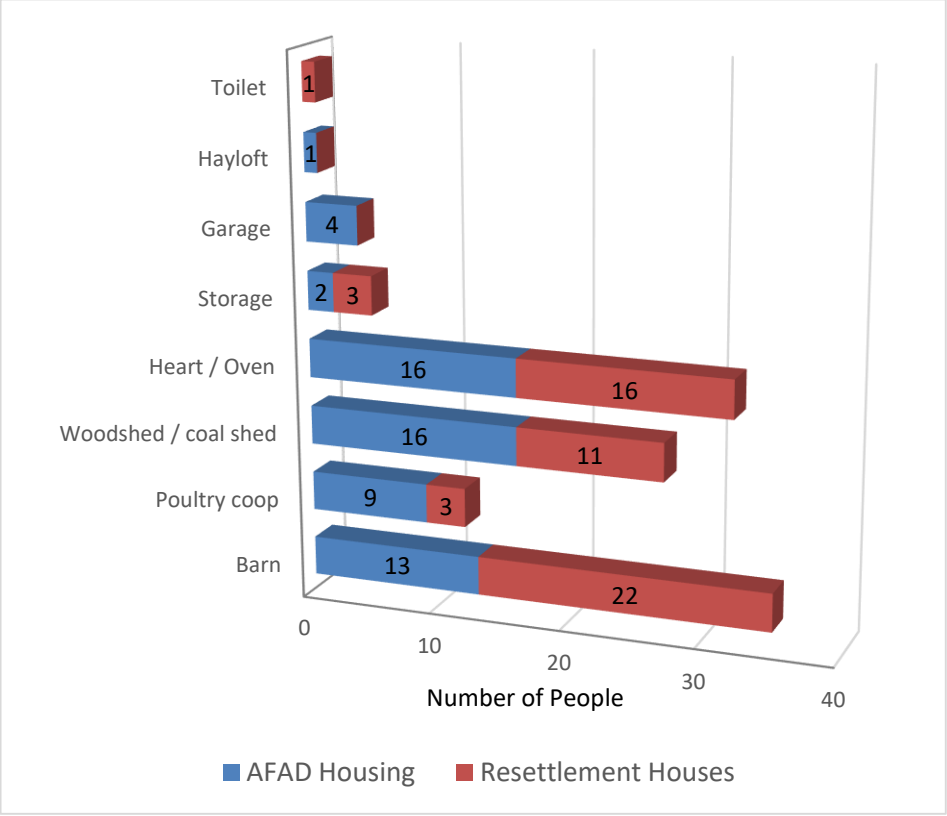

Figure 19. Information about the structures located in the gardens of the houses

The responses to the questions related to housing satisfaction in the survey are presented for AFAD (Disaster and Emergency Management Authority) houses in Figure 20 and for resettlement houses in Figure 21. In both residential areas, satisfaction with the dwelling, layout, lighting, and ventilation is

observed to be high. However, inhabitants' satisfaction with insulation and roofing is low. Eight individuals from AFAD houses and 17 individuals from resettlement houses expressed dissatisfaction with the roofing, while nine individuals from AFAD houses and 14 individuals from resettlement houses indicated dissatisfaction with the insulation of the houses.

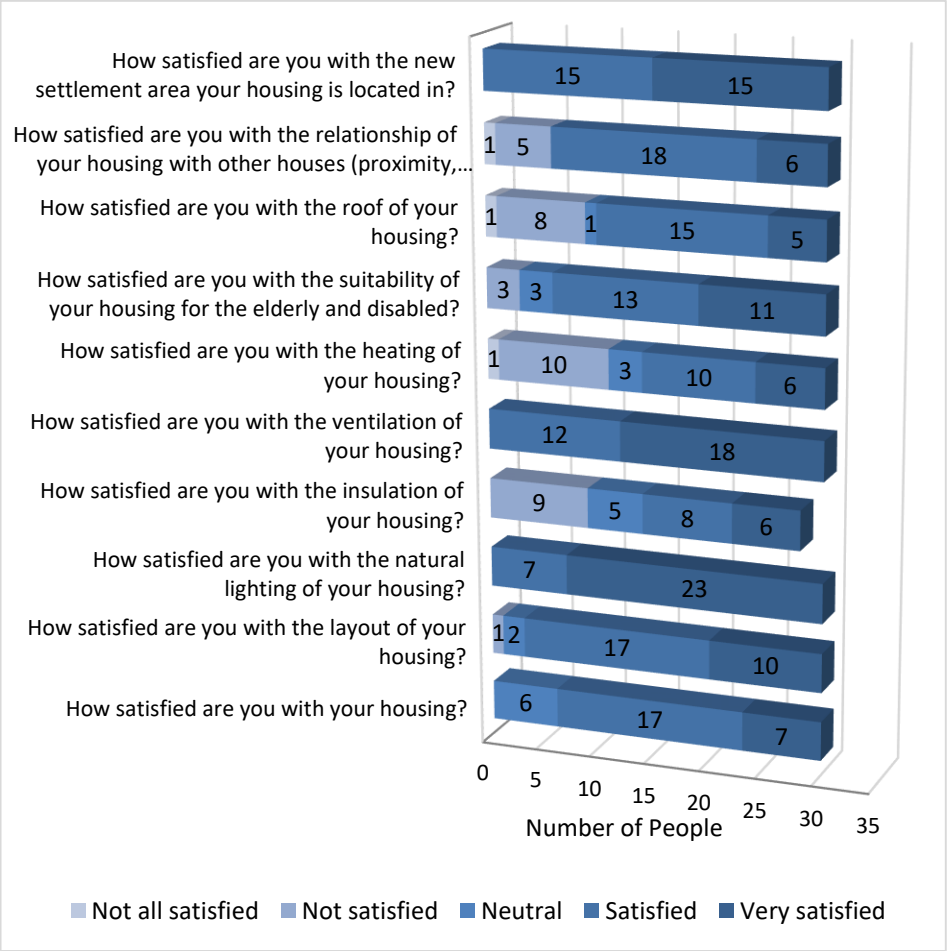

Figure 20. Kalecik Village AFAD Housing Resident Satisfaction

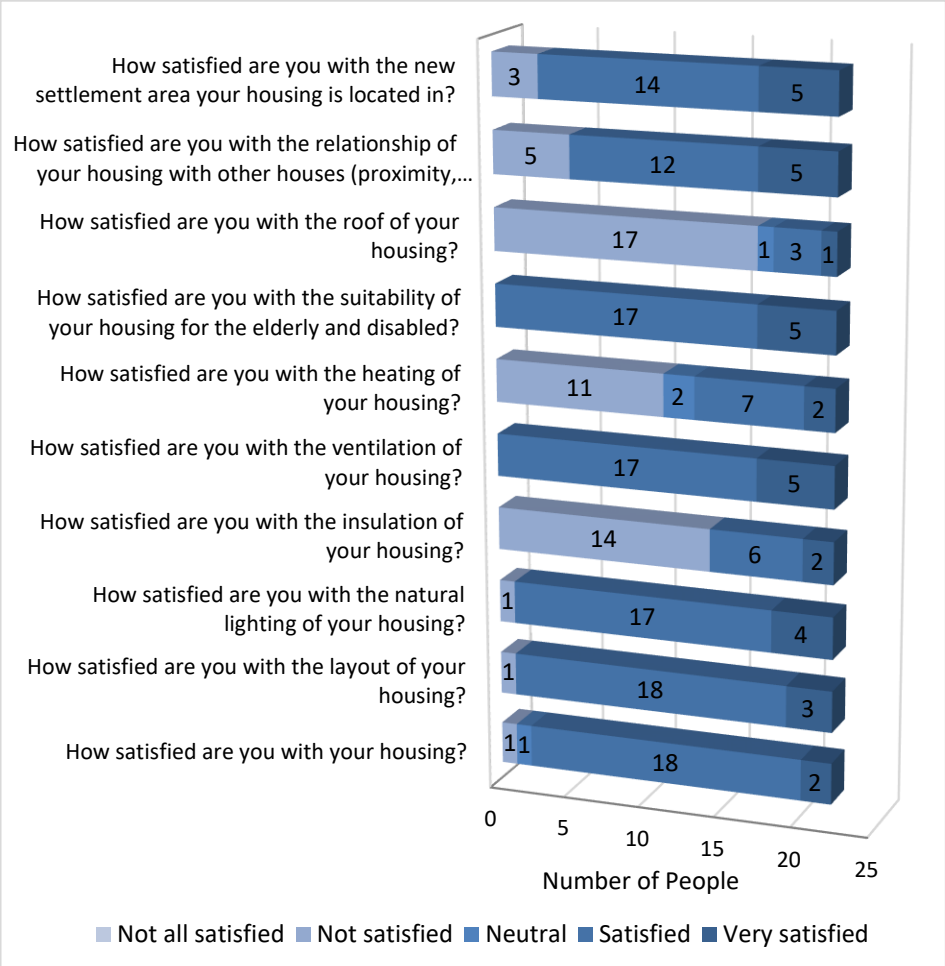

Figure 21. Kalecik Village resettlement housing resident satisfaction

According to the study conducted by Pormon et al. (2023) on housing satisfaction in newly established areas after Typhoon Haiyan in Tacloban, Philippines, it was found that satisfaction with post-disaster constructed housing was moderate to high. However, factors such as wall cracks and infrastructure deficiencies significantly affected housing satisfaction negatively. One of the results of this study in Kalecik village was the distance of post-disaster constructed housing from the settlement area, which similarly emerged as an undesirable situation among the results of Pormon et al.'s study. In another study, Wijegunarathna et al. (2018) found that in new resettlement areas in Sri Lanka after floods, landslides, and tsunamis, the adequacy of the number of rooms and the lighting and ventilation features of the houses increased housing satisfaction. Furthermore, the availability of opportunities for housing orientation, arrangement, expansion, and modification was associated with higher overall satisfaction (Wijegunarathna et al., 2018). Similarly, in our study's results, it was found that individuals were capable of making various changes to their housing in different areas, indicating that housing satisfaction can vary based on these alterations. In a study by Tas et al. (2007) examining the problems related to the usage of Kocaeli Güneşköy Permanent Housing area constructed after the 1999 Marmara Earthquake, it was determined that positive characteristics such as proximity to the city center and necessary social facilities (educational buildings, places of worship, healthcare facilities) and easy access to public transportation were associated with higher housing satisfaction. In Kalecik village, the results similarly indicate that inhabitants in the new settlement areas have high satisfaction with the layout, lighting, ventilation, suitability for the elderly, and the new settlement area itself. However, their satisfaction with insulation and roofing is lower. Karki et al. (2022) found that in Nepal, after the earthquake, the socio-political issues arising in the housing reconstruction process needed more involvement from participants. They also provided solutions such as improving the planning and implementation of reconstruction programs. Oo et al. (2018) highlighted the importance of objectively evaluating the long-term satisfaction and expectations of inhabitants participating in post-disaster

permanent housing reconstruction programs. They noted that user participation significantly affected long-term housing satisfaction, and inhabitants wanted housing designs that were suitable for cultural and local conditions, climate, and cultural sensitivities. In the case of Kalecik village, this study's results emphasize the importance of involving housing inhabitants in the reconstruction process and taking into account their lifestyles and cultures when designing new housing.

He et al. (2019) conducted a study in China's Sichuan region to understand the challenges faced by earthquake survivors and the reconstruction of settlements. According to face-to-face surveys with homeowners, many earthquake survivors felt worse after the reconstruction of settlements. They believed that the newly constructed buildings were more comfortable and modern, but were not satisfied with the size of their new apartments. In contrast, in Kalecik village, inhabitants were generally satisfied with the modern style of the newly constructed housing and found them to be more comfortable and cleaner. This difference may be attributed to the proximity of the new settlement areas in Kalecik village to the old ones.

4. Conclusion and Suggestions

Due to the underground water rise and landslide disaster in Kalecik village, Tercan district of Erzincan province, disaster housing settlements were established by AFAD (Disaster and Emergency Management Authority) with the purpose of consolidating the settlement area and organizing the physical layout of the village, alongside conventional housing settlements by ÇŞİDM (Ministry of Environment and Urbanization). In this study, both the new government-established settlements and the old Kalecik village settlement were examined, and surveys were conducted with inhabitants in the newly established settlements.

While an orthogonal grid system was preferred for AFAD settlement planning, a more flexible and curved grid system was chosen for the ÇŞİDM settlement. The slope of the land is nearly the same in both settlement areas (approximately 10%). Parcels containing conventional housing and barns were designed to be significantly larger compared to parcels with disaster housing. This suggests that AFAD's decision not to build barns but to focus solely on housing planning was effective. In both areas, main roads were designed to be 10 meters wide, while secondary roads were 7 meters wide, except for one axis in the AFAD settlement with a width of 9 meters. The natural vegetation is similar in both areas, consisting of thorny bushes, astragalus, and grasses.

Through the examination, it was observed that in the old village settlement, houses were constructed using stone as the building material and rubble masonry construction method. In contrast, disaster housing used brick as the building material and rubble masonry construction method, while conventional housing used brick and reinforced concrete construction. Despite stone being the main building material in the old settlement, a majority of survey participants expressed a preference for their houses to be made of reinforced concrete due to their cleanliness. As a result, it should be more appropriate and recommended to use reinforced concrete in the new houses to be built in the future.

Regarding the changes made or desired by inhabitants in their houses, survey questions revealed that in both disaster and conventional housing settlements, a significant portion of inhabitants enclosed their terraces, with some being unable to do so due to financial constraints but expressing the desire to enclose them. The primary reason for the terrace enclosure was to protect against the cold. Additionally, many inhabitants in both types of settlements expressed the desire to have wooden parquet flooring and ceramic tiling for wet areas in their disaster housing. İnhabitants generally expressed dissatisfaction with the plumbing system in both types of settlements, stating issues like water leaks and indicating a desire to renew the plumbing systems through the survey. It is recommended that designs for new houses consider climate conditions and are guided by the preferences of the inhabitants. Using high-quality materials and ensuring their correct implementation in the houses can increase user satisfaction and, in the long run, may not result in additional expenses.

In both new settlement areas, it has been determined that a majority of inhabitants have constructed additional structures either independently or in their gardens. For instance, in the settlement established by AFAD, only houses were provided to disaster-affected families, but a significant number

of inhabitants have constructed additional structures in their gardens, such as barns, chicken coops, hearth/oven houses, and wood/coal storage units. Similarly, in the conventional housing settlement, even though barns were provided for all inhabitants, some have expanded their barns through additions or constructed a second barn at a different location. Moreover, inhabitants in both settlement areas have constructed structures like chicken coops, hearth/oven houses, and wood/coal storage units. It is anticipated that designing new housing areas by considering the lifestyle, traditions, and needs of inhabitants, and incorporating structures such as barns, coops, hearths/tandoors, and wood/coal sheds into the design, can increase user satisfaction.

In addition to the findings of our study, the factors influencing housing satisfaction highlighted by the literature, such as neighbourhood experience (KamacI-Karahan & Kemeç, 2022), suitability of the project area, environmental factors (Kürüm Varolgüneş, 2021), customization of projects according to inhabitant needs (Khorshidian & Fayazi, 2023), involving inhabitants more in the decision-making process (Bouraoui & Lizarralde, 2013), sustainability (Bedur, 2011), a distance of housing from social areas and settlement (Pormon, 2023; Tas vd., 2007), climate conditions, and cultural sensitivity (Oo vd, 2018) should be considered in designing new housing areas in rural areas to ensure higher inhabitant satisfaction.

Based on the data obtained from this study, it is evident that when designing settlement areas and housing in rural areas, it is essential to consult with inhabitants to determine their needs and develop projects that are in line with their lifestyles and cultures. Otherwise, it has been observed that inhabitants tend to make changes to the constructed housing, add additional structures to their gardens, and modify the housing to suit their lifestyles. This research is expected to serve as an inventory for future projects in rural areas and guide public institutions in the planning of new settlement areas initiated by the government. This way, the preservation and enhancement of the identity of rural settlements can be supported.

Acknowledgements and Information Note

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Author Contribution and Conflict of Interest Declaration Information

In the article, the first author contributed to the literature review, data collection, processing, analysis, and manuscript writing, while the second author provided guidance, literature review, and critical review. There are no conflicts of interest.

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The Place of Ekphrasis in the Formation of Architectural Narrative

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Abstract

In the architectural design process, the architect(designer) engages in an internal dialogue with themselves, the object of their design, and other stakeholders. This dialogue, in turn, takes place through language and reveals a narrative. Within the architectural design, this language is established through (architectural) representation/ drawing. However, architectural drawing possesses symbolic and semantic layers akin to any language. This study focuses on these layers through "ekphrasis", which is based on the relationship between visual and verbal representation, and asks: "How does ekphrasis as a method relate to the meaning of architectural drawing, and how does it find a place for itself in the architectural narrative?" In this study, the text-meaning-drawing relationship is examined using the deconstruction method and case study techniques. Therefore, a drawing workshop was conducted utilizing Homer's Iliad, as it was the first ekphrastic text. The findings are then discussed in relation to the role of ekphrasis in shaping the architectural narrative.

Keywords: *Ekphrasis, architectural narrative, architectural drawing, architectural representation*.

Mimari Anlatının Oluşumunda Ekfrasisin Yeri

Öz

Mimari tasarım sürecinde mimar(tasarımcı) kendisiyle, tasarladığı şey ile ve/veya diğer paydaşlar ile bir diyalog içerisindedir. Diyalog ise dil aracılığıyla gerçekleşir ve bir anlatı açığa çıkarır. Mimari tasarım süreci bağlamında bu dil, (mimari) temsil/çizim üzerinden/aracılığıyla kurulur. Ancak herhangi bir dilde olduğu gibi, mimari çizimde de sembolik ve anlamsal katmanlar o dilin içerisine yerleşir. Çalışma, bu kapsamda ilerleyerek, mimari temsilde/çizimde anlam üretimine odaklanır. Anlam tartışmasını yürütebilmek için görsel ve sözlü temsil ilişkisi üzerine kurulan "ekfrasis" kavramından faydalanılır. Bir yöntem olarak ekfrasis mimari çizimin anlam dünyası ile nasıl ilişkilenir ve mimari anlatıda kendisine nasıl yer bulur? sorusu üzerine kurulan çalışmada metin-anlam-çizim ilişkisi sorgulanır. Çalışma yapı söküm yöntemi ve örnek olay inceleme tekniğinden faydalanılır. Bu bağlamda ilk ekfrastik metin olması nedeniyle Homeros'un İlyada kitabının Akhilleus'un kalkanı bölümünden bir metin kesitinin seçildiği bir çizim atölyesi gerçekleştirilir. Atölyenin sonunda elde edilen veriler değerlendirilir ve sonuçlar mimari anlatının oluşumunda ekfrasisin yeri bağlamında tartışılır.

Anahtar kelimeler: *Ekfrasis, mimari anlatı, mimari çizim, mimari temsil.*

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1. Introduction

"*Bronze, he flung in the blaze, tough, durable bronze and tin and priceless gold and silver, and then, planting the huge anvil upon its block, he gripped his mighty hammer in one hand, the other gripped his tongs* (…)" (Homer, 1991)

When we read the aforementioned lines, the images that are evoked in our minds and the unfolding plot associated with these images take the form of a "narrative." According to Coates, the term narrative finds its origins in the Latin verb 'narrare'. A narrative "organizes events of a real or fictional nature into a sequence recounted by the narrator" (Coates, 2012, p.15). The inseparable bond of the narrative with the "event" relates to many fields. Within the scope of this study, this field is limited to the architectural design process and (architectural) drawing. The intimate relationship between narrative and architecture is expressed as architectural narrative. At this point, asking how the narrative is formed in the architectural design process would be appropriate.

Dialogue plays an essential role at every stage of the architectural design process. It is established both with the designer himself/herself and with each stakeholder contributing to the process. Here, the dialogue established by the designer with himself/herself during the process has an important place in the development phase of the design, as it contributes to the decision-making process. For this, architectural drawing (with its symbolic and semantic layers)- which refers not only to conventional techniques but also to personal expression forms consisting of sketches, scribbles, and abstract drawings- is used as a tool. The process is sometimes carried out with the dialogue established with an imaginary subject expressed as the user and the actions of that subject, sometimes with (abstract) lines that foster reflection on the space, and sometimes with the space/space thoughts that emerge spontaneously in the traces of the events. The symbolic layers of the (architectural) drawing used in the process appear as a form of expression on which we can agree. Symbolic layers can be thought of through Frascari's (2009) expression of "(…) two lines make a wall, a dash line indicates something hidden, and so on (…)." Here, we are talking about a layer of expression that we can understand as representing the wall when we see two lines side by side in an architectural drawing. On the other hand, the semantic layers of (architectural) drawing also begin to inform us about the intellectual process of the "drawing hand" (Pallasmaa, 2009). In this context, although each process differs in itself, the sequences of events and the search for meaning or expression form new narratives. Thus, the way the narrative is constructed differs through some methods. Within the scope of the study, the ekphrasis, which we can see from the lines above, has been chosen as one of these methods. Ekphrasis, on the other hand, can be expressed in the most general sense as the verbal representation of visual representation (Heffernan, 1993).

Building upon the aforementioned line of thought, the study poses the following question: "How does ekphrasis as a method relate to the world of meaning in architectural drawing, and how does it contribute to the architectural narrative?" Since it is the first ekphrastic text (Becker, 1995), a text section from the chapter, Achilles' Shield, from Homer's (1991) Iliad has been selected. A drawing workshop was also set up to explore the possibilities of using ekphrasis throughout this text. The workshop participants read the text and, using this text, tried to undertake *textual(meaning)* analysis. The participants then produced drawings and texts based on relevant inferences. The workshop encompassed the reading, drawing, and writing stages of a text because while producing and reading a text and/or drawing, images can come to life in the mind, and these images can become a meaningful whole when they are given form in a plot. Finally, all the productions in the workshop process were deconstructed in the context of the *text (meaning)/ drawing-text* relationship, and the resulting data were discussed in terms of the role of ekphrasis in shaping the architectural narrative.

2. Material and Method

The meeting point of a written (literary) text and architectural drawing can be thought of through the concept of *representation.* Similarly, Nane (2021) notes that representation is an important issue in literature and architecture and establishes the intersection of these two disciplines over the representation concept. The origin of the word representation corresponds to the expression "simile,

simulate" (Nişanyan dictionary). The representation concept, which points to a relationship between something itself and its like, can be explained through Joseph Kosuth's *One and Three Chairs* from 1965 (MoMA). The work, which consists of the chair itself, its photograph, and a text describing the word chair, gives visibility to the different dimensions of the representation. The transitive relationship between reality and representation can be evaluated through the chair, which is expressed as "a visual code, a verbal code, and a code in the language of objects" (MoMA) through the relevant example. While the photograph of the chair or the meaning of the chair word is a form of representation, the fact that the chair takes this name in the language also makes the object itself a representation. On the other hand, each object (the chair itself, its photograph, and the meaning of the word) gains a reality as entities. Therefore, the aforementioned transitive relationship between reality and representation is revealed through symbolic and semantic layers, just like in a language. From this point of view, a text containing the layers mentioned above and an (architectural) drawing represent both themselves as objects and what they describe.

A similarity can be established between the fields through the representation approach, used in different fields such as literature, architecture, and art and expressed as a kind of language (Gürer & Yücel, 2005). However, this does not change the fact that they have their language. However, two fields, such as literature and architecture, can feed each other through the meaning layer of language and come together at the intersection of "meaning." In this context, ekphrasis has been used to discuss the relationship between a literary text and an architectural drawing as a tool. The aforementioned relationality has been evaluated through the "text (meaning)/drawing-text" expression, which is generated.

The concept of ekphrasis first emerged in rhetoric and was used as a "full or vivid description" (Wagner, 1996, p.12). In its most familiar form, the concept has been defined by those such as Tom Mitchell, Grant F. Scott, and James Heffernan as "the verbal representation of visual representation" (Wagner, 1996, p.10). Ekphrasis is expressed as the transfer of the visual to the verbal, a "speaking out", or a "telling in full" (Heffernan, 1993, p.6). In this sense, ekphrasis appeals to different sensations and perception styles. However, due to the nature of the sensing and representation systems, the transferences in question also contain a gap in the structure. At this point, an ekphrasis is an expression form/technique in which any element or combination of elements of a story can be told with the vitality required to appeal to the audience's imagination (Webb, 2009, p.65).

The text of Homer's *Shield of Achilles* as "the touchstone for ekphrasis in ancient Greek and Latin literature, and for much later European literature" (Becker, 1995, p.3) is widely accepted. In this context, the first ekphrastic texts were encountered in "literature and art history" (Wagner, 1996, p.13). However, the expansion and recognition of ekphrasis' usage coincide with the middle of the 20th century, in conjunction with the adoption of critical discourse. "Linguistic turn" (Webb, 2009, p.36), which can be considered a development that saves descriptive studies in approaches to works of art from the expectation that language should describe reality and underlines the problems related to oral representation (Webb, 2009, p.36), can be counted among the reasons for this expansion. The semantic expansion in the concept of ekphrasis, starting from poetry, "evolves into the application areas of visual arts such as painting, cinema, and photography" (Şenyigit, 2021). In Leo Spitzer's words: "The ekphrasis, the description of an objet d'art by the medium of the word, has here developed into an account of an exemplary experience felt by the poet confronted with an ancient work of art …" (Cited in Webb, 1999, p. 34). So, the infiltration of the concept into different areas may be related to its inhabiting a similar discussion ground to that of 'narrative'. As a matter of fact, Wagner also noted that "narrative seems to be consubstantial with ekphrasis, if not with verbal representation" (Wagner, 1996, p.70). At this point, Webb's question can be asked again: "When is a narrative 'vivid' enough to be an ekphrasis?" (Webb, 2009, p.71).

The concept of vitality or "enargeia" is the quality that creates the ekphrasis. Therefore, it belongs to language understanding as a quasi-physical force that activates images in the listener's mind. *Enargeia* is essential for activating and recreating perception (Webb, 2009, p.128; Goldhill, 2007, p.7). Therefore, one can say that *enargeia* is effective in using ekphrasis in different fields and in establishing

its relationship with different representation systems. Ekphrasis ranges from various performance arts to films, from art history texts that give detailed descriptions of visual works to stories and novels (Ağıl, 2015, sp.13). In this context, "the main features of ekphrasis, the narrator, referent, viewer/reader relationship, interpretation, open work, narrative, transfer of structural and semantic content" (Somer & Erdem, 2015, p.192) help to relate it to the architectural design process. These contextual relations of ekphrasis pave the way for the interpretation of the text/work (Benton, 1997, p. 367). Thus, each perception, interpretation, analysis, or association reveals creative potential. Each time, the reader or the audience rediscovers the reflection of a representation in another representation tool through their own critical interpretation (Ağıl, 2015, p. 46). In sum, ekphrasis, as a form of transforming visual representation into literary representation, appears as a method and/or approach and contributes to different fields. Within the scope of this study, ekphrasis is discussed together with architectural drawing (representation) as a method, and consideration is also given to how ekphrasis can find a place in the formation of the architectural narrative.

Since the formation of the architectural narrative is related to mental processes, as in other narrative forms, it becomes special for the people who construct that narrative or encounter it, and it needs "a plot (sjuzet)" (Eco, 1995, p.41). The concept of "plot" or "narrative" is what we make every day of our lives (Abbott, 2006), a significant concept that multiplies in the cycle of understanding and explanation (Alemdar & Aydınlı, 2011, p.85). These multiple states of the narrative make establishing relations with different fields easier. The relationality in question enables us to focus on the architectural narrative through (architectural) drawing. Architectural narrative can likewise be multiplied by folding on itself. As a matter of fact, the study in which Alemdar & Aydınlı (2011) discuss architectural narrative through image can be evaluated in this context. According to them, the architectural narrative exists by being articulated with the plot of the built environment. Including an image of a built environment/object in the plot is possible by deciphering, transforming, and interpreting the various network relations of its layered structure. In this context, one can say that the acquisition/existence of the architectural form is the manifestation of the multidimensional structure of a network of relations/meanings. The narrative in question is temporal, and the narrative in this temporality, between the present, the past, and the future, can be constantly reproduced. An image/narrative can potentially be an architectural environment/structure/product or architectural production itself. While the discipline of architecture tends towards philosophy and art through concepts, it is also related to different contexts of reflection and representation in the mind. All this thinking and representation is intertwined with criticism as it leads to reproduction/thinking. In this network of relations that create each other, design, representation, image, and criticism reveal the multi-layered structure of the discipline of architecture (Alemdar & Aydınlı, 2011, p. 85). The multi-layered structure of the architectural discipline and the narrative are discussed in the study through (architectural) drawing, and the meaning dimension of the narrative is discussed through ekphrasis.

In the study, the deconstruction method and case study technique are used. For this, a workshop was designed, and the workshop process was conducted using the *text(meaning)* and *(meaning)drawing-*text stages. The final data were evaluated over the *text(meaning)/drawing-text* relationality.

A workshop was designed to explore the potential of texts in architectural narrative and to reveal the possibilities of ekphrasis as a method. For this reason, it was essential that the workshop participants had both basic architectural knowledge and that they were at the beginning of their education process. Accordingly, participation in the workshop was limited to second-year students. In order to deeply examine the data to be obtained at the end of the workshop, the number of participants was limited to 6. The workshop was conducted with the participation of these 6 volunteer students from the second-year Faculty of Architecture, Department of Architecture of Ondokuz Mayıs University in the fall semester of 2022-2023. Students participating in the study were referred to as A, B, C, D, E, and F.

3. Findings and Discussion

At the beginning of the workshop, the purpose of the workshop and its processes were explained to the participating students. Then, a text fragment from the 18th chapter of Homer's (1991) Iliad was given to them since it is the first ekphrastic text (Ağıl, 2015). The text section given to the students was

the introduction to the story of Achilles' Shield (See Appendix 1). Within the scope of the study, the students first read the text and thus started the workshop's *text (meaning)* process. At this stage, it was observed that the students who had encountered the given text for the first time read it several times, and some of them took various notes on the text and made markings and drawings (Figure 1). After the reading phase, the students moved on to the drawing phase, where they were released in terms of technique and material use. Later, the students were asked to write a few sentences in relation to what they had understood from what they had read and how they had drawn this based on their interpretation. An evaluation was made after all studies were completed. The workshop took a total of 1 hour and 15 minutes.

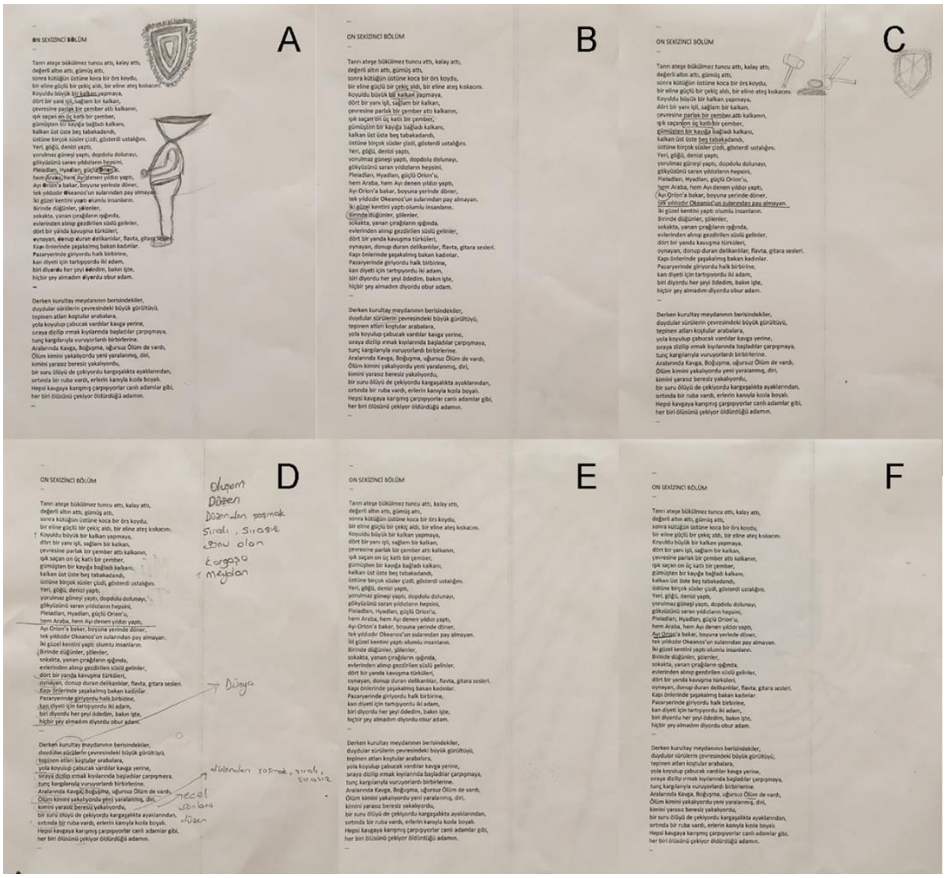

Figure 1. Students' sketches and markings on the given text

The deconstruction of the works produced in the workshop started with the *text(meaning)* stage, and these markings and drawings, which provided data on how the students had read the text and tried to understand it, were evaluated. For this, a word cloud was created using all the underlined words (Figure 2).

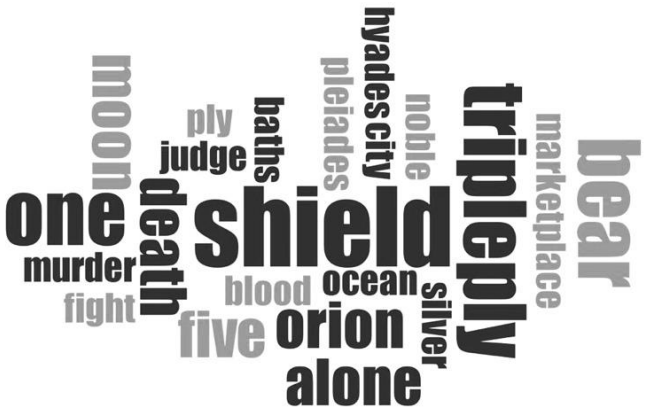

Figure 2. Words that students frequently marked on the given text (@MAXQDA)

As can be seen, the most dominant word in the cloud was the word “shield.” This shows that the students understood the text’s main theme, the story of the formation of the shield. On the other hand, words such as “one, triple-ply, bear” that were dominant in the second degree indicated that the students were primarily looking for quantitative data. In contrast, words such as “Orion, moon, death, five, alone” were in the 3rd degree, indicating that the students had experienced a shift from quantitative data to qualitative data. Words with gradually decreasing dominance contained clues about the meanings and contents each student tried to recreate in their imagination. When evaluating the markings in the given text, it was clear (Figure 1) that students E and F hardly interfered with the paper. For this approach, one can say that the imaginary worlds of the related students were closed to themselves. Student B differed from students E and F because of his/her small intervention in the given text, and the markings made by the student began to give information about the places that attracted his/her attention while reading the text.

With regard to students A, C, and D, the students underlined the words in the text and added new concepts and drawings next to the text. One could argue that such additions contain essential clues about the intellectual process undertaken by the students. For example, students A and C tried to improve their understanding by visualizing the text with the figures they had drawn. While Student A drew a shield and a human figure, Student C drew figures of a hammer, fire, pincer, and shield. On the other hand, Student D continued the process by writing down the words “formation, regular, irregular, sequential, unordered, finite, chaos, square, world, eternal, ending” concepts that he/she had extracted from the text.

Through the text, the differentiation of the thinking/imagining processes of the students also transformed how each of them understood and made sense of the same text. The transformation here indicated that the *text(meaning)* expression was personal, and with this knowledge, the students moved on to the *(meaning) drawing* stage, which was the next stage of the workshop.

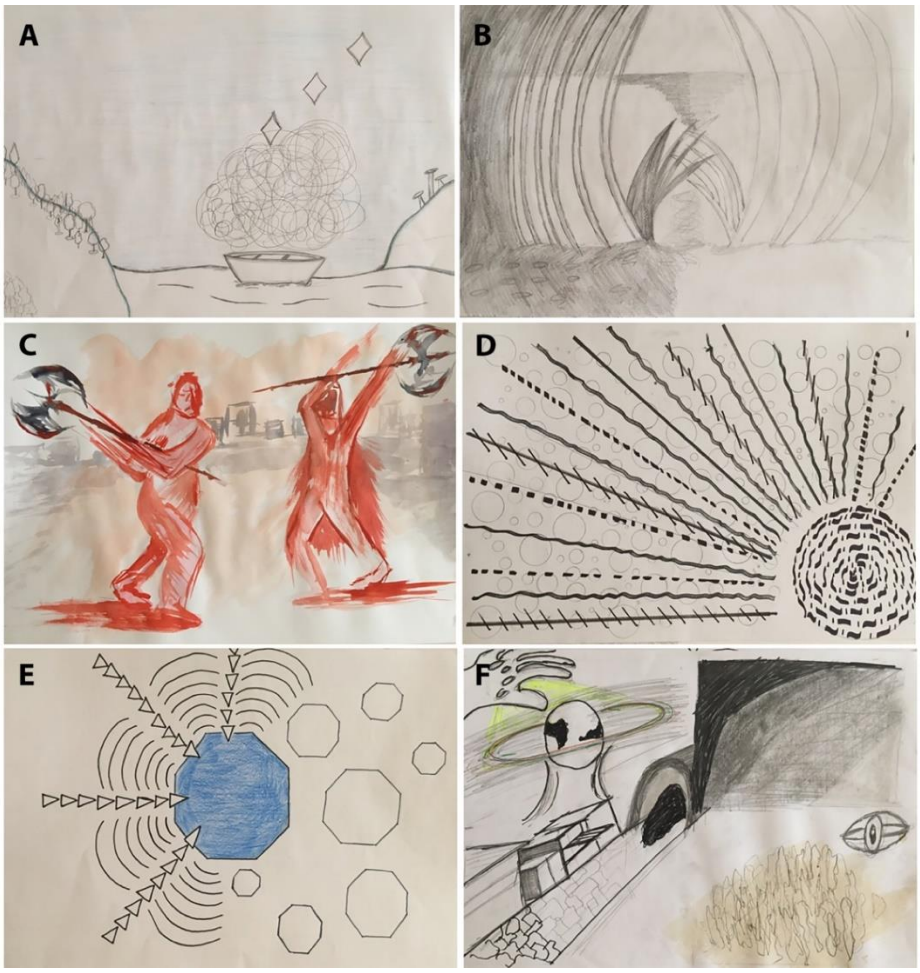

Figure 3. Drawings produced by students after the text-reading phase

We first encounter similarities and differences when each student's drawing is evaluated with the others (Figure 3). For example, when looking at the drawings of students A, B, C, and E, a separated binary order is seen, while the dual situation of students D and F creates a misconception at first glance because they do not appear on the paper equally. As a matter of fact, while Student D captured that duality through intertwining circles and radial lines, Student F captured this duality through clear and ambiguous images. It was essential in the context of the ekphrasis method that the aforementioned dual situation be visible and that it refers to the sentences "two noble cities filled with mortal men" and "two men struggled over the blood price for a kinsman just murdered" in the given text (See Appendix 1). On the other hand, Student E represented the phrase "five layers of metal to build the shield itself" with five separate groups of circular lines on the right side of his drawing. With the triangular series dividing these lines, he/she transformed the confusion mentioned in the second part of the text into a narrative.

Another situation we encountered in the drawings was the approach, which we can describe as figurative/imaginary expressions. These images, which became visible in the drawings of students A, C, and F, were related to how students interpreted the text. While Student A's drawing was reminiscent of a kind of "landscape painting," Student C depicted two human-like figures, which he/she put at the center of his/her work, and their battle with each other. In this sense, we can say that students A and C formed a holistic composition. However, there is no transitive connection between the images/figures drawn by Student F with each other. While this situation makes the figures independent from each other, on the other hand, it leaves the relationship between the figures open to interpretation. It expects the reader to establish the relationship between the pieces. Students B, D, and E, who did not work through figurative expression, turned to an abstract narrative by considering lines and how lines come together. Students D and E, in particular, preferred geometric shapes and created a composition through solid-empty forms or thick-thin lines.

Finally, an evaluation can be made through the color used in the drawings. The choice of color used in the compositions of students C, E, and F provided a focal point for students C and E, while it provided binary separation in the case of Student F. Students A, B, and D used pencil thickness and hatching/painting methods instead of color.

Table 1. The texts that the students wrote after the drawing process

Student	Written texts
A	"I thought something was created in this text. I painted a pure, clean landscape and chaos on an artificial product. The two components of creation: purity and confusion."
B	"In the drawing, I explained the opposition of people and the conflict in the current situation. Different people, same place... The complexity of the environment and the separations within this complexity."
C	"The text seemed to describe what it was like from the viewpoint of God in a culture. God creates everything, heaven and earth, and at the same time, he creates war, death, and that anger in man."
D	"First, there is a creator, and events and situations proceed sequential, in an unordered, regular, and irregular manner within the framework of specific rules."
E	"There are some formations, transformations... These are the interactions of the formations we have created..."
F	"The text describes the world's creation, development, and death over time. I drew these as a process, first the creation and then a space like the market area mentioned in the text. The chaos that ensued, and the death that followed, is a section that gradually darkens to represent nothingness at the end."

The texts the students wrote in the *(meaning) drawing-text* phase (Table 1) were utilized to analyze what the students wanted to express in their drawings. In this context, Student A interpreted the given text through "creation" and tried to express it through the concepts of "purity and confusion". The equivalent of this approach in the drawing is a creation with nature, purity with mountain- tree- water, and chaos with random/cyclic lines on the boat image, which turns into a narrative. It is thought that the student visualized "creation" by using the words "earth, sea, sky" in the lines, "There he made the earth and there the sky and the sea" and "both armies battled it out along the river banks" in the given

text. On the other hand, there is no reflection or traces of the words “shield, Orion, well-wrought, triple-ply, bear” that the student underlined in the text, and the drawing of the “shield and human figure” that he drew on the text.

We can say that the expressions “opposition, conflict, different people, complexity” in the text of Student B find expression through the creation of a contrast where one approach consisted of thin and incomplete lines and the second, thick and fuller lines. The similarity of these may draw on the words “same place” in the student's text. On the other hand, the concepts he/she underlined while reading the text (shield, triple-ply, in one) are not visually reflected in the drawing.

The drawing of Student C, who states that “God creates everything, heaven and earth, and at the same time he creates war, death and that anger in a man” found its response through a kind of war scene narrated by two human figures. We can say that the student, who is thought to focus on the concepts of “anger and death”, focused on the part of the given text that started with the line “And Strife and Havoc plunged in the fight, and violent Death”. On the other hand, although the words that he/she underlined while reading the text (triple-ply, a silver shield-strap, five layers, and bear) are not seen in the images, the traces of the figures of “hammer, fire, claw and shield” he/she drew on the text can be seen. In this context, if the hammer, gripper, and shield figures are interpreted as war tools, the objects held by the human figures in the drawing can be held to be things that refer to these figures. The traces of the fire figure can also be found in the use of color, which makes the human figures dominant in the drawing. At the same time, we can say that the red color expression in the line “the cloak on her back stained red with human blood” in the given text is effective in the student's choice of color. Again, we can say that the two human figures, which form the focal point of the drawing, are related to the line “two men struggled over the blood-price for a kinsman just murdered” in the text. We can infer that the actions indicated by these figures are related to the line in the text “They raked each other with hurtling bronze-tipped spears.”

The expressions “event-situation, sequential-unordered, regular-irregular” expressed by Student D in his/her text appear to be the things that determine the character of the lines in the drawing. Circular expressions in the drawing create a center perception, while linear expressions both point to it and create dual states that derive from it. In addition, in the drawing, the “formation, regular, irregular, sequential, unordered, finite, chaos, square, world, eternal, ending” concepts that Student D extracted from the given text are also visibly present. It can be said that these concepts and the dialectical relationship between them are also revealed through expressions such as “both, two noble cities, two men” in the given text.

On the other hand, Student E’s relation with the drawing of his/her text, which he/she expressed through the concepts of “formation, transformation, and interaction,” lies in the forms of relations that the lines and forms establish. While the student is trying to explain the concept of “formation” with the central situation of the composition shaped around a colorful octagonal form, he/she is trying to explain the concept of “transformation” with circular lines and octagons of different sizes. Moreover, finally, the student expresses the concept of “interaction” with the effect of orientation created by the triangle pattern placed in the spaces between the central octagonal and circular lines. On the other hand, these concepts in Student E’s text also highlight the different situations in the given text. We can say that while words such as shield, earth, sky, and sun in the lines of the text are related to the “formation” concept, words such as cities, weddings, and death are related to the “transformation and interaction” concepts.

Finally, we can say that the expression of “the world’s creation, development, and death over time” in the text of student F corresponds to the images of “the world, the hand, and the built environment” in his/her drawing. This match seems problematic as it comes across as a direct analogy. However, the statement in the student’s own text that the “section that gradually darkens to represent nothingness at the end” may be a sign that he/she is trying to abstract at this point. Nevertheless, the relationship that the student establishes with the text is generally in the form of image transference. An example of this evaluation can be seen in the hand mentioned in the line “he gripped his mighty hammer in one hand, the other gripped his tongs”. Similarly, we can say that the student expressed the lines “There

he made the earth and there the sky and the sea and the inexhaustible blazing sun and the moon rounding full (…)" using a figurative world image. On the other hand, we can argue that the student was inspired by the line "So they clashed and fought like living, breathing men grappling each other's corpses, dragging off the dead" in the given text and expressed this with the abstract lines drawn in the lower right part of the paper.

In examining all the data obtained after the workshop (marking-on-text-scribbles, drawings, and texts), the use of ekphrasis as a method in the formation of the architectural narrative makes it valuable in terms of how it opens up the discussion of meaning in depth.

4. Discussion and Conclusion

In this study, in which the architectural narrative is handled through (architectural) drawing and ekphrasis as a method in the formation of the narrative, it can be noted that both the narrative and the ekphrasis are given form through the concept of "meaning." In this context, the drawings and texts produced in the workshop are revealed as different worlds of meaning intellectually, intuitively, and symbolically. As a matter of fact, when an evaluation is made in relation to the *text(meaning)* phase of the workshop, it is remarkable that the students mark the concrete assets and values on the text. Relevant markings, essential to assess students' mental processes during reading, can also be read as preliminary sketches regarding their moment of understanding and in relation to the drawing of the text. Moreover, writing various concepts and/or drawing figures that are not in the text, but as a result of students' inferences can be considered to be the product of a similar effort. These attitudes and approaches result from the solid descriptive feature of the ekphrastic text. Moreover, it can be said that the markings, notes, or figures in the text do not limit the drawings and that the students' world of thought is above these limiting entities, values, or concepts.

It is clear that the drawings produced by the students through the given text at the *(meaning) drawing* stage provide various clues about the text. The dual order, which takes place in all of the drawings and only in different forms, is the "two noble cities…., two men…" in the given text, which matches their statement. This duality is read in the balance of the paper in which the drawing is made with form relations of various figurative objects and their positions in relation to each other. In addition, the full-blank forms, thick-thin lines, or various hatches in the drawings represent the conflict mentioned in the text. While these evaluations of the drawings make the possibilities of an ekphrastic text visible, they allow for alternative expansions of the architectural narrative.

We can say that the architectural design thought is in contact with ekphrasis as the "oral representation of visual representation" (Heffernan, 1993) in the context of the similarities and differences that emerge when the students' drawings and the texts they write in the *(meaning)text* stage are considered together and associated with the given text. The architectural design process develops by feeding on the interaction of both verbal and visual information fields. Considering that architecture is also a narrative tool, it is undeniable that this narrative is fed from various verbal, written, and visual sources. The position and significance of ekphrasis and ekphrastic texts in architectural thought and the design process, enabling the transmission of meaning, are entirely contingent upon the recipient's background knowledge and the intricate network of relationships within the realms of imagination and thought.

As a result, an ekphrastic text's narrative can give rise to a new storyline, unveiling diverse meanings and eliciting various images in the minds of different readers. It is evident that these textual possibilities serve as valuable data for shaping the architectural narrative. By drawing from the rich realm of meaning and imagery present in ekphrastic texts, the architectural narrative can be enriched, allowing for the creation of unique narratives in architectural production.

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Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to the article. There is no conflict of interest.

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Appendix 1: Homer (1991), Iliad, Chapter 18 (Part given to students). To enable students to focus on the subject of the text, in-text subtractions have been made in the sections shown as (…) in the text.

(…)
Bronze he flung in the blaze, tough, durable bronze
and tin and priceless gold and silver, and then,
planting the huge anvil upon its block, he gripped
his mighty hammer in one hand, the other gripped his tongs.
And first Hephaestus makes a great and massive shield,
blazoning well-wrought emblems all across its surface,
raising a rim around it, glittering, triple-ply
with a silver shield-strap run from edge to edge
and five layers of metal to build the shield itself,
and across its vast expanse with all his craft and cunning
the god creates a world of gorgeous immortal work.
There he made the earth and there the sky and the sea
and the inexhaustible blazing sun and the moon rounding full
and there the constellations, all that crown the heavens,
the Pleiades and the Hyades, Orion in all his power too
and the Great Bear that mankind also calls the Wagon:
she wheels on her axis always fixed, watching the Hunter,
and she alone is denied a plunge in the Ocean's baths.
And he forged on the shield two noble cities filled
with mortal men. With weddings and wedding feasts in one
and under glowing torches they brought forth the brides
from the women's chambers, marching through the streets
while choir on choir the wedding song rose high
and the young men came dancing, whirling round in rings
and among them flutes and harps kept up their stirring call—
women rushed to the doors and each stood moved with wonder.
And the people massed, streaming into the marketplace
where a quarrel had broken out and two men struggled
over the blood-price for a kinsman just murdered.
One declaimed in public, vowing payment in full—
the other spurned him, he would not take a thing—
so both men pressed for a judge to cut the knot.
(…)
Now the besiegers,
soon as they heard the uproar burst from the cattle
as they debated, huddled in council, mounted at once
behind their racing teams, rode hard to the rescue,
arrived at once, and lining up for assault
both armies battled it out along the river banks—
they raked each other with hurtling bronze-tipped spears.
And Strife and Havoc plunged in the fight, and violent Death—
now seizing a man alive with fresh wounds, now one unhurt,
now hauling a dead man through the slaughter by the heels,
the cloak on her back stained red with human blood.
So they clashed and fought like living, breathing men
grappling each other's corpses, dragging off the dead.
(…)

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Determination of the Recreational Landscape Potential of Tarsus (Mersin) District and Its Surroundings for Tourism

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Abstract

The study conducted an investigation into the effective utilization of Tarsus district's historical and cultural assets in Mersin province, with a focus on its tourism potential. The primary objectives were to promote the region and contribute to its economic, social, and cultural advancement. A survey was administered to gather information on dominant tourism types in Tarsus, including historical sites, cultural landmarks, local crafts, cuisine, caves, camping, wildlife, flora, gastronomy, local resources, natural attractions, and aesthetics. The results highlighted Tarsus' prominence due to its cultural heritage, historical structures, and natural wealth. Despite Tarsus's cultural diversity and tourism potential, the study revealed its current underrepresentation and various challenges, including the vulnerability of historical assets, insufficient infrastructure, and unguided utilization. The study suggests adopting a sustainable approach that balances conservation with utilization to address these issues and help Tarsus attain the recognition it rightfully deserves in the field of recreation and tourism.

Keywords: *Mersin-Tarsus, recreation, tourism, landscape architecture, sustainability.*

Tarsus (Mersin) İlçesi ve Yakın Çevresinin Turizme Yönelik Rekreasyonel Peyzaj Potansiyelinin Belirlenmesi

Öz

Bu çalışmada Mersin iline bağlı Tarsus ilçesi tarihi ve kültürel zenginliklerinin etkin şekilde kullanımını ve bölgenin turizm yönünü keşfetmek amacıyla yapılmıştır. Araştırmada yörenin tanıtılmasına yardımcı olmak ve halkın ekonomik, sosyal ve kültürel anlamda gelişmesini katkı sağlamak hedeflenmektedir. Çalışma kapsamında yapılan anket çalışmasında katılımcılara Tarsus kentinin turizm alanında tarihi mekânlar, kültürel yapı, yöresel el sanatları, yöresel yemekler, mağaralar, kamp / karavan, fauna, flora, gastronomi turizmi, yöresel zenginliği, doğal çekicilikleri ve güzellikleri gibi hangi turizm türlerinin baskın olduğu gibi pek çok soru yöneltilmiş ve bölgenin turizm potansiyeli belirlenmeye çalışılmıştır. Elde edilen sonuçlar değerlendirildiğinde Mersin iline bağlı Tarsus ilçesinin özellikle kültürel mirası, tarihi yapıları ve doğal kaynak zenginliği ile ön plana çıktığı görülmektedir. Çalışma sonucunda, rekreasyon ve turizm potansiyeli açısından önemli bir kültür mozaiğine sahip olan Tarsus ne yazık ki pek çok açıdan bugün hak ettiği yerde olmadığı koruma kullanma dengesi içerisinde sürdürülebilir yaklaşımla gerekli önlemler alınması gerekliliği ortaya konulmuştur.

Anahtar kelimeler: *Tarsus (Mersin), rekreasyon, turizm, peyzaj mimarlığı, sürdürülebilirlik.*

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1. Introduction

With the development of urban living worldwide and changes in people's work and living conditions, a different system has emerged to enable a socially and physically higher quality of life. Tourism constitutes the main foundation of this system. As a result of this differentiation, people seek to distance themselves from the intensified urban lifestyle to relax, take a break, explore while traveling, and engage in communication with different individuals. This phenomenon has a significant impact on individuals' physical and mental rejuvenation and transformation.

Tourism not only involves a change of place but also facilitates self-renewal, transformation, and mental relaxation. Moreover, due to its contributions to the economy and national development, tourism is an ever-evolving, developing, and empowering phenomenon.

To comprehensively and accurately analyze the tourism sector, it is essential to correctly define the tourism concept. The definition of tourism holds particular significance for continuously evolving countries. As a social science discipline with humans as its subject, tourism has grown in accordance by changing demands, particularly with the rapid development of technology.

Tourism is derived from the Latin word "tornus," meaning "to turn" or "return." The term "tour" was initially used in the 18th century for young British nobles who visited European cultural and natural landmarks as part of their education. Subsequently, with the advancement of transportation means, mass tourism began to take place. The tourism sector has a long history. In the past, people traveled to different locations due to work or trade-related reasons, which led to the emergence of various trade routes (e.g., the Silk Road and the Spice Route) (Bulu & Eraslan, 2008).

Tourism is a vital industry for modern societies, encompassing various economic, social, and cultural dimensions. The significance of tourism is underscored by the following points as indicated in the literature (Lundberg 2017; Bunghez, 2016; Uğuz, 2014; Akpınar Külekçi, 2013; Sezgin & Ünüvar, 2009; Rita 2000):

- **Economic Contribution:** Tourism significantly contributes to a country's economy. It fosters the growth of local businesses, generates employment, and boosts revenue. Tourists make a wide range of expenditures, including accommodation, dining, transportation, and shopping. Furthermore, the tourism sector also contributes to various other industries such as agriculture, construction, and services.
- **Cultural Interaction:** Tourism facilitates the convergence of different cultures and enhances cultural understanding. Tourists celebrate cultural diversity by experiencing various traditions, languages, cuisines, and lifestyles. Simultaneously, local communities have the opportunity to showcase their own cultures by interacting with tourists.
- **Regional Development:** Tourism can contribute to the development of economically disadvantaged regions. Infrastructure improvements are made in areas that attract tourists, new job opportunities are created, and the living standards of local communities are elevated.
- **Environmental Conservation and Sustainability:** Managing tourism sustainably is essential for environmental protection. Academic research provides guidelines for the preservation of natural resources and the minimization of environmental impacts. The sustainability of tourism contributes to the conservation of natural beauty and resources for future generations.
- **Scientific Research and Education:** Tourism garners substantial interest in the academic world. Research related to tourism aids in understanding and guiding industry trends. Additionally, academic programs exist that offer education in tourism management and sustainable tourism.

Considering the economic, cultural, environmental, and societal impacts of tourism, it holds significant importance. The ethical and sustainable management of the tourism sector can further enhance its positive effects.

Tourism is an important bridge to get acquainted with people from different cultures and establish communication with them. Tourism activities should be carried out without causing harm to the natural environment and cultural heritage. When organizing tourism activities, they should be in harmony with the cultural values of the region. If such harmony and order are absent, negative impacts on cultural values are inevitable (Uslu & Kiper, 2006).

Tourism highlights the unique characteristics, activities, and natural and cultural landscapes of a region as a whole. It fosters the development and preservation of the natural environment and cultural heritage (Uslu & Kiper, 2006).

Tarsus district hosts highly significant artifacts that bridge the past and the present. Therefore, Tarsus is a highly prominent tourism and recreation center. This study aims to establish the foundation for the region to attain the value it deserves by researching and analyzing the natural fragrance, physical, social, and cultural environment of Tarsus and its surroundings to identify the region's tourism potential. The existence of tangible and intangible cultural heritage in Tarsus and its vicinity is considered to contribute to the development of tourism. This study aims to create a framework for the promotion and preservation of the cultural heritage found in Tarsus and its surroundings as well as passing it on to future generations. Additionally, the study attempts to identify suitable tourism activities by analyzing the natural and cultural structure of the region. The reason for selecting Tarsus district and its surroundings as the study area is due to the natural landscape features, historical and cultural values, and existing tourism assets it contains. It is disheartening that despite possessing such riches, the region remains inadequately promoted, and its tourism opportunities are not fully developed. This study aims to raise public awareness, enhance the existing tourism potential, promote the region, and lay the groundwork for future studies and activities related to sustainable tourism and recreational activities. Furthermore, the study seeks to take the lead in planning the promotion of tourism assets in the study area and directing tourism activities appropriately.

2. Material and Method

2.1. Material

The main materials of this study consist of survey forms prepared to determine the tourism potential of the area and the recreational landscape potential, as well as the natural and cultural resource values of Tarsus district and its surroundings. General information regarding these values is provided below:

Tarsus is a district located in the southern part of Turkey and is affiliated with the province of Mersin. It is situated in the western part of the Mediterranean Region and the Çukurova region. The area lies between 36-37° north latitude and 34-35° east longitude. The study area covers a significant portion of the Mediterranean Basin, and the province of Mersin has an approximate area of 15,803 km^2. Tarsus district is located to the east of the Mersin province (Figure 1). The districts of Mersin province include Akdeniz, Anamur, Aydıncık, Bozyazı, Çamlıyayla, Erdemli, Gülnar, Mezitli, Mut, Silifke, Toroslar, Yenişehir, and Tarsus, with Tarsus being the largest district in Mersin province (Anonymous, 2023a). In terms of research materials in the study area, various survey forms conducted in different periods, as well as various maps and documents, have been utilized.

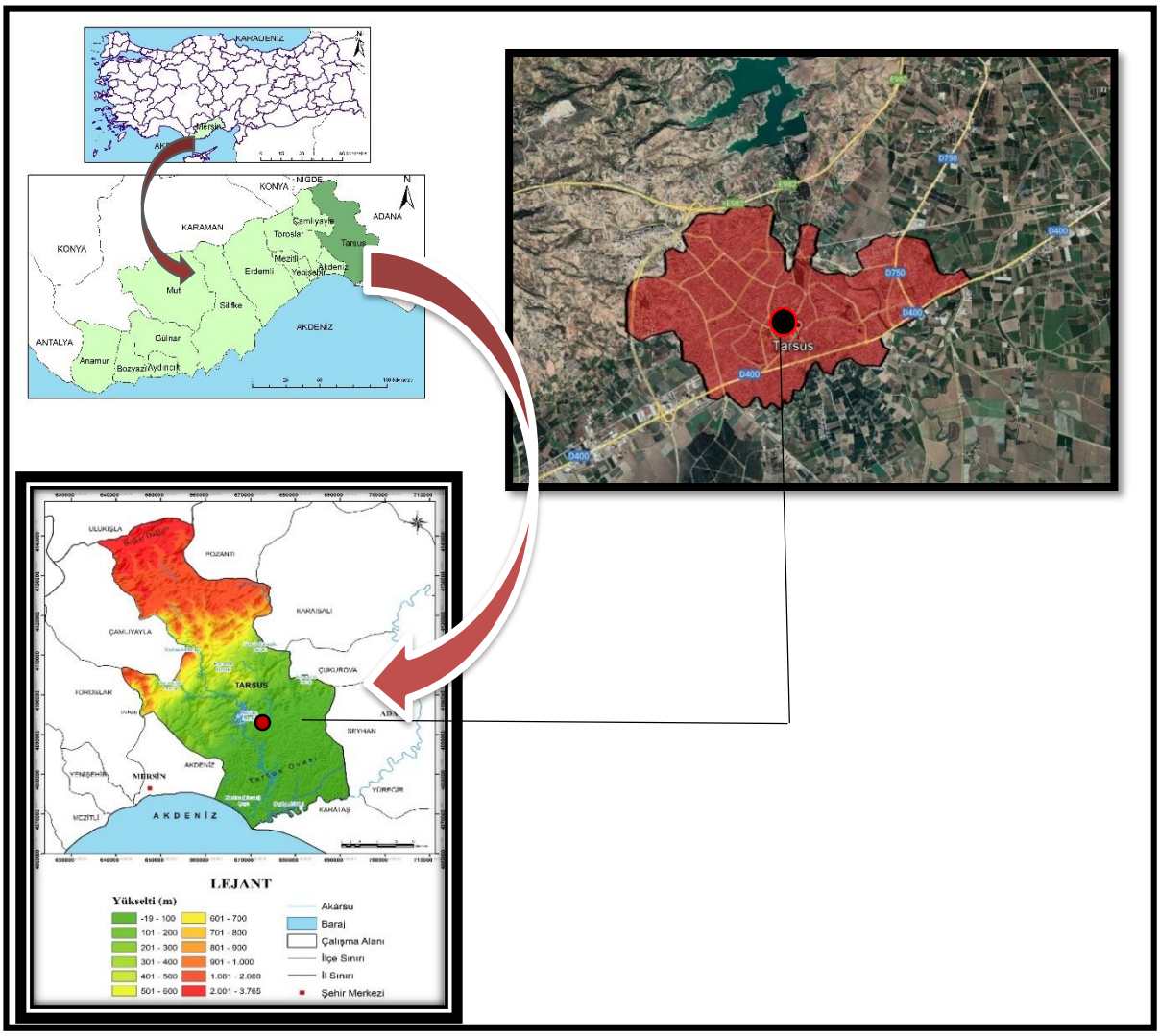

Figure 1. Location of the study area

2.2. Natural landscape features of Tarsus and its surroundings

The study area boasts a diverse range of natural landscape features, including its geological, geomorphological, topographic, vegetation, climate, and hydrographic characteristics. When examining the geological structure of Tarsus and its nearby regions, it becomes evident that the western-northwestern part is composed of structural units belonging to the Bolkar Mountains. This mass, which comprises high mountains, hills, and plateau areas, is accompanied by the Tarsus Plain in the foreground. Notably, the Eshab-Kehf hill, located within the structural units of the Bolkar Mountains, stands out as one of the most significant parts of Tarsus and its surroundings (Hocaoğlu, 2003; Gürani, 1999; Anonymous, 2023b).

Regarding geomorphological features, the Tarsus district presents diverse landforms. A considerable portion of Tarsus consists of plains, mountains, and plateaus. Towards the north of the study area, one can find the high parts of the Central Taurus Mountains, specifically the Bolkar Mountains. Southwards, stretching towards the Mediterranean coasts, there are plateau regions, karstic terrains, and the flatlands where the city center of Tarsus is situated. The average heights of the mountainous regions range from 1750 to 3600 meters, and the mountainous areas become more dense towards the north of the study area. Several significant valleys and gorges are present in the study area, including the Kadıncık Stream Valley and Gorge, Keşbükü Stream Valley and Gorge, Tarsus (Berdan) Stream Valley, Deliçay Stream Valley, and Cehennem Dere Stream Valley (Hocaoğlu, 2003; Kelleboz, 2019).

The formation of the Tarsus River Delta and Floodplain, akin to the vast delta region of Çukurova, is shaped by the combined influence of effective processes. The rivers that played a role in the formation of the Çukurova Delta had an impact on different parts of the delta, causing its expansion in specific

directions during various periods. This area also constitutes a shared alluvial delta floodplain formed by the sediment transportation of the Tarsus River and Seyhan River. Within the delta-floodplain, several swamps can be found, including the Karabucak Swamp located southwest of Tarsus city, the Aynaz Swamp east of Kulak village, the Dipsiz Göl Swamp west of the mouth of the Seyhan River, and the Tuz Gölü Swamp observed west of Tuz Gölü (Hocaoğlu, 2003).

The soil structure of the region is formed by the fragmentation and weathering of rocks and organic materials of various sizes, followed by the mixing of organic materials. The soil properties of the area indicate the dominance of Red Mediterranean soils (Kırmızı Kahverengi Akdeniz toprakları), which are zonal soils affected by climate conditions (Hocaoğlu, 2003).

Regarding its natural vegetation potential, the Tarsus region exhibits significant diversity. The primary factors influencing the characteristics of natural vegetation in each region are climate, altitude, and soil, resulting in distinct vegetation types across different areas. The natural vegetation in this region mainly comprises needle-leaved forests and maquis formations, which are characteristic vegetation of the Mediterranean climate (Hocaoğlu, 2003).

In the northern part of Tarsus, the Central Taurus Mountains are present, while the southern part is bordered by the Mediterranean. Tarsus covers an area of approximately 2,026 km². The areas with altitudes up to 500 meters are dominated by species such as *Olea europaea* L. *var. europaea* L. (Olive tree), *Lourus nobilis* L. (Bay laurel), *Ceratonia siliqua* L. (Carob tree), and *Myrtus communis* L. subsp. *communis* L. (Myrtle tree). At elevations around 1000 meters, *Quercus coccifera* L. (Kermes oak) and *Pinus brutia* L. (Aleppo pine) communities are prevalent, while at 2000 meters, extensive forest areas consist of *Pinus nigra* L. (Black pine), *Cedrus libani* A. Rich. (Lebanon cedar), *Abies cilicia* subsp. cilicica (Cilician fir), and *Juniperus excelsa subsp. excelsa* L. (Greek juniper). In the flatlands, typical vegetation includes *Citrus aurantium* L. (Orange), *Chamaerops humilis* L. (Mediterranean fan palm), *Phoenix dactylifera* L. (Date palm), and various fruit trees (Anonymous, 2023c).

Grape cultivation covers 110,000 decares in the Tarsus region. The area between Sayköy, Cinköy, Ulaş, İbrişim, Dedeler, and Taşkuyu villages is predominantly dedicated to grape vineyards (Anonim 2023d).

There are two afforestation areas within the study area. The first one is the Karabucak forest located between 5 and 2.5 meters contour lines in the south of Tarsus. The other afforestation area is situated on coastal dunes to prevent dune migration (Hocaoğlu, 2003).

The Karabucak Forest is primarily composed of eucalyptus trees and is renowned for being Turkey's first eucalyptus forest. It was established to drain a previously swampy area. The forest consists of two parts: the Güresin Forest, covering an area of 885 hectares, situated close to Tarsus city, and the coastal pine (Pinus pinea) dominated section stretching towards the Mediterranean coast. Among the eucalyptus trees, *'Eucalyptus rostrata'* is the most widespread species (Anonymous, 2023b).

Tarsus experiences a Mediterranean climate, characterized by hot and dry summers and mild and rainy winters. The inner parts of Tarsus have a continental climate, with cooler and dry summers and cold winters with snowfall in high-altitude areas (Anonymous, 2023e).

The hydrographic structure of the area plays a crucial role in determining the natural appearance of the environment, including moving water bodies, groundwater, and surface waters. The Tarsus River, together with the Seyhan and Ceyhan Rivers, have created a shared plain (Çukurova) and a common delta by transporting sediment (Hocaoğlu, 2003).

The length of the Tarsus River is approximately 142-150 km (Figure 2). The upper parts of the Tarsus River flow through the undulating terrain of the mountains, while as it descends, it narrows into deep valleys until it reaches the plain. The Tarsus River gathers waters from an area of approximately 2,000 km², which is mainly comprised of high rainfall regions in the high parts of the Central Taurus Mountains. As a result, the water flow is abundant in both summer and winter (Torun, 2014).

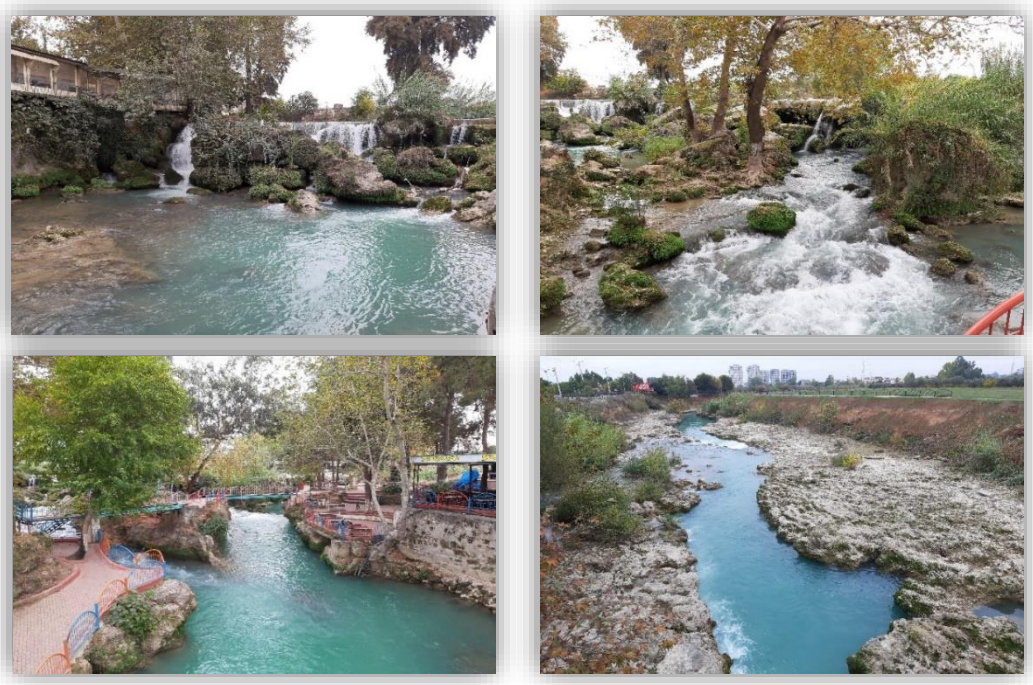

Figure 2. Waterfall formed by the Tarsus River in the City Center (Original)

When examining the socio-economic structure of Tarsus, it is evident that the city has been home to various civilizations, particularly due to its rich historical background. Tarsus is a district located in the Mediterranean region of Turkey, within the province of Mersin. The name "Tarsus" is believed to be derived from the name Tarhon (Tarkon), the founder of Cilicia and the city's oldest god. Over time, the name of the city has been used as "tarzi" in Assyrian, "tarz" in Aramaic, and "Tarsos" in Greek. Later on, the name "Tarsus" was replaced with "Toros," and in Latin, it became "Tarsus," which has remained so until today. According to known sources, Tarsus has a history dating back approximately ten thousand years. Consequently, it possesses a diverse and rich culture due to the civilizations it hosted. As the capital of Cilicia, the district of Tarsus is considered to be one of the earliest settlement areas in Anatolia, which was revealed after archaeological excavations carried out in Gözlükule in 1934. The excavations in Gözlükule indicated that the history of Tarsus began during the Neolithic period and continued until the Middle Bronze Age. However, the exact date and method of Tarsus' establishment have not been entirely clarified. The most emphasized information suggests that the city of Tarsus was founded by the Assyrian ruler Sardanapal. Following the rule of the Assyrians, it came under the dominion of Alexander the Great. After Alexander, Tarsus, along with all of Cilicia, fell under the rule of the Seleucids. In 246 BC, Tarsus came under the administration of Egypt. However, after 66 BC, when Cilicia became a Roman province, Tarsus became its center (Engin, 2004; Çokan, 2017; Sakar, 2019). Tarsus is home to numerous architectural heritages (Figure 3).

Figure 3. Views from Kubat Pasha Madrasa (Original)

Due to its location on trade routes, Tarsus holds a significant position. During the Ottoman Empire, Tarsus was situated along caravan and postal routes. It experienced important developments in terms of economic and commercial activities, especially during the Ottoman era. Today, Tarsus is a center for trade and industry in Mersin. It is the most developed district in terms of industry after Mersin. In addition to industrial establishments that process agricultural products, there are factories producing agricultural tools, machine spare parts, and machine tools, as well as confectionery, brick, and ceramic factories that are essential for the country's economy. The first Chamber of Commerce in Turkey was established in Tarsus in 1879. Agriculture plays a significant role in Tarsus' economy. 51% of the district's land is used for agriculture, while 28% is forested (Torun, 2014; Anonymous, 2023g).

This study was conducted to determine the recreation and tourism potential of the Tarsus district, which is a part of the Mersin province. In the first phase, the purpose of the study and the selection of the area were made, and the social, physical, and cultural evaluations of the area were conducted. Based on these assessments, it was determined that Tarsus has a rich heritage, particularly in terms of its historical, cultural, and natural resources. Literature related to tourism, including digital data and written sources, was utilized to research the topic. Frequency analysis was employed to analyze the data obtained from surveys conducted with the residents of Tarsus. Qualitative and quantitative variables were considered together to determine suitable recreational and tourism activities for the area. The recreation and tourism potential of the study area was determined through surveys based on the preferences and expectations of the local population, interest groups, visitors, and experts familiar with the area. The formula used to determine the sample size is as follows (Özdamar, 2003; Yazıcıoğlu, 2004; Lai & Nepal, 2006):

N: Total population size, n: Sample size

P: Observed rate of X in the population

Q: (1-P): Unobserved rate of X in the population

Zα: α = 0.05 (corresponds to 1.96)

d: Sampling error

For α = 0.05 and (d = 0.10) sampling error, taking (p = 0.5; q = 0.5) and the total population size of Tarsus city as 346,715, the sample size is calculated as:

$N = 346{,}715 * 0.5 * 0.5 * (1.96)^2 / [(346{,}715-1) * (0.10)^2] = 96$

The Turkish Statistical Institute (TÜİK) has reported the population of Tarsus city as 346,715 (Anonim, 2023e). According to this calculation, the sample size for Tarsus city is 96. To conduct the survey with the local people of Tarsus and expert groups who are familiar with the region, ethical approval was obtained. Thus, a total of 100 people were surveyed, considering the margin of error.

The study aimed to determine the recreation and tourism potential of the study area based on the preferences and expectations of the participants, including the local population, interest groups, visitors, and experts familiar with the area.

3. Findings and Discussion

3.1. Determination of Public Perspectives on Tourism Recreational Landscape Potential of Tarsus District and Its Surroundings

A survey was conducted with 100 people between April 19 and May 17, 2021 in order to evaluate the tourism and recreational activities of the local people and visitors in the Tarsus district of Mersin province. The prepared standard questionnaire forms were applied face to face by interviewing the participants one-on-one. As a result of the survey, a lot of information was obtained about the interest of the people of Tarsus in tourism, the tourism potential of Tarsus, the expectations and demands of the people of the region from tourism, and the importance of historical, touristic and recreational activities in the region.

The demographic characteristics of the participants in the survey study conducted to determine the point of view towards historical, touristic and recreational activities in Tarsus district and its

surroundings are given in Table 1. As can be seen in the table, 37% of the participants are male and 63% are female. The highest age distribution was seen in the age range of 26-45 (48%). 43% of the participants are married and 57% are single. The highest education level was at the undergraduate level with 52%, while the lowest education level was at the graduate level (2%). Considering the social status and occupational groups of the respondents, 21% are students, 17% are housewives, 13% are self-employed and civil servants. When the monthly income distributions are examined, 41% of the participants declared that they have an income level of 0-2000 TL, 14% 2001-3000 TL, 17% 3001-4000 TL, 16% 4001-5000 TL and finally 12% 5001 and above.

Table 1. Demographic characteristics of the participants in the survey conducted in Tarsus District

Individual Characteristics	Variables	Percent (%)
Gender Distribution	Male	37
	Female	63
Age Distribution	18-25	33
	26-45	48
	46 and over	19
Distribution by Marital Status	Married	43
	Single	57
Distribution by Education Levels Primary	Primary	6
	Secondary Education	5
	High school	23
	Associate Degree	12
	Bachelor	52
	Master	2
Social Status and Occupational Group Distribution	Student	21
	Self-employment	13
	Officer	13
	Housewife	17
	Farmer	2
	Worker	15
	Other	19
Distribution by Monthly Income Status	0-2000	41
	2001-3000	14
	3001-4000	17
	4001-5000	16
	5001 and above	12
Total		**100**

The respondents were asked how many years they had lived in Tarsus. To this question, 39% were born in Tarsus, 13% answered less than 1 year, 6% 1-5 years, 11% 6-10 years, 2% 11-15 years, 29% more than 15 years (Figure 4).

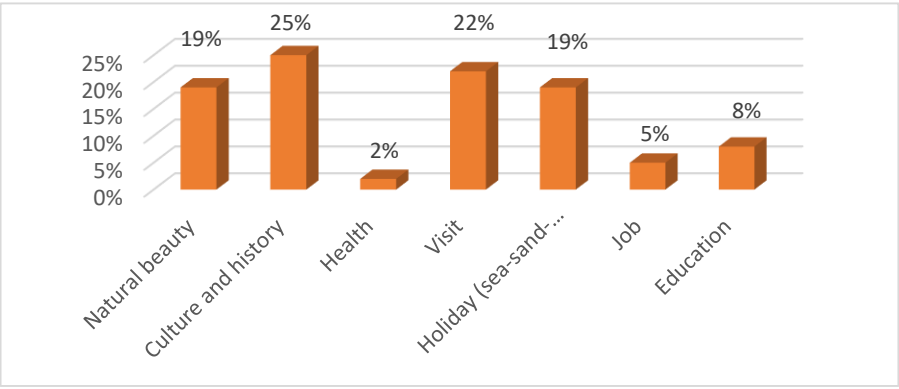

Figure 4. Responses of the participants to the question 'How long have you been living in Tarsus?'

Respondents were asked for what purpose they made their travels. To this question, 19% stated that it was for natural beauty, 25% for culture and history, 2% for health, 22% for visiting friends, 19% for vacation (sea-sand-sun), 5% for work, 8% for education (Figure 5).

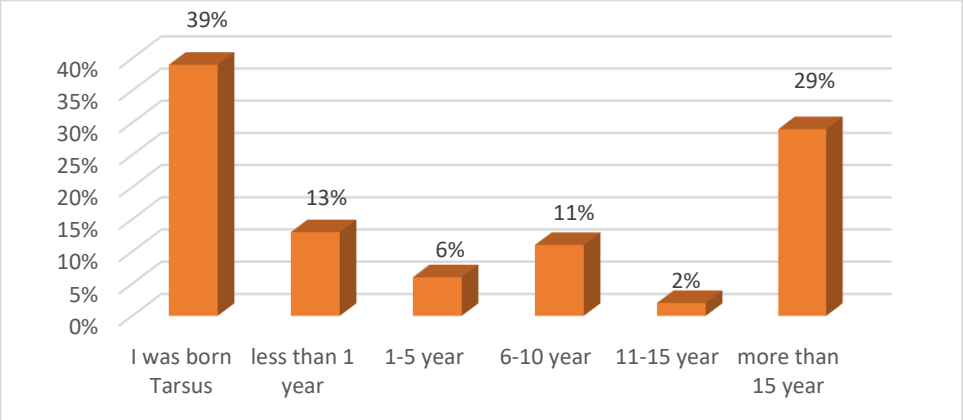

Figure 5. Responses of the participants to the question "For what purpose do you travel?"

The participants were asked a question about whether they had participated in a tourism activity related to entertainment, culture, history, nature or for a different purpose, and 84% of the respondents answered yes, 16% answered no (Figure 6).

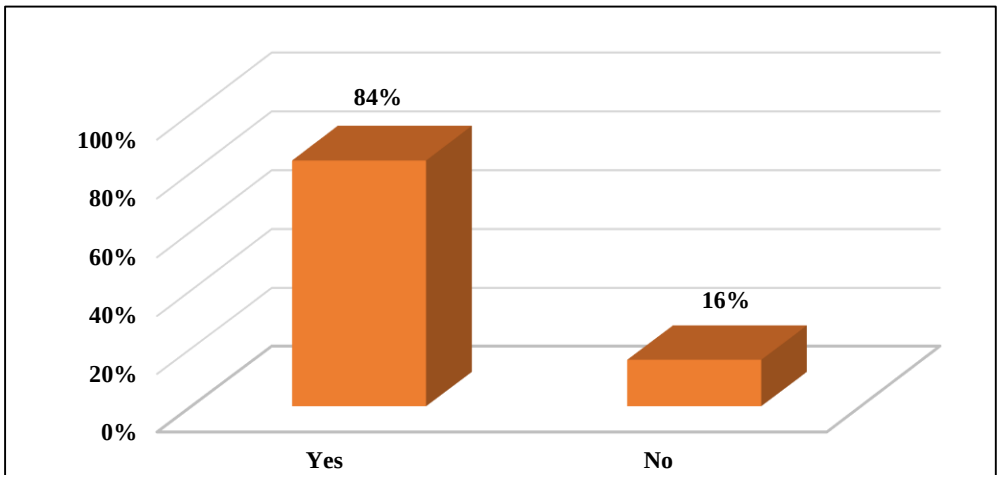

Figure 6. Responses of the participants to the question "Have you ever been involved in a tourism activity related to entertainment, culture, history, nature or for a different purpose?"

When the answers given to the questions asked to the participants about what the concept of tourism means, the most preferred option (48%) was the trips to rest, see and get to know. Then, 14% stated that nature-related tours and excursions included activities, and 17% stated that there were activities that provide escape from stress and relaxation. The least preferred options were a phenomenon that enables various communities to connect (6%), activities that promote the development of trade and industry (6%), and a phenomenon that helps local development (6%) (Figure 7).

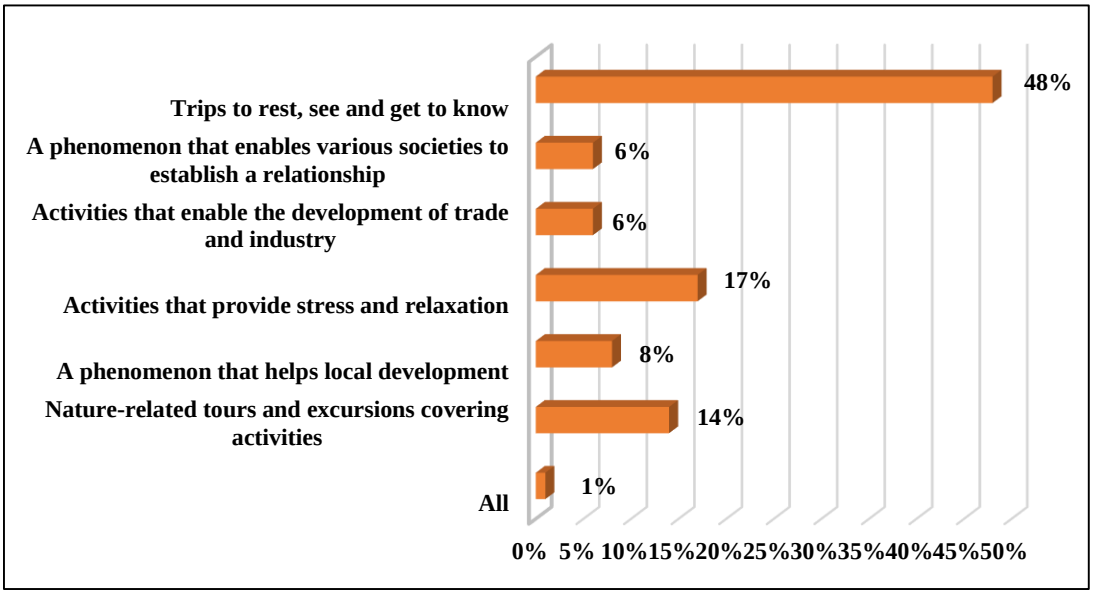

Figure 7. Responses of the participants to the question "What does the concept of tourism mean to you?"

Different answers to the verbal question, "What is the first thing that comes to mind when hearing the name Tarsus," is given in Figure 8. As seen in the figure, the most preferred option was History (24%), Gastronomy tourism (8) and Ashab-ı Keyf (8%), while the least preferred option (1%) was Ulu Mosque.

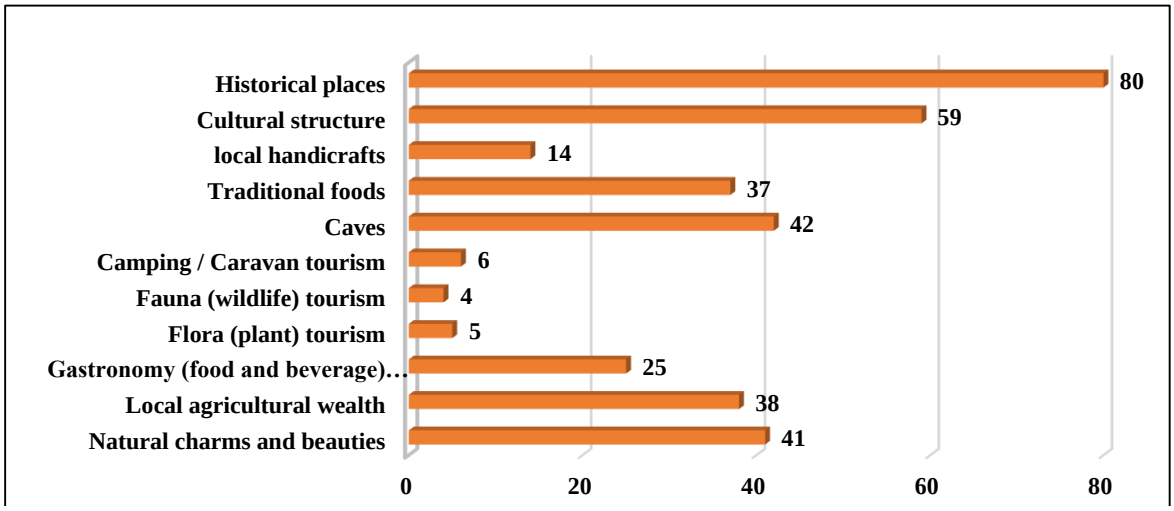

Figure 8. Responses of the participants to the question "Which of the following is Tarsus known for?"

Participants in the tourism area of the city of Tarsus (Historical places, Cultural structure, Local handicrafts, Local food, Caves, Camp / Caravan tourism, Fauna (wildlife) tourism, Flora (plant) tourism, Gastronomy (food and beverage) tourism, Local richness, It was asked which ones (natural charm and beauty) were referred to. Participants were asked to rank their first three choices from these options (Figure 9). According to the results obtained, the most preferred option was historical places (80%), followed by cultural structure (59%) and caves (42%). The least preferred tourism activities were camping / caravan tourism (6%), Flora tourism (5%), and Fauna tourism (4%).

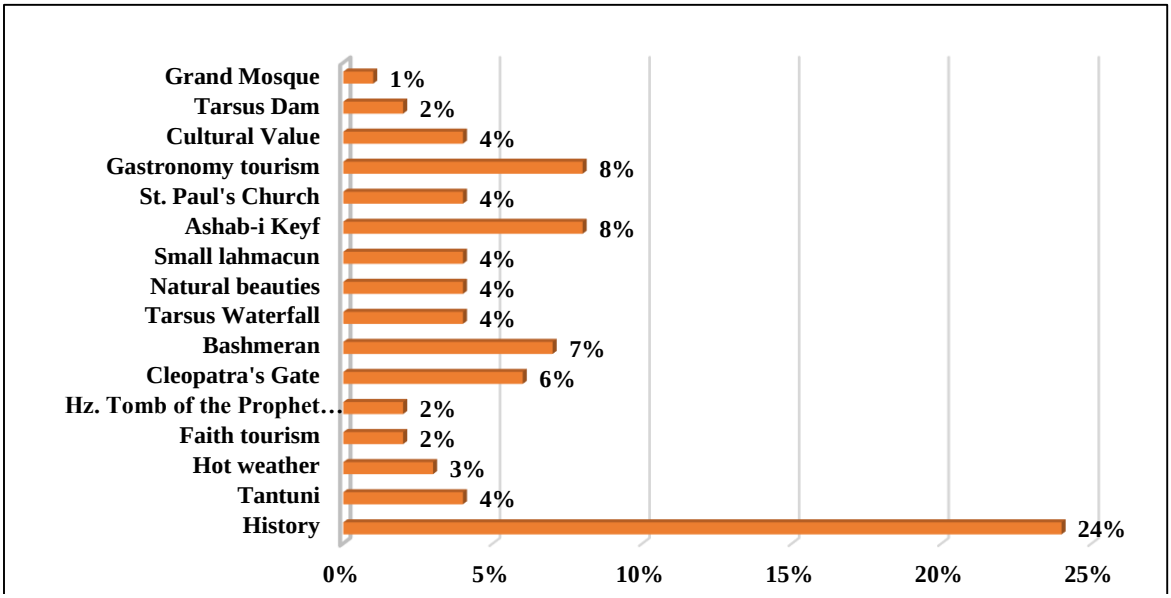

Figure 9. Responses of the participants to the question "Which of the following is Tarsus known for?"

The participants were asked to rank their first three preferences in the question which type of tourism is more suitable for the development of Tarsus City (Figure 10). Accordingly, the most preferred tourism types were cultural tourism (54%) and historical tourism (52%), faith tourism (39%), and highland tourism (35%), respectively. The least preferred tourism activity was Fauna (wildlife) tourism with 1%.

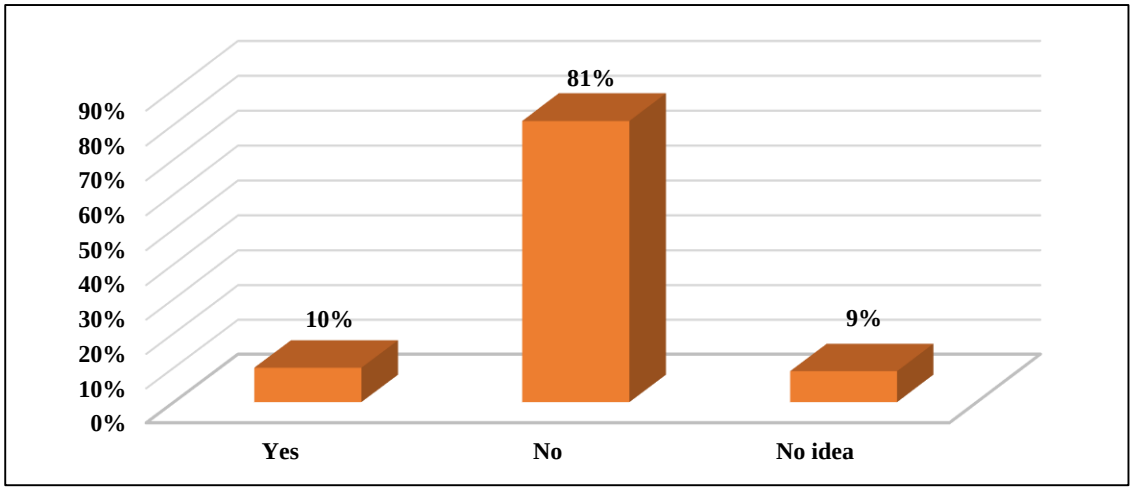

Figure 10. Responses of the participants to the question "Which type of tourism do you think Tarsus region is more suitable for development?"

When the answers were given to the question about whether the city of Tarsus has been adequately promoted or not, 10% of the participants answered yes to this question, 81% said no, and 9% had no idea (Figure 11).

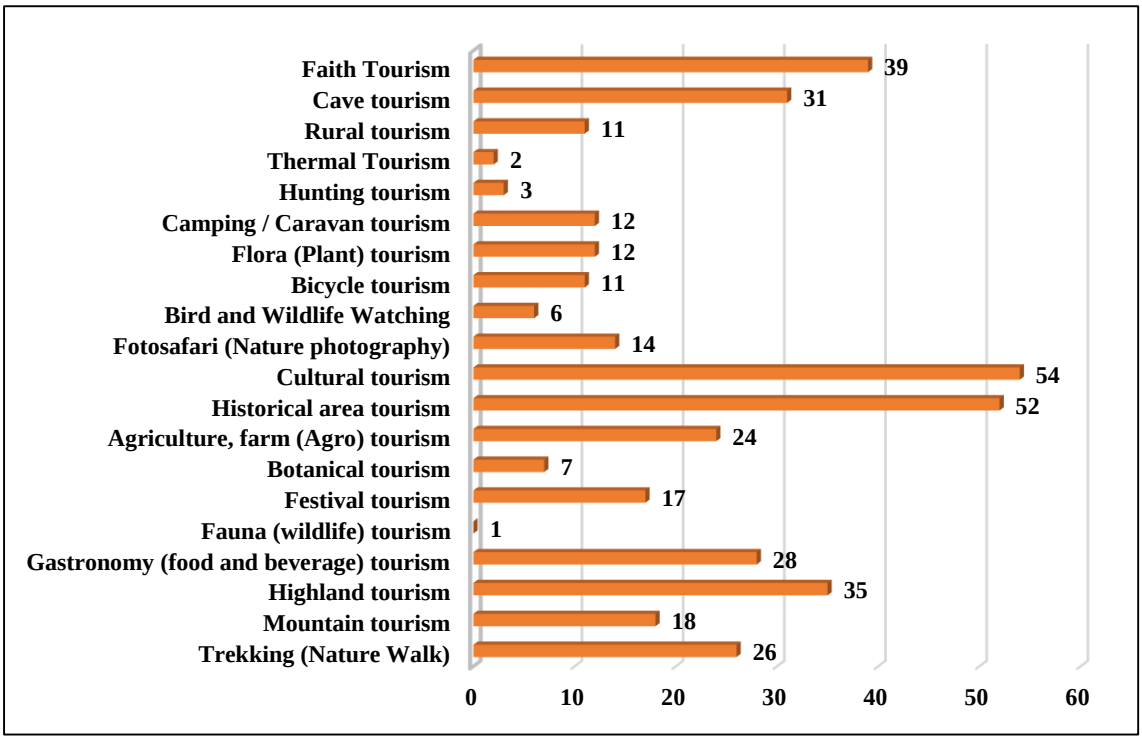

Figure 11. Responses of the participants to the question "Do you think Tarsus is promoted enough?"

Participants were asked whether they wanted the city of Tarsus to develop. 99% of the respondents answered "yes" to this question and 1% answered no (Figure 12).

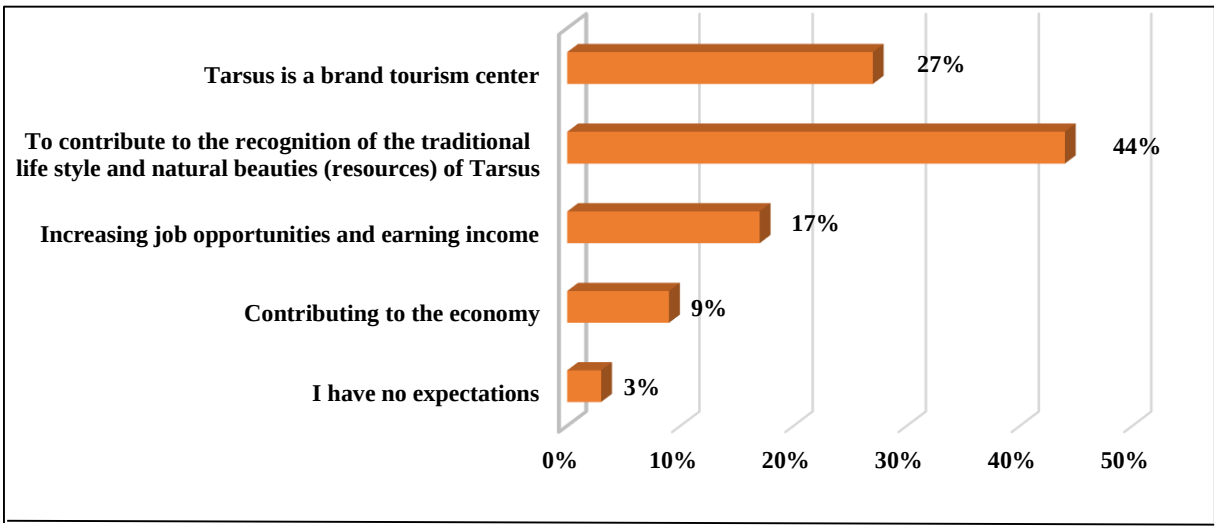

Figure 12. Responses to the question "Do you want tourism to develop in your district?"

Participants were asked what their expectations are from the development of tourism in Tarsus. The biggest expectation (44%) of the local people from the development of tourism in the city of Tarsus was to contribute to the recognition of the traditional lifestyle and natural beauties (resources) of Tarsus. Then, respectively, 27% of the participants answered that the city of Tarsus is a brand tourism center, 17% of them increasing job opportunities and earning income, and 9% of them are contributing to the economy. 3% of the respondents stated that they have no expectations for the development of tourism in the district (Figure 13).

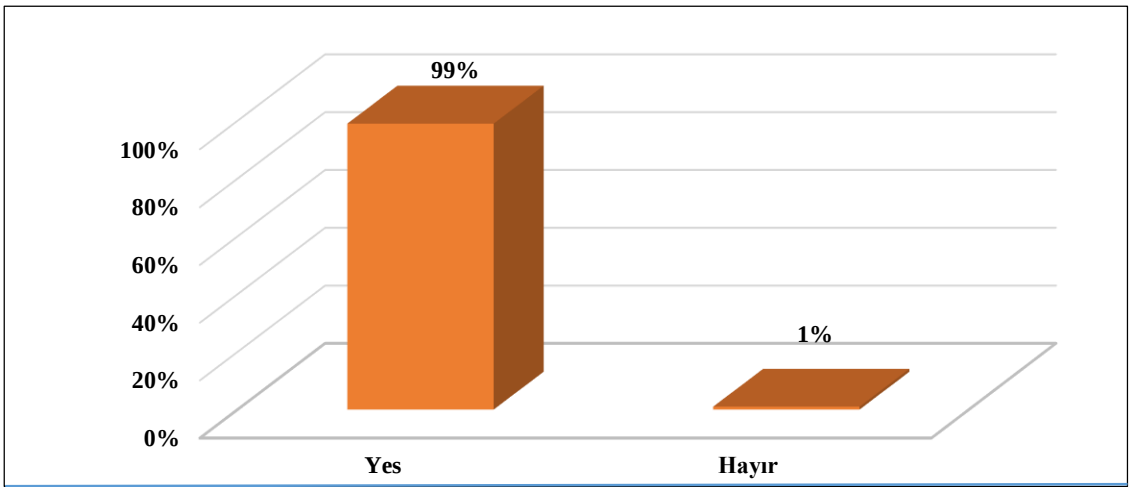

Figure 13. Responses of the participants to the question "What are your expectations from the development of tourism in Tarsus?"

When the answers given to the participants to the question of which factors could negatively affect the development of tourism in Tarsus districts were examined, 47% said that the most important negative effect from Tarsus is the inadequacy of accommodation facilities, 36% inadequacy of tourism activities, 7% inadequacy of transportation, 6% in educational opportunities. inadequacy, 3% of them gave answers as lack of security. 1% of the respondents stated the inadequacy of health facilities as the most important obstacle to the development of tourism (Figure 14).

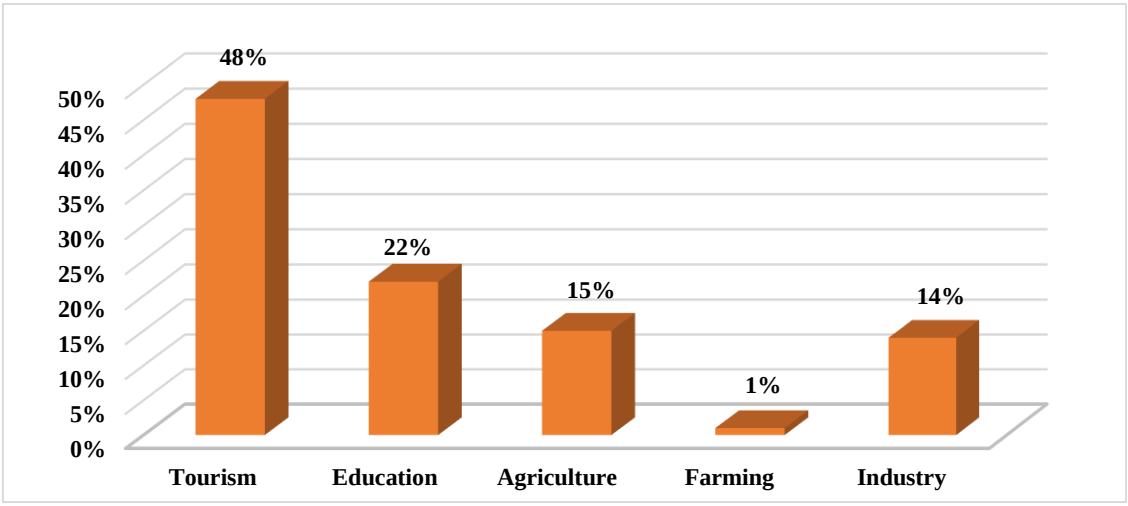

Figure 14. Responses of the participants to the question "Which of the following factors negatively affect the development of tourism in Tarsus?"

"Which sectors should be given priority in the development of the district in Tarsus and its surroundings?" The answers they gave to the question asked as the following were 48% tourism, 22% education, 15% agriculture, 14% industry and 1% animal husbandry (Figure 15).

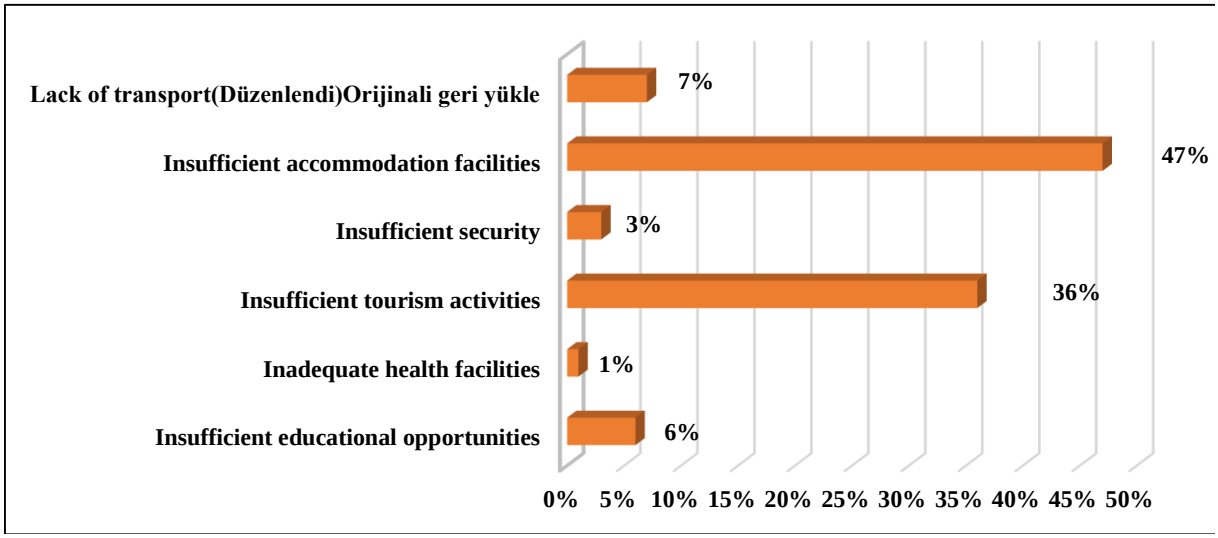

Figure 15. Responses of the participants to the question "Which of the following sectors should be given priority in the development of the district in Tarsus and its vicinity?"

4. Conclusion and Suggestions

To understand ourselves and our society, urban landscapes should be regarded as cultural clues and, thus, as germane areas for conducting research (Aşur et al., 2022; Aşur & Akpınar Külekçi, 2020; Rüzgar et al., 2022; Kaplan & Örücü, 2019).

Tarsus, the focus area of this study, is a district located in the southern part of Turkey, connected to the province of Mersin. Tarsus district is situated to the east of Mersin province. The districts of Mersin province include Akdeniz, Anamur, Aydıncık, Bozyazı, Çamlıyayla, Erdemli, Gülnar, Mezitli, Mut, Silifke, Toroslar, Yenişehir, and Tarsus. Tarsus is the largest district in Mersin province.

Tarsus district boasts a diverse topographic structure, different landscape characters, with natural assets such as mountains, forests, plateaus, and rivers, varying between sea level at the Mediterranean coast and elevations of up to 3000 meters in the northern region. The Mediterranean climate dominates the area, and the surrounding region of Tarsus is rich in diverse plant species. Additionally, Tarsus district is known for its caves, historical structures, and traditional way of life, making it a significant potential destination for tourism. Therefore, sustainable tourism activities in Tarsus should focus on maintaining a balance between conservation and utilization of these natural assets.

In order to promote tourism and recreational potential and contribute to the development of the region, it is recommended to consider the following aspects based on on-site observations, surveys, and literature sources regarding Tarsus district and its immediate surroundings:

- The proximity of natural and historical sites in Tarsus district and the ease of transportation present a favorable advantage for tourism. Being a district with the potential for vibrant tourism and recreational activities, Tarsus should develop well-planned initiatives through participatory, conservation-oriented, and rational approaches. The positive attitude of local residents towards the development of tourism, as indicated in the survey, holds significant importance in fostering tourism activities. Studies by Sinkovics & Penz (2009) have shown that the positive perception of tourists by the local community increases the desire of tourists to travel.
- Local community views and perceptions regarding tourism development will have a positive impact when active community engagement and employment opportunities are provided. Tourism planning and its growth can lead to changes in economic, social, and environmental perceptions within the community (Jamal & Getz, 1995). In Tarsus, there are significant expectations for economic and employment opportunities associated with tourism development. Considering the survey results, which indicate that the region is primarily

associated with historical sites and cultural heritage (80% and 59%, respectively), Tarsus has considerable potential for historical and cultural tourism. This aspect should be taken into account when planning future tourism activities.

- Tourism development can drive local economic growth, generate new employment opportunities, increase revenue, tax income, foreign exchange, and contribute to the development of other industries (Ko & Stewart, 2002). The development of winter tourism in the Karboğazı ski center in Tarsus, which currently lacks sufficient facilities, can lead to the development of other related industries.
- Tarsus district benefits from a well-developed transportation infrastructure, including highways, railways, and the Mersin port. The ongoing construction of the Çukurova Regional Airport will also significantly enhance transportation.
- To further boost tourism in Tarsus, it is essential to focus on restoration efforts to preserve the original state of historical sites and carry out effective promotion campaigns.
- Improving people's standard of living and providing better living conditions are closely related to the country's economic growth. Tourism is an important sector that can achieve better results in a shorter time frame with fewer financial resources and investments. Therefore, given that tourism was the first and most preferred option for the development of Tarsus district in the survey (48%), prioritizing tourism activities in the region is necessary. It is crucial to protect the fertile agricultural lands of Tarsus Plain from urbanization and preserve the natural beauty of the district to increase tourism activities.
- Proper promotion of Tarsus' natural, historical, and cultural attractions is necessary.
- Historic Tarsus houses can be renovated and converted into museums or accommodation facilities for visiting tourists.
- The Tarsus beach, which holds significant potential for sea tourism, is currently in a neglected state. With appropriate investments and promotion, it can become a significant source of revenue for the country and a prominent regional and international sea tourism destination.

To fully realize the tourism potential of Tarsus district, it is essential to emphasize the significance of its cultural assets and natural landscape, identify and promote its tourist attractions. Visitors can explore Tarsus by starting from the Cleopatra Gate in the city center and visiting nearby sites such as Gözlükule Mound. Other historical places within walking distance include St. Paul's Church, St. Paul's Well, Tarsus old houses, and the ancient road. Visitors can then continue to explore Bilal-i Habeş Mosque, Ulu Mosque, Kırkkaşık Bedesten, Kubat Pasha Madrasa, Old Mosque, remnants of the Roman Bath, the Tomb of the Prophet Daniel, and Şahmeran Bath. Additionally, Ashab-ı Keyf and Taşkuyu Cave, located 12 km northwest of Tarsus, offer fascinating attractions and opportunities for paragliding from Ashab-ı Keyf Hill. Visitors can also enjoy the region's local cuisine, shopping venues, and other facilities to cater to their basic needs. In summary, Tarsus district and its nearby surroundings, with its mountains, hills, rivers, vast forests, intriguing geological and geomorphological formations, and historical and cultural structures, offer a remarkable destination that eagerly awaits visitors.

Acknowledgements and Information Note

This research was produced from a master's thesis. In this study, ethics committee compliance approval was received from Atatürk University Science and Engineering Sciences Ethics Committee Presidency with the document dated 02.06.2021 and numbered E-77040475-000-2100142908.

Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to the article. There is no conflict of interest.

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A Restoration Proposal On Antalya Yivli Minaret (Mevlevihane) Bath

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Abstract

Turkish baths and bath culture have a very special place in the social life of Turkish society. In addition, due to the importance given by the Islamic religion to cleanliness and especially to cleaning with rivers, our baths are one of the indispensable architectural monuments of our social life. As in all civilizations, baths have an important place in Anatolian culture. Baths are divided into two as public baths and private baths. Public baths are used by the public, while private baths are baths that serve a limited number of people. In this study, the Yivli Minaret (Mevlevihane) Bath, located within the Yivli Minaret Complex in Antalya Kaleiçi, is discussed. The construction date of the bath, which is included in the group of private baths, is not known exactly. In 2019, extensive excavation work was carried out in the bath by the Antalya Museum. After the excavations, it was determined that new units belonging to the bath emerged. In the light of these findings, different suggestions about the original plan of the bath will be put forward than those known so far.

Keywords: *Antalya, Kaleiçi, architecture, Yivli Minaret, bath, restitution.*

Antalya Yivli Minare (Mevlevihane) Hamamı Üzerine Bir Restitüsyon Önerisi

Öz

Türk toplumunun sosyal hayatında, hamamlar ve hamam kültürü çok özel bir yer tutmaktadır. Ayrıca İslam dininin temizliğe ve özellikle akarsuyla yapılan temizliğe verdiği önem dolayısıyla hamamlarımız toplumsal hayatımızın vazgeçilmez mimari anıtlarının başında gelmektedir. Hamamlar, bütün medeniyetlerde olduğu gibi Anadolu kültüründe de önemli bir yere sahiptir. Hamamlar, genel hamamlar ve özel hamamlar olmak üzere ikiye ayrılmaktadırlar. Genel hamamlar halkın kullandığı, özel hamamlar ise sınırlı sayıda insanlara hizmet eden hamamlardır. Bu çalışmada, Antalya Kaleiçi'ndeki Yivli Minare Külliyesi içerisinde bulunan Yivli Minare (Mevlevihane) Hamamı ele alınmıştır. Özel hamamlar grubu içerisinde yer alan hamamın inşa tarihi tam olarak bilinmemektedir. 2019 yılında Antalya Müzesi tarafından hamamda geniş kapsamlı kazı çalışması yapılmıştır. Kazı çalışmaları sonrasında, hamama ait yeni birimlerin ortaya çıktığı tespit edilmiştir. Bu tespitler ışığında, hamamın özgün planı hakkında bugüne kadar bilinenlerden farklı öneriler ileri sürülecektir.

Anahtar Kelime: *Antalya, Kaleiçi, mimari, Yivli Minare, hamam, restitüsyon.*

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1. Introduction

The lexical meaning of the word hamam (hammâm), which derives from the root hamm (hamem) meaning "to warm; to be warm" in Arabic, is "a place that warms" and is used in the meaning of "a place for bathing". Its Persian equivalent is germâb (Eyice, 1997). There are religious, legal, moral and traditional rules regarding bathing in baths (And, 1979; Önge, 1992; Uzun & Albayrak, 1997; Çimrin, 2008; Denktaş, 2010). Those who serve female customers in the baths are called "natır" and those who serve male customers are called "tellak". At the same time, servants generally called "hamam servants" such as furnaceman, meydancı, peştamalci, çıkmacı and kahveci work in the baths. Western travelers who came to Istanbul between the 17th and 19th centuries also provide important information about the baths and bathing culture (Grelot, 1680; Pardoe, 1838).

There is limited information about the baths built by the Turks in the regions where they settled before the conquest of Anatolia. The Seljuk bath in Nigar in the south of Kirman is similar to the Turkish baths in Anatolia in terms of the arrangement of the caldarium (Denktaş, 2000). The baths built during the Anatolian Seljuks can be analyzed in two groups in terms of the water used: baths with natural hot water and baths with heated cold water.

Anatolian Seljuk Turkish baths consist of four main sections. These are the undressing (camekân), corridor, tepidarium and caldarium sections. In addition to these, there are two installation spaces consisting of cold and hot water tanks and the ashtray section. The baths built in the Ottoman Period consist of three main sections. These are the undressing, tepidarium and caldarium sections. In this period, water tanks and furnace sections continued the architectural tradition.

Kaleiçi, one of the oldest port cities of Antalya, has been home to many settlements from the ancient period to the present day. It is known that the demographic structure of the city in the Ottoman period began to form during the Seljuk period and that Muslims and Christians lived in separate neighborhoods during the Seljuk period (Dinç, 2020). About Antalya Kaleiçi, Battuta mentions that Muslims lived in the very center of the city, there was a Friday Mosque, a madrasah, many baths, crowded and rich bazaars with a very regular plan (Ibn Battuta, 2016). It is known that this settlement order in the Seljuk period continued in the Ottoman period (Evliya Çelebi, 2016).

This study focuses on the Yivli Minaret (Mevlevihane) Bath located in Kaleiçi in Antalya. It is aimed to introduce all the architectural features of the bath to the scientific world in detail together with its location, the repairs it has undergone and the new units unearthed after the excavations.

2. Material and Method

This study focuses on the Yivli Minaret (Mevlevihane) Bath located in Antalya Kaleiçi. In the first stage, a general survey was conducted around the bath. Detailed photographs of the bath were taken during the on-site investigations and the measurements were taken and drawings were made in the Autocad program. In the second stage, a literature and archive search was made about the bathhouse and other bathhouse structures that may have a similar plan with the bathhouse were tried to be identified. In the third phase, a restitution proposal for the original plan of the bath was put forward by interpreting the new units identified during the excavations carried out in 2019.

2.1. Yivli Minaret (Mevlevihane) Bath

The bath was built adjacent to the Yivli Minaret Complex in the Muratpaşa District of Antalya Province. The date of construction and the owner of the bath are unknown. Önge (1995) suggests that the bath was built in the 14th century, while Kırmızı (1986) suggests that it was built during the Ottoman period. Yılmaz (2002) suggests that the bath may have been built in the first quarter of the 13th century. Evliya Çelebi, who came to Antalya in the 17th century, mentions the Mevlevihan within the complex. However, it is noteworthy that he did not give any information about the bath. Evliya Çelebi (2016) mentioned that there was a bathhouse only in the mevlevihan. In 1971, the General Directorate of Foundations carried out demolition and cleaning works (Tiryaki, 2013). In 1979, the bath was registered as an immovable cultural heritage (Antalya Cultural and Natural Heritage Preservation Board Directorate, 22.09.1979 dated and 1850 numbered decision). In 1982, it was restored (Yılmaz,

2002). In 1994, it is understood that the bath was rented to a person (Antalya Cultural and Natural Heritage Conservation Board Directorate, decision dated 01.02.1994 and numbered 191). The bath is not in use today. In 2019, excavation work was carried out by the Antalya Museum.

The bath has a plan with a central space and two halvets (secluded cell) and consists of a dressing room, tepidarium, temperature, halvet, toilet and water tank. The average wall thickness of the bath is 0.72 m (Figure 1).

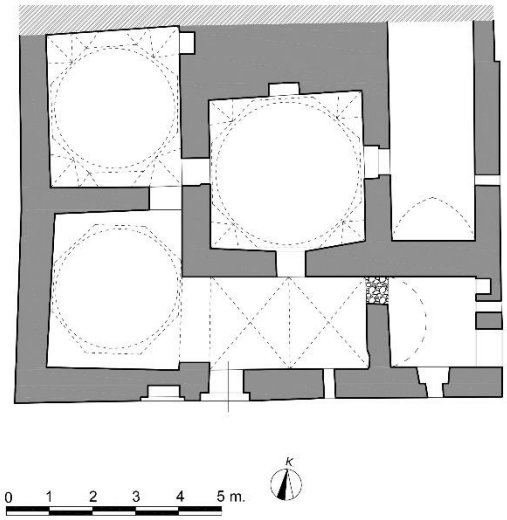

Figure 1. Plan of the Yivli Minaret Bath (edited from Yılmaz)

Rough masonry was employed in the walls of the bath and cut stone was used in the joints of the walls and in the north of the eastern façade. Brick material was preferred for the arches and window pediments inside the bath and for the upper cover. Today, the interior walls, benches and floor of the bath are covered with marble. The upper cover of the bath was plastered with cement from the outside (Figure 2).

Figure 2. Yivli Minaret (Mevlevihane) Bath

The central space of the caldarium, the tepidarium in the northwest of the caldarium and the halvet in the southwest are covered with a dome; the halvet in the south of the bath is covered with a cross vault; and the dressing room, toilet and water tank are covered with a barrel vault. The domes are arranged without pulleys. Hexagonal and circular shaped light eyes were opened on the dome ridges. In the vaults, only a square shaped light eye was placed in the center of the water tank (Figure 3).

Figure 3. General view of the upper covers of the Yivli Minaret (Mevlevihane) Bath

The western and northern facades of the bath are plainly designed. The entrance door to the halvet is located to the west of the south façade. The door is round arched and collapsed inwards. Immediately west of the door, a niche with a collapsed, pointed arch was placed. A small niche was opened in the west corner of the south facade. In the east corner of the south facade, there is a round arched window. A small rectangular upper level window was positioned in the middle of this window and the entrance door to the halvet.

A trace of dilatation was found on the eastern wall of the bath. The intensive use of cut stone in the masonry of the northern wing of the eastern wall suggests that the northern wing of this façade was demolished at an unknown date and later repaired. On the south wing of the east wall, there is a rectangular upper level window. In the center of the façade, the inscription positioned close to the ground level draws attention. The three-line inscription, which we think was used as a spolia, reads;

1) Resmi bi hazihi "l-imareti es-Sultan el-Muazzam"

2) El-A'zam ale'd-dünya ve'd-din Ebu'l-Feth Keykubat bin Keyh (üsrev)

3) Ala elyed el-abdüz zaif Tuğrul fi sene isna aşer…s… (Numan, 1982). A hole was drilled in the center of the third line of the inscription. A round arched niche is placed just above the inscription. A rectangular door was opened in the north corner of the east facade. This door leads to the undressing section, which was uncovered during the excavations in 2019 (Figure 4).

Figure 4. East facade of Yivli Minaret (Mevlevihane) Bath

The dressing section has not survived in its original form. Most probably the space to the east of the north façade has been completely demolished. During the 2019 excavations, a door with a flat arched doorway providing access from the dressing room to the tepidarium was found. The north façade of the dressing area is now approximately 3.00 m. under the soil (Figure 5).

Figure 5. Yivli Minaret (Mevlevihane) Bath door providing passage from the dressing room to the tepidarium section

The tepidarium section is entered through a door with a flat arched door opening to the west of the dressing room. Today, this door has been converted into an interior niche. The space has a trapezoidal rectangular plan with average dimensions of 3.60x2.90 m. The tepidarium is covered with a dome and a squinch is used in the transition to the dome. A total of five light eyes, round in the center and hexagonal in the periphery, were opened on the dome ridge. The four walls of the tepidarium are covered with marble slabs 1.30 m. high from the floor. Seating benches were added to the space from four directions. These benches are also covered with marble. The door on the north of the east façade of the tepidarium leads to the caldarium. This door has been closed and converted into a niche today. The pointed arched door located at the east corner of the south façade of the space leads to the halvets (Figure 6). After the complete demolition of the dressing area and loss of its function, the rectangular space to the south covered with a cross vault and the space to the west of it covered with a dome were transformed into the dressing area. During this transformation, the door on this façade must have been opened.

Figure 6. Yivli Minaret (Mevlevihane) Hamam cold section

The hot room is entered through a pointed arched door opening to the center of the north facade of the halvet covered with a cross vault in the south. Measuring 3.66x3.60 m., it has a slightly trapezoidal square plan and is covered with a dome. A squinch was used in the transition to the dome. A total of five round shaped light wells are opened on the dome ridge. The skirt of the dome is decorated with a thin moulding. Similar to the halvet, marble wall coverings and benches are encountered in this section. A pointed arched niche was added to the centre of the north wall of the hot spring at the

upper level. This niche corresponds to the window found in the centre of the south wall of the dressing room during the 2019 excavations. A window was placed in the centre of the east wall of the hot spring. The window is beveled on the sides and has a pointed arched pediment. The window is associated with the water tank to the east of the bath (Figure 7).

Figure 7. Temperature section of Yivli Minaret (Mevlevihane) Bath

There are two halvets in the south of the bath. The halvet located in the centre of the south façade is entered through a rectangular door with pointed arches opening to the centre of the south façade of the caldarium. The space extends in the east-west direction and measures 3.68x2.16 m. It is covered with two rows of cross vaults. There is a toilet in the east of the cell. However, the door providing access to the toilet section has been filled and cancelled today. To the west of the cell room is the other halvet. Both halvets are separated by a pointed arch (Figure 8).

Figure 8. General view of the halvets of the Yivli Minaret (Mevlevihane) Bath

The halvet in the southwest measures 3.58x3.07 m and has a slightly trapezoidal rectangular plan. This section is covered with a dome and a pendant was used for the transition to the dome. This section is illuminated by a total of six light wells, round in the centre and hexagonal in the periphery, which open onto the dome ridge (Figure 9). The water tank is located to the east of the bath and measures 3.62x1.98 m. The tank is covered with a barrel vault.

Figure 9. The south-western halvet of the Yivli Minaret (Mevlevihane) Bath

3. Conclusion and Recommendations

The date of construction and the owner are unknown and the bath is simple in terms of ornamentation. The bath has been subjected to many interventions and repairs until today. In 2019, during the excavations carried out on the north façade, a part of the dressing section of the bath, which was buried under approximately 3.00 m. of soil, could be reached. From the information obtained from this excavation, it was confirmed that the dressing section of the bath was located on the north façade, contrary to what was known until today. From the information obtained during the excavations, it is understood that the length of the south wall of the dressing section is approximately 6.60 metres. However, excavations need to be completed in order to be able to give an accurate opinion on both the dimensions and the upper cover of this section. During these excavations, the arched doorway providing passage from the dressing room to the tepidarium section and the arched window providing connection with the temperature were also reached. Particularly in Anatolian Turkish bath architecture, it is noteworthy that the window application opening from the undressing area to the caldarium is encountered here for the first time. This application can be explained by the fact that this bath was not a public bath and was a private bath serving only a limited number of people (Figure 10). Likewise, the bath was built in accordance with the land condition of the Yivli Minaret Complex. For this reason, since this bath does not fit into any of the typologies in Turkish bath architecture, the plan of the bath is evaluated within the special bath typology.

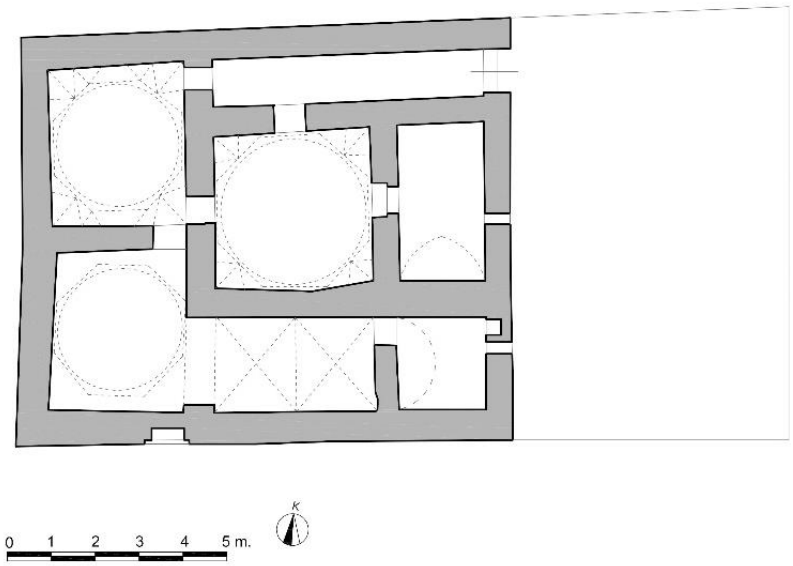

Figure 10. Yivli Minaret (Mevlevihane) Bath Restitution plan

In our opinion, the bath, which has been subjected to many repairs, was designed as a bath with a central space of undressing, tepidarium and two halvets. However, the dressing section was completely demolished and out of use in a period for which we do not yet know the reason. Later, due to the need, a door was added to the walls of the halvets on the south façade and these were then converted into a dressing room and the bath continued to be used for some time.

Firstly, the intensive use of cut stones on the northern wing of the eastern wall of the bath indicates that this wing was partially or completely demolished and then repaired. During this repair work, it can be suggested that the inscription, which we think as spolia material, was added. When the plan of the bath is examined, it is understood that the toilet in the southeast corner is entered through the door opening to the east wall of the halvet section. However, this door is closed today. In addition, the round arched window in the south corner of the water tank has been filled and cancelled today. It is also thought that this window is not original. Because in the toilet rooms, large windows close to the floor and in terms of their dimensions are not opened. Likewise, considering the place of the bath in Turkish bath architecture, it is understood that the doors and windows on the south façade are not original and were opened at an unknown date.

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The article has a single author and there is no conflict of interest.

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An Analysis on Learning Styles and Personality Types of Students in the Techniques of Architectural Presentation Course

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Abstract

Determining the learning styles of the students in the process of constructing curricula is significant for the development of architectural education. This study aimed to evaluate the relationship between the learning style of first-year architecture students and their successful performance in "The Techniques of Architectural Presentation" course and to discuss the relationship between learning styles-gender and learning styles-course curriculum. Kolb and Briggs Myers learning style inventories were used in the study. It was determined that the students with a diverging style had a large share of participants, and no significant relationship was established between gender, course success, and Kolb's learning style. According to the MBTI inventory, it was determined that the differences in the mean scores of the students' genders in the "Intuition", "Feeling," and "Perception" profiles were significant. An increase in success rate in 3D studies indicates the importance of the development of syllabi with 3D applications.

Keywords: *Architecture education, learning styles, personality types, Kolb, Briggs Myers.*

Mimari Anlatım Teknikleri Dersinde Öğrencilerin Öğrenme Stilleri ve Kişilik Tipleri Üzerine Bir Analiz

Öz

Öğrencilerin öğrenme stillerinin ders müfredatının oluşturma sürecinde belirlenmesi mimarlık eğitiminin gelişimi açısından önemlidir. Bu çalışma birinci sınıf mimarlık öğrencilerinin öğrenme stili ile "Mimari Anlatım Teknikleri" dersindeki başarı performansı ilişkisinin değerlendirilmesini; öğrenme stilleri-cinsiyet ile öğrenme stilleri-dersin müfredatı arasındaki ilişkinin tartışılmasını amaçlamıştır. Çalışmada Kolb ve Briggs Myers öğrenme stili envanterleri kullanılmıştır. Değiştiren stiline sahip olan öğrencilerin büyük paya sahip oldukları, ve cinsiyet, ders başarısı ve Kolb öğrenme stili arasında anlamlı bir ilişki kurulamadığı tespit edilmiştir. Briggs Myers envanteri öğrencilerin cinsiyet faktörü bağlamında değerlendirildiğinde "Sezgisel", "Hisseden" ve "Algılayan" profillerindeki puan ortalamaları arasında anlamlı farklılıklar saptanmıştır. Üç boyutun dahil edildiği çalışmalarda başarı oranının artması ders izlencesinin üç boyutlu uygulamalar ile geliştirilmesinin önemini belirtmektedir.

Anahtar kelimeler: *Mimarlık eğitimi, öğrenme stilleri, kişilik tipleri, Kolb, Briggs Myers.*

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1. Introduction

Architecture education in the changing-transforming environment, as in other fields, requires updating. The structure of architectural education is influenced by variables such as curricula, teaching environments, changing technological and socio-cultural environments, and related professional dynamics, and student, and teacher characteristics. Student characteristics include variables such as age, gender, intelligence type, and learning style. Hemdan, Taha & Cherif (2023) state that students' performance depends on the school characteristics, educator's influence, and students' attributes which include personality and abilities.

Understanding individual differences will help architecture education and educators improve design teaching techniques and help students improve themselves and achieve their goals. While students need to identify their own learning needs, it is also the responsibility of the university to recognize and plan to meet them (Hodgkinson, 1994). However, there are limited studies on the contribution of learning style and personality types to the educational process and its relationship with the curriculum in architectural education. This study investigates the learning styles and personality types of architectural students and the relationship between these styles and the level of success in the student's education. The results obtained are intended to aid in the curriculum's development. The principal aims of this study are.

- to determine differences in learning styles and personality types among first-year architecture students
- to investigate the relationship between learning styles, personality types, and success in the Techniques of Architectural Presentation course
- to determine the correlation between different learning styles, personality types, and the gender of students taking the course
- to determine the relationship between homework evaluations, learning styles, and personality types

To these ends, learning style inventories were applied to first-year undergraduate students who took the ARCH101-Techniques of Architectural Presentation course in the Department of Architecture at Gebze Technical University. These inventories were evaluated together with homework evaluations and course success through SPSS.

1.1. The Learning Styles and Personality Types

Demirkan and Demirbaş (2010, p.1390) define learning as an internal process that is different for each individual and learning style as an individual's way of acquiring new knowledge. Dunn and Dunn (1993) define learning style as the way individuals start to concentrate, process, internalize, and store new and difficult information, further asserting that the interactions of these elements occur differently in each individual. Vygotsky (1978) argues that learning styles are gender, culture, and discipline-specific and are both the product and the process of socio-cultural learning environments.

Learning style theory asserts that students are academically successful in learning environments that suit their learning styles (Dunn 1983; Kolb 1984). Various models have been developed since the 1960s to investigate these styles. Coffield, Ecclestone, Moseley & Hall (2004, p. 8-9) examined the learning style literature and determined that out of seventy models surveyed, the most valid and widely used are those of Jackson, Riding, Sternberg, Dunn and Dunn, Gregorc, Honey and Mumford, Kolb, Entwistle, Herrmann, Myers-Briggs, Apter, Vermunt and Allinson and Hayes, of which Kolb's learning style inventory is the most widely used. Kolb's model, however, determines only an individual's learning preferences, while others, such as those of Apter, Jackson, and Myers-Briggs, help to identify both the learning preferences and personality type. This study uses both the Kolb learning style inventory and the Myers-Briggs personality type inventory to probe into the relationship between differences between individual students and course success by determining both their personality types (MBTI) and learning styles (KOLB).

1.1.1. The Kolb learning style

Experiential Learning Theory, developed by David Kolb in the early 1970s, along with the Learning Style Inventory (LSI) designed to test the theory, is one of the most widely used models in the literature (Tucker, 2008). Kolb, dissatisfied with traditional teaching methods, developed an inventory idea that would determine individual learning differences and indicate the resulting preferences (Kolb, 1981). Experiential Learning is a dynamic learning model based on a learning cycle driven by the dual dialectic of action/thinking and experience/abstraction. It defines learning as the process that occurs through the transformational experience of gaining knowledge (Kolb, 1984). Moreover, it asserts that learning arises from the synthesis of grasping and re-transforming experiences (Kolb, 1984). Grasping experience refers to the process of receiving information while transforming experience comprises how individuals interpret and act upon that information. The Experiential Learning model encompasses four dialectically related modes: two (Concrete Experience-CE and Abstract Conceptualization-AC) in the experience cognition dimension, and two (Reflective Observation-RO and Active Experimentation-AE) in the transforming experience dimension (Fig. 1).

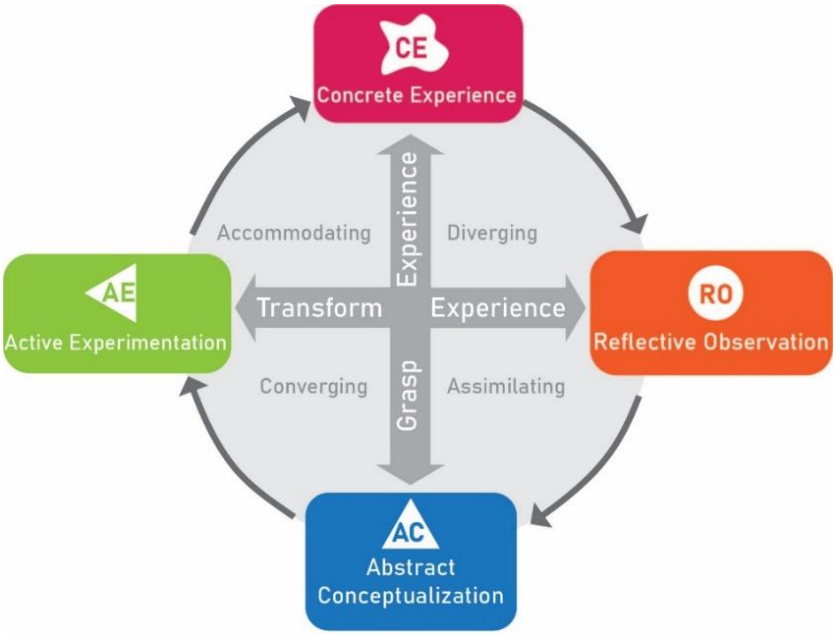


Figure 1. Kolb's learning style inventory (Kolb, 1984)

CE focuses on being involved in experiences and dealing with human situations. It emphasizes emotion rather than thinking, is concerned with the uniqueness and complexity of existing reality instead of theories and generalizations, and takes an intuitive, "artistic" approach to problems rather than a systematic, scientific one. RO focuses on understanding reality through examination and description of ideas and situations. It emphasizes reflection and understanding rather than action and practical application, concerned more with the best approach to determining what is right or what will work. AC focuses on the use of logic, ideas, and concepts, emphasizing thinking over feeling, constructing general theories over intuitively understanding specific areas and taking a scientific rather than an artistic approach to problems. AE focuses on actively influencing people and changing situations, emphasizing practical applications, unlike reflective understanding; it takes a pragmatic interest in what works rather than in absolute truth and focuses on doing rather than observing (Kolb & Kolb, 2013, p. 7-8). Out of the definition of this dual matrix emerge four learning styles: converging, diverging, assimilating, and accommodating.

Type 1: Converging (abstract, active) is based on abstract conceptualization and active experience; those with this learning style are good at problem-solving, decision-making, and the practical application of ideas, perform best in situations such as traditional intelligence tests, are controlled in the expression of emotion, and prefer to deal with technical rather than interpersonal issues.

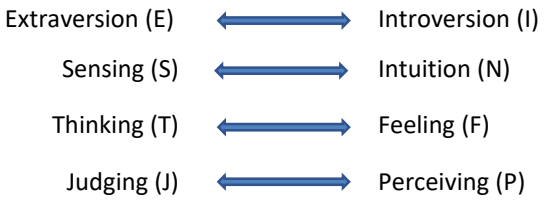
Type 2: Diverging (concrete, reflective) emphasizes concrete experience and reflective observation; those with this learning style are creative and aware of meaning and values, see concrete situations from many angles, adapt through observation rather than action, and are interested in people and emotion-oriented.

Type 3: Assimilating (abstract, reflective) is based on abstract conceptualization and reflective observation; those with this learning style like to reason by induction, and create theoretical models; they are more concerned with ideas and abstract concepts than with people and think that the abstract rationality of ideas is more important than their practice.

Type 4: Accommodating (concrete, active) emphasizes concrete experience and active experience; those with this learning style like to make plans and get involved in new experiences, are good at adapting to changing conditions, solve problems intuitively through trial and error, and communicate efficiently with others; however, they can sometimes be perceived as impatient and aggressive (Coffield et al., 2004, p. 60-61).

1.1.2. Myers-Briggs type indicator (MBTI)

The Myers-Briggs Type Indicator (MBTI) was developed in the early 1940s to make Jung's (1991) theory of human personality understandable and useful in daily life (Coffield et al., 2004, p. 46-47). The MBTI inventory that Myers and Briggs developed comprises 16 personality types through the addition of the Judging and Perceiving (J-P) dichotomy to Jung's eight basic psychological types (Myers & McCaulley, 1998). The development of several variants followed the publication of the first MBTI guidelines in 1962 (Form G, form M, form J, and form K) (Myers & McCaulley 1985). For this study, form M, comprising 93 questions, was used. The inventory consists of two answer questions addressing four different dichotomies (Coffield et al., 2004, p. 46-47).



Through the evaluation of each of the four dichotomies separately, the dominant dimensions can be brought together, and the personality type is revealed (Table 1).

Table 1. Personality types and characteristics (Myers & McCaulley, 1998, p. 38)

		Feeling Types				Intuitive types			
		With thinking		With feeling		With feeling		With thinking	
Introverts	Judging Types	**ISTJ**		**ISFJ**		**INFJ**		**INTJ**	
		I	Depth of concentration	I	Depth of concentration	I	Depth of concentration	I	Depth of concentration
		S	Reliance on facts	S	Reliance on facts	N	Grasp of possibilities	N	Grasp of possibilities
		T	Logic and analysis	F	Warmth and sympathy	F	Warmth and sympathy	T	Logic and analysis
		J	Organization	J	Organization	J	Organization	J	Organization
	Perceiving Types	**ISTP**		**ISFP**		**INFP**		**INTP**	
		I	Depth of concentration	I	Depth of concentration	I	Depth of concentration	I	Depth of concentration
		S	Reliance on facts	S	Reliance on facts	N	Grasp of possibilities	N	Grasp of possibilities
		T	Logic and analysis	F	Warmth and sympathy	F	Warmth and sympathy	T	Logic and analysis
		P	Adaptability	P	Adaptability	P	Adaptability	P	Adaptability
Extraverts	Perceiving Types	**ESTP**		**ESFP**		**ENFP**		**ENTP**	
		E	Breadth of interests	E	Breadth of interests	E	Breadth of interests	E	Breadth of interests
		S	Reliance on facts	S	Reliance on facts	N	Grasp of possibilities	N	Grasp of possibilities
		T	Logic and analysis	F	Warmth and sympathy	F	Warmth and sympathy	T	Logic and analysis
		P	Adaptability	P	Adaptability	P	Adaptability	P	Adaptability
	Judging Types	**ESTJ**		**ESFJ**		**ENFJ**		**ENTJ**	
		E	Breadth of interests	E	Breadth of interests	E	Breadth of interests	E	Breadth of interests
		S	Reliance on facts	S	Reliance on facts	N	Grasp of possibilities	N	Grasp of possibilities
		T	Logic and analysis	F	Warmth and sympathy	F	Warmth and sympathy	T	Logic and analysis
		J	Organization	J	Organization	J	Organization	J	Organization

MBTI is evaluated in single, binary, or quart categories. Keirsey & Bates (1974) also sort personality types into four categories to better understand and correlate them: NF, SP, NT, and SJ.

1.2. Learning Style, Personality Types and Architecture

In architectural education, active learning takes place when students question design theories, relate these theories to existing design problems, and engage in a creative exploration process.

The architecture studio creates a context that promotes active learning through group or individual problem-based projects. The challenge of defining a problem and its boundaries and developing a creative approach to its solution helps develop justified reasoning, interpersonal skills, thinking in action, and critical thinking for the practices that form the foundation of architectural education (Schön, 1983). Design is a process where potential solutions to a problem are first generated in the mind, followed by processes of analysis and synthesis, and the best of these potential solutions is then turned into a design output (Yurtgün & Çınar, 2023, p. 297). In this experiential learning model, students pose and negotiate design problems while teachers act as facilitators prodding students in the direction of learning. Kvan and Jia (2005) stated that the characteristics of students' learning styles can be utilized to further the development of learning in design. Under the influence of these perspectives, the use of learning styles in the architectural profession has been a research topic since the last quarter of the 20th century.

Demirbaş & Demirkan (2003), arguing that design education can be examined through Kolb's Experiential Learning Theory, conducted a study examining the effects of learning styles on the design processes of design students. They observed statistically significant differences in the performance

scores of students with different learning styles at various stages of the design process. Students with an assimilating style had the largest and those with an accommodating style the smallest increase in performance scores; however, accommodating students were more successful overall in the project course. Tucker (2007) emphasized that there was a significant relationship between KOLB learning styles and participation in a study year for first and third-year students in the architectural design course, and as the learning process progressed, there was a shift toward the abstract conceptualization axis (converging and assimilating) in the learning style graph. Tucker also noted that students further along the axis of abstract conceptualization were more successful. Yazıcı (2014, p. 155-168) also used Kolb's Learning Style Inventory to determine the learning styles of students in a study investigating the relationship between perspective drawing success and the learning styles of architecture students, finding that students with an assimilating style were more successful, followed by those with a diverging style, and then by those with a converging style. Students with an accommodating learning style showed the weakest performance. Özdemir (2016) investigated the connection between learning style and success among first-year Basic Design students in the architectural department, determining that students with assimilating and diverging learning styles were more successful. Yazıcı investigated again in 2021 the relationship between successful evaluations in architectural design courses over 8 semesters and the learning styles of students who started architectural education in two different academic terms, 2010 and 2012, using the Kolb Learning Style Inventory, noting that the academic success of both sets of architectural students showed similar results. The most successful students were, in descending order, those with diverging, converging, assimilating, and accommodating styles. Kolsal & Kandemir (2021) determined that 76.4% of the first-year architecture students evaluated through the Kolb learning style inventory had a diverging learning style, followed by assimilating and accommodating, with no students in the converging group. They also noted that students with an assimilating style in the design process were more successful.

Various learning style studies on architectural education have been conducted using the MBTI inventory since the 1990s. Brown, Hallett & Stoltz, (1994) found that NT and NF were the dominant learning style groups in their research on landscape architecture students in Canada. Russ and Weber (1995) used the MBTI inventory to examine the personality traits of two hundred and thirty-four interior architecture students at twelve accredited universities in the USA. Of these students, 40.2% were identified as NF and 16.2% as ENFP personality types. Durling, Cross, and Johnson (2019) applied the MBTI inventory to extract the personality profiles of 71 first-year design students in England. Their results indicated that the dominant personality groups were ENTP, ENFP, and ENTJ, at 26.8%, 15.5%, and 9.9% of the students surveyed, respectively. Poursafar, Devi, and Rodrigues (2015) employed the MBTI inventory to investigate personality types in architectural offices, e-surveying one hundred twenty-six Indian and one hundred seventy-six Iranian architects; the most dominant personality types were ESTJ (25.17%), ISTJ (15.56%), ENTJ (12.25%), and ENFJ (8.61%). Robert Gaarder applied the Myers-Briggs inventory to 100 architects in the US and determined the dominant personality type (31% of the total) to be ENTJ (Architect Magazine, 2011). The literature seems to indicate that different features in the Myers-Briggs inventory can be associated with the architectural profession. At the same time, similar studies in different cultures have produced different results.

2. Material and Method

In line with the stated aim of the research, in the fall semester of 2019-2020, Kolb and MBTI inventories were used to classify forty-seven first-year architecture students at Gebze Technical University's Department of Architecture's ARCH 101 Techniques of Architectural Presentation course. To complete the study, an ethical declaration numbered E-100822 was provided by the Ethics Committee of Gebze Technical University.

2.1. The Course of Techniques of Architectural Presentation

The course is one of the basic vocational courses given in the first semester of the first year for six hours a week. Its purpose is to provide students with the ability to use different representational environments to solidify design thinking. Although hand drawing is the predominant representational

method in the course, the students also use computer technologies to experience three-dimensional model applications (Table 2).

Table 2. The Content of ARCH 101

Weeks	Content	Scope	Techniques	Homework
1	Freehand sketching, writing and line drawing, line types, hatching techniques	2D	theory+practice	H01, H02, H03
2	Dividing a line segment, circular drawings	2D	theory+practice	H04, H05, H06, H07, H08, H09, H10
3	Projection drawings, descriptive geometry	2D+3D	theory+practice	H11, H12
4	Projection drawings, descriptive geometry	2D+3D	theory+model+computer+practice	H13
5	Projection drawings, descriptive geometry	2D+3D	theory+model+computer+practice	H14, model
6	scale, furnishing (room drawing)	2D+3D	theory+practice	H15, model
7	Projection drawings (plan, section, elevation)	2D+3D	theory+model+practice	H16, H17, H18
8	Projection drawings (plan, section, elevation)	2D+3D	theory+model+practice	H19, H20, H21
9	Mid-Term Exam			H22, H23
10	Sample project 1/200, 1/100 scales	2D+3D	theory+practice	H24, H25, H26, H27
11	Sample project 1/50 plan-section-elevation	2D+3D	theory+practice	H28, H29
12	Sample project 1/50 plan-section-elevation	2D+3D	theory+practice	H30
13	One-point perspective	2D+3D	theory+practice	H31, H32, H33, H34
14	Two-point perspective	2D+3D	theory+practice	H35, H36, H37

2.2. The Implementation of Kolb and MBTI Inventories

Kolb and MBTI inventories were applied to forty-seven students over one hour. A pilot study was conducted, and the test period was determined before implementation. A personal data form was used to obtain information such as age and gender. Inventories were evaluated according to the Kolb and MBTI Form M answer keys.

The Kolb inventory consists of twelve questions with four choices each. Participants rank the choices in each question from 1 to 4 points (4 being most suitable and 1 least suitable). In the evaluation process, the points applicable to each dimension (CE, AC, RO, AE) are categorized accordingly. By subtracting the RO score from the AE score and the CE score from the AC score, the x and y values of the matrix, which indicate the learning style of the participant, are revealed.

In the evaluation process of the MBTI inventory, the answers given by the participant for each question are calculated along four dichotomy axes (E-I, S-N, T-F, J-P). Each dichotomy is examined in itself, and the answers applicable to each dichotomy dimension are subtracted from the others to determine the dominant dimension. Then, the preference clarity category is then determined by considering the size of the dominant dimension (Table 3).

Table 3. Preference Clarity Categories (Myers & McCaulley, 1998)

Dichotomy	Greatest Raw Points	Preference Clarity Category
E-I	11-13	Slight
	14-16	Moderate
	17-19	Clear
	20-21	Very Clear
S-N	13-15	Slight
	16-20	Moderate
	21-24	Clear
	25-26	Very Clear
T-F	12-14	Slight
	15-18	Moderate
	19-22	Clear
	23-24	Very Clear
J-P	11-13	Slight
	14-16	Moderate
	17-20	Clear
	21-22	Very Clear

The data obtained from the inventories were evaluated with the SPSS statistical program.

3. Findings and Discussion

A total of 47 students participated in the research, 30 females and 17 males. Data taken from the Kolb and MBTI inventories were examined separately and thereafter evaluated jointly.

3.1. KOLB

According to the Kolb inventory, the distribution of learning styles was: 7 participants (14,9%) accommodating, 32 participants (68,1%) diverging, 2 participants (4,3%) converging, 5 participants (10,6%) assimilating, and 1 participant (2,1%) diverging- assimilating.

Although Figure 2 highlights a significant gender disparity in the proportion of diverging learning styles, the results of the independent samples' t-test indicate that the differences between the mean scores of the "converging", "diverging", "assimilating" and "accommodating" profiles for female and male students were not significant. (Table 4).

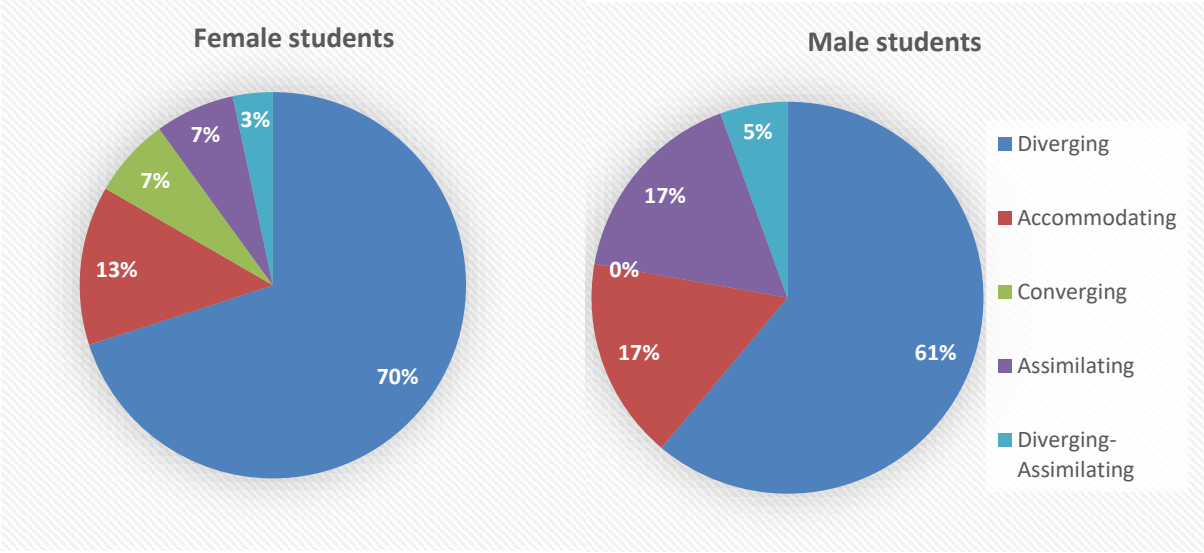


Figure 2. Learning styles according to gender variable

Table 4. Independent samples' t-test results of gender variable

No	Gender	Independent samples t-test	Converging	Diverging	Assimilating	Accommodating
		t value	-1,145	-,450	-,287	-,880
		Significance Level	,258	,655	,775	,383
30	Female	Mean	26,00	26,066	34,233	33,400
		Std. Deviation	5,988	5,394	5,144	5,443
		Std. Error	1,093	,984	,939	,993
17	Male	Mean	28,058	26,082	34,705	34,941
		Std. Deviation	5,803	5,779	5,881	6,309
		Std. Error	1,407	1,407	1,426	1,530

The forty-seven students' coursework was categorized as 2D or 3D based on the scope (Table 2). The averages of the coursework obtained in each group were evaluated on three scales (0-69, 70-84, 85-100). The coursework averages of the participants were then grouped with their Kolb learning styles. According to Table 5, while diverging and accommodating learning styles were associated with higher scores in 3D studies, no significant difference was observed in students with converging and assimilating learning styles.

Table 5. The relationship between Kolb learning styles and coursework

	Points	Diverging	Accommodating	Converging	Assimilating	Diverging-Assimilating	Total
2D	0-69	3 (9,37%)	1 (14,28%)	0	0	0	4
	70-84	25 (78,12%)	5 (71,42%)	2 (100%)	4 (80%)	1(100%)	37
	85-100	4 (12,5%)	1 (14,28%)	0	1 (20%)	0	6
Total		32 (100%)	7 (100%)	2 (100%)	5 (100%)	1 (100%)	47 (100%)
3D	69	2 (6,25%)	0	0	0	0	2
	70-84	18 (56,25%)	4 (57,14%)	1 (50%)	4 (80%)	0	27
	85-100	12 (37,5%)	3 (42,86%)	1 (50%)	1 (20%)	1 (100%)	18
Total		32 (100%)	7 (100%)	2 (100%)	5 (100%)	1(100%)	47(100%)

When set against course grades, there were more significant differences between the grades of those in the "Diverging" category, with insignificant disparities recorded for the other learning styles (Figure 3).

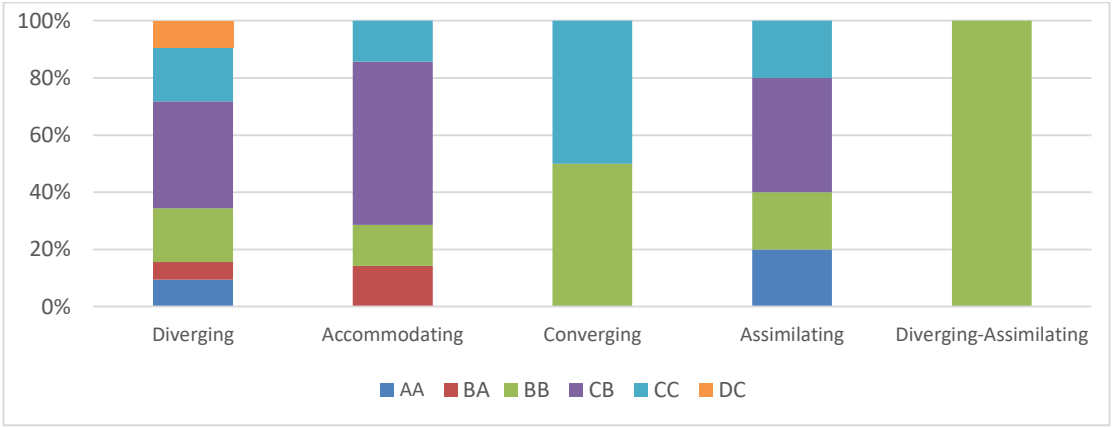


Figure 3. Participants' learning styles vs. course grades.

A one-way ANOVA test comparing participants' course grades and Kolb learning styles indicated no significant differences, suggesting there is no meaningful relation between Kolb learning styles and course grades (Table 6).

Table 6. The relationship between participants' learning styles and course grades.

		Sum of squares	Df	Mean square	F	Sig.
Converging	Between groups	70,425	5	14,085	,371	,865
	Within groups	1554,511	41	37,915		
	Total	1624,936	46			
Diverging	Between groups	66,153	5	13,231	,411	,838
	Within groups	1318,400	41	32,156		
	Total	1384,553	46			
Assimilating	Between groups	69,219	5	13,884	,453	,809
	Within groups	1254,100	41	30,588		
	Total	1323,319	46			
Accommodating	Between groups	147,748	5	29,550	,882	,502
	Within groups	1374,167	41	33,516		
	Total	1521,915	46			
Diverging-Assimilating	Between groups		5			
	Within groups		41			
	Total		46			

When the relationship between Kolb and course grades is examined through the scatter chart, there again appears to be no significant difference (Figure 4). However, evaluation of the coefficient averages of the students' Kolb categories and course grades together (coefficient values: AA:4; BA:3.5, BB:3; CB:2.5; CC:2; DC:1.5) indicate some differences. On a 4-point scale: assimilating 2.8; accommodating 2.64; diverging 2.61; converging 2.5.

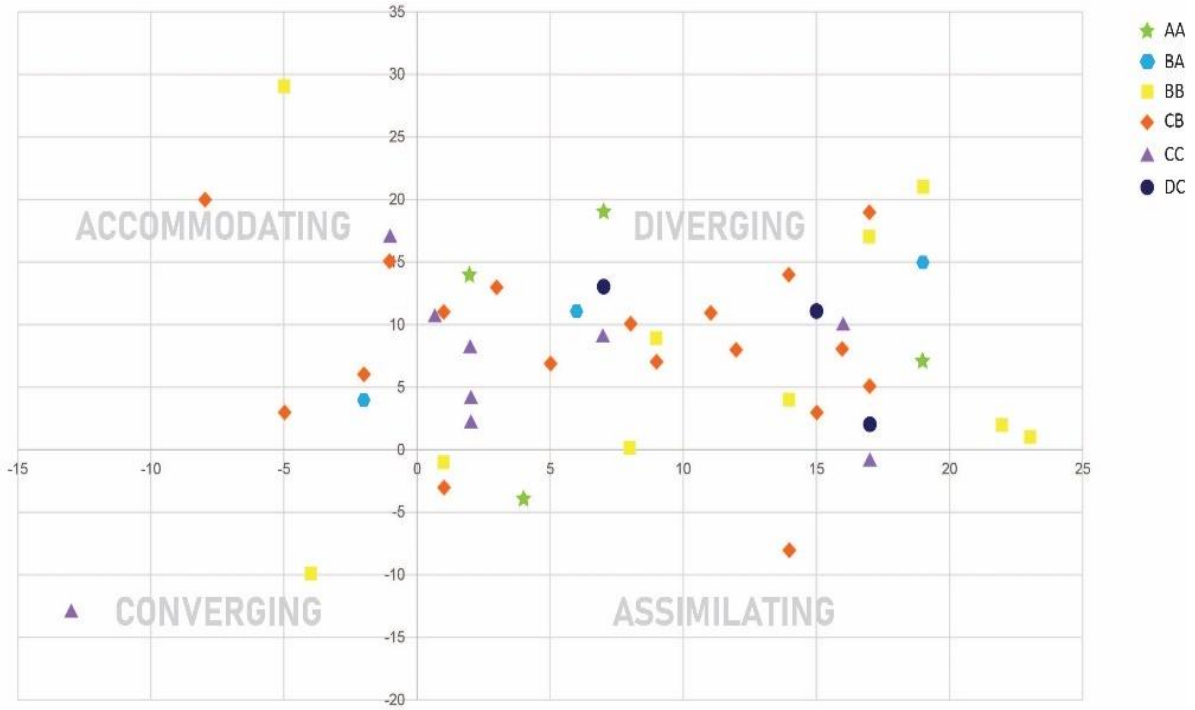


Figure 4. Scatter chart of Kolb learning styles vs. course grades

3.2. MBTI

The distribution of the participants' MBTI profiles in a single grouping was as follows; E:20, I:27, S:12, N:35, T:21, F:26, J:27, and P:20. Binary groupings revealed differences in the MBTI profiles of the participants according to gender (Figure 5).

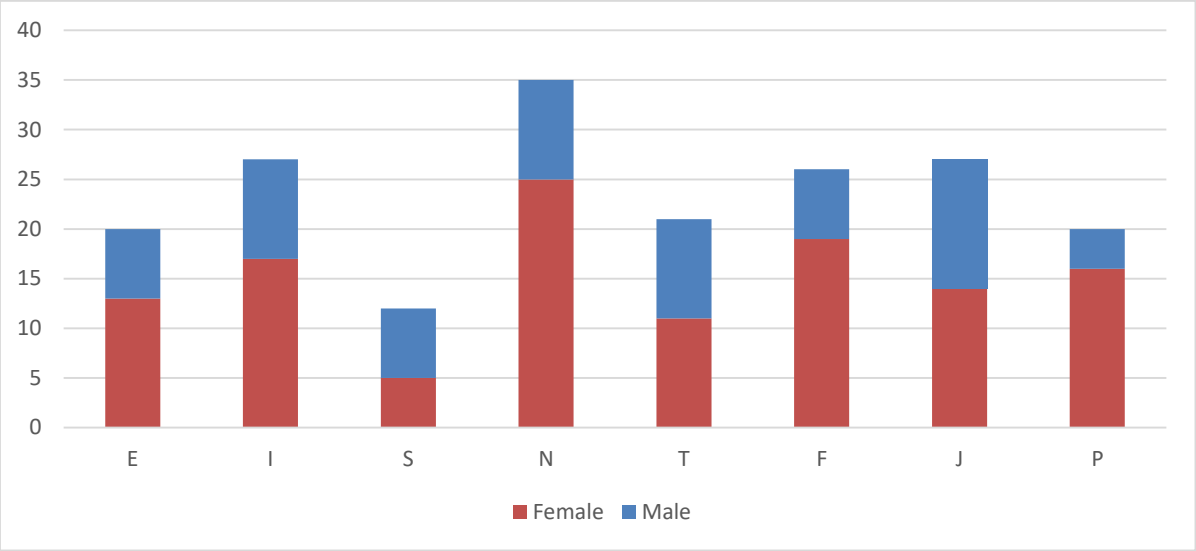


Figure 5. MBTI profiles of participants by gender

According to the results of an independent t-sample test analysis performed between the MBTI profiles (single) of the participants and the gender variable (Table 7), there were significant differences between the mean scores of the participants' genders in the N, F, and P profiles ($p<0.05$). In the same test performed with binary grouping profiles (Table 8), a significant difference was found at a 95% confidence level in the JP profile ($p<0.05$).

Table 7. Differences between participants' MBTI profiles (single) by gender variable

No	Gender	Independent samples t-test	E	I	S	N	T	F	J	P
		t value	,609	1,355	1,648	2,171	1,334	2,351	1,684	2,683
		Significance Level	,546	,182	,106	**,035***	,189	**,023***	,099	**,010***
30	Female	Mean	9,26	11,16	11,63	14,03	11,23	11,40	10,46	11,80
		Std. Deviation	2,59	2,52	2,189	2,189	1,77	1,65	3,52	3,44
		Std. Error	,47	,460	,399	,399	,324	,301	,642	,629
17	Male	Mean	9,76	10,17	12,64	12,70	12,00	9,764	12,29	9,058
		Std. Deviation	2,86	2,18	1,69	1,64	2,09	3,13	3,67	3,21
		Std. Error	,694	,530	,410	,400	,507	,759	,890	,778

Table 8. Differences between participants' MBTI profiles (binary) by gender variable

No	Gender	Independent samples t-test	E-I	S-N	T-F	J-P
		t value	1,298	1,016	1,296	2,704
		Significance Level	,209	,315	,211	**,010***
30	Female	Mean	20,433	25,666	22,633	22,266
		Std. Deviation	,678	,994	,889	1,201
		Std. Error	,123	,181	,162	,219
17	Male	Mean	19,941	25,352	21,764	21,352
		Std. Deviation	1,477	1,057	2,681	,931
		Std. Error	,358	,256	,650	,225

Table 9 gives both the 2D and 3D coursework score distribution alongside the personality types (NF, NT, SJ, SP) of the participants. The success rates of all participants were higher in the 3D-related coursework.

Table 9. The relationship between MBTI and coursework

	Points	SJ	SP	NF	NT	Total
2D	0-64	0	1 (16,67%)	1 (5%)	2 (13,33%)	4
	65-84	3 (50%)	5 (83,33%)	18 (90%)	11 (73,33%)	37
	85-100	3(50%)	0	1 (5%)	2 (13,33%)	6
Total		6	6	20	15	47
3D	0-64	0	0	0	2 (13,33%)	2
	65-84	1 (16,67%)	4 (66,67%)	14 (70%)	8 (53,33%)	27
	85-100	5 (83,33%)	2 (33,33%)	6 (30%)	5 (33,33%)	18
Total		6	6	20	15	47

Figure 6 below illustrates the relationship between MBTI profiles and course grades.

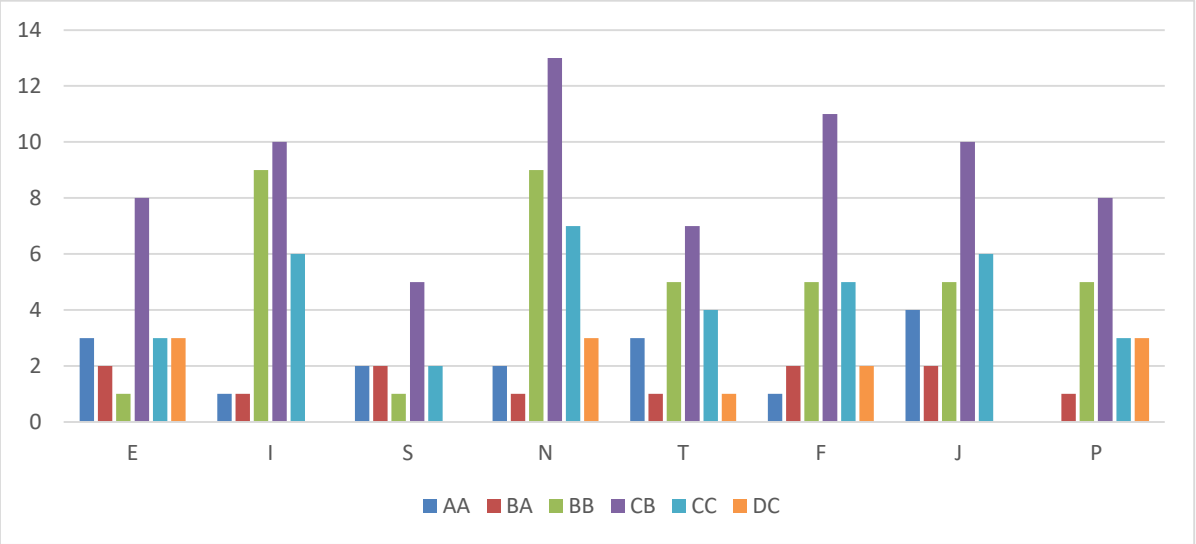


Figure 6. Participants' learning styles according to the variable of course grades.

No significant difference was found in a one-way ANOVA test comparing the MBTI profiles (binary) and the course grades of the participants (Table 10).

Table 10. The relationship between participants' MBTI profiles (binary) and course grades

		Sum of squares	Df	Mean square	F	Sig.
E/I	Between groups	6,170	5	1,234	1,130	,360
	Within groups	44,767	41	1,092		
	Total	50,936	46			
S/N	Between groups	6,284	5	1,257	1,247	,305
	Within groups	41,333	41	1,008		
	Total	47,617	46			
T/F	Between groups	8,313	5	1,663	,494	,779
	Within groups	137,900	41	3,363		
	Total	146,213	46			
J/P	Between groups	5,909	5	1,182	,823	,541
	Within groups	58,900	41	1,437		
	Total	64,809	46			

The results of a one-way ANOVA test comparing the MBTI profiles (single) and course grades of the participants indicate significant differences between the "E" and "S" profiles (Table 11).

Table 11. The relation between participants' MBTI profiles (single) and course grades

		Sum of squares	Df	Mean square	F	Sig.
E	Between groups	99,134	5	19,827	3,527	**,010***
	Within groups	230,483	41	5,622		
	Total	329,617	46			
I	Between groups	63,093	5	12,619	2,485	,047
	Within groups	208,183	41	5,078		
	Total	271,277	46			
S	Between groups	59,067	5	11,813	3,537	**,009***
	Within groups	136,933	41	3,340		
	Total	196,00	46			
N	Between groups	37,350	5	7,470	1,864	,122
	Within groups	164,267	41	4,007		
	Total	201,617	46			
T	Between groups	20,922	5	4,184	1,169	,341
	Within groups	146,822	41	3,581		
	Total	167,745	46			
F	Between groups	18,732	5	3,746	,623	,683
	Within groups	246,544	41	6,013		
	Total	265,277	46			
J	Between groups	102,501	5	20,500	1,652	,168
	Within groups	508,733	41	12,408		
	Total	611,234	46			
P	Between groups	87,510	5	17,502	1,424	,236
	Within groups	503,767	41	12,287		
	Total	591,277	46			

The sorting of the categories in the context of course grades, according to the category system of Keirsey and Bates (1974), were as follows: NF (2,45), SP (2,5), NT (2,7), and SJ (3,25). Statistically, there was no significant relationship between category and course grades, but it should be noted that the majority of students (71.4%) were from the NF and NT categories (Figure 7).

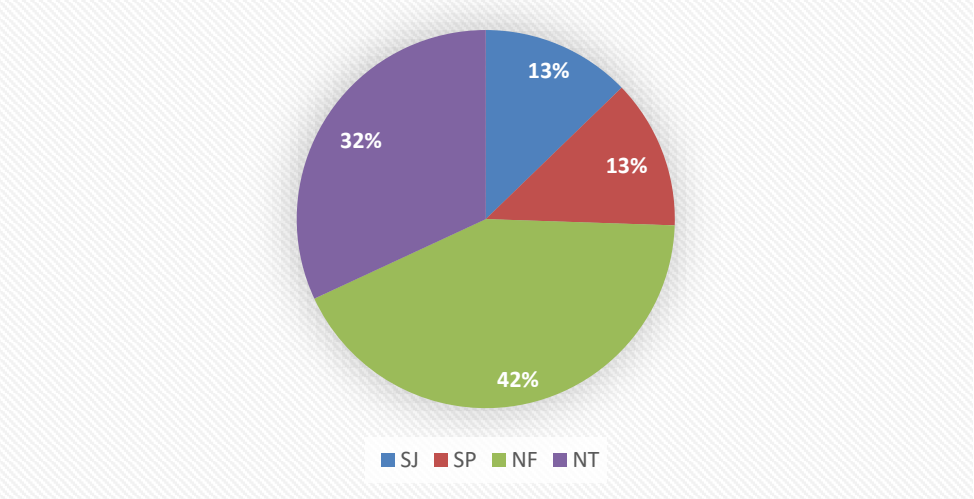


Figure 7. MBTI profiles of the participants by category

According to MBTI data regarding quartile grouping, the most frequently observed personality types were as follows (in descending order): INFJ, INTP, INTJ, ENFP, and ENFJ (Table 12).

Tablo 12. The participants' MBTI profiles

	ESTJ	ESFJ	ENTJ	ENFJ	ESTP	ESFP	ENTP	ENFP	ISTJ	ISFJ	INTJ	INFJ	ISTP	ISFP	INTP	INFP
Frequency	2	3	3	**5**	0	1	1	**5**	0	0	**5**	**8**	4	1	**6**	2
Percentage	4,2	6,3	6,3	**10,6**	0	2,1	2,1	**10,**	0	0	**10,6**	**17,0**	8,5	2,1	**12,7**	4,2

3.3. Discussion

The research revealed that 68.1% of the participants had a diverging learning style. The predominance of this style is compatible with the profession of architecture, as it emphasizes concrete experience and reflective observation and encompasses professions related to creativity. Analysis of concrete situations through an approach of reflective observation is also in accord with the concept of reflective practice put forward by Schön (1983). Schön (1983) states that designers should originally evaluate the design problems instead of applying standard problem-solving techniques, regarding designs as problematic, reframing them, and giving new meanings to the problem. Through the evaluation of new meanings, new criteria are brought to the problem, and the designer reframes the reshaped problem. In this process, the designer develops a deeper understanding of the problem.

Tucker (2007) stated in his study that as the learning process progresses, there is a shift toward the abstract conceptualization dimension (converging and assimilating) in the learning style graph, particularly successful architecture students showing more aptitude along this axis.

Kolsal &Kandemir (2021) noted that according to the Kolb learning style surveys applied to the first-year students of the architecture department, 76.4% of the students were diverging, with the rest in the assimilating and accommodating groups and none in the converging group. Similarly, the current study observed that 68.1% of the first-year architecture students had diverging, 10.6% assimilating, 14.9% accommodating, and 4.3% converging learning styles. It was observed that the learning styles were mostly on the north axis, in concrete experience (accommodating and diverging). The fact that students remained in the concrete experience zone in both current studies suggests that the exam-oriented pre-university education system in Turkey may also have an effect. All the students participating in the research were first-class novice students. Because of the architectural education curriculum, a change in learning styles may be observed over the course of students' studies. The study also highlights that students with concrete experience express themselves better in 3D studies.

In the study of Yazıcı (2014), which analyzed success in the perspective drawing of architecture department students based on Kolb learning styles, it was noted that students with assimilating, diverging, and converging learning styles performed best, in descending order of success. Yazıcı's more current study (2021), covering eight semesters of the undergraduate process, indicated that students with a diverging learning style showed the highest success rates, followed by those with converging, assimilating, and accommodating styles (in descending order). Kolsal & Kandemir (2021) argued that students with an assimilating style are more successful in the design process. In a similar finding, Demirbaş & Demirkan (2003) recorded that an assimilating style was associated with the highest progress in a project course, and Özdemir (2016) determined that students with assimilating and diverging learning styles were more successful in a Basic Design course. Although certain differences were observed between Kolb learning style and course grades in previous studies, no significant differences were found in this study.

Tucker (2007) concluded that, at least in the context of the architectural design course, gender does not affect academic achievement. In this study, no significant results were obtained when contrasting gender and Kolb learning style. In this context, Halpern & Collaer (2005), who argued that gender differences are socially based, emphasized that with the Women's Movement began in the 1960s, gender discrimination may almost disappear in the future due to equal learning opportunities for men and women, and the society will advance to a gender-neutral state.

When it came to MBTI profiles and gender, significant differences were observed in the N, F, and P profiles. The profiles of the female participants were dominant in the intuition, feeling, and perceiving profiles rather than the sensing, thinking, and judging profiles. When evaluated according to binary grouping, a significant difference was observed in the J/P dichotomy. In the context of 2D vs. 3D coursework, students belonging to the SJ, SP, NF, and NT categories were more successful in the 3D studies, while participants belonging to the SJ category were more successful in both 2D and 3D studies. According to Myers & Myers (1980), the attraction of S types to occupations that allow them to deal with a constant stream of facts can be associated with such first-year architecture students' success in a technical course.

The one-way ANOVA test comparing the MBTI profiles (single) and the course grades of the participants demonstrated that the differences between the mean scores of the participants' course grades were significant for those in the "E" and "S" profiles. The fact that the students in the SJ category had the highest success rates in the coursework evaluation is in accord with their high course grades overall, indicating that such extroverted students are more successful than introverted students in a technical course that includes hand drawing, modeling, and computer drawing.

In a study conducted by Russ & Weber (1995), 40.2% of interior architecture students were identified as being in the NF group. Brown et al. (1994) found the dominant learning style groups to be NT and NF in their research on landscape architecture students in Canada; similarly, NF and NT learning style groups were dominant in this paper, while the SJ group was more successful in course grades. An evaluation of the MBTI profiles of those students with higher average course grades gave the following results: NT:7 participants, NF:5 participants, SJ:4 participants, and SP:1 participants. When the students with grades above the class average were analyzed by KOLB inventory, of the 17 students, 12 were in the diverging, 2 in the accommodating, 2 in the assimilating, and 1 in the converging group. 70.59% of the successful students were in the diverging learning style group; a closer examination of these students reveals that 4 of the 11 students in the group were in the NT, 3 in the NF, 4 in the SJ, and 1 in the SP personality type group. There was a total of 6 students belonging to the SJ group among all participants, all of whom had diverging learning styles, and their success rates were higher than those of the other personality types. Although NF and NT personality types were observed more frequently in the study, the course grades of the SJ personality type were higher. The fact that the learning styles of all the participants with the SJ personality type varied is not data that can be emphasized due to the small number of participants. However, in future studies, the learning style tendency of the SJ personality type group can be investigated with a larger number of participants.

Labip et al. (2017) highlighted the interconnections between the different learning style model dimensions and learning styles with the relevant learner characteristics. It was concluded that a learner related to Kolb's Concrete Experience (Kolb-CE) and MBTI's Sensing (MB-S) dimensions had several common characteristics like literal manner, tangible facts, direct and hands-on experience, practical, and concrete thinking. In this context, having diverging learning styles (CE) of the SJ group among all participants, and their higher success rate than those of the other personality types point out they have common characteristics that increase success in architectural education and there may be an interconnection between Kolb-CE and MB-S. The personality types observed most frequently in the study were the INFJ, INTP, INTJ, ENFP, and ENFJ groups, but these data do not match those of the literature (Russ & Weber, 1995; Durling et al., 2019; Poursafar et al., 2015; Architect Magazine, 2011).

The higher success rate in 3D studies in both the Kolb and MBTI coursework evaluation tables requires that the syllabus be developed with 3D applications. In the world of the Fourth Industrial Revolution, where information technologies are developed and systems progress autonomously, architecture education needs to interpret current trends and reflect them in the curriculum.

4. Conclusion and Suggestions

This study aimed to evaluate the relationship between the learning styles and personality types of first-year Architecture students using the Kolb learning style and MBTI personality type inventories. The findings of the study were correlated to observe the impact of gender and impact on course success. As a result of the KOLB inventory, it was determined that the students with a diverging learning style had a large share, and no significant relationship was established between gender, course success, and learning style. The learning styles of 82,98% of students were on the concrete experience axis of the inventory (accommodating and diverging). Although significant correlations were found between KOLB learning style and course grades in the literature, no such significant results were obtained in this study. This finding can be derived from the fact that the students participating in the research were novice architecture students. When the same students reach their fourth year, an inventory can be applied to determine the change in their learning styles.

In the context of the MBTI inventory, the differences between the mean scores of the students' genders in the "Intuition," "Feeling," and "Perception" profiles were significant. A significant difference was also found between the "Judgment-Perception" profile of female and male students. However, the personality type differences between genders do not correlate with either the learning styles of the students or course grades.

The dominant personality types observed in the study were INFJ, INTP, INTJ, ENFP, and ENFJ; these data do not match those of the literature. Various dominant personality types have been identified in studies conducted in different countries, therefore cultural differences can thus be regarded as a variable in personality type, as determined before. To examine this variable, a regional study with a higher number of participants may be conducted in the future.

Students in the NT, NF, SP, and SJ categories of the MBTI inventory were also evaluated based on their KOLB learning styles; the most frequently successful students belonged to the NT and NF groups, while those in the SJ group saw the highest overall success. Since the number of participants with the SJ personality type was small, these data cannot be considered valid. In future studies, the learning style tendency of the SJ personality type group can be investigated with a larger number of participants.

The relationship between Kolb learning styles, MBTI, and success in coursework was investigated, and a higher likelihood of success in 3D studies was observed for certain learning styles, which highlights the importance of the development of 3D applications within the syllabus.

This study is limited to coursework and course grades in an undergraduate course; the information obtained is therefore not valid for students' learning abilities in other courses. Despite these limitations, the study can contribute to the improvement of the techniques of architectural presentation courses in the architecture departments. In future studies, changes in students can be observed by repeating the study in the fourth year with the same participants.

Acknowledgements and Information Note

The article complies with national and international research and publication ethics. Ethics Committee approval in the study, Ethics Committee of the University of Gebze Technical University dated 13.04.2023 and E-100822 numbered.

Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to the article. There is no conflict of interest.

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Predicting Various Architectural Styles Using Computer Vision Methods

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Abstract

Computer Vision (CV), subfield of artificial intelligence (AI), enables computers to process visual data and recognize objects. CV is widely used in, automotive, food industry and diseases diagnosis. AI achieves this by algorithms. One of the important algorithms based on object detection is YOLO (You Only Look Once), provides more accurate results with high processing speed. The aim of this study is to perform an object detection-based CV project, to determine the structures in given video belong to one of the architectural styles: Gothic, Baroque, Palladian, or Art Nouveau. The study consists of data set creation, data labeling, model creation and model training. Roboflow was used as the data labeling platform and YOLOv8 was used for model building and training phases. At the end of the process, the fact that the model predicts architectural styles with high accuracy in a short time revealed that the model is a successful real-time object detection algorithm, and it was emphasized that CV can be used in the field of architecture and can contribute to other fields related to architecture.

Keywords: *Computer vision, object detection, YOLO, architectural style.*

Computer Vision Metodlarıyla Çeşitli Mimari Üslupların Tahmin Edilmesi

Öz

Yapay zeka (AI) alanının alt dalı olan Computer Vision (bilgisayar görüşü, CV), bilgisayarların görsel verileri işleyerek nesneleri tanıyabilmesine olanak sağlar. CV, otomotiv, gıda endüstrisi, hastalıkların teşhisi gibi alanlarda yaygın kullanılmaktadır. AI bunu yaparken, algoritmaları kullanmaktadır. Nesne algılamaya dayalı algoritmaların en önemlilerinden biri yüksek veri işleme hızıyla daha net sonuçlar veren YOLO (You Only Look Once) dur. Bu çalışmanın amacı, temel alınan videodaki öne çıkan yapıların gotik, barok, palladyen, art nouveau mimari üsluplarından hangisine ait olduğunu belirlemeye yönelik nesne algılama tabanlı CV projesi gerçekleştirmektir. Çalışma veri seti oluşturma, veri etiketleme, model oluşturma ve modelin eğitimi aşamalarından oluşmaktadır. Veri etiketleme platformu olarak Roboflow, model oluşturma ve eğitim aşamaları için YOLOv8 kullanılmıştır. Süreç sonunda modelin mimari üslupları yüksek doğruluk payı ile kısa zamanda tahmin etmesi modelin başarılı gerçek zamanlı bir nesne algılama algoritması olduğunu ortaya koymuş, CV'ın mimarlık alanında da kullanılabileceği ve mimarlık ile ilgili diğer alanlara da katkı sunabileceği vurgulanmıştır.

Anahtar kelimeler: *Computer vision, nesne algılama, YOLO, mimari üslup.*

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1. Introduction

Computer Vision (CV), a subfield of artificial intelligence, enables computers to process visual data and recognize objects. These data can range from still images, videos captured using traditional methods or more complex videos recorded with multiple cameras to multidimensional data from any medical scanner (Szeliski, 2010). The field of CV research dates to the 1960s when early methods for image recognition and classification were relatively simple. However, the advancement of deep learning techniques in recent years has led to significant progress in the field of CV. Today, CV is extensively used in various domains such as autonomous vehicles in the automotive industry, diagnosis of numerous diseases in the medical field, and determining the quality standards and existing quality of a product in the food industry, providing a significant advantage through the integration of artificial intelligence into daily life. CV encompasses a range of core tasks, including content recognition, video analysis, content-aware image editing, and scene reconstruction (Hosni, 2022). Among these fundamental tasks, "Object Detection" is considered a primary task within content recognition.

Object detection is a crucial CV task used to detect instances of visual objects in digital images such as photographs or video frames belonging to specific classes (e.g., humans, animals, cars, or buildings) (Boesch, 2023a). This modern approach of artificial intelligence develops computational models that provide essential information required by CV applications. It counts objects, processes their precise locations, and accurately labels the visual data being worked on, utilizing the same data. Object detection can be achieved using traditional image processing techniques or modern deep learning networks (convolutional neural networks - CNN). While traditional approaches require defining the features of the processed data and employing techniques like Support Vector Machines (SVM) for classification, deep learning approaches based on neural networks can perform end-to-end object detection without explicitly defining these features, following a one- or two-stage object detection algorithm (Contributors to Wikimedia projects, 2008). One of the most significant single-stage object detection algorithms is YOLO (You Only Look Once).

YOLO (You Only Look Once), developed by Joseph Redmon in 2016, stands out in this field due to its ability to detect objects in an image in a single pass, which results in faster performance compared to other object detection algorithms. Different versions of YOLO (e.g., YOLOv2, YOLOv3...Yolov8) have been developed, and ongoing research continues to improve these versions. YOLO has been utilized in various studies based on object detection. Kasper-Eulaers et al., (2021) used YOLOv5 to detect heavy-duty vehicles waiting in a parking area during the winter season. In another study, YOLO was used for crack detection in suspension parts (Özel, Baysal, & Şahin, 2021). Kristo, Ivasic-Kos, & Pobar (2020) conducted a study using YOLOv3 to detect humans in thermal camera images under challenging weather conditions. One of the areas where YOLO is applied is the field of architecture.

Architecture, in its simplest definition, is the art and science of designing and constructing buildings and other physical structures. Another definition characterizes it as the art and science of designing and constructing structures and the physical environment in appropriate proportions (Contributors to Wikimedia projects, 2001b). Vitruvius describes architecture as a concept that should be based on functionality, durability, and aesthetics (Vitruvius, 1999). Architectural style, on the other hand, refers to a specific design style that emerges from the combination of characteristic features of an architectural work, unique to a particular time and place. Historically, architectural styles reflect the aesthetic and cultural understanding of specific periods. For example, styles such as Gothic, Baroque, Palladian, and Art Nouveau provide distinct differences and insights into the architectural features of past eras.

1. Gothic Architecture: Originating in France in the 12th century, gothic architecture continued until the end of the 16th century and spread to various countries in Europe. Its aim was to build structures that symbolized the greatness of God and the helplessness of man in the face of God. The main gothic architectural elements are rib vaults, pointed arches, rose windows and flying buttresses. Two of the most important examples are Notre Dame Cathedral in Paris and Milan Cathedral in Milan.

a b

Figure 1. Gothic Architecture examples: **a)** Notre-Dame de Paris (Contributors to Wikimedia projects, 2002a) **b)** Milan Cathedral (Contributors to Wikimedia projects, 2003)

2. Baroque Architecture: Emerging in the 17th century in and around Rome, baroque architecture was mostly used in palace buildings as an effect of the desire of the royalty to show its power. The most important elements of baroque architecture, which has the understanding of using nature to give it a new form, are fountain pools, rich use of ornament and color, magnificent sculptures, frescoes on gods and mythology, and vase-shaped balusters. The most important examples include the Trevi Fountain in Rome and the Palace of Versailles in Paris.

a b

Figure 2. Baroque Architecture examples: **a)** Trevi Fountain (Contributors to Wikimedia projects, 2003a) **b)**Palace of Versailles (Contributors to Wikimedia projects, 2002)

3. Palladian Architecture: Palladianism is an architectural style named after the Venetian architect Andrea Palladio (1508-1580) and modeled after his designs. This movement emerged as a result of the evolution of Palladio's works and gained popularity in Europe. The works of Andrea Palladio are characterized by a pronounced symmetry and perspective, and often bear traces of classical temple architecture inspired by Ancient Greece and Ancient Rome. These elements, combined with Palladio's original concepts, shaped the Palladian architectural style. An important example of this architectural style is the Palladian Villas in Veneto, Italy.

a b

Figure 3. a) Palladian Architecture example: Palladian Villas (Contributors to Wikimedia projects, 2006) **b)** Art-Nouveau Architecture example: Casa Batllo (Contributors to Wikimedia projects, 2001)

4. Art-Nouveau Architecture: Art-Nouveau is an art movement pioneered by the famous Austrian painter Gustav Klimt and developed in Europe in the 19th century as a reaction to the Industrial Revolution. This movement includes elements such as the processing of iron for decorative purposes in response to the technological conditions of the age. Art-Nouveau is characterized by stylized, flattened, curved, asymmetrical and curved shapes. Rhythmic motifs, animals and plants, female figures, flying hair and feathers, flowers and vine shoots are important elements of this movement. These characteristics influenced the artists to design their works in accordance with the aesthetic understanding of the period. One of the most important examples is Antoni Gaudi's Casa Batllo in Barcelona.

These architectural styles exhibit similar repetitive patterns manifesting at different scales (Yıldız, Ertosun Yıldız & Beyhan, 2023). Determining the architectural style of a structure involves distinguishing fundamental architectural elements such as forms, materials, and details that may exhibit variations or similarities.

This study aims to demonstrate that CV can also be used in the field of architecture by realizing a CV project based on object detection using YOLOv8 to determine whether the prominent structures in a given video belong to one of four architectural styles (Gothic, Baroque, Palladian or Art Nouveau).

The application of these technologies in architecture is important for the analysis and recognition of architectural styles. Artificial intelligence algorithms enable designers, engineers and architects to perform fast and precise analysis by accurately identifying the characteristics of structures. As a matter of fact, the number of studies focusing on architectural style identification using artificial intelligence techniques is limited in the literature (Xu, Tao, Zhang, Wu, & Tsoi, 2014). Therefore, considering the method and approach based on the basic program used in this study and the original results targeted to be obtained, it is thought that it will make a significant contribution to the literature by differentiating from the others.

2. Material and Method

In this study, we utilized YOLOv8, a state-of-the-art single-stage computer vision (CV) algorithm specifically designed for object detection tasks. YOLOv8 has proven to be highly effective in accurately identifying and localizing objects in complex visual scenes.

To train the model, we created a comprehensive dataset consisting of images and videos showcasing prominent structures with various architectural styles, including Gothic, Baroque, Palladian, and Art Nouveau. Each image and video frame were carefully annotated to provide ground truth labels for the architectural style of the structures.

The training process involved feeding the dataset into the YOLOv8 model and optimizing its parameters through a series of iterative epochs. During training, the model learned to extract meaningful features from the input data and associate them with the corresponding architectural styles. The training was performed on a powerful GPU-enabled system, allowing for efficient computation and accelerated convergence.

To evaluate the performance of our approach, we conducted a thorough validation process. We used a separate validation dataset that included diverse images and videos representing different architectural styles. The model was tested on this dataset, and various performance metrics were calculated, including precision (P), recall (R), mean average precision at 50% overlap (mAP50), and mean average precision from 50% to 95% overlap (mAP50-95). These metrics provide insights into the accuracy and robustness of the model's predictions.

Furthermore, we employed a confusion matrix analysis to assess the model's ability to correctly classify structures into their respective architectural styles. The confusion matrix provided a comprehensive overview of the model's prediction accuracy for each architectural style, allowing us to evaluate its performance in a more detailed and specific manner.

In addition to evaluating the model's accuracy, we also analyzed its inference speed. The object detection process was applied to each frame of the video using the trained model, and the time taken

for processing each frame was measured. This analysis provided valuable insights into the model's efficiency and its suitability for real-time applications.

Overall, our methodology combined the power of YOLOv8 with a carefully curated dataset, extensive training, rigorous validation, and performance evaluation to achieve accurate architectural style determination. The comprehensive approach employed in this study ensures the reliability and robustness of our results.

2.1. Computer Vision (CV) and YOLO (You Only Look Once) Algorithm

According to Trucco & Verri (1998), CV is the calculation of three-dimensional world properties from one or more images. Research conducted by Chang Shu defines CV as a field that involves extracting useful information from digital image contents and employing computer models to simulate the way living beings perceive through their eyes, thereby interpreting and understanding images (Su, 2008). The aim in this field is to mimic the process of visual perception and comprehension performed by human eyes using computer models by extracting information from the contents of images and videos. The objectives of CV tasks include enabling computer systems to automatically perceive, recognize, and understand the visual world using computational methods to simulate human vision (Boesch, 2023).

CV as a field utilizes the latest technologies, such as deep learning methods, which are a subfield of machine learning, to train algorithms. Currently, many of the methods employed in CV are based on layered neural networks called convolutional neural networks (CNN). Convolutional operations, which have been used in mathematics, physics, and engineering applications to simplify complex calculations, have yielded the best results in the field of computer vision (CV). When processing image data, a CNN network is applied to "look at" the computer data. CNN breaks down labeled pixels to allow the deep learning model to understand the images. Artificial intelligence models make predictions about the images using these labels. The accuracy of the obtained predictions is repeatedly checked until the desired outcome is achieved. Artificial neural network models, first developed in 1943 (Elmas, 2018) by Warren McCulloch, a neurologist, and Walter Pitts, a mathematician, indicate their potential significance, particularly in enhancing the quality of daily life for robots in the near future (Efe & Kaynak, 1999).

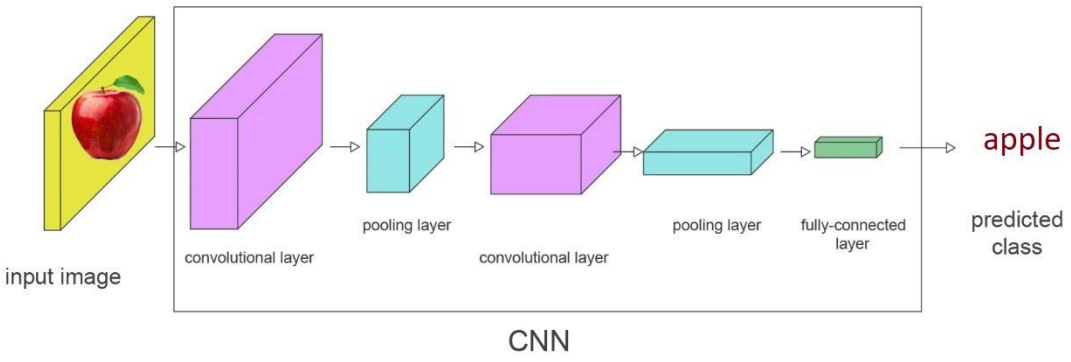

Figure 4. CNN neural network architecture diagram

1. Convolutional Layer: Extracts relevant features from input images by applying learnable filters and generating feature maps. Enables the model to automatically learn and differentiate architectural features associated with different styles.
2. Pooling Layer: Reduces spatial dimensions of feature maps while preserving important information. Enhances computational efficiency and robustness to transformations. Retains prominent features and suppresses noise.

3. Fully Connected Layer: Connects neurons from previous layers to classify architectural styles. Maps high-level features to style classes, determining the architectural style of structures in the video.

These layers collectively form a neural network architecture for automatic detection and classification of architectural styles, improving accuracy and enabling comprehensive analysis of the prominent structures.

Computer Vision (CV) encompasses various tasks and techniques for understanding and analyzing visual content. In this section, we will summarize key CV tasks and their relevance to our study.

1. Content Recognition: Content recognition involves recognizing and categorizing visual content. Image classification is a core task in CV, where models are trained to assign labels to images based on their features. Convolutional Neural Networks (CNNs) are commonly used for image classification, leveraging large datasets and backpropagation for accurate recognition.

    1.1. Object Detection: Object detection identifies and localizes multiple objects in images, providing both class labels and bounding box coordinates. This task is crucial for our study as it determines the architectural style of prominent structures. YOLO and Faster R-CNN are popular algorithms for real-time object detection.

    1.2. Object Localization: Object localization focuses on precisely locating a single object within an image. It provides the bounding box coordinates enclosing the object of interest, enabling precise analysis of architectural features.

    1.3. Object and Instance Segmentation: Object segmentation partitions an image into regions corresponding to different objects, assigning labels to pixels or regions. Instance segmentation goes further, distinguishing individual instances of the same object class. While not directly used in our study, these tasks are important for spatial understanding in CV applications.

    1.4. Pose Estimation: Pose estimation estimates the spatial orientation of an object in an image or video. It determines the object's position, scale, and orientation relative to a reference system. Pose estimation can aid in understanding the spatial arrangement of architectural structures.

2. Video Analysis: CV techniques can be applied to analyze videos, including object tracking, action recognition, and motion prediction.

    2.1. Object Tracking: Object tracking follows objects across consecutive video frames, enabling the study of their movement and behavior over time.

    2.2. Action Recognition: Action recognition identifies and classifies human actions in video sequences. It helps analyze human interactions with architectural structures.

    2.3. Motion Prediction: Motion prediction forecasts future positions and movements of objects based on their past trajectories, assisting in understanding and predicting the behavior of structures in a video.

3. Content-Aware Image Editing: CV techniques can be used for automatic understanding and modification of specific image aspects while preserving overall quality. Content-aware image editing is valuable for architectural analysis and visualization, allowing modifications while maintaining architectural integrity.

4. Scene Reconstruction: Scene reconstruction creates a 3D model of a real-world scene from 2D images or videos. CV algorithms enable accurate representation of architectural scenes, supporting immersive visualization and precise measurements in architectural analysis and design.

These various CV tasks and applications provide the foundation for our study, enabling us to leverage object detection and architectural style determination in the context of video analysis. By utilizing these techniques, we can gain valuable insights into the architectural characteristics and styles exhibited by prominent structures within a video.

In computer vision, particularly for real-time object detection, both multi-stage and single-stage algorithm groups based on CNN are used. Multi-stage algorithms are more accurate but slower than single-stage algorithms. Multi-stage algorithms, exemplified by R-CNN models such as Mask-RCNN, Fast RCNN, and Faster RCNN, excel in achieving higher levels of precision but operate at a slower pace. Conversely, single-stage algorithms like SSD, RetinaNet, YOLOv3, YOLOv4, YOLOR, YOLOv5, YOLOv7, and YOLOv8 prioritize real-time processing and computational efficiency overachieving the utmost accuracy (Boesch, 2023).

YOLO (You Only Look Once), developed by Joseph Redmon and Ali Farhadi from the University of Washington, was introduced in 2015 and quickly gained popularity due to its high speed and accuracy in object detection and image classification (Jocher, Waxmann, & Chaurasia, 2023). Unlike R-CNN algorithms, YOLO does not make any prior position predictions. Instead, YOLO processes the entire image to extract the locations of objects and their corresponding classes in a single pass. This approach is based on treating object detection as a single regression problem. The YOLO algorithm surrounds the detected objects on the images with bounding boxes (bb). To achieve this, the input image is first divided into grids of size s x s (such as 5x5, 7x7, 9x9). Each grid considers whether there is an object within its own area and if the object is considered to have its center point within its own area. The grid that determines the object's center point then predicts its x-coordinate, y-coordinate, width, and height. Additionally, the boxes include a confidence score indicating whether the object belongs to the defined class. The YOLO network detects and classifies objects using the confidence scores of these bounding boxes.

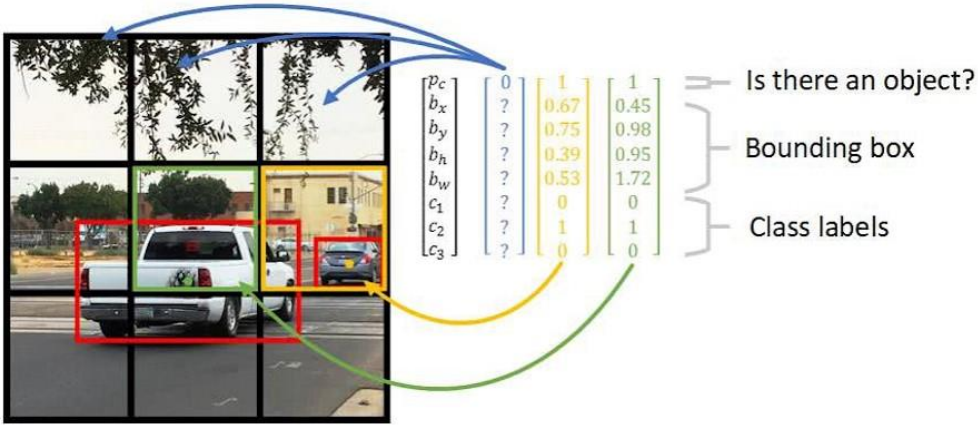

Figure 5. YOLO grid system and bounding boxes (Handuo, 2018)

The confidence score indicates how confident the model is about the presence of an object within the current grid. Confidence score formula is:

Confidence Score = Pr(object) x IoU

Pr(object): Probability of the object being present within the grid.

IoU: Overlap between the ground truth box and the predicted box.

When the model considers that there is an object within the grid, it checks how certain it is about whether the object is indeed that object and the coordinates of the surrounding box. Multiple grids may consider that the object is within their own area, resulting in unnecessary bounding boxes on the screen. To address this, the Non-max Suppression algorithm is primarily used in object detection, aiming to select the best bounding box from a series of overlapping bounding boxes. It considers only the ones with a confidence score above a certain threshold as the final output and draws them on the screen (Redmon, Divvala, Girshick, & Farhadi, 2016).

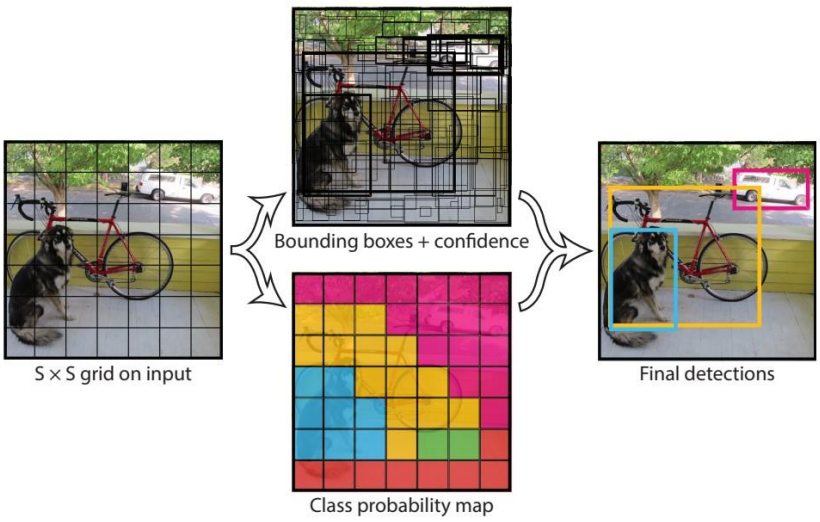

Figure 6. YOLO bounding box working system (Redmon et al., 2016)

Different versions of YOLO (Figure 7) have been introduced since its initial development until the present day, including YOLOv1, YOLOv2, YOLOv3, YOLOv4, YOLOR, YOLOv5, and YOLOv8. YOLOv8, introduced in 2023, is the latest and most advanced version of the YOLO object detection and image segmentation model. Building upon the success of previous versions, this latest model offers new features and improvements in terms of performance, flexibility, and efficiency (Figure 8). YOLOv8 is designed with a focus on factors such as speed, size, and accuracy, making it highly effective for various artificial intelligence tasks. This versatility allows users to leverage the capabilities of YOLOv8 in different application domains. In this study, the YOLOv8 version was used.

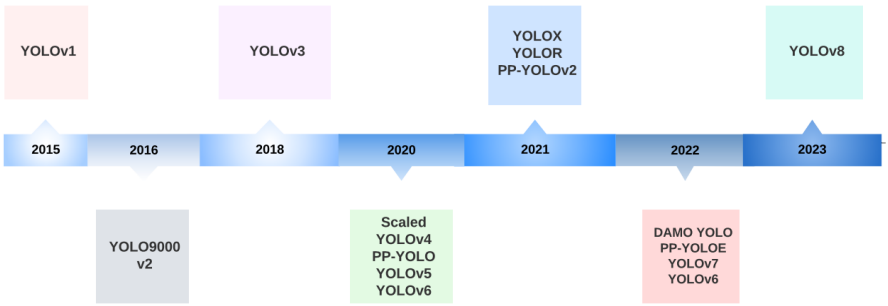

Figure 7. Timeline of YOLO versions (Terven & Cordova-Esparza 2023)

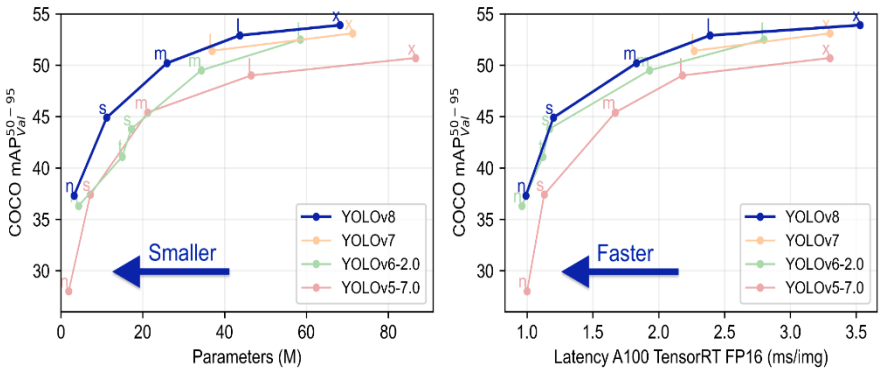

Figure 8. Performance comparison of YOLOv8 with other versions (Jocher & Waxmann, 2023)

The studies conducted to reach the conclusion based on the definitions mentioned above were carried out in three stages.

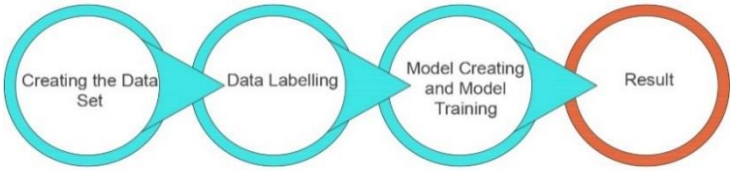

Figure 9. Stages of the study

2.2. Dataset Creation

The initial stage of this study involved the creation of the dataset, which progressed through four selected architectural styles: Gothic, Baroque, Palladian, and Art Nouveau. (In subsequent works, it is planned to expand the number of these styles.) Photographs corresponding to each architectural style were collected from free stock photo websites and the online community platform Kaggle (Wwymak, n.d), which consists of data scientists and machine learning practitioners. The dataset, comprising 1434 images (Figure 10), was transferred to the Roboflow platform for data labeling (Öztürkoğlu, 2023). Roboflow is a computer vision platform that enables users to create CV models faster and more accurately by providing improved data collection, preprocessing, and model training techniques (Roboflow, 2020).

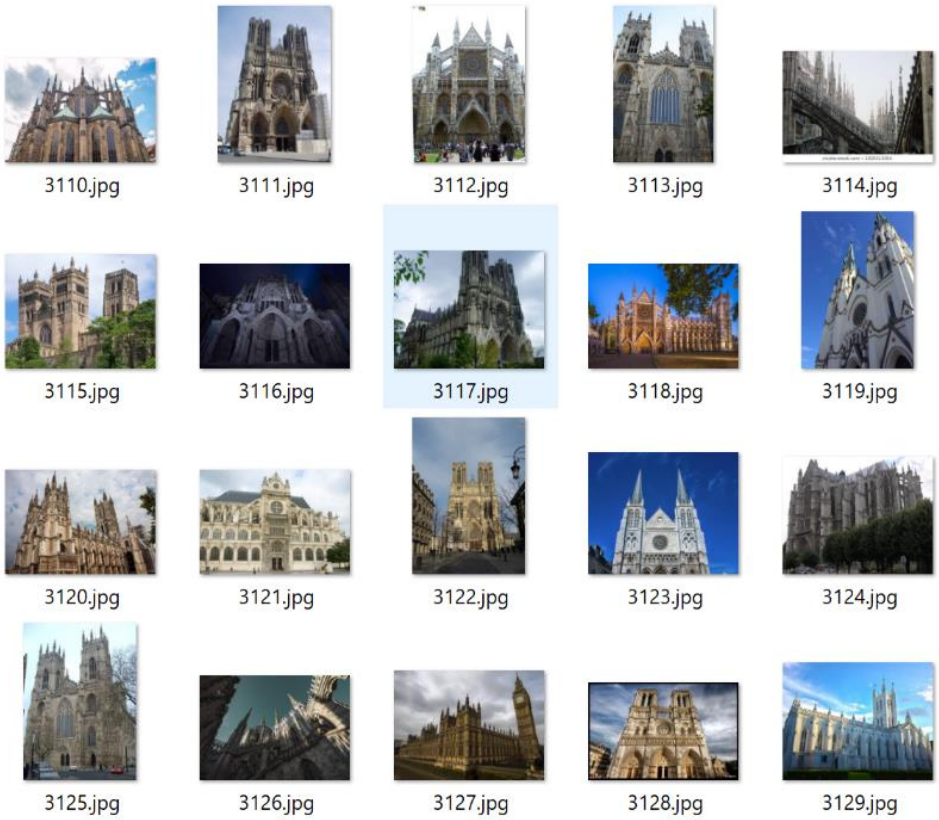

Figure 10. Photos from the dataset

2.3. Data Labelling

CV models cannot comprehend raw data in their original form. Therefore, the categorization and labeling of data provide meaning to the CV models. Labeled data is used as the training set and helps models produce accurate results. This process involves annotating and categorizing meaningful parts of the data.

There are various data labeling platforms in the literature (Sager, Janiesch, & Zschech, 2021). Some of them include LabelMe, LabelImg, VIA, and Image Tagger. In this study, the Roboflow platform was used for data labeling. Roboflow allows users to upload custom datasets, add descriptions, change image orientations, resize images, adjust image contrast, and perform data augmentation for model training.

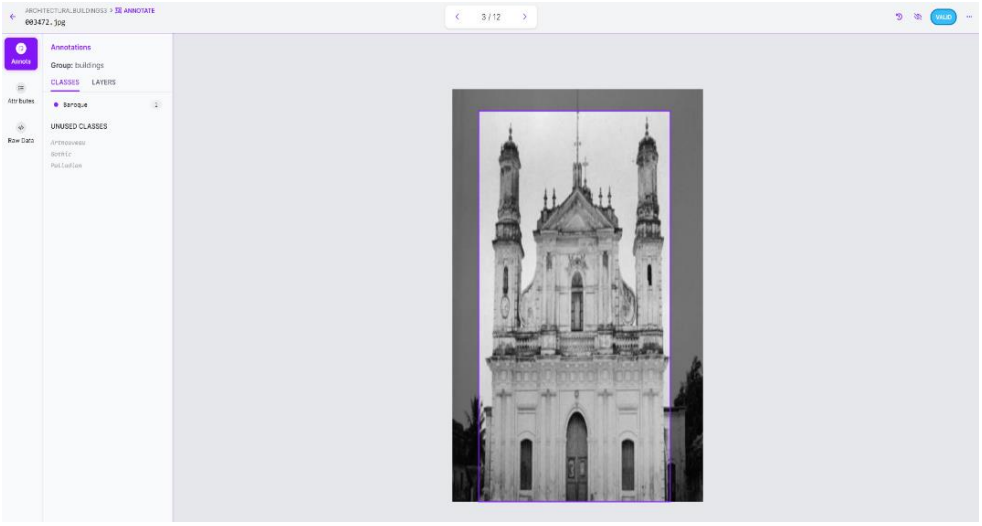

Figure 11. Data labeling on the Roboflow platform

2.4. Model Creation and Model Training

The process of data collection, adding annotations and retraining is referred to as "active learning", training a model from a checkpoint of a previous model is known as "transfer learning" (Williams, 2021). In this study, the active learning method was employed.

2.4.1. Model creation

To achieve desirable accuracy and consistency performance, the dataset was divided into training, validation, and test parts. The training process involves optimizing the model's parameters, enabling accurate prediction of object classes and their locations in an image. This separation was performed using the Roboflow platform. Accordingly, the dataset consisting of 1434 images with four classes (Gothic, Baroque, Palladian, Art Nouveau) was split into 60% for training, 30% for validation, and 10% for testing.

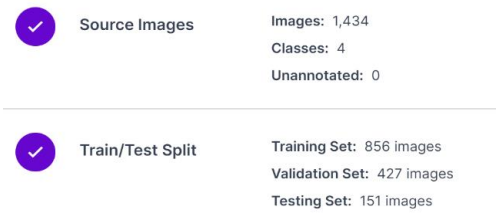

Figure 12. Train/test split on the Roboflow platform

The validation process is used after model training for validation purposes. It is employed to measure the model's accuracy and generalization performance. The test process measures the model's ability to predict previously unseen data. After dividing the dataset into train/validation/test, the images underwent a preprocessing step. Image preprocessing includes formatting steps such as resizing, color correction, and orientation adjustment. These steps are employed to reduce training time and increase model prediction speed. Resizing large images, in particular, improves training time without compromising model performance.

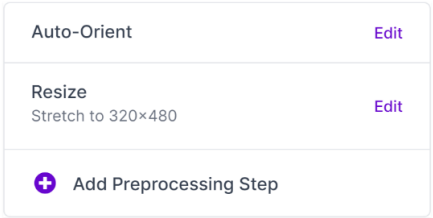

Figure 13. Preprocessing process on the Roboflow platform

In this process, auto-orient (automatic orientation) was applied as the first step, followed by resizing as the second step. Depending on how the pixels of an image are stored, the data determines how the image is displayed. However, some image viewers may display images in the wrong direction without using this data. Auto-orient prevents this misdirection. The second step, resizing, aims to reduce all the images in this study to the same size, thus improving model speed.

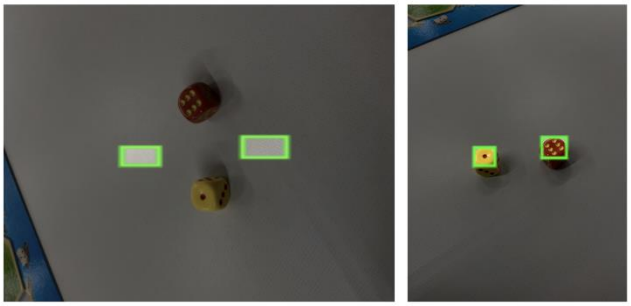

Figure 14. Left: Inconsistency between additional annotation and image orientation, Right: Corrected orientation with auto-orient (Dwyer, 2020)

Image augmentation is a process used to increase the accuracy of the model by generating synthetic training data and improving the model's prediction performance. In this stage of model creation, the flip operation was applied, flipping the images horizontally.

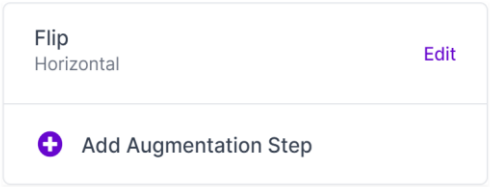

Figure 15. Flip augmentation process

To increase the number of images in the dataset, the generating process was employed in this stage of model creation. As a result, the dataset consisting of 1434 images was transformed into a dataset consisting of 3146 images. In the final step, the model was exported in the YOLOv8 format, enabling its extraction from the platform (Figure 16).

```
!pip install roboflow

from roboflow import Roboflow
rf = Roboflow(api_key="[redacted]")
project = rf.workspace("meryem-dgz60").project("architecturalbuildings3")
dataset = project.version(1).download("yolov8")
```

Figure16. Export process

By completing all the above steps, the model was created and prepared for training.

2.4.2. Model training and validation

The model training in this study was performed using the notebook (a workspace created by Python code) on Google Colab (Öztürkoğlu, 2023a), which provides free usage service. To utilize the full potential of YOLOv8, the ultralytics package was installed to meet the requirements.

YOLOv8 provides both a comprehensive Command Line Interface (CLI) API and a Python SDK for training, validation, and prediction (Rath, 2023). In this study, the CLI was used. Figure 17 illustrates an example command line for running an object detection task using the CLI.

```
yolo task=detect \
mode=predict \
model=yolov8n.pt \
source="image.jpg"
```

Figure 17. YOLO CLI example usage

YOLO can perform three tasks: detection, classification, and segmentation. In this study, the "detect" task of YOLO was utilized. As for the mode, there are training (train), validation (val), prediction (predict), and export modes used to export a trained model.

```
yolo task=detect    mode=train
          classify       predict
          segment        val
                         export
```

Figure 18. YOLO task and mode types

In this study, the command "mode = train" was used for model training, "mode = val" for model validation, and "mode = predict" for predicting the test data. Each category of YOLOv8 models has five models for detection, segmentation, and classification.

Upon examining the values in Table 1, it can be observed that YOLOv8x outperforms other versions in terms of model detection performance. YOLOv8 nano is the fastest and smallest, while YOLOv8 extra-large (YOLOv8x) is the most accurate but slowest version. In this study, the "yolov8s (small)" model was used.

Table 1. Object detection performance comparison of YOLOv8 nano, small, medium, large, xlarge models (Jocher & Waxmann, 2023)

Detection | Segmentation | Classification | Pose

Model	size (pixels)	mAP^{val} 50-95	Speed CPU ONNX (ms)	Speed A100 TensorRT (ms)	params (M)	FLOPs (B)
YOLOv8n	640	37.3	80.4	0.99	3.2	8.7
YOLOv8s	640	44.9	128.4	1.20	11.2	28.6
YOLOv8m	640	50.2	234.7	1.83	25.9	78.9
YOLOv8l	640	52.9	375.2	2.39	43.7	165.2
YOLOv8x	640	53.9	479.1	3.53	68.2	257.8

After splitting the dataset into a training set, a validation set, and a test set with proportions of 60%, 30%, and 10%, respectively, the model was trained on a desktop computer equipped with a Windows 10 (64-bit) operating system, an AMD Ryzen 5 1600X Six-Core processor running at 3.60 GHz, and 16 GB RAM. The training process lasted approximately 1 hour and 40 minutes, consisting of 100 epochs. In the context of computer vision learning, an epoch refers to a single forward and backward pass of the training data through the neural network via an algorithm. When an epoch's worth of data is larger than what the computer can handle, it is divided into smaller parts called "batches." The number of batches required to complete an epoch is referred to as an "iteration" (Simplilearn, 2022).

3. Findings and Discussion

In this study, the aim was to determine the architectural style of a structure among Gothic, Baroque, Palladian, and Art Nouveau styles using YOLOv8, a one-stage algorithm based on object detection in computer vision (CV). The evaluation of the model's performance was conducted through

measurements between the 1st and 100th epochs, using the training and validation sets, as well as the confusion matrix and loss functions. These evaluations were presented in Figures 19, 20, 21, 22, and 23, including numerical values and graphs.

Figure 19 illustrates the values of precision (P), recall (R), and mean average precision (mAP) between the 1st and 100th epochs. It can be observed that these values gradually increase. High P and R values indicate that the model performs well in correctly identifying all true positive detections and minimizing false negatives. Additionally, high mAP50 and mAP50-95 values indicate the model's effectiveness in detecting and localizing objects in different categories. Values close to 1 for P, R, and mAP indicate successful training processes on the training and validation datasets.

```
Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
1/100      6.14G      1.132      2.358      1.724         36        800: 100% 94/94 [01:03<00:00,  1.48it/s]
           Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100% 14/14 [00:06<00:00,  2.17it/s]
             all        427        427      0.687      0.554      0.664      0.399
      Artnouveau        427         23      0.551     0.0435      0.273      0.121
         Baroque        427        173      0.796      0.711      0.828      0.506
          Gothic        427        203      0.901      0.783      0.916      0.676
       Palladian        427         28      0.501      0.679      0.638      0.293

Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
100/100    6.52G     0.1739     0.1418     0.8875         11        800: 100% 94/94 [00:44<00:00,  2.13it/s]
           Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100% 14/14 [00:08<00:00,  1.69it/s]
             all        427        427      0.919      0.932      0.948      0.796
      Artnouveau        427         23      0.915      0.936       0.95      0.814
         Baroque        427        173      0.941      0.965      0.976      0.852
          Gothic        427        203      0.974       0.97      0.987      0.932
       Palladian        427         28      0.847      0.857      0.879      0.585
```

Figure 19. Values between the 1st and 100th epochs

The mAP values, which measure how well the model accurately detects and classifies objects in different categories, reaching values close to 1 after the training (Figure 20), demonstrate the success of the training process.

```
Model summary (fused): 168 layers, 11127132 parameters, 0 gradients, 28.4 GFLOPs
           Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100% 14/14 [00:08<00:00,  1.68it/s]
             all        427        427      0.941      0.915      0.951      0.797
      Artnouveau        427         23      0.953      0.886      0.956      0.808
         Baroque        427        173      0.953      0.942      0.977      0.841
          Gothic        427        203       0.98      0.975      0.989       0.93
       Palladian        427         28      0.878      0.857      0.883      0.609
Speed: 2.0ms pre-process, 5.0ms inference, 0.0ms loss, 1.9ms post-process per image
```

Figure 20. Training values

The validation values (Figure 21) were similar to the training values, indicating the success of the validation process.

```
           Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100% 27/27 [00:08<00:00,  3.24it/s]
             all        427        427      0.941      0.915      0.951      0.796
      Artnouveau        427         23      0.953      0.886      0.956      0.808
         Baroque        427        173      0.953      0.942      0.977      0.841
          Gothic        427        203       0.98      0.975      0.989      0.931
       Palladian        427         28      0.878      0.857      0.883      0.604
Speed: 1.0ms pre-process, 9.8ms inference, 0.0ms loss, 1.7ms post-process per image
```

Figure 21. Validation values

According to the confusion matrix results in Figure 22, the model correctly predicts art nouveau structures with an accuracy of 0.87, baroque structures with an accuracy of 0.96, gothic structures with an accuracy of 0.98, and palladian structures with an accuracy of 0.89. However, it mistakenly predicts art nouveau structures as baroque with an accuracy of 0.09 and baroque structures as gothic with an accuracy of 0.01. The lower accuracy in predicting art nouveau structures compared to other styles can be attributed to the smaller number of labeled photos belonging to the art nouveau style. As the number of labeled photos increases, the model's accuracy also improves.

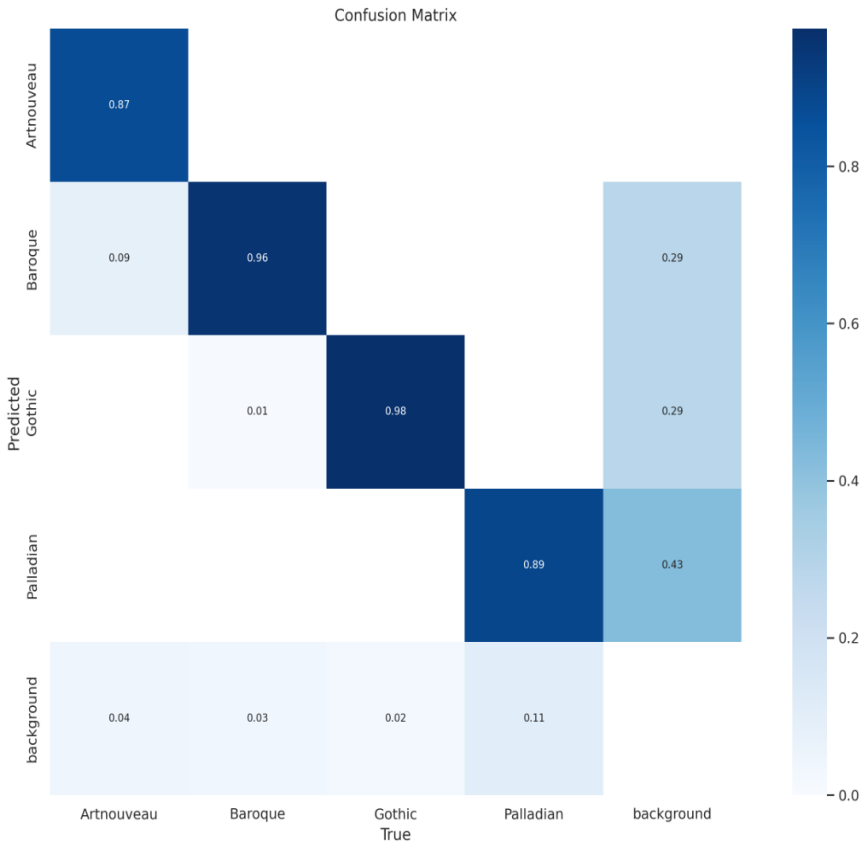

Figure 22. Confusion matrix

Figure 23 presents the results of the training and validation sets using graphs. These graphs show the measurements of three different loss types (box_loss, cls_loss, dfl_loss) as well as P, R, mAP50, and mAP50-95 values. Box_loss represents how well the algorithm can find the center of an object and how accurately the predicted bounding boxes (bb) cover an object. Cls_loss measures how well the algorithm predicts the class of an object. Dfl_loss is a measurement directly optimizing the distribution of bb boundaries. After 25 epochs, the model has significantly improved in terms of P, R, and mAP values, and it becomes stable after 50 epochs. This indicates that early stopping could provide almost similar results in 50% less time.

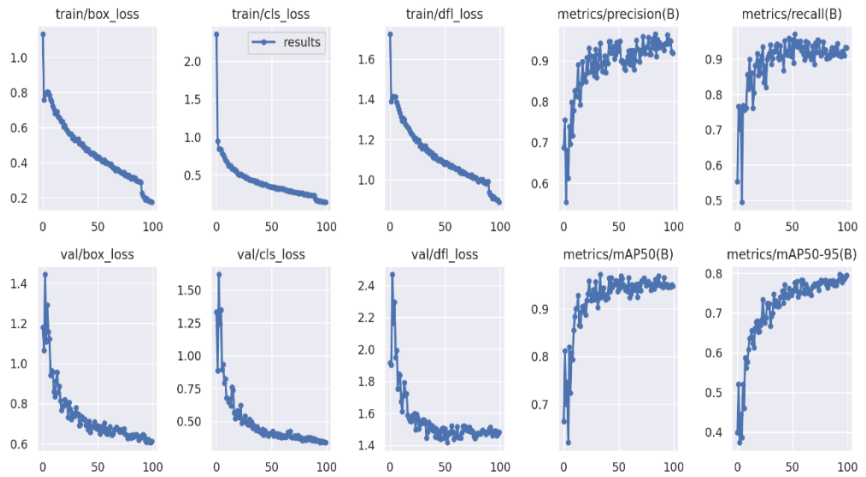

Figure 23. Graphs showing box_loss, cls_loss, dfl_loss, P, R, and mAP during the training period on the training and validation sets

After training the model, unseen photos (test set) and a video (Öztürkoğlu, 2023c) were shown to the model with a confidence threshold of 0.25 for inference. The algorithm was able to detect the

architectural styles of structures with an accuracy of over 0.90 in most cases (Figure 24). The entire video, including the images in the figure and their accuracy rates, can be viewed on YouTube (Öztürkoğlu, 2023d).

Figure 24. Predicted values of test photos

Furthermore, when observing the object detection time for each frame of the video, it took between 8-17 ms to process each frame. This value indicates that the detection of structures belonging to four different architectural styles with an average accuracy of 0.80-0.95 is almost real-time object detection.

Xu et al. (2014), conducted a study titled "Architectural Style Classification Using Multinomial Latent Logistic Regression", where they used a dataset consisting of photos of 25 different architectural styles to classify architectural styles using a Multinomial Latent Logistic Regression (MLLR) based model. In their study, they compared the prediction values of a 10-class model and a 25-class model, which they presented in Table 2. According to their findings, the prediction values of their model were below 0.70 for the 10-class model and below 0.50 for the 25-class model.

Table 2. Prediction results of Xu's study (Xu et al.2014)

	GIST	SP	OB-Partless	OB-Part	DPM-LSVM	DPM-MLLR	MLLR+SP
10 classes	30.74	60.08	62.26	63.76	65.67	67.80	**69.17**
25 classes	17.39	44.52	42.50	45.41	37.69	42.55	**46.21**

Architectural styles emerge and change over time, influenced by factors such as the geographical, demographic, and sociological characteristics of societies. In this sense, determining the architectural style of a structure paves the way for identifying the characteristics of the society to which it belongs. Reaching a conclusion about the architectural style of a structure requires the accumulated knowledge and expertise in that field by architects, designers, engineers, or artists. This study highlights the potential use of CV in intricate tasks like architectural style identification, emphasizing the contribution and efficiency that artificial intelligence algorithms can provide in this field. As a next step, this study can be extended by labeling and incorporating photos of structures belonging to other architectural styles into the model, allowing for more comprehensive utilization of the model in architecture, engineering, art, and related disciplines.

4. Conclusion and Suggestions

In this study, a CV project based on object detection using YOLOv8 was successfully conducted to determine the architectural style of prominent structures in a video, specifically focusing on the Gothic, Baroque, Palladian, and Art Nouveau styles. A comprehensive dataset was created, and the model was subjected to a rigorous training process consisting of 100 epochs. The results obtained from the study are highly promising and provide valuable insights into the capabilities of the approach employed:

Upon concluding the training process, our model achieved impressive performance metrics for all architectural styles. The precision (P), recall (R), mean Average Precision at IoU 0.50 (mAP50), and mean Average Precision at IoU 0.50-0.95 (mAP50-95) values were measured at 0.941, 0.915, 0.951,

and 0.797, respectively. These exceptional ratios clearly demonstrate the effectiveness of our training procedure in capturing the distinctive features of different architectural styles.

Similarly, the validation process yielded remarkable results, with the model exhibiting P, R, mAP50, and mAP50-95 values of 0.941, 0.915, 0.951, and 0.796, respectively, for all architectural styles. These metrics further validate the robustness and generalizability of our model, highlighting its ability to accurately identify architectural styles in unseen data.

Moreover, our confusion matrix analysis revealed the model's high accuracy in predicting architectural styles. Specifically, the model demonstrated an outstanding accuracy of 0.98 for Gothic structures, 0.96 for Baroque structures, 0.89 for Palladian structures, and 0.87 for Art Nouveau structures. These findings provide strong evidence of the model's reliability and its ability to correctly classify diverse architectural styles.

In the video used for inference, our model exhibited an impressive average accuracy range of 0.80 to 0.95 when identifying structures belonging to the four different architectural styles. This demonstrates the model's capability to make accurate predictions consistently, even in the presence of challenging variations in lighting conditions, angles, and environmental factors.

Furthermore, the object detection process for each frame of the video demonstrated remarkable efficiency, with a processing time ranging from 8 to 17 milliseconds. This real-time performance, coupled with high prediction values, signifies that our model can effectively operate as a practical real-time object detection algorithm for architectural style recognition tasks.

In conclusion, this study showcases the significance of computer vision (CV) in the field of architecture and emphasizes its potential contribution to related domains. By accurately identifying and classifying architectural styles, our model provides a valuable tool for architectural analysis, preservation, and historical research. Moving forward, we recommend further research and development in CV algorithms to expand the scope of architectural style recognition and explore additional applications within the architectural and cultural heritage domains. Additionally, efforts should be made to increase the dataset size, incorporate more architectural styles, and explore the integration of other CV techniques to enhance the model's performance and extend its practical utility.

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Author Contribution and Conflict of Interest Declaration Information

The article has a single author and there is no conflict of interest.

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Investigating Remote Working Spaces during the COVID-19 Pandemic

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Abstract

The business world has experienced a pandemic for three years, affecting the workforce's productivity and efficiency. Since workers' well-being and satisfaction are crucial to effective workforce management, organizations and authorities make the employee's well-being and satisfaction the primary target to be achieved even in the post-pandemic period. Many countries and organizations have developed strategies to meet the emerging requirements of the business world. Like other countries, many of the workgroups in Türkiye were also forced to adopt working-from-home (WFH) practices. Although a substantial number of research studies were conducted for investigating well-being and productivity, there is still a need for empirical studies investigating WFH satisfaction and the well-being of workers to be used as a reference and guide for research. A survey was designed and implemented among employees from Türkiye to inspect and measure negative and positive relations between the physical work environment, well-being, and satisfaction of WFH workers. Regarding the range of participants, the survey results could be generalized to illustrate challenges, conditions, and aspects of working-from-home practices in Türkiye to define remote working spaces.

Keywords: *Remote working, employee comfort, working conditions, Covid-19, space features.*

Covid- 19 Pandemisi Süresince Uzaktan Çalışma Mekanlarının Araştırılması

Öz

İş dünyası üç yıldır süren bir pandemi deneyimi yaşadı ve bu durum işgücünün verimliliği ve etkinliği üzerinde etkili oldu. Çalışanları refahı ve memnuniyeti etkili işgücü yönetimi için önemli olduğundan, kuruluşlar ve yetkililer, çalışanların refahını ve memnuniyetini pandemic sonrası dönemde bile ulaşılması gereken birincil hedef olarak belirlemektedir. Birçok ülke ve kuruluş, iş dünyasının ortaya çıkan gereksinimlerini karşılamak için stratejiler geliştirmiştir. Diğer ülkeler gibi, Türkiye'deki birçok çalışma grubu da evden çalışma uygulamalarını benimsemek zorunda kalmıştır. Performans, refah ve verimlilki konusunda önemli sayıda araştırma yapılmış olmasına rağmen, çalışanların evden çalışma memnuniyeti ve refahını inceleyen ampirik çalışmalara ihtiyaç duyulmaktadır. Bu tür çalışmalar, referans ve araştırma rehberi olarak kullanılmak üzere Türkiye'deki çalışanların evden çalışma memnuniyeti ve refahını incelemek ve ölçmek için bir anket tasarlanmış ve uygulanmıştır. Katılımcılar aralığı açısından, anket sonuçları, zorlukları, koşulları ve evden çalışma uygulamalarının yönlerini belirlemek için genelleştirilebilir ve Türkiye'deki uzaktan çalışma alanlarını tanımlayabilir.

Anahtar kelimeler: *Uzaktan çalışma, çalışan konforu, çalışma koşulları, Covid-19, mekan özellikleri.*

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1. Introduction

With the sudden spread of COVID-19 in early 2019, lockdowns were introduced, movements were restricted, and people were forced to stay at their homes worldwide (Selvaraj, Krishnamoorthy, Vivekanandhan & Manoharan, 2022). The sudden shock of society due to restrictions and illness has caused social changes (Houweling, Power & Smith, 2022), addressing both positive and negative aspects of the well-being of people (Lemoine, Ebert, Koga & Bertin, 2022). Many business models have been transformed into remote and distributed working practices since people were locked in their homes. The new working formation is called Working-From-Home (WFH).

WFH has been so sudden for people worldwide that adjustments of individuals and organizations were significant, fast, and notable and impacted everyone within the same, very short time (George, Atwater, Maneethai & Madera, 2022). Organizations have not had time and chance to plan and intervene with measures designed to make the transition smooth for the workers. On the other hand, it was challenging for both organizations to establish effective business management and for employees to create an efficient working environment.

The pandemic changed to the epidemic in early 2022, and the business industry has returned to regular office work. On the other hand, literature has stated that the particular impact of the pandemic has continued and affected both business management and employee satisfaction. Workers demand and expect the ability to work remotely (Bhushan, Brown, Stubbings & Davies, 2021; Jordan & Baker, 2022; Osibanjo, 2022), the inclusion of the home as an alternative workplace (Bhushan et al., 2021; McLaurin, 2022), increased privacy since they were at a certain level of privacy during WFH (McLaurin, 2022), priority for health and well-being (Jordan & Baker 2022; McLaurin, 2022; Moss, 2022), seek for better work-life balance (Aaron, Dowling, Mugayar-Baldocchi & Schaninger, 2021; Bhushan et al., 2021; Craven, Staples & Wilson, 2022; Klein, Cameron & Basiouny, 2022; Moss, 2022; Osibanjo, 2022) and more green and sustainable life (Boyd, O'Keeffe & Sheth, 2022; Francis, Madgavkar & Smit, 2022; Schwab & Sternfels, 2022).

Since workers' well-being and satisfaction are crucial to effective workforce management, organizations, and authorities make the employee's well-being and satisfaction the primary target to be achieved even in the post-pandemic period. Many countries and organizations have developed strategies to meet the emerging requirements of the business world. Türkiye has a significant number of workers employed in various business sectors. Like other countries, many of the workgroups in Türkiye were also forced to adopt WFH practices. Although a substantial number of research studies were conducted for investigating specific work groups' performance, well-being, and productivity, there is still a need for empirical studies investigating WFH satisfaction and well-being of workers to be used as a reference and guide for research. Especially physical work environment and the impact of its upon well-being and satisfaction of WFH workers were investigated in this study.

2. Material and Method

The research aims to present Türkiye-specific WFH challenges and negative and positive aspects by addressing well-being and productivity dimensions. The practical approach of the study is to explore the relationship between the workplace's conditions and workers' feedback about productivity and social well-being. Firstly, existing studies on evaluating remote working experiences, their contributions, and gaps are investigated. Secondly, the criteria used to measure well-being and productivity are explored to construct the survey objectives. As indicated in Figure 1, the research study outlines the problem of WFH practices in Türkiye regarding the literature data, establishes a survey framework, executes the survey, analyzes the findings, and concludes and discusses the results.

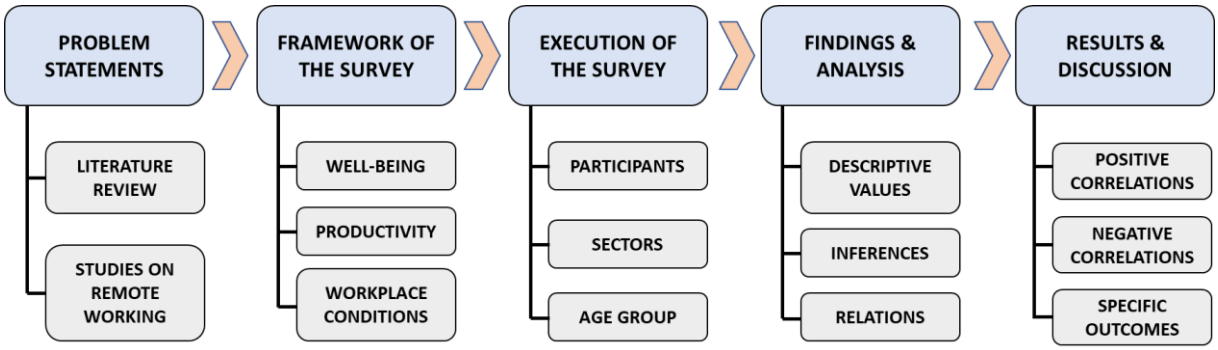

Figure 1. Research outline

2.1. Studies About the Remote Working

The literature review study focused on discussions about WFH practices. The scholar's findings about the WFH range as illustrated in Table 1. Some of the scholars stated that since WFH is working, there is no need for physical space out of the home for working (BBC Worklife 2020; Dickler 2021; Lufkin 2021; Morgan 2021; O'Connor 2021; Parker et al. 2020; Rubinstein 2021). The people on this side of the argument presented that the home environment is more suitable for them than offices due to its comfortable and flexible work environment. On the other hand, there were also opposite solid findings expressing that home cannot be an alternative to office workspaces (BBC Worklife, 2020; Hickok, 2021; McMenamin, 2021; Morgan, 2021; O'Connor, 2021; Parker et al., 2020; Yeung, 2021). Parents especially suffer from not finding a proper work environment at home since lockdown conditions stated that their responsibility has increased in both work and parental duties. Another group of scholars argues that WFH and resulting habits will terminate open office plans and culture (Johanson, 2021; Morgan, 2021; O'Connor, 2021; Rubinstein, 2021). The organizations have still been demanding a central office that would serve as headquarters; there is still a need for an analog world requiring address and physical existence at face-to-face communication (BBC Worklife, 2020; Lufkin, 2021; Morgan, 2021; O'Connor, 2021).

In early 2022, many countries slowly eased certain restrictions due to a typical fall in disease numbers. Organizations have started to call back their staff to their central office. On the other hand, many employees were already volunteers to return to the office; many resisted experiencing pre-pandemic office conditions again. People were getting used to the home environment's comfort, personalization, and flexibility. Furthermore, some employees consider resigning if they are not provided flexible time and work (O'Connor, 2021; Yeung, 2021). The companies have been required to not only re-design and arrange office environments but also the working schedule of employees in compile with COVID-19 guidelines where these new environments and working styles are called hybrid work. The hybrid work model allows employees to retain the flexibility of working from home and still have the kind of in-office contact with colleagues that strengthen teams and collaboration (Rubinstein, 2021).

Table 1. Existing discussions and arguments about working from home during the COVID-19 pandemic

Title	Arguments	Sources
Remote work is working. So, why do we need a physical space?	• Employees' adaptability to remote work is apparent. • Employees have proved remote work is both possible and profitable. • An office is not necessary for productivity. • There are proper work environments at home, enabling much more comfortable and flexible work than in an office environment. • Employees seek flexibility in terms of when and where to work. • Employers would like to decrease operation costs by eliminating the real estate cost of offices. Thus, working outside the office is good for them.	(BBC Worklife, 2020; Dickler, 2021; Lufkin, 2021; Morgan, 2021; O'Connor, 2021; Parker et al., 2020; Rubinstein, 2021)

The home is not suitable for being an alternative to the office workplace	• Parents do not desire to be at home working. • Being in the office enables focusing and getting away from home environmental factors preventing concentration. • There are too many interruptions at home. • The office environment is designed for productivity and the well-being of employees, while the home environment is designed for the family's life. Therefore, a home design needs a substantial change to achieve the same performance caught at the office workplace. • The corporate culture of companies expressed in the office environment cannot be dictated when employees do not stay there.	(BBC Worklife, 2020; Hickok, 2021; McMenamin, 2021; Morgan, 2021; O'Connor, 2021; Parker et al., 2020; Yeung, 2021)
The end of the open office plan and culture	• Employees seek more activity-oriented workplaces for meeting various services instead of a monotonous open plan expressing the same identity everywhere. • Employees do not want to return to the old working culture. They seek flexibility regarding when and where to work at the office and at home.	(Johanson, 2021; Morgan, 2021; O'Connor, 2021; Rubinstein, 2021)
The corporate headquarters	• Companies still need a central office that would serve as the headquarters. • There are still analog worlds requiring address. • The office is a way to express company identity. • The office is a collection of company-specific culture, providing a sense of belonging to both customers. • Physical existence instead of online collaboration and communication is still valuable for some people.	(BBC Worklife, 2020; Lufkin, 2021; Morgan, 2021; O'Connor, 2021)

Following the decrease in diseases, many governments announced returning to normal life conditions by still obeying specific COVID-19 guidelines. On the other hand, discussions continue about WFH and the centralized office concept. Covid requirements for presenting a healthy workplace have forced the organization to eliminate open-plan, co-working, hot desking, and other shared desk concepts, which were the familiar office pattern of the pre-pandemic business world (Cummins & Johanson, 2020). These new conditions bring extra operation costs for the organizations to meet both the requirements of COVID-19 transmission concerns and corporate profit and productivity challenges.

Many countries release WFH practice reports representing the workers' comfort, challenges, and productivity concerns, as depicted in Table 2. The results vary regarding the well-being and comfort of workers during working-from-home practices. Some workers stated that their jobs could be done from Home (Parker et al., 2020). Working mothers and parents struggle to balance work and family responsibilities (Houweling et al., 2022; Mars, Arroyo & Ruiz 2022; O'Connor, Wetherall, Cleare, McClelland, Melson, Niedzwiedz, O'Carroll, O'Connor, Platt, Scowcroft, Watson, Zortea, Ferguson & Robb, 2021; Parker et al., 2020). The well-being of the workers was decreased due to lockdown conditions (Houweling et al., 2022; Juchnowicz & Kinowska, 2021; Mars et al., 2022; Mostafa, 2021; O'Connor, Conboy & Dennehy, 2021; PARKER et al., 2020). On the other hand, there were studies indicating improvement in the productivity and well-being of workers (George et al., 2022; Mostafa, 2021; O'Connor et al., 2021). Furthermore, people's positive expectations about WFH and the pandemic represented much more satisfaction and productivity (Fida, Paciello, Watson, & Nayani, 2022; Zion, Louis, Horii, Leibowitz, Heathcote & Crum, 2022).

Table 2. Working from home practice findings in the literature

Source	Research Field and Group	Findings
(Parker et al., 2020)	United States citizens forced to be work-from-home	• 40% of the workers' jobs can mostly be done at Home • 50% of the parents working from home have been confronted with home-related interruptions • A significant portion of the workers prefer working from home
(Mars, Arroyo & Ruiz 2022)	1827 citizens in the Valencian Region of Spanish	• The youngest participants and females present lower values of psychological well-being. • Those who walked more are related to lower values of well-being.
(Bamberry, Neher, Jenkins, Sutton, Frost, Roberts, Dwivedi, Omeara & Wong, 2022)	665 police professionals from all states and territories in Australia	• Increased stress, anxiety, and occupational burnout have been found • The rapid change in environmental factors has increased their stress. • Police were dealing with increased domestic violence, mental health cases, and alcohol consumption, resulting in assaults and antisocial behavior.
(O'Connor, Wetherall, Cleare, McClelland, Melson, Niedzwiedz, O'Carroll, O'Connor, Platt, Scowcroft, Watson, Zortea, Ferguson & Robb, 2021)	3077 adults in the UK participated in the survey. The survey covers waves 1 (31 March to 9 April 2020, 2 (10 April to 27 April 2020), and 3 (28 April to 11 May 2020)	• Symptoms of anxiety and levels of defeat and entrapment decreased • Positive well-being increased when compared with first-wave results • The level of loneliness did not change over the waves • Mental health problems have worsened in the following groups: Women, young people, those from more socially disadvantaged backgrounds, and those with pre-existing mental health problems
(Zion et al., 2022)	5,365 American adults participated in the survey conducted in March 2020.	• Agreement with the opportunity mindset is related to more significant positive affect, more experiences of growth/connection, fewer experiences of isolation/meaninglessness, and better well-being.
(Fida et al., 2022)	393 full-time employees participated in the UK across three waves (January 2020, October 2020, and January 2021)	• Being in two at-risk profiles significantly increases the likelihood of experiencing lower well-being during the pandemic. • The probability of belonging to Profile 2, "high assertive and task self-efficacy but low emotional," also significantly increased the risk of lower well-being in the longer timeframe.
(Mostafa, 2021)	318 employees participated in Egypt during the post-Covid-19 quarantine period	• Employees' perception of remote working significantly positively affects psychological well-being and work-life integration. • A significant negative effect of employees' perception of remote working and emotional exhaustion
(Juchnowicz & Kinowska 2021)	1000 Polish workers participated in the survey conducted in January 2021	• Working exclusively remotely was shown to negatively affect well-being in terms of workplace relationships and work-life balance. • There was no statistically significant association between remote working and subjective health assessment.
(George et al., 2022)	278 US workers who reported spending at least 50% of their time working at home or remotely rather than at their usual workplace participated in the survey	• Nearly half of the respondents report that their responsibilities, working hours, accountability, and demands have not changed. • 56% agree that the experience of working at home has been permanently transformative in a positive way • 61% agreed that if they had a choice, they would continue working remotely even when no longer necessary • Respondents perceive WFH as having a solid and positive impact on the aspects of work.
(Houweling et al., 2022)	274 UK parents participated in the survey conducted between February-May 2021	• Surveyed parents lacked space as well as time. • The difficulties of inadequate living space experienced widely during lockdown draw attention to those experiencing persistent social inequalities.

(Schifano, Clark, Greiff, Vögele & D'Ambrosio 2021)	More than 8,000 people from France, Italy, Germany, Spain, and Sweden, covering the period May–November 2020	• Well-being among workers is lower for those who work from home, and those who are not working have the lowest well-being of all. • Policy stringency is always negatively correlated with well-being. • The well-being penalty for working at home is more significant for the older, the better-educated, those with young children, and those with more crowded housing.
(Olsen, Hildrum, Kummen & Leirdal 2023)	The study uses data from a survey among young employees in a telecommunications company in Norway conducted in May 2021	• The results show that the difficulty of work tasks is positively related to stress, while time spent working from home, managing work-life balance, and receiving support from leaders are negatively related to stress. • A dedicated workspace at home is unrelated to job stress or engagement, and no gender differences exist.

The literature presented various outcomes for WFH practices during the pandemic lockdown. It is hard to result in a typical attitude toward WFH practices. On the other hand, organizations suffer from increased operating costs of the centralized office concept and some workers' insistence on WFH. However, organizations require not only developing and applying the right strategies for maintaining their operability but also challenging satisfying their employees' work environment.

The quality of most of the built environment in Türkiye, concerning comfort and well-being, was inspected as problematic by many Turkish scholars. Şentürk Sipahi & Yamaçlı explored the impact of daylight in dwelling units upon occupants' well-being. Even before the pandemic, the occupants spent 90% of their time in their homes. With the sudden spread of the pandemic, similar to other countries, People in Türkiye and their built environment were not ready and resilient to ensure the well-being of their users (Billur & Billur, 2020; Oğur, Özdede & Kalonya, 2022; Şentürk, Sipahi & Yamaçlı, 2021). Although findings about WFH practices during the lockdown vary in the literature depending on the country and focus group, there is less research on the well-being and productivity of workers in Türkiye during the WFH practices during the COVID-19 lockdown period. Regarding the gap in the literature, our research study investigates workers' satisfaction and comfort in experiencing WFH during the pandemic.

2.2. Survey and Variables

Surveys capture knowledge from the individual about their thoughts and behaviors (Marczyk, DeMatteo & Festinger, 2005). The themes aimed to measure should show the relationships and causality between facts. The questions, sample group, and execution procedure should be developed according to the survey's objectives. The survey was conducted among workers older than 20 with remote working experience during the pandemic. The survey was approved on 10.02.2023 and applied between 01.04.2022 and 09.05.2022. Questionary was delivered to the respondents by online survey system, and there was no restriction for the respondent selection to avoid focusing on a specific group. Any personal information has not been recorded. Any survey should have objectives and arrangements to avoid bias and conflicts. The objectives of measurements are listed as follows:

- Age, working conditions, and sector.
- Remote working frequency and remote working place type
- Physical conditions of remote working place
- Satisfaction level among spaces
- Productivity and well-being level during remote working

The question of the survey is designed to measure the objectives. Multiple choices diversify due to the fiction of the questions. The items are listed as follows:

- Questions 1, 2, 3, and 4 in order: Age, the density of traffic and population, sector, and occupation. The objective is to seek the relation of outcomes with a descriptive situation of respondents.
- Question 5: Remote working frequency in last two years and weekly. The objective is to ensure and measure respondents' remote working level.
- Question 6: The place of remote working with ratio (Home with private space, home, out of home)

- Questions 7 and 9 in order: The physical conditions of the home, the physical conditions of out of the home. The objective is to describe the features of remote working spaces.
- Questions 7 and 10 in order: Satisfaction level of the home, the satisfaction of out of the home. The objective is to measure the satisfaction level of respondents in remote working places.
- Question 11: The items related to productivity and well-being level during the remote working period.

3. Findings and Discussion

One hundred twenty-six respondents participated in the survey. Figure 2 and Figure 3 show the age distribution and traffic & and population features of the respondents' living environment. 63% of the group was between 31-45 years, and 24% was between 20-30 years. 87% of the respondents were between 20-45 years old and actively working. Figure 3 states that many respondents lived in areas with high traffic and population frequencies.

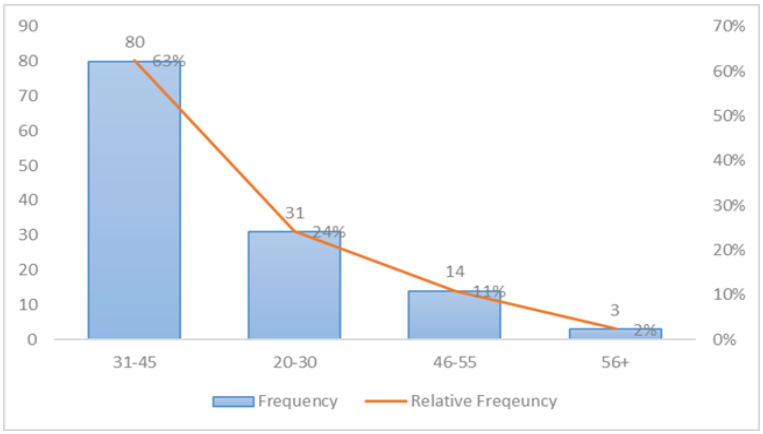

Figure 2. Age distribution

Figure 3 shows the relative and cumulative frequencies; 86 participants are in High Population and Traffic, 29 are in Mid Population and Traffic, and 13 are in Low Population and Traffic. Figure 4 shows the participants' distribution by the work area sector. With 36 people, Education &Consultancy has the most, while Sales &Marketing has the least participatory work area with ten people. Figure 5 shows the participants' distribution and relative frequencies according to the occupation type. Forty-four people are the highest frequency of the Full-Time category and the least number of participatory working types, with three people in the Freelance category.

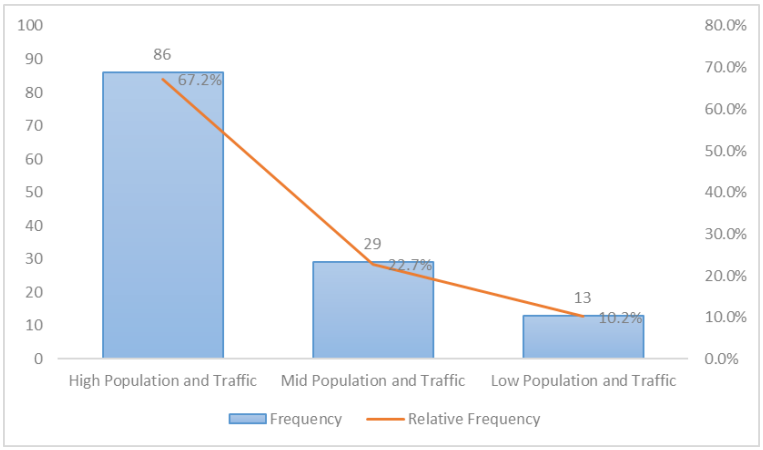

Figure 3. Traffic and population

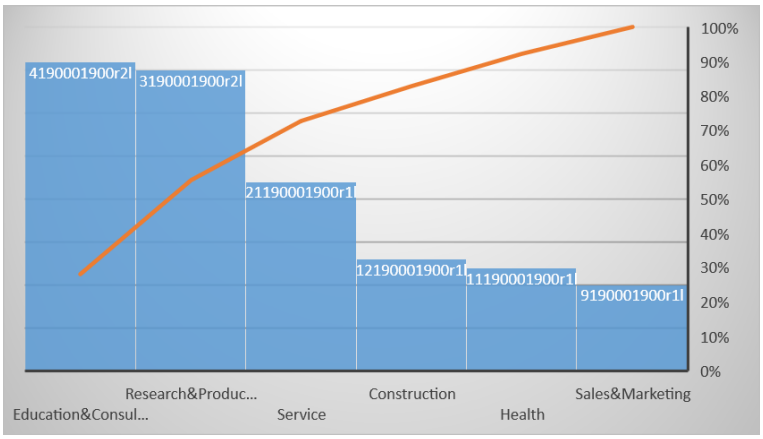

Figure 4. Working sector

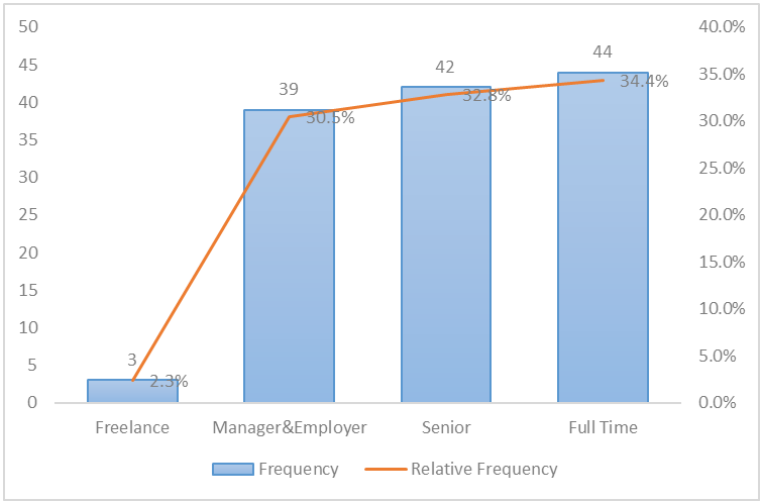

Figure 5. Occupation

Figure 6 shows the distribution and relative frequencies of the participants according to the type of remote work. The relative frequency of the Ratio of Yearly Remote Working was 51%, while the relative frequency of the Ratio of Weekly Remote Working was 49%. Figure 7 shows the distribution and relative frequencies of the participants according to the type of remote workplace. The relative frequency of "Remote Working Area (Private House Space)" was 51%, the relative frequency of "Remote Working Area (House)" was 39%, and the relative frequency of "Remote Working Area (Out of House)" was 14%.

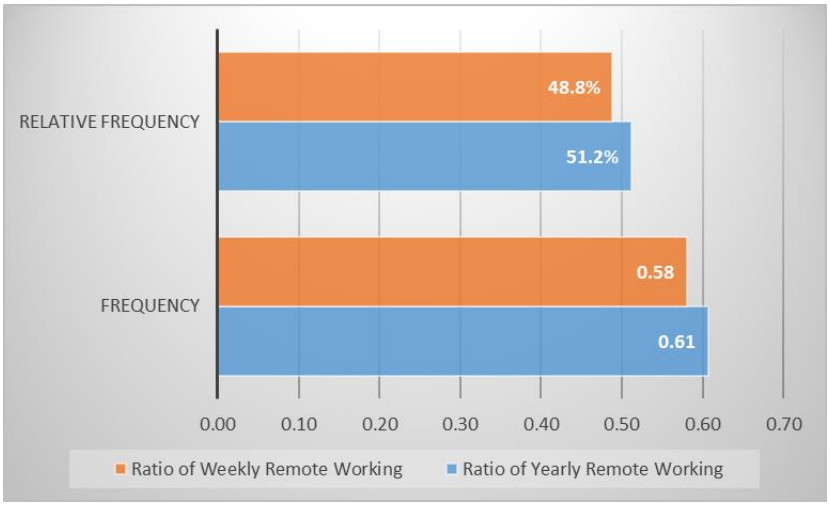

Figure 6. Remote working frequency

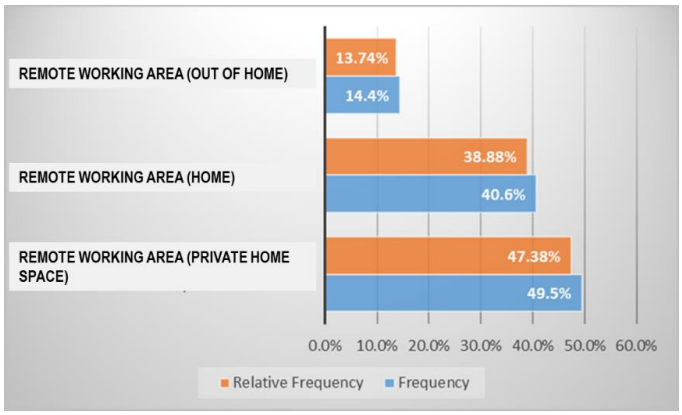

Figure 7. Remote working places

When the Ratio of Yearly Remote Working and Ratio of Weekly Remote Working participation rates are analyzed cumulatively, 47% of the participants were in the Remote Working Area (Private House Space), 39% in the Remote Working Area (House), and 14% in the Remote Working Area. (Out of House). Linear regression is used to study the linear relationship between a dependent variable Y () and one or more independent variables X (). The dependent variable Y must be continuous, while the independent variables may be continuous, binary, or categorical. The initial judgment of a possible relationship between two continuous variables should always be based on a scatter plot. Table 3 shows the calculations of the regression equation for working from home. The findings show that the equation explicitly created for "Remote Working Area (House)" is explained at a rate of 34% over independent parameters. The ratio of the explained to total variation is the sample coefficient of determination, which is 0.34 for this equation. The coefficient of determination measures the percentage of variability in Y, the Remote Working Area (House), which can be explained through knowledge of the variability (differences) in the independent variable X. The coefficients, directions, and intensities can be observed in the above equation based on the correlation matrix. The coefficients, directions, and intensities can be observed in the above equation based on the correlation matrix. For example, with a constant coefficient of 0.417, "Home / Satisfaction-Comfort," with a coefficient of 0.577, is the variable that affects the equation in the most positive direction. At the same time, "Home / Daylight" is the variable that affects the equation most negatively, with a coefficient of -0.35.

Table 3. The regression equation for working from home

RW-House = 0.417 + 0.0 Home / Private Space Usage_0 - 0.111 Home / Private Space Usage_1
+ 0.177 Home / Private Space Usage_2 + 0.0 Home / Desk-Chair-Computer Suff_0
- 0.133 Home / Desk-Chair-Computer Suff_1
- 0.138 Home / Desk-Chair-Computer Suff_2 + 0.0 Home / Daylight_0
- 0.350 Home / Daylight_1 - 0.286 Home / Daylight_2
+ 0.0 Home / Natural Ventilation_0 + 0.459 Home / Natural Ventilation_1
+ 0.379 Home / Natural Ventilation_2 + 0.0 Home / Not Being Disturbed_0
+ 0.378 Home / Not Being Disturbed_1 + 0.252 Home / Not Being Disturbed_2
+ 0.0 Home / Sound Level_0 + 0.126 Home / Sound Level_1
+ 0.066 Home / Sound Level_2 + 0.0 Home / Similarity to Office Spa_0
- 0.069 Home / Similarity to Office Spa_1
+ 0.117 Home / Similarity to Office Spa_2 + 0.0 Home / Lighting_0
- 0.096 Home / Lighting_1 - 0.137 Home / Lighting_2 + 0.0 Home / Temperature_0
+ 0.354 Home / Temperature_1 + 0.346 Home / Temperature_2
+ 0.0 Home / Services(internet,electr_0 - 0.069 Home / Services(internet,electr_1
- 0.038 Home / Services(internet,electr_2 + 0.0 Home / Eating_0
- 0.108 Home / Eating_1 - 0.153 Home / Eating_2
+ 0.0 Home / Satisfaction-General Con_-1 - 0.239 Home / Satisfaction-General Con_0
- 0.003 Home / Satisfaction-General Con_1 + 0.0 Home / Satisfaction-Visual Appe_-1
- 0.187 Home / Satisfaction-Visual Appe_0
- 0.102 Home / Satisfaction-Visual Appe_1 + 0.0 Home / Satisfaction-Comfort and_-1
+ 0.577 Home / Satisfaction-Comfort and_0
+ 0.336 Home / Satisfaction-Comfort and_1 + 0.0 Home / Satisfaction-Privacy_-1
- 0.267 Home / Satisfaction-Privacy_0 - 0.185 Home / Satisfaction-Privacy_1
+ 0.0 Home / Satisfaction-Cleaning_-1 - 0.075 Home / Satisfaction-Cleaning_0
+ 0.060 Home / Satisfaction-Cleaning_1

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0.390564	34.39%	0.00%	*

Table **4** shows the calculations of the regression equation for working from out of home. The findings show that the equation explicitly created for "Remote Working Area (Out of House)" is explained at a rate of 59.5% over independent parameters. The ratio of the explained to total variation is the sample coefficient of determination, which is 0.595 for this equation. The coefficient of determination measures the percentage of variability in Y, the Remote Working Area (Out of House) that can be explained through knowledge of the variability (differences) in the independent variable X. The coefficients, directions, and intensities can be observed in the above equation based on the correlation matrix. For example, with a constant coefficient of -0.056, "Out of Home / Daylight" with a coefficient of 0.592 is the variable that has the most positive effect on the equation. In contrast, "Out of Home / Satisfaction-Comf" is the variable that affects the equation most negatively, with a coefficient of -0.571.

Table 4. The regression equation for out-of-home

RW-OH = -0.056 + 0.0 Out of Home / Private Space Usa_0
+ 0.262 Out of Home / Private Space Usa_1 + 0.400 Out of Home / Private Space Usa_2
+ 0.0 Out of Home / Desk-Chair-Comput_0 + 0.027 Out of Home / Desk-Chair-Comput_1
+ 0.075 Out of Home / Desk-Chair-Comput_2 + 0.0 Out of Home / Daylight_0
+ 0.288 Out of Home / Daylight_1 + 0.592 Out of Home / Daylight_2
+ 0.0 Out of Home / Natural Ventilati_0 - 0.550 Out of Home / Natural Ventilati_1
- 0.854 Out of Home / Natural Ventilati_2 + 0.0 Out of Home / Not Being Disturb_0
+ 0.133 Out of Home / Not Being Disturb_1 - 0.320 Out of Home / Not Being Disturb_2
+ 0.0 Out of Home / Sound Level_0 + 0.050 Out of Home / Sound Level_1
+ 0.293 Out of Home / Sound Level_2 + 0.0 Out of Home / Similarity to Off_0
- 0.147 Out of Home / Similarity to Off_1 + 0.204 Out of Home / Similarity to Off_2
+ 0.0 Out of Home / Lighting_0 + 0.082 Out of Home / Lighting_1
- 0.224 Out of Home / Lighting_2 + 0.0 Out of Home / Temperature_0
- 0.046 Out of Home / Temperature_1 + 0.104 Out of Home / Temperature_2
+ 0.0 Out of Home / Services(internet_0 - 0.099 Out of Home / Services(internet_1
- 0.258 Out of Home / Services(internet_2 + 0.0 Out of Home / Eating_0
+ 0.222 Out of Home / Eating_1 + 0.353 Out of Home / Eating_2
+ 0.0 Out of Home / Satisfaction-Gene_-1 + 0.164 Out of Home / Satisfaction-Gene_0
- 0.010 Out of Home / Satisfaction-Gene_1 + 0.0 Out of Home / Satisfaction-Visu_-1
+ 0.238 Out of Home / Satisfaction-Visu_0 + 0.339 Out of Home / Satisfaction-Visu_1
+ 0.0 Out of Home / Satisfaction-Comf_-1 - 0.571 Out of Home / Satisfaction-Comf_0
- 0.415 Out of Home / Satisfaction-Comf_1 + 0.0 Out of Home / Satisfaction-Priv_-1
+ 0.298 Out of Home / Satisfaction-Priv_0 - 0.011 Out of Home / Satisfaction-Priv_1

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0.258967	59.54%	0.00%	0.00%

Figure 8 shows the relationship between "Remote Working Area - Home" and other variables over the correlation (r) values. "Home / Private Space Usage," "Home / Satisfaction-General Conditions," and "Home / Desk-Chair-Computer Sufficiency" were the strongest, respectively, while the weakest were "Home / Eating," "Home / Lighting" and " Home / Temperature." A positive relationship was observed with all variables.

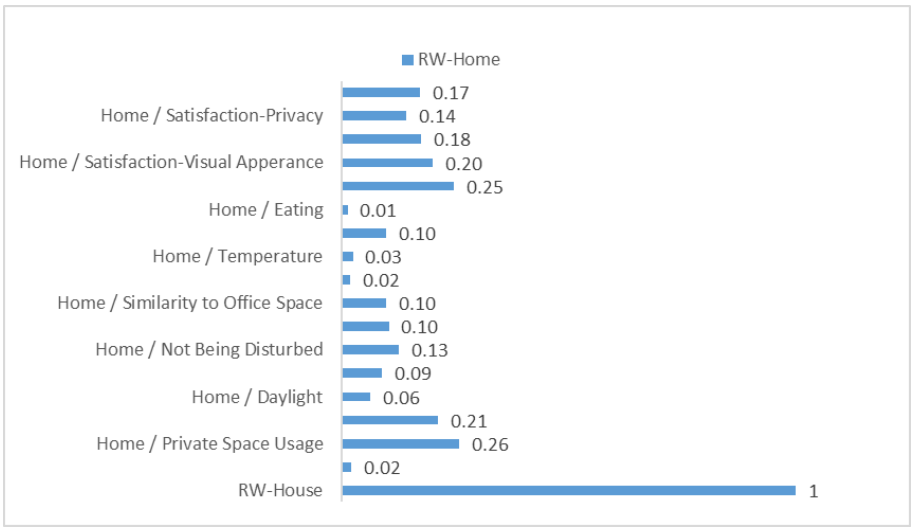

Figure 8. Correlation analysis of remote working for home

Similarly, Figure 9 shows the relationship between "Remote Working Area -Out of House" and other variables over correlation (r) values. While the strongest correlation is "Out of Home / Desk-Chair-Computer Sufficiency, "Out of Home / Satisfaction-General Conditions" and "Out of Home / Satisfaction-Visual Appearance," the weakest and negative relationship is "Out of Home," respectively. / Sound Level" and "Out of Home / Not Being Disturbed" A positive correlation was observed with all variables.

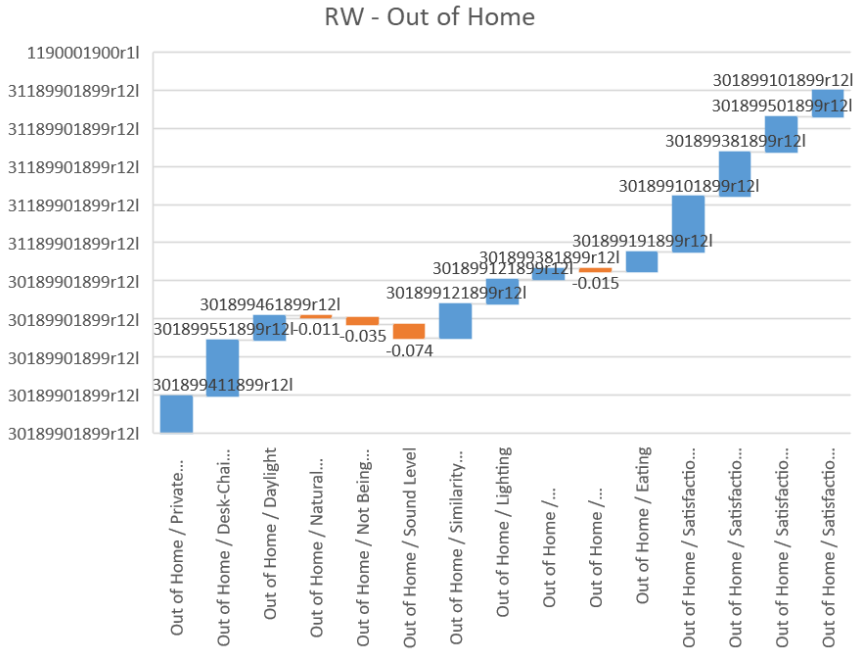

Figure 9. Correlation analysis of remote working for out-of-home

In Figure 10, the level of proficiency is shown with a distribution between 2 and 0, with 2 representing the best level and 0 being the lowest level. While the highest competency in high population and traffic (HPT) was Natural Ventilation, Temperature, and Eating, respectively, the lowest was Satisfaction-Comfort and Flexibility, Satisfaction-Privacy, and Satisfaction-Visual Appearance. While the highest proficiency in mid-population and traffic (MPT) was Temperature, Natural Ventilation, Daylight, and Desk-Chair-Computer Sufficiency, respectively, the lowest proficiency was analyzed as Satisfaction-Visual Appearance, Satisfaction-Privacy, and Satisfaction-Comfort and Flexibility, respectively. The highest proficiency in low population and traffic (LPT) is Desk-Chair-Computer Sufficiency, Daylight, and Sound Level, respectively. In contrast, the lowest proficiency is Satisfaction-Visual Appearance, Satisfaction-Comfort, Flexibility, and Satisfaction-Privacy.

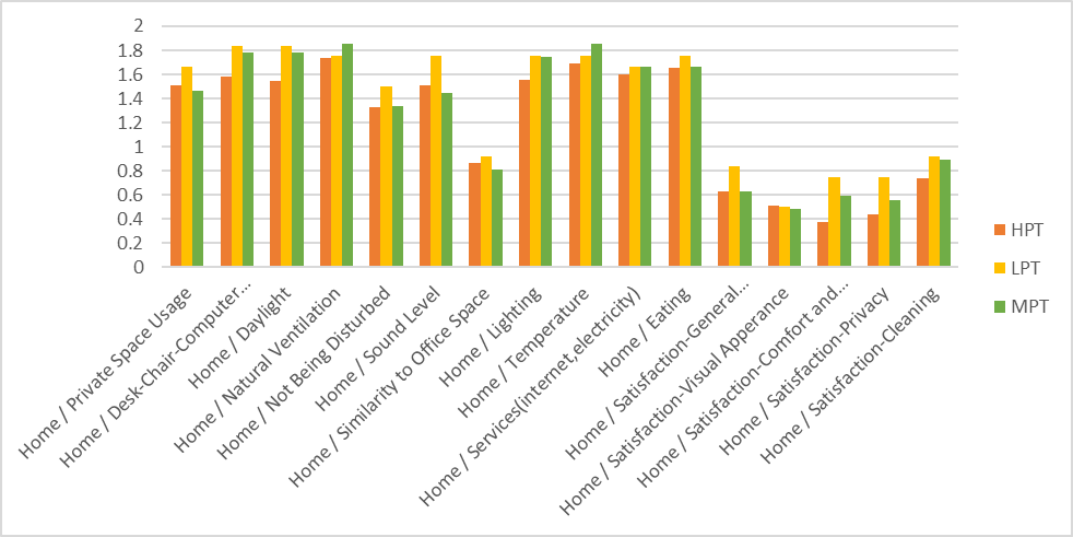

Figure 10. Level of proficiency correlation study regarding High Population and Traffic (HPT), Mid Population and Traffic (MPT), and Low Population and Traffic (LPT)

Correlation coefficients presented in Figure 11 stated that the positive and most robust relationship is between "Prefer Remote Working" and "My work is proper for remote working" with a coefficient of 0.744, "Ability to manage roles" and "Managing common life at home" with a coefficient of 0.668, and "Managing common life outside" and "ability to manage roles" with a coefficient of 0.653, respectively. On the other hand, the negative and most substantial relationship is between "Managing relations in work and personal life" and "Managing common life at home," with a coefficient of 0.201, and between "Need to change remote working space to continue" and "Managing relations in work and personal life" with a coefficient of 0.196, respectively. Thirty-six correlation coefficients were positively correlated, while nine were negatively correlated.

	Managing relations in work and personnal life	Managing common life at home	Managing common life outside home working space	Ability to manage roles	Have a life near to ideal	Pleased of working life	My work is proper for remote working	Prefer Remote Working	Need to change remote working space to continue	Comfort level in remote working
Managing relations in work and personnal life		0.5836	0.4891	0.5570	0.4716	0.4135	0.4184	0.3681	-0.1959	0.4071
Managing common life at home	0.5836		0.5151	0.6683	0.3999	0.3550	0.2430	0.3119	-0.2006	0.4160
Managing common life outside home working space	0.4891	0.5151		0.6532	0.3156	0.4059	0.2450	0.2600	-0.0965	0.2296
Ability to manage roles	0.5570	0.6683	0.6532		0.4671	0.4770	0.3474	0.3627	-0.1004	0.3394
Have a life near to ideal	0.4716	0.3999	0.3156	0.4671		0.6181	0.4645	0.4993	-0.1074	0.3714
Pleased of working life	0.4135	0.3550	0.4059	0.4770	0.6181		0.5382	0.4659	-0.0632	0.4117
My work is proper for remote working	0.4184	0.2430	0.2450	0.3474	0.4645	0.5382		0.7440	-0.0413	0.5349
Prefer Remote Working	0.3681	0.3119	0.2600	0.3627	0.4993	0.4659	0.7440		-0.0971	0.5867
Need to change remote working space to continue	-0.1959	-0.2006	-0.0965	-0.1004	-0.1074	-0.0632	-0.0413	-0.0971		-0.1627
Comfort level in remote working	0.4071	0.4160	0.2296	0.3394	0.3714	0.4117	0.5349	0.5867	-0.1627	

Figure 11. Correlation analysis for working from home

Similarly, the correlation coefficients study presented in Figure 12 demonstrated that the positive and strongest correlations were between "Increase in Productivity" and "Increase in Productivity of Company" with a coefficient of 0.822, between "Contribute working performance" and "Increase in Productivity" with a coefficient of 0.678, and between "Increase in Productivity of Company" and "Contribute working performance" with a coefficient of 0.63, respectively. On the other hand, the negative and most vital relationship was found between "The needed working space cannot be ensured in remote working space" and "Contribute working performance" with a coefficient of 0.517, and between "Need to change remote working space to continue" and "Increase in Productivity" with a coefficient of 0.488, respectively. Twenty-six correlation coefficients were positively correlated, while 19 were negatively correlated.

	Increase in Productivity	Increase in Productivity of Company	Increase in personnal comfort	Contributte working performance	Situation of remote working space decreased productivity	All working actions are proper for remote working	The needed working space can not be ensured in remote	For stable and beneficial remote working, the space of house	For stable and beneficial remote working, the space out of	Conditions of working space is important for comfort and
Increase in Productivity		0.8221	0.4885	0.6784	-0.3668	0.5694	-0.4875	-0.0056	-0.1585	0.1530
Increase in Productivity of Company	0.8221		0.4221	0.6302	-0.3638	0.5093	-0.3772	0.0320	-0.1112	0.1426
Increase in personnal comfort	0.4885	0.4221		0.5639	-0.2404	0.3631	-0.3971	0.2020	-0.0115	0.0802
Contributte working performance	0.6784	0.6302	0.5639		-0.4363	0.5637	-0.5166	0.0805	-0.0852	0.1533
Situation of remote working space decreased productivity	-0.3668	-0.3638	-0.2404	-0.4363		-0.3136	0.3521	0.0410	0.1945	-0.1926
All working actions are proper for remote working	0.5694	0.5093	0.3631	0.5637	-0.3136		-0.3967	0.0381	-0.0664	0.1761
The needed working space can not be ensured in remote working space	-0.4875	-0.3772	-0.3971	-0.5166	0.3521	-0.3967		-0.0396	0.1109	-0.2355
For stable and beneficial remote working, the space of house should be arranged	-0.0056	0.0320	0.2020	0.0805	0.0410	0.0381	-0.0396		0.4256	0.1947
For stable and beneficial remote working, the space out of the house should be arranged	-0.1585	-0.1112	-0.0115	-0.0852	0.1945	-0.0664	0.1109	0.4256		0.1480
Conditions of working space is important for comfort and productivity	0.1530	0.1426	0.0802	0.1533	-0.1926	0.1761	-0.2355	0.1947	0.1480	

Figure 12. Correlation analysis for out-of-home

4. Conclusion and Suggestions

The impact of remote and distributed working practices during the Türkiye pandemic on participants' working-from-home experiences was investigated in this study by surveying 126 participants. The findings of the research were studied by correlation analysis to statistically present the relations between survey parameters. It has been revealed for correlation analysis at working from home that a positive and most robust relationship exists between the couples of "Prefer Remote Working – My work is proper for remote working," "Ability to manage roles – Managing common life at home" and "Managing common life outside – Ability to manage roles." In contrast, the negative and most robust relation existed between the couples "Managing relations in work and personal life," – " Managing common life at home," "Need to change remote working space to continue," – and "Managing relations in work and personal life." Similarly, a correlation analysis study for out-of-home revealed that there is a strong and positive relation between the couples of "Increase in Productivity" and "Increase in Productivity of Company" and "Increase in Productivity of Company" and "Contribute to working performance." At the same time, there is a negative but strong relation between the couples of the needed working space cannot be ensured in remote working space" and "Contribute working performance" and "Need to change remote working space to continue" and "Increase in Productivity."

Regarding the correlation analysis study for working from home, it has resulted in the following:

- The workers prefer remote working because their work is proper for remote working, and they can manage work and life roles at home.
- On the other hand, workers who do not have good remote work at home need to change remote workplace at home to continue and thus manage relations in work and personal life.
- The above two findings are paralleled by the literate statement that “the home is not suitable for being an alternative to the office workplace.”

Regarding the correlation analysis study for out of home, it has been unveiled that:

- Remote working increases productivity and the working performance of remote workers and the company.
- On the other hand, not having proper remote working space at home decreases working performance. Furthermore, remote working space needs to be changed to increase the productivity of the company and workers.
- The above two findings are correlated with the literate statement that “remote work is working, so why do we need a physical space?”.

The findings of working from home in Türkiye represented that the success of the WFH strictly depends on having a proper workplace environment in the workers' home. Although the literature discussions in Table 1 covered four titles, two seem valid for Türkiye practices. When remote workers have a proper workplace at their home, working from home could be accepted as an alternative to office workplaces and increase the workers' productivity. On the other hand, when there is no proper workplace at home, working from home cannot be an alternative to office workplaces. The valid arguments in Turkiye draw a layout for the remote workers' workplace conditions that Turkish remote workers are happy to work remotely when they have a proper home working environment.

Considering the literature findings in Table 2, the remote working practices in Turkiye are paralleled to the findings of Parker et al. (2020) that a significant portion of the workers prefers working from home, and Houweling et al. (2022) that inadequate living space decreases the wellbeing of the workers at home.

Regarding the quality of the built environment in Türkiye for occupancy comfort and well-being is low by many scholars; the increase in the remote workers' productivity addresses two possibilities. Either the workers are not satisfied with the office workplaces or the quality of the living environment at home is better than office workplaces for the workers. However, these possibilities require further investigation. The research study could be expanded to investigate the validity of these possibilities.

The study results are expected to be informative for the researchers considering Türkiye's business practices and work performance during the pandemic lockdown. Remote workers' workplace environment needs can be improved to increase the productivity and performance of remote working. The findings of the research present inputs for the improvement studies and state the spatial features' impact on the productivity, performance, and well-being of workers.

Acknowledgments and Information Note

The article complies with national and international research and publication ethics. Ethics Committee approval in the study was taken from the Ethics Committee of the University of Ankara Yıldırım Beyazıt with the decision no 2022-05.

Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to the article. There is no conflict of interest.

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Examination of Interventions and Defects on Façades: The Case of Selamsız Low-Cost Mass Housing in Istanbul, Türkiye

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Abstract

Conservation of 20th century mass housing is discussed considering their heritage value. On the other hand, intervention might be required since they do not meet the today's requirements and defect might have occurred. In that case, primary objective should be the managing of changes to sustain existing building stock. Within the study, the current situation of one of the modern period mass housing projects in Istanbul/Türkiye Selamsız Low-Cost Mass Housing was documented for interventions and defects on the front façade. Besides, determining the frequency of intervention and defects, examining relations between them and external factors, and identifying reasons for the interventions were also aimed. Data collected about 108 existing buildings and photographic research was made through literature review/archive search/site visits. Collected data were evaluated with a systematic order. As a result, almost half of the defects are caused by interventions on building/element/component scale to fulfil spatial and performance requirements.

Keywords: *Mass housing, façade, intervention, defect, building element/component.*

Cephelerde Müdahale ve Hasarların İncelenmesi: Selamsız Ucuz Evler Örneği İstanbul, Türkiye

Öz

20. yüzyılda inşa edilen toplu konutların miras değerleri; sosyal, ekonomik ve teknolojik sebepler nedeniyle tartışılmaktadır. Diğer taraftan; günümüz mekânsal, performans ve teknolojik gereksinimlerini sağlayamamaları ve süreç içerisinde çeşitli hasarların meydana gelmesi sebebiyle bu yapılara müdahale etmek gerekebilir. Mevcut yapı stokunu ve bunların miras değerini sürdürmek için yapılacak müdahaleyi planlamak temel amaç olmalıdır. Bu doğrultuda çalışma kapsamında; İstanbul/Türkiye'deki 20. yüzyıl toplu konutlarından biri olan Selamsız Ucuz Evlerinin ön cephelerinde yer alan müdahaleler ve hasarların incelenmesi amaçlanmıştır. Bunun yanında; müdahaleler ve hasarların sıklığı ile bunların dış etmenlerle (cephe yönelimi, daire/kat sayısı, yol seviyesine göre konum) arasındaki ilişkinin tespit edilmesi hedeflenmiştir. Mevcut 108 yapı, alan gezileri sırasında fotoğraflanarak belgelenmiş, yapılara ait bilgiler literatür ve arşiv taramaları doğrultusunda derlenmiştir. Müdahale ve hasarlar ile ilgili elde edilen veriler yapı, eleman ve bileşen ölçeğinde, hiyerarşik bir düzen içerisinde incelenmiştir. Sonuç olarak; hasarların neredeyse yarısının mekân/performans gereksinimlerini iyileştirmek için bina/eleman/bileşen ölçeğinde uygulanan müdahaleler kaynaklı olduğu tespit edilmiştir.

Anahtar kelimeler: *Toplu konut, cephe, müdahale, yapı elemanı/bileşeni.*

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1. Introduction

In the 18th century, in England, the developments in the production process, which is called the Industrial Revolution caused changes in construction technology, and social, cultural, and economic fields (Albrecht, 2012). On the contrary to the developments, increasing immigration to the industrial city centres caused insufficient working and living conditions with lack of health care, education, and social and infrastructural services (Albrecht, 2012; Henket, 1998). In the 20th century, the housing problem had increased exponentially with the post-war demolition (Henket, 1998; ICOMOS, 2017; MacDonald, Burke, Lardinois, & McCoy, 2018). For this problem, a solution was found in line with the reason i.e., Industrial Revolution. Through construction and production techniques brought by the developing technology and material's potential, mass housing was built by considering health conditions, mass production, affordability, function, and simplicity (Henket, 1998; ICOMOS, 2017; MacDonald et al., 2018; Tostões, 2018; Vos & Storgaard, 2018).

Housing problem started to emerge within the current borders of Türkiye due to population exchanges in the last periods of the Ottoman Empire and the first years of the Republican Period. At the beginning of the 1930's, this problem has been tried to be solved with the workers' houses within the factory premises established with government support, however, these attempts were interrupted because of Great Depression and World War II (Sey, 2007). Although Türkiye remained out of the war and did not suffer any destruction, it was still affected (Hasol, 2017; Sey, 2007; Tapan, 2007; Tekeli, 2007). At the end of the 1940's, the political changes and mechanization in agriculture accelerated the migration to the cities such as Ankara, Istanbul, Izmir, etc. from the rural areas (Hasol, 2017). The population of the cities, which increased by 3% per year in the 1920's, started to increase by 9% after the 1950's (Cem, 2021). As a result of this rapid and uncontrolled urbanization, the existing housing stock became insufficient and squatter zones almost have become to contain 40-50% of the urban population (Tapan, 2007). In the architectural magazines of the period, e.g., in Arkitekt, the housing problem was discussed especially for Istanbul and the reason of the housing problem was attributed to the lack of cooperatives similar to those that provide rapid housing production in Europe, the cost of construction materials, the lack of production of building materials, and the rapidly increasing number of squatter houses (Kessler, 1949; Sayar, 1946). To solve the housing problem, Emlak Kredi Bankası (Emlak Kredi Bank) was established in 1946, Bina Yapım Teşvik Kanunu (Building Construction Incentive Law) and İmar Kanunu (Building Law) were published in 1948 and 1956, respectively. Apart from these, Ucuz Evler Yarışması (Low-Cost Houses Competition) was organized by Istanbul Municipality and İstanbul Belediyesi Tarafından Taksitle Satılacak Ucuz Evler Yönetmeliği (Regulation on Low-Cost Houses to be Sold by Istanbul Municipality in Instalments) was published in 1950. The scope of these attempts was facilitating the loans to be used for house construction, land, and materials, and specifying minimum dimensions and requirements for the houses (Bina Yapım Teşvik Kanunu, 1948; İmar Kanunu, 1956; Istanbul Belediyesi Tarafından Taksitle Satılacak Ucuz Evler Yönetmeliği, 1950; Özdoğan, Feridun; Balkan, Aydemir & Arpat, 1950).

Conservation of these buildings constructed in the 20th century started to be discussed in the world in the early 1990's, and in Türkiye in the 2000's (Polat & Can, 2008) since they are the evidence of that period's historical, social, economic, and scientific characteristics, and construction technology even if they are not monumental (Henket, 1998; ICOMOS, 2017; Macdonald, 1996; Vos & Storgaard, 2018). However, modern period mass housing was designed solution with specifically to its function, its materials and technology are not long-lasting, and there are lack of spatial and technological performances expected today; thus, interventions are made to upgrade their performance or to reuse with a different function, and even might be demolished (de Jonge, 2017; Henket, 1998; Macdonald, 1996; Vos & Storgaard, 2018). In other words, interventions might be required and inevitable to sustain modern period building stock. This situation is taken into consideration in the New Delhi Document as managing changes in Articles 5, 6, 7, and 9, and it is highlighted that in the case where intervention is necessary, it must be considered within the integrity and authenticity of the building (ICOMOS, 2017). In short, it is important to understand and document modern period building stock as soon as possible, to manage the conservation process considering the cultural significance of their original design, and also later additions (Henket, 1998; ICOMOS, 2017; Vos & Storgaard, 2018).

To plan a proper conservation process, it is important to understand the current situation of the building, user needs, and requirements and restrictions defined by law, regulation, and conservation board. Within the scope of the study, it is aimed to document the current situation of one of the modern period mass housing projects constructed with the initiative of the Municipality in 1950's in Istanbul, Türkiye. Selamsız Low-Cost Mass Housing in Uskudar, which is a district in Istanbul, is one of the great examples of its period with its construction techniques, materials, plan types, façades, etc., and also, it has particular importance since most of the buildings still preserve their original function. In that context, the main objective of the study is documenting the interventions and defects of that mass housing. Documentation is made over the façade, where interventions and defects are seen more since it is part of the envelope that separates the external and internal environments. Besides the main objective, there are some additional objectives intended to be achieved as a result of the examination of the documented data, and these are:

- Determining the frequency of interventions and defects
- Identifying reasons for interventions and thus assessing user needs
- Determining the relations between interventions, defects, and external factors such as direction, number of living units, height according to road level, etc.

In the following sections, a brief literature review is presented. The analysis method, which was developed in line with the literature research, is explained with the information about Selamsız Low-Cost Mass Housing. Afterward, with the proposed methodology, the interventions, and defects on the front façade of the buildings were presented and analysed in a systematic order. Results of the analysis are then presented to understand the additional objectives mentioned above. Finally, the results are discussed in line with the literature review.

2. Literature Review

In BS EN 15978 (2011), the building lifecycle is divided into four phases as (i) the product (row material supply, transport, and manufacturing), (ii) construction process (transport and construction-installation process), (iii) use (use, maintenance, repair, replacement, and refurbishment), and (iv) end of life (de-construction, transport, waste processing, and disposal). Douglas (2006), on the other hand, added maintenance/adaptation, irreversible building obsolescence, and building fully obsolescence phases between usage and demolition phases. As mentioned in Section 1, interventions might be made to modern period buildings to upgrade and extend their service life, and these are divided into two as maintenance and adaptation by Douglas (2006). While the maintenance interventions are made to protect the building in its current situation, to prevent and/or repair simple defects; adaptation means either to improve the building with its current function or to reuse it with a different function (Douglas, 2006). In line with the objective of the study, literature related to defects and their repair methods, interventions made on different scales, and documentation/analysis of the defects/interventions on mass housing is reviewed.

There are studies on the defects that are either generally observed in the buildings (Abbott, McDuling, Parsons, & Schoeman, 2007; Faqih, Zayed, & Soliman, 2020; Guo, Wang, & Li, 2021; Macarulla et al., 2013; Richardson, 2002) or specifically on the façade (Amaro, Saraiva, de Brito, & Flores-Colen, 2013; Çelik, Ergin, Dal, & Ay, 2023; Ertemir & Edis, 2022; Pereira, Silva, Brito, & Silvestre, 2020), and some of them consider heritage value too. Amaro et al. (2013) and Pereira et al. (2020) offer methods for inspection and diagnosis of defects on the wall covered with thermal insulation composite system and rendered façade, respectively. On the other hand, Ertemir & Edis (2022) develops an inspection approach, especially for the rendered-painted façade defects in modern period mass housing.

Defects and repair of the façade are discussed together in some of the research. Sá et al. (2015) work on inspection, diagnosis, and repair techniques (e.g., full/partial replacement, cleaning, application of new finishing, etc.) of rendered wall. Madureira et al. (2017) examine defects and repair techniques similarly and offer repair techniques according to the priority level of defects. Apart from these, Okumuş (2020) and Okumuş & Eren (2020) focuses on one part of the façade i.e., windows, and

develops inspection, diagnosis, and repair methods considering components of the window (frame and infill i.e., glass, insulation, and complementary parts).

Some of the studies examined interventions made to improve and reuse buildings (Çakır & Edis, 2022; Douglas, 2006; Engin, 2009). Douglas (2006) classifies interventions for the maintenance/adaptation of the building as extensions (i.e., vertical/horizontal additions), structural alterations (e.g., changes in façade opening, form of the roof, etc.), and refurbishment (e.g., spatial arrangement, change/addition of finishing/insulation layer, etc.). In other words, while the extensions affect the mass, structural alterations, and refurbishments are related to elements, and parts of the elements respectively. Engin (2009) and Çakır & Edis (2022) develop an approach to examine existing reused industrial facilities, and they both evaluate interventions in element scale as additions and removals considering the original situation. Besides, Yaman & Arpacıoğlu (2021), attract attentions on adaptive façade system which enhance performance parameters. Considering existing building, this technology can be implanted on the existing building façade, too.

There are studies that examine the current situation of mass housing considering its heritage value. Öztürk (2020) examines the Selamsız Low-Cost Mass Housing's current situation and its authenticity according to the alterations on the façade, mostly from a conservation perspective. Similarly, Erdal et al. (2020) study another mass housing project i.e., Koşuyolu Neighbourhood, and discuss the buildings' current situation under layout and architectural character. Havinga et al. (2020a, 2020b) aim to manage changes during refurbishment considering heritage value under four scale levels; area, ensembles, building, and building element. Besides, Koman (2021), examines innovation in building technology during modernism period in the context of Walter Gropious's works and also mentions on "housing industry".

In short, although the interventions are briefly mentioned in the studies examining the current situation of modern period housing, the damages and interventions seen in the buildings have not been examined in detail.

3. Methodology

The study to document the current situation of the modern period mass housing's interventions and defects on the front façades, and to examine the frequency of interventions/defects, their relations to each other and with external factors through an example of 131 buildings of Selamsız Low-Cost Mass Housing, consists of three phases. These are (i) data collection, (ii) analysis of interventions and defects on the front façade, and (iii) comparative evaluations of findings.

3.1. Data Collection

In the first phase, information about Selamsız Low-Cost Mass Housing was collected from the literature, the archive of Üsküdar Belediyesi İmar ve Şehircilik Müdürlüğü (Uskudar Municipality Directorate of Construction and Urban Planning), and the photographic record made through site visits in November 2021. Although the original project could not be obtained directly, the renovation projects of some of the buildings with small additions were attained, and their original situations were determined through them.

The construction process of 131 buildings was started in 1950 and completed in three stages as shown in Table 1 (Öztürk, 2020). All of the buildings were constructed with almost similar construction techniques and materials, such as rendered brick masonry walls, strip foundations, gable roofs, timber windows and doors (Uskudar Municipality Directorate of Construction and Urban Planning Archive, n.d.). On the contrary, there are differences in typologies in terms of the number of stories/dwellings (single/multi-family house), façade organization (e.g., with/without balcony), and position to the road level (at the same level as the road, below or above the road). To facilitate and systematize the study, the codes are given to the buildings (B) according to their stages (S) and typologies (T) (e.g., S1_T1_B01 to refer to stage 1, type 1, building 1).

Table 1. General information about buildings according to construction stage

General Information	**Examples (close to original version)** (Çakır, 2021)
Construction Stage: 1st stage **Construction Year:** 1950-1952 **Contractor Institution:** Istanbul Municipality **Number of Building:** 50 T1 – 24 T2 – 26	 a) **T1** – Two-story/single-family house, at road level, without balcony (S1_T1_B01-B24) b) **T2** – Two-story/single-family house, at road level, with balcony, entrance door located inside of the façade (S1_T2_B25-B50)
Construction Stage: 2nd stage **Construction Year:** 1957-1959 **Contractor Institution:** Electricity, Gas, and Motor Vehicle Workers Union Construction Cooperative **Number of Building:** 25 T3 – 7 T4 – 5 T5 – 13	 a) **T3** – Two-story/multi-family house, below the road (S2_T3_B01-B07) b) **T4** – Two-story/multi-family house, at road level (S2_T4_B08-B12) c) **T5** – One-story/single-family house, at road level (S2_T5_B13-B25)
Construction Stage: 3rd stage **Construction Year:** 1958-1962 **Contractor Institution:** Istanbul Union of Workers Construction Cooperative **Number of Building:** 56 T4 – 2 T6 – 36 T3 – 18	 a) **T4** – Two-story/multi-family house, at road level (S3_T4_B1, S3_T4_B6) b) **T6** – Two-story/multi-family house, above the road (S3_T6_B2-B5, S3_T6_B7-B20, S3_T6_B30-B47) c) **T3** – Two-story/multi-family house, below the road (S3_T3_B21-B29, S3_T3_B48-56)

Although the example buildings are close to original version, various interventions and defects were observed while the photographs were taken during site visit. Prefix S, T, and B refers to stage, type and building respectively. Building codes are shown in the Figure 1.

In the current situation given in Figure 1, which was detected on the site visit, 23 of 131 buildings (18%) were destroyed. Among the existing ones, 93/108 are used for residential purposes, 11/108 are used for commercial purposes, while the rest of them (4/108) are neither used nor there is clear information about them. It has been determined that buildings that are adapted to different functions such as cafe, kindergarten, dentist, pharmacies, etc., are generally located on Gazi Main Street and Yeniocak Street, which form the boundary of the region.

The building located on the left side of the S3_T6_B30 (Figure 1), is not seen on the satellite image of 1966, which is the first image of the in which examined mass housing is appeared (Istanbul Metropolitan Municipality, n.d.), and is located in the same parcel with the S3_T6_B30 on the plan (General Directory of Land Registry and Cadastre, n.d.). For all these reasons, it is not included in the scope of the study.

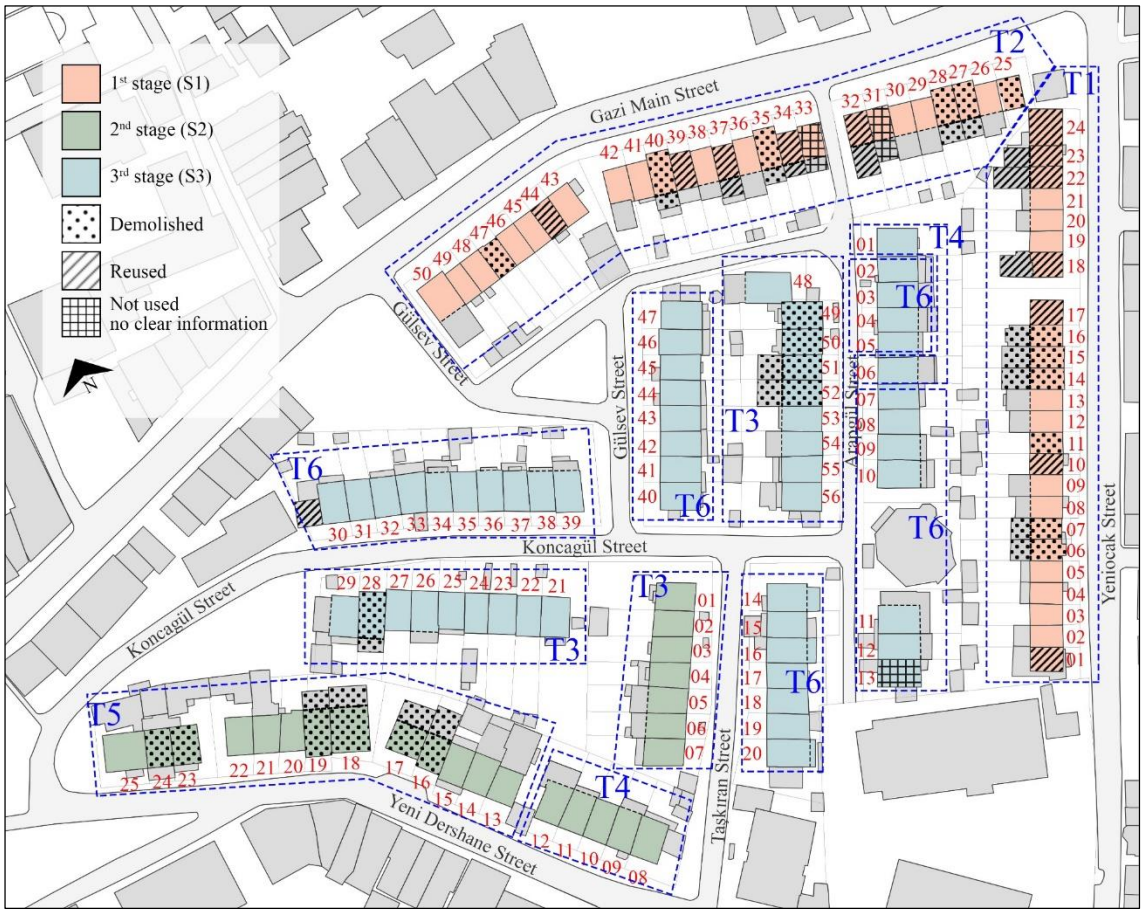

Figure 1. Layout plan (According to site visit in 2021. The original parts of the buildings are coloured, additions to them are given in grey colour - Adapted from plan taken from Uskudar Municipality Directorate of Construction and Urban Planning Archive)

3.2. Analysis of Interventions and Defects

In the second phase of the study, an analysis method has been developed to document the interventions and defects seen on the front façades of the buildings. First of all, the buildings are considered as a system and evaluated in hierarchical order as a subsystem, element, and component (Çakır & Edis, 2022; Douglas, 2006; Havinga et al., 2020a, 2020b). The subsystem and elements are divided into four groups as; (i) the structural system (masonry structural wall, skeletal structural member, foundation, and floor), (ii) envelope (non-structural external wall, wall opening, and roof), (iii) spatial dividers (non-structural internal wall, circulation element), and (iv) mechanical system (ISO 19208:2016; Rush, 1986). The functional components of these elements are accepted to be the core (structural component), protective layer, finishing layer, and complementary component(s).

Considering this hierarchy and literature review, documentation and analysis of the interventions and defects on the front façades of 108 buildings of the Selamsız Low-Cost Mass Housing that still exist today, consist of two stages, which are the analysis of the (i) interventions, and (ii) defects.

3.2.1. Analysis of the interventions

Analysis of the interventions is made in three hierarchical levels as building, element, and component benefiting from the literature review (Çakır & Edis, 2022; Douglas, 2006; Engin, 2009; Havinga et al., 2020a; Öztürk, 2020) given in Section 2.

The first level contains interventions at building scale that affect the whole building which are made to improve or reuse it and are divided according to the type of the area that is created additionally (i.e., open, and close), and the direction of the intervention (i.e., vertical, and horizontal). In the second level, interventions on the external wall and wall openings (i.e., window/door) which are the elements of the façade subsystem made to repair/refurbish/reuse of building are examined. Besides, rare

interventions related to other building elements such as the addition of vertical skeletal element, fire escape stair, changes/removal of the roof, etc. are also considered because they affect the façade visually. In short, in the study, interventions in the external masonry wall, window/door, and other elements (i.e., skeletal structural member, circulation element, and roof) are examined. The last level contains interventions at component scale which are related to the functional parts of the elements such as finishing or protective layer. Through these examinations, intervention types identified during site visit, element/component that was intervened, and their codes are given in Table 2.

Table 2. Intervention types at the scale of building/element/component

	Intervention Type	Element that is intervened	Component that is intervened	Code
Interventions at Building Scale (BS)	Interventions to create additional open spaces			
	Addition of entrance canopy			**BS1**
	Addition of pergola (connected with the building)			**BS2**
	Changes in the form of the entrance terrace (lengthening, widening, reorientation)			**BS3**
	Interventions to create additional closed spaces			
	In horizontal direction – Expansion of the floor spaces (in single floor/through the whole building)			**BS4**
	In vertical direction – Addition of floor			**BS5**
Interventions at Element Scale (ES)	**Intervention Type**	**Element that is intervened**		**Code**
	Changes in the size/form of the window/door	Masonry wall – window/door		**ES1**
	Changes in the number of window/door (opening a new one or closing the existing one)	Masonry wall – window/door		**ES2**
	Addition of circulation element (e.g., fire escape stair)	Other elements		**ES3**
	Addition of skeletal structural member (e.g., column to support additional floor)	Other elements		**ES4**
	Intervention to the roof (changes of the form or removal of partially/fully)	Other elements		**ES5**
Interventions at Component Scale (CS)	**Intervention Type**	**Element that is intervened**	**Component that is intervened**	**Code**
	Addition of external thermal insulation	Masonry wall	Protective layer	**CS1**
	Changes in finishing layer (throughout the façade, socle region or skirting level)	Masonry wall	Finishing layer	**CS2**
	Addition of decorative elements to the façade	Masonry wall	Complementary	**CS3**
	Material changes in the window/door frame	Window/door	Core	**CS4**
	Intervention to the sill (Material change or addition of new one)	Window/door	Complementary	**CS5**
	Addition of protective elements in front of the windows (window security bars, shutter)	Window/door	Complementary	**CS6**

3.2.2. Analysis of the defects

The second stage of the methodology is the analysis of the defects seen on the masonry wall and window/door benefiting from the literature given in Section 2 (Amaro et al., 2013; Ertemir & Edis, 2022; Pereira et al., 2020). The defects observed through site visits, the elements that are damaged, the zone of the defects, and their codes are given in Table 3. During site visits, since inspections were visual, the exact components with the defect could not be determined especially for the masonry wall, and all of them were accepted to be on the finishing layer. Although this acceptance has been made, it has also been observed that the defects were concentrated in certain zones. For this reason, contrary to the interventions, in the examination of the defects, it was preferred to give the region instead of the component in which the defect was seen. A masonry wall is divided into parts as the surrounding of the window/door, socle region, additional/adjacent building-related surface, and plumbing-related surface, and entire wall surface except aforementioned parts, while the window/door is classified as frame, infill (i.e., glass), sill, and window security bar. Regarding the window/door, the grouping components and zones are parallel to each other. For instance, frame/glass can be considered as core, and sill/security bar can be taken as a complementary component.

Table 3. Defects on masonry wall and window/door

Type of Defect	Element that is observed	Zone of defect	Code
Biological formation	Masonry wall	Surrounding of the window/door, Socle region, Additional/adjacent building-related surface	**DE1**
Efflorescence	Masonry wall	Surrounding of the window/door, Socle region, Additional/adjacent building-related surface	**DE2**
Corrosion	Window/door	Window security bar	**DE3**
Cracks	Masonry wall	Entire wall surface, Surrounding of the window/door, Socle region, Additional/adjacent building-related surface, Plumbing-related surface	**DE4**
Bubbling-spalling	Masonry wall	Entire wall surface, Surrounding of the window/door, Socle region, Additional/adjacent building-related surface, Plumbing-related surface	**DE5**
	Window/door	Window/door frame, Sill	
Discoloration/colour changes	Masonry wall	Entire wall surface, Socle region, Additional/adjacent building-related surface, Plumbing-related surface	**DE6**
	Window/door	Window/door frame, Sill	
Surface irregularities (roughness, point holes)	Masonry wall	Entire wall surface, Surrounding of the window/door, Socle region, Additional/adjacent building-related surface, Plumbing-related surface	**DE7**
Material loss	Window/door	Window/door frame, Window infill (i.e., glass)	**DE8**

3.3. Comparative Evaluations of Findings

General information (current situation, function, direction), interventions (at the scale of the building/element/component with the codes and where they are observed), and defects (types, element/component location that are observed, codes) on 108 buildings are listed together in a spreadsheet computer program at the end of phase 1 and 2. In the last phase of the study the collected data are evaluated. First, the incidence of the data obtained from each stage of the analyses is taken separately. Considering the frequency of the interventions observed in each building type, it is aimed to identify reasons for interventions and in turn, to determine user needs related to spatial and thermal performance, and against water leakage. Then, the reason and frequency of the defects are examined to find their relation to interventions. On the contrary of interventions analysis, in the evaluation of the defects, building types are neglected, since no significant difference was observed for the building types. Finally, the relation of the intervention and defects with the other factors is discussed.

4. Results and Discussion

As a result of the analyses, the number and frequency of interventions and defects detected on the front façades of 108 buildings of the Selamsız Low-Cost Mass Housing are evaluated separately for each building type.

4.1. Evaluation of the Interventions

The interventions implemented to the buildings at the scale of building/element/component are given in Table 4 for each building type. Regarding incidences, CS – Interventions at Component Scale are found to be the most common intervention and seen in all of the buildings (108/108), followed by BS – Interventions at Building Scale (79/108), and ES – Interventions at Element Scale (35/108), respectively. CS could be completed without requiring relatively much change and budget such as changes of the finishing layer of the façade, changes of window frames, sill, etc. On the other hand, the preference of this intervention, which is related to performance requirements such as thermal insulation, waterproofing, etc., can be interpreted as the buildings do not provide the required performance level of the housing function. BS were generally implemented to customize the entrance areas of the building that are directly related with the exterior. Similarly, it is observed that the ES applied for the spatial requirements, were preferred less since it required changes in both external masonry wall and window/door. In addition, since external masonry walls are load-bearing elements at the same time, the intervention possibilities are limited.

Table 4. Total number and frequency of intervention types at the scales of building/element/component

Int. Scale	Int. Type	Building Type and Number						Total[1]	Total[2]
		T1	T2	T3	T4	T5	T6		
		18	20	20	7	7	36	108	108
Interventions at Building Scale (BS)	**BS1**	7 – 38.89%	7 – 35.00%	11 – 55.00%	2 – 28.57%	2 – 28.57%	24 – 66.67%	**53 – 49.07%**	**79**
	BS2	1 – 5.56%	–	–	1 – 14.29%	–	1 – 2.78%	**3 – 2.78%**	
	BS3	–	–	–	–	–	6 – 16.67%	**6 – 5.56%**	
	BS4	10 – 55.56%	15 – 75.00%	2 – 10.00%	–	4 – 57.14%	3 – 8.33%	**34 – 31.48%**	
	BS5	–	5 – 25.00%	4 – 20.00%	–	–	13 – 36.11%	**22 – 20.37%**	
Interventions at Element Scale (ES)	**ES1**	11 – 61.11%	9 – 45.00%	2 – 10.00%	–	-	–	**22 – 20.37%**	**38**
	ES2	3 – 16.67%	15 – 75.00%	–	–	1 – 14.29%	1 – 2.78%	**20 – 18.52%**	
	ES3	1 – 5.56%	–	–	–	–	–	**1 – 0.93%**	
	ES4	–	–	–	–	–	1 – 2.78%	**1 – 0.93%**	
	ES5	–	2 - 10.00%	1 - 5.00%	–	–	–	**6 – 5.56%**	
Interventions at Component Scale (CS)	**CS1**	5 – 27.78%	10 – 50.00%	5 – 25.00%	–	–	11 – 30.56%	**31 – 28.70%**	**108**
	CS2	7 – 38.89%	11 – 55.00%	6 – 30.00%	2 – 28.57%	2 – 22.22%	11 – 30.56%	**39 – 36.11%**	
	CS3	4 – 22.22%	10 – 50.00%	5 – 25.00%	–	–	12 – 33.33%	**31 – 28.70%**	
	CS4	17 – 94.44%	18 – 90.00%	20 – 100.00%	7 – 100.00%	7 – 100.00%	36 – 100.00%	**105 – 97.22%**	
	CS5	13 – 72.22%	17 – 85.00%	19 – 95.00%	6 – 85.71%	5 – 71.43%	36 – 100.00%	**96 – 88.89%**	
	CS6	16 – 88.89%	18 – 90.00%	18 – 90.00%	7 – 100.00%	5 – 71.43%	28 – 77.78%	**92 – 85.19%**	

Int.: Intervention. Building types are given in Table 1. Intervention codes are given in Table 2.
Intervention percentages are calculated per building type in the building type and number columns.
Total [1]: Total number and percentage of the interventions of 108 building for each intervention type.
Total [2]: Total numbers of interventions for each intervention scale.

In the following paragraphs, findings of each intervention scale are discussed and exemplified separately:

- BS – Interventions at Building Scale: Among 79 building that intervened at building scale, in 29/79 buildings, intervention types to create only open spaces (BS1, BS2, BS3), in 23/79, interventions to form closed additional spaces (BS4, BS5), and in 27/79 buildings both were preferred. The most common intervention type is BS1 – Addition of entrance canopy (53/108) and was generally preferred to create a covered area in front of the entrance door, regardless of building type (Figure 2-a). The second line is BS4 – Expansion of the floor spaces (in single floor/through the whole building) horizontally (34/108) and specifically implemented in T2 to include the empty spaces in front of the entrance door to the interior space as an entrance hall (Figure 2-b). In addition, there are examples where the floor area is expanded only on the ground floor or throughout the building side façade, especially in the buildings located at the corner. However, the expansions made on a single floor (32/34) were observed to be preferred more than the expansions made through the whole building (2/34). BS5 – Addition of floor in vertical direction (22/108) is the third in line, and generally was applied in T6, since this type of building is multi-family house, and the usable area is considerably small in comparison to the single-family house (Figure 2-c). Intervention types BS2 - Addition of pergola (connected with the building) (Figure 2-d) and BS3 - Changes in the form of entrance terrace (lengthening, widening, reorientation) were applied relatively less according to others (Figure 2-e). Although many pergolas have been built in the gardens, very few of them are connected to the building which are excluded from the scope of the study.

Figure 2. Examples for BS (Hatice Yasemin Çakır, 2021); **a)** BS1 (S1_T1_B13, S3_T6_B10); **b)** Entrance that close to original version (left) (S1_T2_B46), BS4 (the others) (S1_T2_B45, S1_T2_B39, S1_T1_B02, S3_T6_B12); **c)** BS5 (S3_T6_B39); **d)** BS2 (S3_T4_B06); **e)** entrance terrace that close to original version (left) (S3_T6_B30), BS3 (right) (S3_T6_B42)

- ES – Interventions at Element Scale: Among the intervention types at the element scale, the ones that affect external masonry wall, and window/door were applied mostly (33/38), according to other ones that related to other elements (5/38). ES1 – Changes in the size/form of the window/door (22/108), and ES2 – Changes in the number of window/door (20/108) have been determined relatively high compared to others. These two intervention types were generally preferred in T1 and T2 (Figure 3-a, b), since they are single-family houses which have one decision maker, and also on the first-floor, the number and dimension of the windows are not adequate. These are followed by ES5 – Intervention to the roof (3/108) with relatively less frequency (Figure 3-c). It is thought that to create a usable flat roof, the roof was removed partially/fully. The least common intervention types are ES3 – Addition of circulation element, and ES4 – Addition of skeletal structural member, and both were made in only one building (1/108). In one of the reused buildings as a kindergarten, steel fire escape stair was added to the front façade (Figure 3-d), while in the other one that was still used for housing purposes, the vertical skeletal structural member was added to support an additional floor (Figure 3-e).

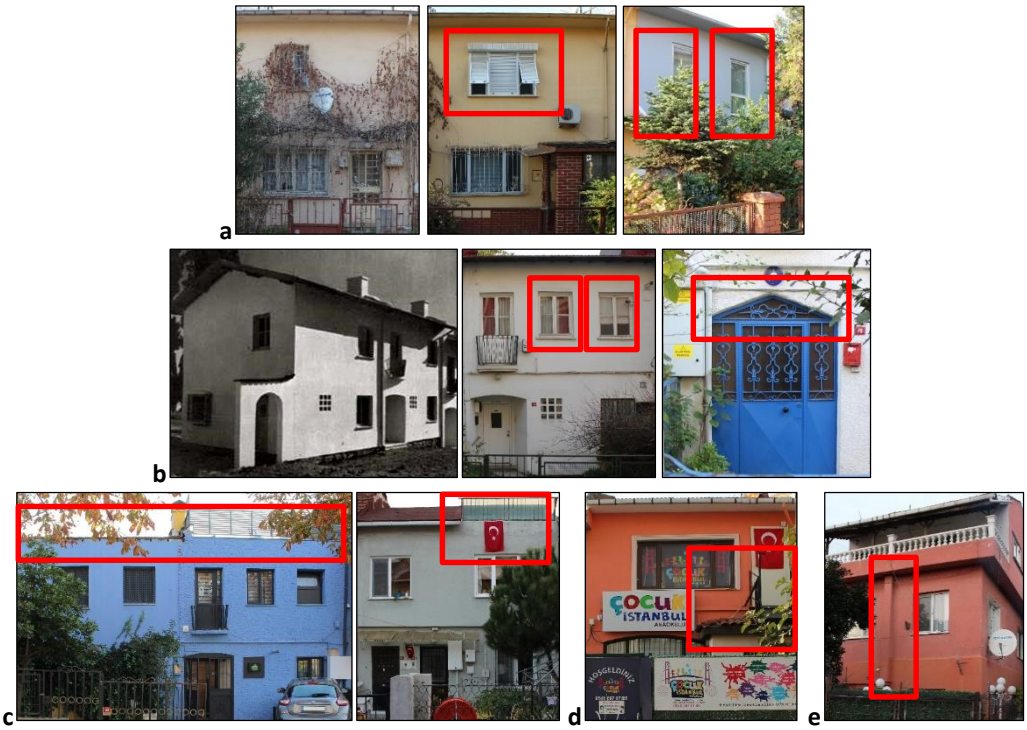

Figure 3. Examples for ES (Hatice Yasemin Çakır, 2021); **a)** façade that close to original version (left) (S1_T1_B03), ES1/ES2 (the others) (S1_T1_B04, S1_T1_B09); **b)** original photographs of T2 (left) (Uskudar Municipality Plan and Project Directorate Archive, n.d., as cited in Öztürk, 2020), ES1/ES2 (the others) (S1_T2_B46, S1_T2_B44); **c)** ES5 (S1_T2_B33_B34, S3_T3_B23); **d)** ES3 (S1_T1_B23); **e)** ES4 (S3_T6_B39)

- CS – Interventions at Component Scale: Interventions at components of both window/door and masonry wall are detected in 57/108 buildings, while in 51/108 of them only interventions on window/door are determined (CS4, CS5, CS6). In short, interventions at component scale were only implemented in the window/door of the buildings. CS4 – Material changes in the window/door frame, which is the core of the window/door, is the most common intervention type, observed in almost all buildings (105/108). The wooden window/door were renewed with PVC in the window, iron/steel in the door, and their original partitions were not preserved (Figure 4-a). The reason of this intervention is probably insufficient thermal insulation, water leakage, and security problems. The second line is CS5 – Intervention to the sill one of the complementary components of the window/door (96/108) and probably was made with similar reasons as the previous one. CS5 is seen in two different ways as changes of the sill with a new one (81/96), and the addition of a new sill on top of the existing one (6/96) (Figure 4-b). The third mostly seen intervention is CS6 – Addition of protective elements in front of the window (92/108), which is the complementary component (Figure 4-c). Due to the security reasons, generally, window security bars were added on the ground floor, and sometimes on both floors. It is followed by, CS2 – Changes of finishing layer which is the intervention to the finishing layer of the masonry wall (39/108). CS2 is seen in three different ways, as changes in the material of the entire wall surface (18/39), socle region (8/39), and skirting (13/39) (Figure 4-d). In 6 of the 11 reused buildings, the façade finishing material observed to be changed with stone, brick, etc. However, it would not be directly associated with the reuse, because it has been determined that PVC cladding is widely preferred in some of the buildings that still maintain residential function. In short, it is thought that material changes in socle region, and skirting is made to protect buildings from water infiltration and splash water. While for the material change in entire surfaces thermal performance could be the important factor, besides water infiltration. The fifth line is CS1 – Addition of thermal insulation and CS3 – Addition of decorative elements to the façade which are related to the protective layer and complementary component of the masonry wall and are the least implemented (31/108). It is estimated that decorative elements located around the window and on wall edges were added during the application of thermal insulation material (Figure 4-e).

Figure 4. Examples for CS (Hatice Yasemin Çakır, 2021); **a)** window/door that close to original version (left) (S1_T1_B12), CS4 (right) (S1_T1_B05); **b)** CS5 (S1_T2_B43, S1_T2_B45); **c)** CS6 (S2_T3_B05); **d)** CS2 (S2_T3_B05, S1_T1_B04, S1_T2_B37); **e)** CS3 (S3_T3_B56)

In short, these unplanned interventions cause the loss of original details of the buildings. As in the study, Havinga (2020a) presents these type of interventions as "negatively values attribute" which means interventions that have a negative impact on the front and rear façade in different scale. In building scale, addition of the storages of the ground floors are evaluated as negative impact on heritage value since causing changes on the window/door of the façade. While in the element scale, applying thermal insulation to the external side of the façade, loss of fenestration, window frames replaced by PVC, addition of entrance canopy and snoops, etc. are taken as negative interventions. These results are consistent to the results presented above, especially in the case of addition of entrance canopy, changes in the number/form/size of the window, and changes in the material of the window. However, in this study, while the component scale was descended to a lower scale, Havinga (2020a) started to examine the case studies from a broader scale as area, and ensemble. In the study conducted by Erdal et al., (2020), interventions such as addition/expansion of floor, additions to the garden are considered as interventions that affect mass organization and cause the building to lose its originality. These are parallel to the building scale interventions mentioned in this paper, except additions to the garden, since in this study only interventions that related to the front façade are taken consideration.

4.2. Evaluation of the Defects

Analysis on the defects shows that; among the 108 buildings that exist, there are defects in different dimensions in the 83/108 buildings, while the remaining 25/108 buildings do not have any defects as they probably have been repaired recently (Table 5). In the 72 of the 83 buildings, defects are located only on the masonry wall, and both on masonry wall and window/door in the 11 of them. Concerning the incidences (T1-P1, T2-P2), entire wall surface (71/232), surrounding of the window/door (56/232), and socle region (43/232) are the most defected zones, respectively. The most common defect types (T1-P1, T3-P3), their zones, and their relation to the factors (intervention, natural factor) are given below, in detail:

Table 5. Total number and frequency of the defect types according to their zones and factors

Zone	F	Codes of Defect Types								
		DE1	DE2	DE3	DE4	DE5	DE6	DE7	DE8	Total[2] T[2]-P[2]
Entire Wall Surface	F1	-	-	-	5	2	9	4	-	20
	F2	-	-	-	2	2	29	18	-	51
	T[1]-P[1]	**-**	**-**	**-**	**7–9.86%**	**4–5.63%**	**38–58.32%**	**22–30.99%**	**-**	**71–30.60%**
Surrounding of the window/door	F1	-	1	-	5	4	13	27	-	50
	F2	1	-	-	1	-	3	1	-	6
	T[1]-P[1]	**1–1.79%**	**1–1.79%**	**-**	**6–10.71%**	**4–7.14%**	**16–28.57%**	**28–50.00%**	**-**	**56–24.14%**
Socle region	F1	-	1	-	1	1	-	1	-	4
	F2	1	9	-	3	15	11	-	-	39
	T[1]-P[1]	**1–2.33%**	**10–23.26%**	**-**	**4–9.30%**	**16–37.21%**	**11–25.58%**	**1–2.33%**	**-**	**43–18.53%**
Building-related surface	F1	1	1	-	3	5	3	2	-	15
	F2	-	-	-	-	-	-	-	-	-
	T[1]-P[1]	**1–6.67%**	**1–6.67%**	**-**	**3–20.00%**	**5–33.33%**	**3–20.00%**	**2–13.33%**	**-**	**15–6.47%**
Plumbing-related surface	F1	-	-	-	8	3	6	7	-	24
	F2	-	-	-	-	-	-	-	-	-
	T[1]-P[1]	**-**	**-**	**-**	**8–33.33%**	**3–12.50%**	**6–25.00%**	**7–29.17%**	**-**	**24–10.34%**
Window/ door frame	F1	-	-	-	-		-	-	1	1
	F2	-	-	-	-	7	-	-		7
	T[1]-P[1]	**-**	**-**	**-**	**-**	**7–87.5%**	**-**	**-**	**1–12.5%**	**8–3.45%**
Window infill	F1	-	-	-	-	-	-	-	1	1
	F2	-	-	-	-	-	-	-		-
	T[1]-P[1]	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1–100.00%**	**1–0.43%**
Sill	F1	-	-	-	-	-	-	-	-	-
	F2	-	-	-	-	2	5	-	-	7
	T[1]-P[1]	**-**	**-**	**-**	**-**	**2–28.57%**	**5–71.43%**	**-**	**-**	**7–3.2%**
Window security bar	F1	-	-	-	-	-	-	-	-	-
	F2	-	-	7	-	-	-	-	-	7
	T[1]-P[1]	**-**	**-**	**7–100.00%**	**-**	**-**	**-**	**-**	**-**	**7–3.2%**
Total[3]	F1	1	3	-	22	15	31	41	2	115
	F2	2	9	7	6	26	48	19	-	114
	T[3]-P[3]	**3–1.29%**	**12–5.17%**	**7–3.02%**	**28–12.07%**	**41–17.67%**	**79–34.05%**	**60–25.86%**	**2–0.86%**	**232**

F: Factor. F1: Factor 1 (Intervention). F2: Factor 2 (Natural factor). Defect types are given in Table 3.
T^1-P^1: Total number of the defects for each zone and defect type, separately. Percentages are calculated per zones.
Total[2]/T^2-P^2: Total number of defects for each zone. Percentages are calculated considering total number of defects (232).
Total[3]/T^3-P^3: Total number of defects for each defect type. Percentages are calculated considering total number of defects (232).

DE6 – Discoloration/colour changes (79/232) is the most common defect, and generally, seen on the entire wall surface (38/79), followed by surrounding of the window/door (16/79), and socle region (11/79) respectively (Figure 5-a). DE6 on the entire wall surface and socle region consist of natural factors, while on the surrounding of the window/door related to intervention to the sill. It is thought that incorrect workmanship, and detail design during CS5 – Intervention to the sill, caused water leakage under the sill, and in turn, DE6 occurred. The second in line is DE7 – Surface irregularities (60/232), and mostly seen on the surrounding of the window/door (28/60), followed by entire wall surface (22/60), and plumbing-related surface (7/60) respectively (Figure 5-b). DE7 on the entire wall surfaces are observed as point holes, generally on the buildings facing south-east, and north-west which are caused by natural factors (hail). The ones that are on the surrounding of the window/door, and plumbing-related surfaces are originated from material (i.e., plaster and paint) applied to cover mistakes made during interventions (e.g., material changes in window frame/sill, assembly of mechanical elements, material applied to cover interventions, etc.). The third in line is DE5 – Bubbling-spalling (41/232), and unlike others, it is located mostly on the socle region (16/41), and followed by window/door frame (7/41), and additional/adjacent building-related surface (5/41) respectively (Figure 5-c). It is thought that the defects on the additional/adjacent building-related surface occurred due to different seismic characteristics of the structural system of existing and additional parts (i.e., masonry and skeletal structural system). DE5 is observed due to groundwater in the buildings where the socle region or skirting is not covered (i.e., CS2 – Changes of finishing layer is not applied) which can be considered as a design fault. In the buildings where the original window/door frame is preserved (i.e., CS4 – Material change in window/door frame is not implemented), defect has occurred in the

paint layer of the wooden frames because of natural factors. DE5 on additional/adjacent building-related surface is generally caused by natural factors. These defects are followed by DE4 – Cracks (28/232), DE2 – Efflorescence (12/232), DE3 – Corrosion (7/232), DE1 – Biological formation (3/232 – 1.29%), and DE8 – Material loss (2/232 – 0.86%), respectively (Figure 5-d, e, f, g, h). DE4 occurred due to the mounting of mechanical system elements. DE1/DE2 are related to the water leakage problem in the socle region and can be regarded as an advanced level of DE5. DE3/DE8 are specific to the window/door which is seen on the complementary component (i.e., window security bar), and core (i.e., window frame, infill) respectively, and generally seen on the buildings that are not used, and the material of the window was not changed with PVC.

Figure 5. Examples for CS (Hatice Yasemin Çakır, 2021); **a)** DE6 (S3_T4_B01, S1_T2_B38); **b)** DE7 (S2_T3_B03, S3_T6_B12, S1_T2_B29); **c)** DE5 (S1_T2_B31, S1_T1_B12, S3_T6_B19); **d)** DE4 (S1_T1_B02); **e)** DE2 (S1_T1_B02); **f)** DE3 (S3_T6_B40); **g)** DE1 (S1_T2_B37); **h)** DE8 (S3_T6_B18)

Shortly, defects are related to both interventions and natural factors. In the study performed by Sá et al. (2015) about defects seen on the rendered façades, the most common defects are listed as dirt/particle deposit, biological colonization, colour change/discoloration, and linear cracking. Although the results obtained in this paper are consistent to result of Sá et al. (2015), the biological formation has not been seen so often, instead, surface defects have been encountered. Okumuş (2020) evaluated defects especially on window system and stated that the rate of defect seen in the wooden frames is greater than that of PVC frames. Parallel to this, in this paper, the defects seen on the windows are observed to be in wooden ones due to neglect and natural effects.

5. Concluding Remarks

A study was performed to document Selamsız Low-Cost Mass Housing in Uskudar, Istanbul/Türkiye, which is an important example of the modern period that still preserves its original function and design as much as possible. The data of 108 buildings that still exist today among the 131 constructed buildings were obtained from the literature, archive search, and site visit and their front façades were evaluated in terms of (i) interventions at the building/element/component scale, and (ii) defects. As a result of that documentation, the frequency of the interventions and defects, their relation to each other and external factors, and user requirements were discussed. The following conclusions were drawn from the comparative evaluations of intervention and defects:

- Considering the current situation of the existing 108 buildings, when the results obtained from this paper and Öztürk (2020)'s research were compared, it was seen that both demolished and obsolete buildings were increased by one.
- To meet spatial requirements (e.g., spatial dimensions, daylight) interventions at building scale (79/108), and element scale (35/108) such as addition/extension of floor, size/form/number change in the window/door were implemented. These unconscious interventions led to the destruction of the original façade layout. In addition, intervention at the component scale such as material change in frame/sill, addition of thermal insulation layer, and decorative elements to meet performance requirements were observed in all buildings (108/108). Although these interventions did not affect the façade on a massive scale, caused the disappearance of original details such as the partition of the window frame.
- Defects are generally located on masonry wall (mostly on the entire wall surface, surrounding of the window/door, socle region), since most of the window/door have been renewed. It has been determined that half of the defects were caused by unconscious interventions as mentioned above. In addition, environmental factors, orientation, and design decisions are also effective.

As a result, buildings of Selamsız Low-Cost Mass Housing, which were built in the 1950's, could not meet the spatial and performance requirements due to various reasons, in turn, interventions were made at different scales or some of them were demolished. In line with the interventions and external factors, defects occurred in different dimensions. It is believed that documentation and registration of these buildings, which are an important part of modern heritage of Türkiye, and creating appropriate solutions in line with the requirements will prevent unplanned interventions, defects, and destruction of original details. In this context, this paper is seen as a preliminary study to determine the frequency of interventions and defects to find proper solutions/precautions for them.

In further studies, maintenance/repair method is planned to be suggested according to the urgency of the intervention, which will be determined by grading the detected defects. Using digital scanning techniques instead of visual inspection and transferring obtained data to the Building Information Modelling (BIM) programs will enable the performance values of the façades to be determined more accurately and enable to propose a more planned intervention method to be followed. The methodology has the potential to be applied into a different region where the number of reused buildings is more, and in such a case, the effects of the selected functions on the interventions can be evaluated.

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The Interplay Between Gender and Controlled Environments: A Study on Stimulus Perception

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Abstract

Understanding the interplay of gender and environmental perception is important in recognizing how architectural environments can either reinforce or challenge gendered norms and experiences. Literature reviews at a glance show differences between the environmental perception of women and men, which have significant implications for projects aimed at improving the quality of the environment. Thus, 240 architecture students were invited to participate in a photo exhibition of forty images of various architectural buildings and answer a survey questions regarding the content of photos in the current study. The purpose was to determine how students perceive the environment and to examine perceptual differences among them. Data obtained were collected based on inferential and comparative approaches and were analyzed with SPSS software using Pearson correlation tests and one-sample t-tests. Specifically, the results suggest that females pay more detailed attention to the environment's components than males, while males focus more holistically on the environment content. The results typically indicate that individuals are sensitive to all aspects when confronted with the environment, so all of their senses are active in such a process, accordingly, this should be considered when designing the environment so that all of the user's senses are stimulated in a desired manner.

Keywords: *Environment, gender, perception, senses, stimulus.*

Cinsiyet ve Kontrollü Çevreler Arasındaki Etkileşim: Uyaran Algısı Üzerine Bir Çalışma

Öz

Bulgular, kadın ve erkeklerin çevre algısı arasında farklılıklar olduğunu göstermektedir ve bu farklılıklar, çevre kalitesini iyileştirmeyi amaçlayan projeler için önemli sonuçlar doğurmaktadır. Bu nedenle, 240 mimarlık öğrencisi, çeşitli mimari yapıların kırk fotoğrafından oluşan bir fotoğraf sergisine katılmaya ve mevcut çalışmadaki fotoğraflarla ilgili soruları yanıtlamaya davet edildi. Amaç, öğrencilerin çevreyi nasıl algıladıklarını belirlemek ve aralarındaki algısal farklılıkları incelemektir. Sonuçlar, özellikle, kadınların çevrenin bileşenlerine erkeklerden daha ayrıntılı bir şekilde dikkat ettiklerini, erkeklerin ise çevrenin içeriğine daha bütünsel bir şekilde odaklandıklarını göstermektedir. Ayrıca, sonuçlar tipik olarak bireylerin çevreyle etkileşim kurduklarında tüm yönlere duyarlı olduklarını, dolayısıyla böyle bir süreçte tüm duyularının aktif olduğunu ve buna göre, kullanıcının tüm duyularının istenen şekilde uyarılması için çevre tasarlanırken bu durumun dikkate alınması gerektiğini göstermektedir.

Anahtar kelimeler: *Çevre, cinsiyet, algı, duyular, uyaran.*

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1. Introduction

Interaction with the environment requires perceiving environmental information by human beings. As an effector, the environment sends information in different dimensions and ways. As the receptor, sensory organs transmit the received data to the brain's neural system for processing and perceiving. The majority of this information is processed by the central nervous system after being received by the human sensory organs. Humans use artificial systems to convert imperceptible data into perceptible data to obtain information that their sensory organs cannot receive. The spectrum of human senses is thus expanded, and humans learn about new facets of the world. In truth, we receive information from our environment through our senses. Without sight, hearing, touch, smell, and taste, the human brain would not perceive its environment at all, a world defined by darkness, silence, numbness, odorlessness, and colorlessness (Iriguchi et al., 2018; Barati & Soleimannejad, 2011). Perception shapes man's interpretation of the environment and manifests itself into behavior in the environment. Therefore, the experience of the environment and how it is perceived is a necessary topic for studies of human-environment interaction. Since the neural and perceptual systems are responsible for establishing communication between humans and the environment, it is slopwork to contribute to the environment regardless of having a good command of the processes of environmental perception (Jeffery, 2021). When it comes to architecture and design, it is necessary to pay more attention to the sensation, perception, and cognition processes as eminent dimensions, which accomplish the spatial experience (Spence, 2020). In other words, to create environments compatible with the perceptual-behavioral needs of individuals, recognizing the relationship between the environmental elements and their effect on the users' behavioral, emotional, and perceptual levels is of particular importance. Whatever should be considered about perception is that although individuals have similar mechanisms of sensation and perception, each has a different understanding of the environment. Hence, different perceptions of similar stimuli arise from several factors, and just an influencing factor cannot determine what is perceived (Dixit & Bhattacharya, 2021). Indeed, there are relatively significant psychological differences in the perception of architectural space. Accordingly, architects and designers should give importance to the psychological understanding of human perceptions and behaviors in architectural space. In this context, there are distinct and individual cognitive frames between women and men that set them apart and shape their perspectives on the constructed environment (Basu et al., 2021). Wallhagen et al. (2018) have shown that professionals should improve both women's perceived and actual ability to influence environmental issues to improve environmental design. Ceylan (2020) has revealed that gender equality in the built environment and society have a mutual relationship so architecture needs to consider them as primary input data in design. Gou et al., (2021) have shown that gender as a moderating factor influences the impact of color meaning, color attitudes, and recognition of this aspect is critical to gaining a scientific understanding of how men and women perceive urban architecture and its visual and physical quality.

Based on the concepts, it can be suggested that several factors have an influence on the process of feeling, understanding and knowing the environment. On the other hand, environmental and gender preconditions also play an important role as important factors in the aforementioned process, causing differences in the extent and manner in which people feel, perceive, and experience place. Therefore, the present study aims to investigate the way people feel and perceive the controlled space and gender ratio as an effective factor in the perception of spatial elements. In this context, the study attempts to answer the following questions:

1. Is there a significant difference between the two genders in the recognition of spatial elements in the environment and spatial perception in a controlled environment?

2. Do gender differences cause differences in the perception of expected and unexpected environmental stimuli?

According to the conceptual model of the study, which is derived from the review of the basic concepts such as emotion, perception, and the gender variable in psychology, the study attempts to find answers to the aforementioned questions by showing a series of images of different environmental landscapes to 240 male and female architecture students. In this experiment, in addition to visiting the

photo exhibition, subjects were unintentionally exposed to other unexpected stimuli such as color, sound, and the smell of perfume. After visiting the exhibition, volunteers completed a questionnaire that asked about other stimuli in addition to the content of the images. Finally, the qualitative data obtained from this test were collected and then analyzed using inferential and comparative analysis, and the results were compared with the research hypotheses. At the end of the article, the summary of the test results is presented.

2. Theoretical Framework

2.1. Environmental and Sensational Perception

Perception of the environment is a process that is at the core of environmental behavior. The environment stimulates all the senses and causes a person to be confronted with information that is processed through cognitive experiences. In perceptual processing, the perceiver is considered part of the observed environment and plays an effective role in defining the boundaries and other features of the environment and space due to his or her spatial behavior (Marques et al., 2020). In this regard, perception is intertwined with sensation from the perspective of environmental psychology, especially when individuals separate the perception of objects from the perception of the environment (Steg & de Groot, 2018). The topic of sensation and perception is introduced in psychology under the title of sensation perception, which is based on the achievements of experimental sciences, especially physiology and experimental psychology (Goldstein & Brockmole, 2016). In these sciences, sensational perception is viewed as a process involving human response and psychological interpretation under the influence of environmental stimuli that results in environmental adaptation or environmental cognition (Munro, 2021). The cognition of the environment is a product of sensational perception and leads to the person's adaptation to the environment and the adaptation of behavior (Xue et al., 2017). Based on the above, it can be claimed that the three processes of sensation, perception, and cognition play an important role in the formation of individuals' sensational perceptions toward their environment. In this context, the process of sensation involves the stimulation of the human sensory organs by environmental stimuli and their conversion into electrical impulses and their transmission through the central nerves to the human brain. In this process, sight, hearing, smell, and touch function as the four most important sense organs. As the most basic sense, vision (sight) gathers information from the environment and transmits it to the brain so that distances, colors, shapes, textures, contrasts, and distinctions in the environment can be perceived with the help of this sense. Sound (authitory) provides little information to the human brain, but it is rich in emotion. Music, thunder, falling water, and the sound of the wind, for example, are all emotionally charged. Compared to hearing, it can be said that the human sense of smell (odor) has not made much progress and functions less than hearing in terms of providing information. But this sense is emotive. On the other hand, many human experiences with the tissues (touch) that shape the environment are obtained using skin sensors in the hands and feet when walking or sitting (Stone et al., 2018).

The process of perception in a mental way is actively responsible for selecting, ordering, and giving meaning to sensory information. In this phase, the received information is first identified, then the associated elements are integrated and classified according to previous or new mental concepts (Akoğlu & Akten, 2022). In general, previous sensory experiences, concepts, and individual motivations are effective factors in this process. Other factors that influence the perception process include individual psychological factors (sadness and happiness), physical factors, environmental factors (crowd and loneliness), cultural factors, gender, and personality characteristics (Peat, 2022). After the phase of gathering information and the process of perceiving and interpreting information, the process of cognition takes place. Cognition is the process of acquiring, storing, retrieving, processing, and using knowledge and information. Namely, when we understand from perceived information what that information refers to and how we should respond to it, cognition is achieved (Green, 2020). From the above material, it is clear that the processes of sensing, perception, and cognition involve complex phases and influencing factors. When a person recognizes tangible facts through sensory perception, he or she is informed by sensory receptors of the existence of external or internal world realities. This

sense, after interpretation and interpretation, leads to perception, and the development of this perception ends in the recognition of phenomena.

2.2. Gender and Its Effect on Perception

Gender has a tremendous impact on how people view the world around them. Gender norms and expectations impact how we interpret and understand numerous areas of life from an early age. Gender stereotypes can affect a variety of areas, including social interactions, personal relationships, and professional endeavours. Gender stereotypes, for example, frequently impact how people judge the behaviour, talents, and emotional displays of others. Because of gender biases, men and women may be seen differently in terms of assertiveness, empathy, and leadership abilities. Furthermore, gender can impact how people see their own identities and experiences, since people may internalise cultural messages about what it means to be a man or a woman. Overall, the effect of gender on perception emphasises the need of recognising and fighting these prejudices in order to create a more inclusive and fair society (Kobayasi et al., 2018).

As an important component in relation to spatial design, special attention should be paid to gender. Gender is not defined by the boundaries of people's bodies but is linked to social relationships and is shaped and extended by space. Gender encompasses behaviors, actions, and social thoughts that the dominant culture in any society assigns to both men and women. In terms of gender roles, stereotypical ideas about both genders are observed in society, defining the range of expectations for both genders (Hawes, 2016). Due to the difference between men and women in terms of gender, women and men have different needs. Gender represents a type of relationship in which women and men have different experiences in life. Men and women not only use space in different ways, but they also experience it differently (Palumbo et al., 2021). Studies that have focused on gender in recent decades have moved into architectural and urban space, opening up another topic of social knowledge about space. In general, identifying the differences between men and women can play a role in influencing the behavior of each party. These differences can be studied in the context of various issues. Knowing the differences is important for compatibility, vitality, health, and peace in personal and social life. It is also possible to observe other dimensions of familiarity in the social environment and in the design of spaces, and to consider a kind of balance in this area, considering the psyche of both sexes (Toccaceli et al., 2018).

As far as the perception of gender is concerned, there are various factors, each of which includes a number of viewpoints. For instance, mental visualization is considered a factor in the three-dimensional perception of space. In this regard, Xin et al. (2019) show that men and women have different cerebral processes when it comes to geographic knowledge. According to studies, men outperform women when it comes to transforming two-dimensional maps into three-dimensional representations. Women's cognitive maps are less extensive, but more detailed and rich than men's. Women's cognitive maps are not standard but are based more on internal information (Cocquyt et al., 2022). Visual-spatial perception is another factor that distinguishes men from women. Men and women have different perspectives on the world. This is because women have partial perception, while men have broad perception. Women see details, but men perceive broad lines. In this regard, women have faster perceptual processing (Yuan et al., 2019; Fider & Komarova, 2019). In addition, men and women differ in imagination and auditory perception. Women's hearing is better than men's, and women excel at recognizing sounds (Krizman et al., 2020). Research has shown that women hear almost all of the hundred sound stimuli. Men can hear bass tones better because of their larger heads. For this reason, men often prefer speakers that produce clear and bright bass tones. Women, who often have trouble hearing very low tones, usually prefer those hi-fi devices that provide undistorted sounds. This means that a woman's ear is sensitive and needs appropriate music (Krizman et al., 2021).

Based on reviewing the literature, the study's conceptual model, which shows the interaction between gender and controlled environment in stimulus perception, is presented in Figure 1:

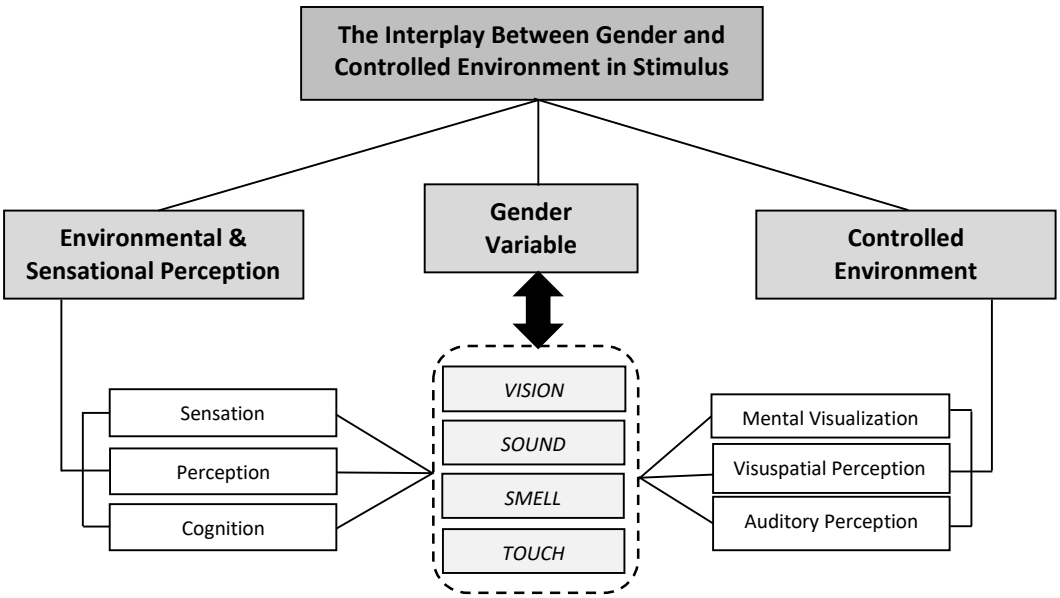

Figure 1. The conceptual model of the study (Khaleghimoghaddam, 2023)

3. Material and Method

In order to examine the effect of gender on the perception of stimuli in a controlled environment, a photo exhibition was held at the Faculty of Architecture and Design, Konya Technical University. According to the conceptual model of the study, the four emotional-perceptual factors of vision, smell, hearing, and touch were measured. Therefore, 20 photographs depicting different architectural buildings were selected. Three scales were used to evaluate visual perception: Color (blue and white), architectural style (modern and traditional), and the presence of a tree in all photos. For this purpose, 6 images of blue buildings (3 modern buildings and 3 traditional buildings) and 6 images of white buildings (3 modern buildings and 3 traditional buildings) were presented (see Figure 2). The aim was to evaluate the participants' recognition of the common elements of the images, i.e., color, architectural style, and tree. In addition, 8 images were shown to evaluate tactile perception. For this purpose, 4 architectural places were built with real materials and 4 images of modeled places were displayed using 3D drawing software. The aim was to evaluate participants' recognition of real and virtual materials. To evaluate participants' olfactory perception, four mango incense sticks were secretly lit in the four corners of the exhibition hall. In addition, a musical device in one corner of the exhibition played the piano continuously with a relatively soft tone. It was important that other elements, including two big maquettes, were placed in addition to the pictures in the hall and in the way the pictures were displayed so that they would not directly attract the attention of the participants. The statistical population of this study includes a total of 240 architecture and urban planning students at Konya Technical University in Turkey. 120 architecture students (60 males & 60 females; M=20.65) and 120 urban planning students (60 males & 60 females; M=21.45) volunteered to participate in this study. Volunteers were asked to enter the hall one at a time, move along a designated path to view the images (such that each image could only be viewed once), then exit the hall and answer a few questions. At the end of the visit to the exhibition, each candidate was given a questionnaire in which they were asked to answer the following questions:

1) What were the colors used in the depicted buildings? 2) In terms of design style, what kind of buildings were exposed in the pictures? 3) What constant factor do you think was repeated in all the images? 3) How many maquettes do you think were present in the exhibition hall? 4) Was music played in the exhibition hall? If so, can you remember the music? 5) Did you notice a certain smell in the exhibition environment, and what do you think it was? 6) What were the images that you did not like and what was the reason?

To ensure that all conditions were as equal as possible, the timing of the test was considered on three consecutive days between 14:00 and 16:00. The validity of the questionnaire was confirmed by a pilot

study with 20 participants (10 women and 10 men). Questionnaire data were analyzed with SPSS software using Pearson correlation tests and one-sample t-tests ($p < 0.01$). Confirmatory factor analysis was performed using structural equation modeling. The reliability of the questionnaire was determined to be 0.787 using Cronbach's alpha test.

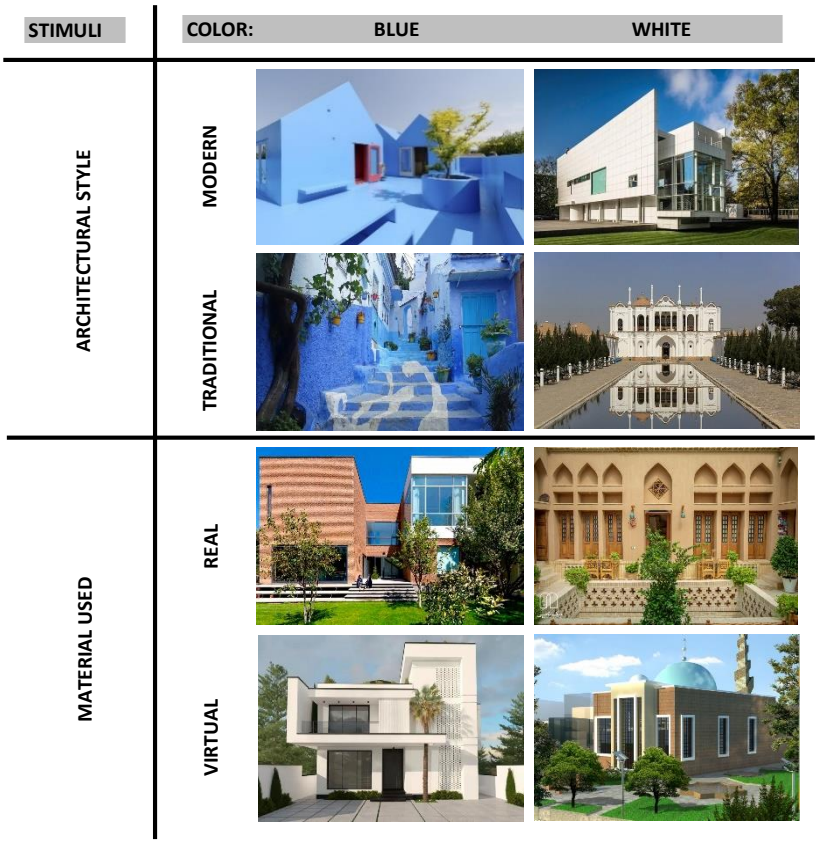

Figure 2. Examples of used architectural stimuli in the study (Khaleghimoghaddam, 2023)

4. Results and Discussion

After completion of the testing procedure, the questionnaires were evaluated, and the data were extracted and analyzed quantitatively. In the analysis phase, first, the whole statistical population was considered and then the data obtained from the questionnaires were analyzed separately for each female and male group, showing the level of perception of each of the participating groups. As shown in Table 1 and Figure 2, 77% of the participants ($M=33.69$, $SD=8.62$, $p<0.01$) rated blue and white as the dominant colors of the depicted buildings in response to the question 'What colors were used in the depicted buildings?'. To the question 'What type of buildings were shown in the pictures?', 59% of the participants ($M=31.21$, $SD=7.14$, $p<0.01$) divided the style of the buildings shown in the pictures into modern and traditional. In response to the question 'What constant factor do you think was repeated in all images?', 48% of participants ($M=28.71$, $SD=6.43$, $p<0.01$) rated the tree as a constant factor in all images. In response to the question 'How many maquettes do you think were presented in the exhibition hall?', 53% of participants ($M=30.61$, $SD=7.27$, $p<0.01$) correctly remembered the number of maquettes presented in the hall. In response to the question 'Was music played and can you remember the music?', 62% of participants ($M=31.85$, $SD=6.87$, $p<0.01$) remembered music and the sound of the piano. 5) Did you notice a particular smell in the exhibition environment and what do you think it was? 51% of the participants ($M=29.00$, $SD=6.66$, $p<0.01$) recognized and remembered the smell that was spread in the hall. To the question 'Which images did you not like and what was the reason?', 79% of participants ($M=34.39$, $SD=8.82$, $p<0.01$) answered that they did not like the rendered images and considered them unreal and untouchable. As the results show, participants paid close attention to the stimuli of color and material. This implies that vision and touch have played roles as the most effective senses in shaping participants' perceptions.

Table 1. The level of perception of all participants (Khaleghimoghaddam, 2023)

Perceptual Variable	Stimuli	M	SD	*p-value*
Vision (Sight)	Recognizing blue and white colors used in buildings	36.39	8.62	0.000
	Recognizing the traditional and modern styles used in buildings	31.21	7.14	0.000
	Recognizing tree as the constant factor in all photos	28.71	6.43	0.000
	Recognizing the number of maquettes in the exhibition hall	30.61	6.77	0.000
Sound (Auditory)	Recognizing the music played during visiting exhibition	31.85	6.87	0.000
Smell (Odor)	Recognizing the smell of incense sticks	29.00	6.66	0.000
Touch	Recognizing real and virtual materials presented in the pictures	34.39	8.82	0.000

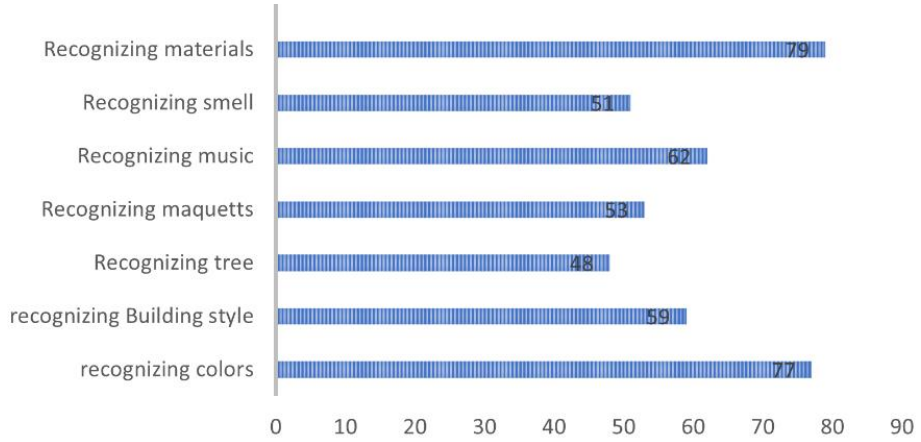

Figure 2. The perception of stimuli by all participants (Khaleghimoghaddam, 2023)

As shown in Table 2 and Figure 3, 86% of female students (M=38.25, SD=8.97, p<0.01) and 68% of male students (M=35.13, SD=8.84, p<0.01) distinguished the blue and white as two more used colors in buildings represented in photos. The 18% difference between female and male ratings shows that women pay more attention to the role of color in shaping the architectural space than men. Such result supports the study results of Fider & Komarova (2019) and Paramei et al. (2018), which have shown that women are superior to men in recognizing colors. This evidence may demonstrate that visual components impacting architecture are more important for women than men (Irguchi et al., 2018), and maybe women are more concerned with the function of color (Abramov et al., 2012). Regarding building styles, 57% of female students (M=28.72, SD=6.99, p<0.01) and 61% of male students (M=33.70, SD=7.23, p<0.01) recognized the categorization of buildings as modern and traditional styles. This shows that both gender groups recognized the distinction between architectural styles in the images almost to the same extent. The 4% difference between male and female ratings suggests that in line with the study results of Hidayati et al. (2020) and Li (2019), architectural styles attract more attention in terms of three-dimensional perception or geometric shapes in men than women.

60% of women (M=34.29, SD=8.23, p<0.01) and 36% of men (M=23.13, SD=4.63, p<0.01) distinguished trees as the constant component in all photos. This indicates that women have paid more attention to details, aesthetic aspects, and judging beauty in space than men. 58% of men (M=23.13, SD=4.63, p<0.01) and 48% of women (M=34.29, SD=8.23, p<0.01) remembered the three big maquettes in the exhibition hall. Such finding suggests that men's perceptions are broad, and they see the general in an architectural environment. It suggests that males who are exposed to architectural surroundings recall both the general and specific elements of the architectural space. This is related to the hormone testosterone, which plays an important role in mental visualization and spatial memory in males (Reinitz et al., 2015). Regarding recognizing the music played, 73% of women (M=36.79, SD=8.61,

p<0.01) recognized the piano sound, compared to 51% of men (M=26.91, SD=6.54, p<0.01) that recognized the piano sound. This supports the study results of Krizman et al. (2020), which show that Women's hearing is better than men's, and women excel at recognizing sounds. Recognizing the smell is concluded in 52% of females (M=26.91, SD=6.54, p<0.01) and 50% of men (M=26.91, SD=6.54, p<0.01). In both test groups, the perception of the smell stimulus differed by 2%. This minor difference has no statistical significance, therefore it can be assumed that the sense of smell in the female and male groups was practically similar. Finally, 87% of female students (M=38.30, SD=8.86, p<0.01) and 71% of male students (M=36.01, SD=8.50, p<0.01) recognized real and virtual materials used in photos and did not like the rendered images and considered them unreal and untouchable. According to Allison et al. (2017) and Liao and Dong (2017), this can be justified by the fact that women pay greater attention to the aesthetic features of environments. Men interpret space in three dimensions purely and mathematically. This could also be due to biological differences, in which women perceive the characteristics of a space in greater detail and pay more attention to material, colour composition, aesthetics, and light, whereas men pay more attention to the general and dimensional characteristics of the architectural space from a higher level (Pletzer et al., 2019; Sneider et al., 2015).

Table 2. Comparison between the perceptional level of female and male (Khaleghimoghaddam, 2023)

Perceptual Variable	Stimuli	Gender	M	SD	t	*p-value*
Vision (Sight)	Recognizing blue and white colors used in buildings	*Female*	38.25	8.84	4.03	0.000
		Male	35.13	8.40		
	Recognizing the traditional and modern styles used in buildings	*Female*	28.72	7.05	3.54	0.000
		Male	33.70	7.23		
	Recognizing tree as the constant factor in all photos	*Female*	34.29	8.23	3.31	0.000
		Male	23.13	4.63		
	Recognizing the number of maquettes in the exhibition hall	*Female*	28.81	7.09	3.55	0.000
		Male	32.41	7.15		
Sound (Auditory)	Recognizing the music played during visiting exhibition	*Female*	36.79	8.61	3.68	0.000
		Male	26.91	6.54		
Smell (Odor)	Recognizing the smell of incense sticks	*Female*	26.94	6.56	3.69	0.000
		Male	26.90	6.54		
Touch	Recognizing real and virtual materials presented in the pictures	*Female*	38.30	8.86	4.34	0.000
		Male	36.01	8.50		

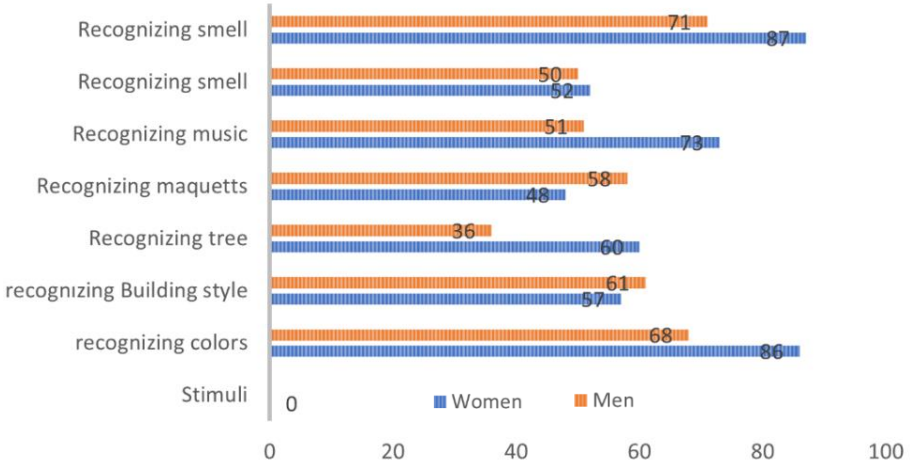

Figure 3. The perception of stimuli by two groups of female and male (Khaleghimoghaddam, 2023)

Generally, the results show that the female participants were more concerned with the conditions and characteristics of the exhibition environment, whereas the male participants were more concerned with the exhibition's content. As a consequence, it is clear that females perceive the controlled environment differently than male, and they pay more attention to the environment and its components.

5. Conclusion and Suggestion

Finally, this study, which focused on the interplay of gender and controlled environment, shed insight into the intriguing dynamics of stimulus perception. Gender has a significant influence on how individuals perceive and behave in controlled situations, according to this study. Such findings show that there are gender differences in how people interpret and interact with stimuli, highlighting the significance of a more nuanced understanding of gender's influence on perception. Indeed, these findings identify important factors that contribute to gender differences in stimulus perception by exploring several controlled conditions and employing rigorous methods. These features include social, perceptual, and physiological components that demonstrate the intricacies of gender and controlled environments. This study also emphasizes the need to recognize and remove gender biases in controlled environments. Recognizing the potential effect of gender on stimulus perception is crucial, as is ensuring fair and impartial treatment in controlled environment research, design, and implementation. Accordingly, further research is needed in the future to delve deeper into the processes behind these gender-related discrepancies in stimulus perception. Investigating the underlying cognitive processes and socio-cultural consequences will provide a fuller picture of how gender influences people's experiences in controlled environments. Finally, this study contributes to the growing body of knowledge about the interplay of gender and controlled environments, emphasizing the significance of a more inclusive and equitable approach to developing and analyzing such environments. By considering gender-specific challenges, we may create environments that welcome different points of view and improve the overall experience for all people.

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Author Contribution and Conflict of Interest Declaration Information

1st author %100 contributed. There is no conflict of interest.

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Development of Fashion Museums and Fashion Exhibitions

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Abstract

The preservation of cultural and artistic heritage, raising awareness of cultural values, elevating aesthetic and artistic values, expressing historical styles, reflecting social, cultural, and economic facets of daily life, and serving as information hubs with research opportunities are all reasons why fashion exhibitions and museums are so important. While clothing exhibitions originally took the form of ethnographic exhibitions featuring historical garments, they have now evolved into creative and dynamic exhibitions featuring the creations of modern fashion designers, installations, and sensory-appealing display spaces. In this context, the goal is to discuss the history of fashion museums, categorize and define fashion exhibitions, look at current fashion museums, and emphasize the significance of these institutions. This descriptive study reviewed clothing-fashion shows from the 2000s to the present; fashion exhibitions that incorporate on-site observations and conclusions to enrich and diversify them stylistically, contextually, and spatially are classified. By combining interesting exhibition themes, new museology, new technologies, and innovative space design, fashion exhibitions give visitors one-of-a-kind experiences.

Keywords: *Fashion, clothing, museum, fashion museums, exhibition.*

Moda Müzelerinin Gelişimi ve Moda Sergileri

Öz

Moda sergi ve müzeleri; kültürel, sanatsal mirasın korunması, kültürel değerlere olan duyarlılığın artması, estetik ve sanatsal değerlerin yüceltilmesi, dönemin tarz ve üsluplarını ifade etmesi, toplum yaşamına sosyal, kültürel, ekonomik boyutlarıyla ayna tutması, araştırma olanaklarıyla bilgi merkezleri olması açısından önemlidir. Giysi sergileri önceleri tarihi kostümlerle, etnoğrafik sergiler olarak biçimlenirken, çağdaş modacıların eserleriyle, enstalasyonlarla, duyulara hitap eden sergileme ortamlarıyla, yenilikçi, dinamik sergilere dönüşmüştür. Bu kapsamda çalışmada, moda müzelerinin tarihine değinmek, moda sergilerini sınıflamak, tanımlamak ve çağdaş moda müzeciliğini irdelemek ve günümüz moda müzelerinin öneminin altını çizmek amaçlanmıştır. Yapılan betimsel çalışmada, 2000'li yıllardan günümüze giysi-moda sergileri incelenmiş, yerinde gözlem ve saptamalarla mekânsal, içeriksel, biçimsel olarak zenginleşen ve çeşitlenen moda sergileri sınıflandırılmıştır. Moda sergileri, ilgi uyandıran sergi temaları, yeni müzecilik, yeni teknolojiler ile mekan tasarımı ile bütünleşerek özgünlüğü ve biricikliğiyle, ziyaretçilere eşsiz deneyimler yaratmaktadır.

Anahtar kelimeler: *Moda, giysi, müze, moda müzeleri, sergi.*

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1. Introduction

With its social, cultural, and economic components, fashion is an inescapable aspect of our lives and a reliable gauge of the passing of time. Fashion is more than just an expression of changes in how clothes are made; it is a significant part of many cultural histories.

Fashion was defined and examined in terms of its social, cultural, and economic dimensions as a result of the academic interest that began to develop in the concept of fashion in the second half of the 19th century. The definition of fashion is given as an abstract idea that establishes the time frame for change in a variety of consumer goods and socially acceptable behaviours. The term "fashion" is typically associated with clothing because it is easier and more practical to manipulate the economic change period for clothing than for other consumables.

“Fashion is invisible components that are covered by clothing rather than visible clothing. Fashion is a term that is frequently used to describe both clothing and appearance trends. Although clothing is often used to express fashion, it is the manner of dress, decorum, furniture, and speaking that is popular during a given period (Kawamura, 2016)”.

As stated by Watson in 2007, "The history of fashion appeals to everyone in some way or another, and fashion is much deeper than skirt lengths, silhouettes, and colours." Roland Barthes claimed that although change is at the heart of fashion, it is also a system of cultural codes, and Benjamin (2002) has questioned the relationship between fashion and modern life. George Simmel, a sociologist of modernity, dealt with fashion as an interest in the desire for innovation and examined it concerning its social dimensions. No matter which historical period is mentioned, the decisive essence of fashion is innovation and change. Innovation is regarded as a crucial component of fashion. "We can only conclude that what we call fashion is what disappears as quickly as it arises," said Simmel (2003).

The archives and exhibits of museums include fashion and clothing collections in addition to the interest in fashion. Museum exhibition designs are influenced by the creativity and dynamism of fashion. Fashion exhibitions are the focus of viewers and museums because of their creativity. For those who are interested in fashion and the history of clothing, designers, and other professionals in the galleries of museums, costume and fashion exhibitions create an educational, research, and archive environment through their informational content. Fashion exhibitions that highlight the design process, are rich in interdisciplinary research, and have rich sensory and emotional environments built on performances attract attention and become the centre of attention. It is common to come across fashion houses displaying their archives in store museums to highlight their rich history, expertise, and creativity. The viewer's perception of museum space with showcases has been transcended by fashion exhibitions and museums, which have evolved into settings that are accessible democratic environments where contemporary fashion is displayed with creative, dynamic, warm, and appealing modern presentations. In this way, modern clothing enhances the appeal of museums and draws visitors.

With the idea that fashion, considered a part of fine arts, mirrors a period sociologically, the study mentions the history of fashion museums and draws attention to the significance and development of fashion exhibitions and museums. By highlighting the rapidly growing number of fashion collections and specialized fashion museums added to the collections of museums, as well as their causes, contents, exhibition venues, and changes in exhibition designs, it aims to increase awareness and contribute to the literature.

2. Material and Method

The descriptive research methodology was used in the study. The study in this axis is founded on two fundamental methods: a literature review and on-site observation. The historical evolution and transformation of clothing-fashion exhibitions and museums are discussed in the first stage. Three phases of Melchoir's fashion museology have been identified as a result of extensive research on the subject.

In the second stage, samples from the literature were determined depending on the scanning model. In selecting the sample, a case study with the clothing-fashion exhibitions put on by esteemed organizations like the V&A, Bath, and MET Museums was made. These exhibitions, which reflect the current situation and are acknowledged in the international press and dated to the 21st century and gaining attention in the current literature, reflect the situation today. Additionally, observations were made regarding the clothing exhibition museums that the author visited personally while traveling between 2013 and 2020. It is considered rather critical in the analysis and evaluations that the author experiences clothing fashion exhibitions as a museum visitor and designer and communicates the observations and conclusions. In light of Melchoir's fashion museum periods and new museology concepts, the information gleaned from the literature review and the author's on-site observations was analysed, and current clothing and fashion exhibitions were categorized. The original part of the study emphasizes the spatial, contextual, and presentational diversity of today's clothing-fashion exhibitions and museums through this classification, which also serves as the study's findings.

In the literature, terminologically speaking, the words dress, clothing, costume, textile, and fashion are used to describe the attire displayed in museums. Fashion is seen as a concept related to production that began with the industrialization process in the 19th century and modernity in the 20th century, taking into account the rate of change in fashion and the studies on the concept. According to Melchoir (2011), it is now critical to make a distinction between the ideas of clothing-costume-textile museology and fashion museology to comprehend how fashion has evolved in museums. In this sense, it would be more appropriate to refer to historical clothing and costumes with ethnographic value as clothing exhibitions-museums. Industrial processes in the 19th and 20th centuries led to a difference between clothing with ethnographic value and changing fashion with rapidly evolving consumption habits. When referring to the attire and exhibition methods that are typical of this era, it would be more accurate to say fashion exhibitions and fashion museums.

3. Findings

History and development of fashion museums

In museums, clothing is gathered, displayed, archived, and researched as a component of cultural identity. Since the end of the 18th century, historical clothing has been displayed in a variety of ways and locations, according to Petrov (2019), in the book "Fashion, History, Museums." However, for Melchoir (2011), fashion exhibits in museums are a 20th-century invention. Clothing and fashion collections have primarily been displayed in cultural history, art, and design museums. Today, both the number of museums adding fashion exhibitions to their collections and the number of museums with specialized fashion collections are rising quickly. The Victoria & Albert Museum in London, the Metropolitan Museum in New York, and the museums listed in Table 1 were historically responsible for creating the first collections of clothing and fashion (Vrencoska, 2015; Petrov, 2019) (Table 1).

The most recent fashion trends that contributed to the trend include those from The Mode Museum (Antwerp, 2002), The Fashion&Textile Museum (London, 2003), Museo de la Moda (Santiago, 2006), and MUDE Museo do Design et da Moda (Lisbon, 2008). The Kyoto Costume Institute (Japan, 1976), America Costume Institute (1937), Fashion Institute of Technology (USA, 1967), Galliera - Musee de la Mode de la Ville Paris (Paris, 1977), and Musee de la Mode Les Arts Decoratifs (Paris, 1986) are some of the fashion museums that exist outside of the countries listed in the table below (Melchoir, 2011). With the recognition of the significance of the cultural heritage of casual and contemporary clothing, the Louvre added a fashion museum in 1986. Galleria del Costume opened in Florence's Pitti Palace in 1983 with the goal of promoting the preservation and historical study of the local clothing heritage. Rich fashion museums have been established by or are associated with sizable educational institutions, including Bath in England and Bunka Gakuen in Tokyo (Waquet & Laporte, 2011). Collections and exhibitions are being launched in nations that do not yet have a fashion museum as a focus (Melchoir, 2011).

Table 1. Museums that historically created the first collection of clothing and fashion, (Edited from Petrov (2019)

Museums	Collection	Date Established	First appearance of fashion in galleries
Victoria & Albert Museum (Londra)	Arts and manufactures; decorative arts and design	1852	1913
Metropolitan Museum (New York)	Fine and decorative arts	1870	1929
Brooklyn Museum(New York)	Fine and decorative arts	1897	1925
Royal Ontorio Museum (Toronto)	World culture and natural history	1933	1939
McCord Museum (Montreal)	Canadian social history	1921	1957
Moda Museum (Bath)	Contemporary and historical fashion	1963	1963

Melchoir (2011), a historian and fashion writer, divides the history and evolution of fashion exhibitions in museums into three key eras:

First Period: "The first attempts were made with collections intended to display the attire of historical figures rather than current fashion. Its roots were planted in the years leading up to World War II. In general, museums—especially those that focus on cultural history—collect clothing during this time. The main purpose of these collections was to demonstrate how people dressed in various social classes, from peasants to aristocrats, from rural to urban, before the industrial era. In a recent development, clothing collections during this time, in the years leading up to World War II, became a part of art museums. These museum clothing collections' cataloging, identification, documentation, display, preservation, and research studies have produced data that will be used to develop the ICOM costume museums' costume guide on a global scale" (Melchoir, 2011).

"For clothing museology to emerge as a separate field of study, it was necessary to wait until the middle of the 20th century and the gradual specialization of a select group of museum conservators worldwide. The Victoria & Albert Museum in London was home to the first conservator who made a formal attempt to start a textile division in 1953 (Waquet & Laporte, 2011).

Second Period: With the help of popular culture, the fashion phenomenon started to emerge in museums from the 1960s until the 1990s. The 1960s and 1970s saw a rise in the popularity of fashion. Fashion an Anthology exhibition, curated by fashion photographer Cecil Beaton at the Victoria & Albert Museum in these years, was designed on the axis of modern, innovative, houte coutre fashion design (Melchoir, 2011). Diana Vreeland has been compiling contemporary clothing collections for the City Museum of New York's thematic, monographic, and chronological exhibitions since the 1970s (Baudot, 2001). Vreeland has planned exhibitions that give more attention to contemporary designers and fashion than to the historical progression of clothing and fashion. A large audience visited the Vreeland-curated exhibitions of avant-garde clothing. The exhibitions by Vreeland are regarded as benchmarks in fashion museology. Exhibitions during this time created atmosphere and emotion by drawing inspiration from commercial fashion shows (Melchoir, 2011). "International museums of fine and decorative arts started building their own textile, apparel, and costume collections in the 1960s and 1970s" (Waquet & Laporte, 2011).

Third Period: "Contemporary fashion has been viewed as an influential focus in museums since the late 1990s, with masters of haute couture and various display techniques. The third period, or the contemporary phase, sees an increase in museums' interest in fashion. It seems more appropriate to discuss fashion museology at this time. Visitors' primary interest in fashion is either current fashion designers or 20th-century fashion history, which makes museums more vibrant and appealing. Savage Beauty, an exhibition by Alexander McQueen, was among the noteworthy displays during this time. Live performances were held along with small fashion shows as part of the exhibition, which produced

visually stunning scenes that stimulated all the senses. Without being categorized as museum objects, clothes were displayed. Exhibitions of clothing not only draw visitors to the museum but also keep it current and relevant. The flexible arrangements used to create these exhibitions go beyond the ICOM (International Council of Museums) costume guidelines used to preserve, define, display, and store clothing in the context of museums as a part of cultural heritage for future generations" (Melchoir, 2011) (Figure 1).

Figure 1. Savage Beauty, Alexander McQueen, MET Museum, New York, 2011 (Metmuseum, 2022a; V&A, 2022a)

According to Melchoir (2011), it is now necessary to make a distinction between the ideas of clothing (costume, textile) museology and fashion museology to comprehend how fashion has evolved in museums. Based on ICOM costume guidelines, clothing (costume, textile) museology takes precautions to preserve clothing and textiles in exhibition design so that they can be passed down to future generations as cultural heritage. Here, it is possible to mention various barriers, the necessity of physical conditions, and an understanding of display with a glass. While a continuation of the clothing museum, the fashion museum focuses on staging and visual performance. The fashion industry's marketing strategy, museum management's collaborative integration, and society's interest in consumption have all contributed to the dynamism of fashion museology. Museums become more inviting, lively, and appealing, particularly when contemporary fashion designers have exhibitions (Melchoir, 2011).

"One of the most notable aspects of the exhibitions held during this time is the abandonment of the emphasis on the material qualities and cyclicality of the clothing in favour of emphasizing the ideas behind the fashion products by ignoring the chronological order. By considering fashion in its social context and the social, production-based, and consumption-oriented aspects of fashion, rather than treating clothing as historical objects, it can be seen that exhibitions during this time emphasize the social, consumer, popular, and conceptual aspects of fashion. A combination of installation and performance arts has replaced the chronological and anthropological exhibition styles used to display the collections" (Özüdoğru, 2013).

Under the following categories, the primary factors that boost the popularity of clothing-fashion exhibitions and museums can be identified:

- Public benefit museums require financial support, according to Anderson (2000), who also noted that fashion exhibitions, particularly those showcasing modern designer wear or the history of 20th-century fashion, draw large crowds and provide much-needed entrance fees for museums.

- Maintaining public interest in fashion designs through a variety of channels, including publications, blogs, and fashion shows.

- Since clothing reflects the spirit of the age and fashion reflects social events, research is done on the history of clothing and fashion.

- Understanding fashion as a subset of the fine arts, cultivating aesthetic awareness and being inspirational

- The democratization of fashion, the availability of expensive, handcrafted items in museums to the general public, and the Houte Coutre tailor-made sewing, all pique curiosity.

- Dramatic settings that evoke the senses and the body with a fresh perspective on museology; dynamic fashion exhibitions with audience-centred approaches.

- Museum visitors can easily interact with the clothing and historical fashions on display. With popular culture, entertainment, television, magazines, and consumption, fashion is a part of daily life. While knowledge of sociology, literature, art history, and other related fields is required, it is not necessary to be familiar with fashion to understand fashion design because it can be read through bodily syntax (Melchoir, 2011).

- Retrospective exhibitions of stars, famous people's clothes, fashion houses, and corporate and contemporary designers make fashion exhibitions attractive with the awareness created by fashion, art, architecture, design, nature, and similar interdisciplinary works, thematic exhibitions, inspiration sources of designers, technological developments, 3D production methods, conceptual art, wearable art, slow fashion movement, sustainability, current concepts such as the famous film with the influence of popular culture.

4. 21st Century Fashion Exhibitions - Understanding and Classification of Museology

Neoclassical museums ushered in the golden age of the museum at the end of the 19th century, and as a result, museum spaces lost their monumental neoclassical atmosphere and acquired a new character. Le Corbusier, introduced neoclassicism to replace the rigid, conventional museum space in the early 20th century. The museum space underwent a significant transformation in the 20th century as a result of the modernist architects Wright, Mies van der Rohe, and Louis Kahn leaving it to a new era. Mies pioneered the modern museum space with the New National Gallery, which features galleries that stand out for their transparency and flexibility as opposed to the sobriety of art-focused institutions (Jodidio, 2011). While the modernist space offers fresh gallery space experiences, O'Doherty (2013) uses the white cube phenomenon to define the ideal gallery space: “The ideal gallery space is one that excludes any element that prevents the artwork from being perceived as "art.” “The rules and limitations of the architecture of the spaces where art was exhibited started to be questioned, even though artistic practices underwent a significant change during the cultural revolution of the 1960s. Alternative spaces against the white cube and new spaces for the unrestricted practice of installation, performance, and related art forms were created in the process from the 1960s to the 1970s” (Antmen, 2013).

A new era in museum architecture was ushered in by designers like Peter Eisenman, Frank Gehry, Zaha Hadid, Bernard Tschumi, and Daniel Libeskind in the 1980s (Marotta, 2012). The understanding of museology, which follows chronological information with guiding and commanding routes, has been replaced by more flexible museum routes and free spatial setups with a thematic exhibition understanding as a result of these spatial changes. Due to this diversity, very different exhibition spaces have been produced. The idea of an exhibition space being neutral has been rendered obsolete by the white cube's use as an artistic sign. The well-defined rules of the white cube phenomenon have given way to an experimental exhibition concept that blends with the aesthetic of the space in forward-thinking museums. Within the framework of the new museology, this understanding of exhibition has led to the development of new curatorial techniques. “Every element of cutting-edge museums' exhibition spaces is efficient at communicating with visitors and conveying information. By seeing, touching, hearing, and feeling, the visitor responds per his own knowledge, and learning occurs through personal, attention-focused experience. Therefore, cutting-edge museums adopt the idea of encouraging exploration in a fully immersive exhibition setting and learning through experience” (Aykut, 2021). The new idea of museology has caused museums to change their administrative procedures in a way that will draw more people inside. As stated earlier, concepts that have transformed fashion museology include concurrent changes in the fields of architecture, space, art, technology, and museology.

As mentioned above, Melchoir (2011) divided fashion museums into three thresholds as a result of her thorough research. Melchoir came to the conclusion that fashion was exhibited from 1990 to the present by morphing into theatrical stage shows with the concepts behind it.

The ways of exhibiting clothing and fashion collections, exhibition methods, and venues have evolved and diversified over time in the twenty-first century, just as Melchoir determined. With the new knowledge of museology, clothing and fashion can be displayed in various ways with various thematic names, conceptual contents, and communicative channels in an effort to create an emotional and sensory connection with the visitor. In addition to allowing designers to share their artistic discoveries and creative processes, exhibitions invite viewers to read fashion from a variety of perspectives. When analysing 21st-century clothing-fashion exhibitions and museums in terms of spatial, contextual, formal, communication channels with visitors, and exhibition designs, the following categories can be made:

- Ethnographic exhibitions
- Chronological fashion exhibitions
- Visual arts costume exhibitions
- Interdisciplinary interactions - thematic exhibitions
- Period features, contextual exhibits
- Conceptual art, wearable art exhibitions
- Retrospective exhibitions
- Designer museums-store museum exhibitions
- Sustainable fashion exhibitions

4.1. Ethnographic exhibitions

According to Gökalp (2013), "Ethnography is the material cultures produced by human societies." Exhibitions of ethnographic clothing are held along with a variety of period pieces, accessories, and jewellery. These exhibits offer crucial information and records for historians, sociologists, anthropologists, and researchers. It also serves as a source of inspiration for designers, who gain from the extensive body of historical evidence. The collections of ethnography, history, and city museums include ethnographic clothing as a cultural heritage because it serves as an excellent indicator of social identity, production methods, and arts and crafts.

The Benaki Museums of Greek Cultures, founded in 1930 in Athens by collector Antonis Benakis, is one example of a museum with extensive ethnographic clothing collection exhibitions. The museum's first floor is home to a vast collection of Greek regional costumes, wedding and ceremonial gowns, shoes, and other accessories. The collection of Greek traditional clothing from the 18th and 19th centuries is on display alongside other historical ethnographic items. Mannequins, wall showcases, and labels with information about the clothes on display are used to display women, men, and children as well as their genders. In the exhibitions, the diversity of the objects accompanying the composition, the grouping of the clothes with double, triple and multiple combinations, and the backgrounds that create a stage ambiance in the showcase create integrity with the clothes and also emphasize the diversity and richness of the clothes. The composition, design, diversity and richness of the displays add excitement to the exhibition space. While the understanding of informing with labels carries the museum to the understanding of classical museology, the dynamic and aesthetic effect of the displays takes the Benaki Museum clothing exhibition away from the boringness of the classical chronological museum (Figure 2).

Figure 2. Traditional Greek Costumes, The Benaki Museums of Greek Cultures, Athens (Personal archive, 2014)

Original attire and accessories worn by city residents are kept in collections at city museums that preserve the history of the city. These museums' clothing and accessories provide insight into social life, historical eras, urban life, and the local and authentic through clothing. As an illustration of local identity, shawls, and fans are displayed alongside local clothing in the History Museum of Madrid. Informational texts, images, and graphics were used as supplemental materials to explain the historicity and significance of the garments due to the new museology's role in facilitating effective information transfer. Displays of clothing complement the urban history artifacts and documents in the exhibition space by bringing a human element (Figure 3).

Figure 3. Traditional Spanish Accessories, History Museum of Madrid (Personal archive, 2016)

4.2. Chronological Fashion Exhibitions

A historical perspective is gained by the chronological exhibitions, which are arranged in accordance with the timeline. Exhibitions of clothing and fashion that are organized chronologically serve as educational resources, and the collection that corresponds to the timelines follows an evolutionary framework.

The Modagallery was added to the Kunstgewerbe Museum's collection, which chronologically displays costumes, accessories, and apparel from the 18th to the 21st centuries. The clothing and accessories

of well-known fashion designers from the 2000s round out the tour, which is set in the timeline-based history of fashion. The collection includes garments from the modern and pre-modern eras by Paul Poiret, Elsa Schiaparelli, Coco Chanel, Christian Dior, and others. The works of fashion designers are exhibited in deep recessed large showcases in the black-coloured space. The built-in showcases, which are white in contrast to the showcase, direct the viewer through the exhibition's chronological order like a flowing film strip. The visitor is encouraged to take action, a sense of exploration is evoked, and the chronological timeline is directed with movement thanks to the fluid transitions of the window layouts, horizontal window bands, and lighting design. The showcase surfaces feature sophisticated information graphics. The exhibition's added designer and model visuals grab viewers' attention and break up the large built-in showcases' monotonous effect. Chronological exhibitions can be remarkable with the design of the space and exhibition elements, despite the perception that they can be dull and tiresome in the traditional understanding of museology (Figure 4).

Figure 4. Modagalerie, Kunstgewerbe Museum, Berlin (Personal archive, 2018)

4.3. Visual Arts Costume Exhibitions

As captivating as the representations, the costumes used in opera, theater, ballet, film, and other similar performance arts should be preserved and displayed as a part of the company's culture and identity. The Victoria & Albert Museum features more than 3,500 stage costumes and props dating from the middle of the 18th century to the present. The ingenuity and expertise of costume designers and makers are showcased in the costumes worn in performances of drama, opera, dance, musicals, pantomime, rock and pop, music hall, films, cabaret, and circus (V&A, 2022b). The National Centre of Stage Costume in Moulin, France has 10,000 costumes and accessories for theatre, opera, and ballet. Several masterpieces from Opera Paris' costumes as well as vintage costumes from opera and ballet productions like Aida, Scheherazade, Swan Lake, Sleeping Beauty, and Macbeth are on display in the museum (CNCS, 2022).

Opera, ball, and theatre costumes are preserved in the archives of the Bolshoi Theatre Museum. Around two hundred thousand costumes, accessories, sketches, posters, and photos are kept in the Bolshoi Theatre Museum's collection. For the sake of conservation, a portion of the collection is on display (Artsandculture, 2022).

The costume departments of performance venues like operas and theatres work to preserve their stage costumes, whereas fashion and costume museums build extensive collections of costumes (Waquet & Laporte, 2011). Charles Garnier's elegant baroque stairs, foyer, and corridors of the Paris Opera House display opera costumes that were worn during performances. By blending in with the ambiance of the historic location, the costumes displayed on circular pedestals, with mannequins, and in glass showcases give the impression that a representation space has been established in the foyer. The circular base allows viewers to rotate 360 degrees while viewing the costumes in detail. In the foyer, the costume visuals along the large wall surfaces and the visuals showing the behind-the-scenes production process of the costumes bring the authenticity of the costumes and representations to the space. (Figure 5)

Figure 5. Opera costumes, Opera Garnier, Paris (Personal archive, 2013)

4.4. Interdisciplinary Interactions - Thematic Exhibitions

Different things inspire designers. The advancements in the arts, particularly the visual arts like painting, sculpture, architecture, and dance, are very important to fashion designers (Davis, 1992). Additionally, according to Crane (2000), "connecting fashion design to the arts is a way of giving meaning to fashion products and giving dignity to the profession." Since the turn of the century, fashion, design, and architecture have been closely related. Designers and artists are now much more frequently seen interacting on an interdisciplinary level in terms of aesthetic, conceptual, and formal terms. Numerous interdisciplinary, thematic fashion exhibitions are planned in this setting. For instance, the "Cubism and Fashion" exhibition (1998-1999) at the MET Museum depicts the aesthetics of cubist paintings and how they are reflected in clothing (Metmuseum, 2022b). In collaboration with the MET Museum and Orsay Museum, the exhibition "Impressionism, Fashion and Modernity" (2013) presents the history of fashion and painting during the modern era (Metmuseum, 2022c). Exhibition of Spanish Paintings from the 16th to the 20th Century featuring Balenciaga designs highlights the connection between Spanish painting from the 19th century. The exhibition spotlights the intertextuality of various disciplines with formal similarities and highlights Balenciaga's study of art history and interpretation of historical costumes in a modern style. Balenciaga's clothing was on display at the Thyssen Bornemisza Museum in 2019 alongside works by Spanish artists like El Grego, Zubain, Goya, and Zurbaran (Museo Thyssen, 2022). (Figure 6)

Figure 6. Balenciaga, Thyssen Bornemisza Museum, Madrid (Forbes, 2022)

One of the pieces that highlighted interdisciplinarity on the fashion and architecture axis was the Skin+Bones Parallel Practices in Fashion and Architecture exhibition. Since the 1980s, the exhibition has focused on the conceptual and formal connections between the work of architects and fashion designers. The works of architects like Zaha Hadid, Bernard Tschumi, Herzog de Meuron, FOA, and Frank Gehry, as well as fashion designers like Hüseyin Çağlayan, Viktor Rolf, Yohji Yamamoto, and Alexander McQueen, are highlighted for their formal and conceptual similarities. At the intersection of ideas like pleating, draping, and folding, fashion designs and architectural designs are presented (Somersethouse, 2021). A good illustration of Melchoir's understanding of display is the "Skin+Bones

Parallel Practices in Fashion and Architecture" Exhibition, where the third stage of fashion museology is defined and the ideas behind fashion are presented (Figure 7).

Figure 7. Skin+Bones Parallel Practices in Fashion and Architecture, Museum of Contemporary Art, Los Angeles, 2008 (Somersethouse, 2021)

4.5. Period Features, Contextual Exhibits

A time's taste and socio-cultural values are reflected in the collective spirit that creates fashion and clothing, everyday objects, architectural designs, and works of art that reflect this spirit. Through a contextual approach and a focus on artistic, social, cultural, and economic issues, as well as the seasonal characteristics of how the displayed clothing is made and worn, fashion exhibitions foster a holistic perspective. The exhibitions combine various disciplines with a holistic approach to reflect the spirit of the time. For instance, the MET Museum displays historical clothing using a contextual approach (Petrov, 2019).

The Art Deco exhibition, which set the trends for a time period, is presented at the Victoria & Albert Museum using a contextual approach with items, furniture, ceramics, glassware, metalwork, fabrics, prints, and clothing (V&A, 2021).

A palace museum called the Palazzo Pitti Fashion and Costume Museum was founded in Florence in 1983 (Uffuzi, 2022). To invite the audience to a different reading with cultural allusions, the museum's contextual exhibition "Traces" followed the aesthetic codes of designers of clothing, paintings, and sculptures from the 1930s to the present. The exhibition, which includes apparel, accessories, paintings, and sculptures, focuses on the connections and interactions between the creations of artists and designers from the 1930s to the present. The visual language unity between graphic designs and objects, clothing, paintings, and sculpture was highlighted in the exhibition (Theflorentine, 2022).

Mirrors and light effects virtually create a sense of depth in the intriguing Palazzo Pitti, where clothing is exhibited like works of art. Each composition is unique thanks to the display layouts and display styles used throughout the palace, which also add excitement to the exhibition that is seen in various locations (Figure 8).

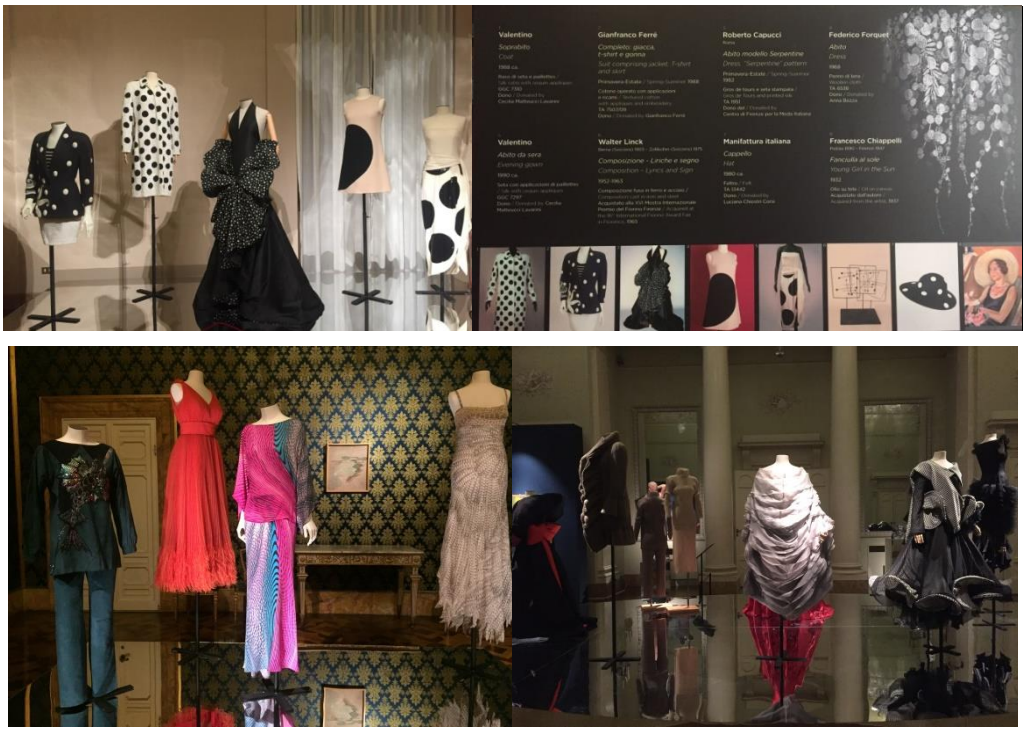

Figure 8. Traces Exhibition, Palazzo Pitti Fashion and Costume Museum, Florence (Personal archive, 2018)

4.6. Conceptual Art, Wearable Art Exhibitions

The 20th century is a time when various styles merge, challenging conventional notions of art and its creation with critical and inventive content and methods. In this sense, the term "art" can refer to a wide range of products and materials. Clothing, textiles, and other materials of all kinds are utilized in the creation of conceptual art and wearable art. Joseph Beuys, one of the founders of conceptual art, gained notoriety when he displayed his "Felt Suit" in 1970. Textiles and clothing are used in various ways as conceptual art materials today and are displayed as parts of collections in museums and at events. “In the 1980s, fashion designers like Rei Kawakubo, Issey Miyake, and Martin Margiela began to create "conceptual clothing," which they positioned as art objects separate from mainstream fashion” (Özüdoğru, 2013).

According to Leventon (2005), cited in Günay (2012), wearable art is a subset of fine art in which textile materials are incorporated into both the materials and the creative processes. The idea of wearable art, a movement whose primary means of production is clothing, has been viewed in a different way than fashion. A movement has emerged that blurs the distinction between performance and static art and wearable art, clothing, and sculpture (Onur, 2020) (Figure 9).

The works of Martin Margiela, who produces conceptual garments, are described as a combination of classical tailoring and conceptual thinking (MOMU, 2023). The white and orange colour scheme of the "Margiela: The Hermes Years" Exhibition (2017), which debuted at the Mode Museum, also conveys Margiela's connection to Hermes. Deconstruction and timeless luxury, two seemingly incompatible ideas, came together thanks to the space's strikingly graphic use of strong colour contrast. The exhibition's fragmented model images allude to the clothing's dismantling aesthetic. The similarity between Joseph Beuys' display of felt suits and the clothing in the exhibition also attracts attention.

The MET Museum's in-between exhibition by Rei Kawakubo challenges conventional ideas of beauty through its cutting-edge designs. The nine themes that make up the exhibition's divisions—such as fashion/anti-fashion, design/not design, and clothing/not clothing—examine the dichotomy that exists in designs that fall somewhere between those of clothing and those of art. The clothing is arranged inside a series of white volumes that vary in size and shape and are organized by colour rather than historical period. Text is not placed next to the garments to avoid taking away from the designs, and the fluorescent tube cage that runs along the ceiling casts diffuse light rather than a spotlight that is directed at the attire (Dezeen, 2023) (Figure 9).

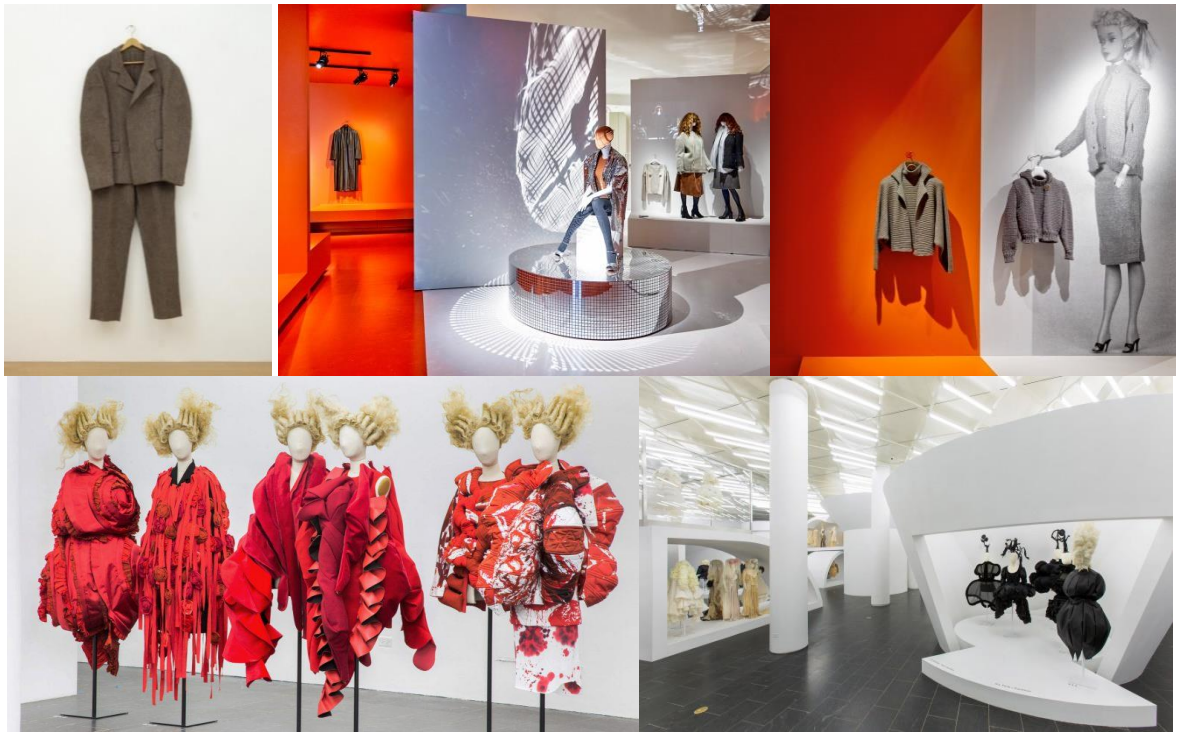

Figure 9. Felt Suit, Joseph Beuys, 1970 (TATE, 2022); Margiela: The Hermes Years, Mode Museum, Antwerp, 2017 (Exhibiting Fashion, 2023); Rei Kawakubo, in-between, MET Museum, 2017 (Dezeen, 2023)

4.7. Retrospective Exhibitions

A retrospective exhibition is described as displaying the pieces that an artist has created over the course of their career or from the founding of an institution to the present in chronological order (Erbay, 2011). Clothes and costumes that are a part of the fashion-shaping styles of famous people, designers, and artists can be displayed in retrospective exhibitions. As an illustration, the V&A Museum's Grace Kelly Style Icon Exhibition of the actress and fashion icon's attire and accessories debuted in 2010. The MET Museum (2001) featured an exhibition of Jacqueline Kennedy's iconic style, including a selection from "The White House Years" that was accompanied by pictures. Jacqueline Kennedy is a fashion icon with her clothes, clothes, accessories, and documents containing various sections from her life (Metmuseum, 2022d). The Kensington Palace exhibition "Diana: Her Fashion Story" (2020) showcases clothes that emulate Diana, Princess of Wales's fashion sense as well as original fashion sketches of the clothes the designers created for Diana (HRP, 2022).

Modern fashion is presented as a visual show with the designers' inspirations in the museums' mixed and retrospective exhibitions of contemporary fashion designers. The installations give the exhibitions a distinctive display language while also reflecting the designers' emotions and ideas.

Christian Dior's "Designer of Dreams" Exhibition traces Dior's groundbreaking fashion history and legacy by visiting the V&A Museum, the Brooklyn Museum, and the Museum of Contemporary Art (Tokyo). Many of Dior's sources of inspiration, including flowers, nature, and classical, and modern art, are brought to life in the exhibition. The exhibition, which includes items from the Dior archives, features many of the iconic silhouettes created by the French fashion designer, including haute couture garments, photos, archive videos, sketches, perfume items, accessories, and the 1947 "New Look" collection (Brooklyn Museum, 2022). The exhibition uses digital technology, decorative elements, and unusual architectural forms to create fascinating atmospheres. Scenes that bring out the atmosphere of the space shaped by various themes are designed by eschewing the periodical and technical features of the clothing exhibition (Figure 10).

Figure 10. Designer of dreams, Christian Dior (Dezeen, 2022)

4.8. Designer Museums-Store Museum Exhibitions

French fashion designers build their archives over time by preserving the key items from their collections. Christian Dior is a fashion designer and runs a private museum. In 2001, Yves Saint Laurent inaugurated his personal museum (Waquet & Laporte, 2011). A true art and fashion culture has started to emerge from the museum to the documentation centre as some major fashion houses have archived models of their design studios after the model of Yves Saint Laurent (Baudot, 2001). The Yves Saint Laurent Paris Museum emphasizes the designer's creative brilliance, the creation of the haute couture collection, and iconic pieces (Musee YSL, 2022). There are 5,000 items in total in the impressive collection at the Marrakech Yves Saint Laurent Museum. The black box concept in the interior design allows for dramatic exhibition design with references to theatre and stage. The museum's façade, which first opened its doors in the fall of 2017, is reminiscent of the monolithic brick surface of the building with its textile textures. In addition to the clothing displayed with the installation, it also includes written and audio information, photographs, interviews, music, and film summaries (Arkitera, 2021) (Figure 11).

Figure 11. Yves Saint Laurent Marrakech Museum (Architonic, 2022)

As a contemporary approach, fashion designers display their iconic fashion garments, design approaches, archives, strong corporate identities, and historicity in boutique fashion galleries in spaces designed together with their stores.

The Salvatore Ferragamo Museum presents the development of footwear, as well as the artistic viewpoint and global significance of Ferragamo. The museum, which was established in Florence in 1995, houses an assortment of images, patent papers, shoe patterns, clothes, and accessories. The collection's footwear and apparel are displayed in accordance with various seasonal themes. Collaborations with prominent artists at the time served as inspiration for Ferragamo. Shoes are like works of art that reflect the historical era's cultural milieu thanks to their designs, quality materials, and fine craftsmanship. The designer's creations are displayed in various concepts with sources of inspiration (Museo Ferragamo, 2022). The transatlantic theme is incorporated into the sea and underwater environments. The museum's various themes add interest to the experience and keep the spaces connected. Every year, the museum is updated within the parameters of a specific theme, with the energy of a fashion museum (Figure 12).

Figure 12. Salvatore Ferragamo Museum, Florence (Personal archive, 2018)

Gucci Garden is intended to be an imaginative metaphorical garden that alludes to nature, where the brand's traditional heritage will be showcased alongside its collections inside its boutique store. The wardrobe includes iconic bags, travel bags, sketches, and clothing. The presentation of fashion designs, which aren't shown in the typical window layout, uses installations, videos, and other non-chronological methods. Contemporary art is featured in the Gucci Garden, which was created to resemble a testing ground for new ideas. The store offers museum, art, food, fashion, and shopping all in one location. It was established in Florence in 2011 and represents the evolution of traditional museum understanding into an interactive experience (Abitare, 2022) (Figure 13).

Figure 13. Gucci Garden, Florence (Personal archive, 2018)

4.9. Sustainable Fashion Exhibitions

Fashion is frequently associated with disposable use because it is seen as ephemeral and short-lived. Growing concerns are being raised about the fast fashion cycle and consumption culture. The 21st century is associated with sustainable fashion in response to this circumstance (Fogg, 2014).

“In the research carried out by the EU Parliament, it was determined that the effect of millions of tons of over-produced clothing on the pollution of the ecosystem is in the first place after the petrochemical industry (Ökten, 2020). According to reports (Busch, 2017; Kipöz, 2015; Kipöz, 2020), fashion is destroying the environment and ecosystem. Hoskins (2015) has criticized the fashion industry's production practices for their lack of attention to environmental issues. With all of these issues, the anti-fast fashion, slow fashion, and sustainable fashion movements are born, and designers show their concern for the environment by recycling their designs on various platforms, in galleries and museums, and through performances.

For instance, the V&A Museum's "From Nature to Fashion" exhibition brought attention to environmental issues while explaining the inspiring and exciting relationship between nature and fashion for designers (Ehrman, 2020). The exhibition takes viewers on a journey that directly addresses the issues brought on by the industry by drawing inspiration from the natural world, highlighting modern innovations, and plundering the natural world (V & A, 2022c). The exhibition "Fast Fashion/The Dark Side of Fashion" encourages visitors to participate in consumer behaviour by critically examining the effects of fashion consumption on producers and the environment (SMB, 2022) (Figure 14).

Figure 14. From Nature to Fashion, V & A Museum, 2020 (V&A, 2022c); Fast Fashion/The Dark Side of Fashion, Tim Mitchell, KunstGewerbe Museum, Hamburg (SMB, 2022)

5. Conclusion

In the 18th and 19th centuries, clothing and fashion exhibitions were added to the collections of anthropology, history, and cultural history museums. In the 20th century, as fashion came to be regarded as a subset of fine arts as art, they started to appear in the collections of art museums. While there is a growing interest in museums creating and exhibiting collections of fashion clothing, the number of fashion museums is rising quickly, and their content and presentation methods are becoming more varied.

The significance of clothing-fashion exhibitions and fashion museums, as well as their growth and evolution over time and their varied content, are discussed in the study. In the descriptive study, clothing-fashion exhibitions and museums from the 2000s to the present were looked at, and fashion exhibitions that had undergone on-site observations and determinations to enrich and diversify them in terms of space, context, and style were categorized. According to this classification, it can be seen that fashion's contextual diversity, multilayered structure, visual age-mimicry, and popularity have broadened the scope of fashion exhibitions and museums and placed them in a desirable audience-centred position. Examining 21st-century clothing and fashion exhibitions in terms of spatial, content, exhibition styles, visitor communication channels, and curator practices reveals a wide range.

When the locations of clothing-fashion exhibitions are considered, they are displayed in very different settings than ethnography, city, history, contemporary art, palace, and store museums. By blending with the environment and the genuine, original values of the space, the exhibition designs in these settings, like in the case of Palazzo Pitti, demonstrate the attractive potential of clothing and fashion. The well-known white cube that Doherty described has been replaced, as seen in retrospective exhibitions, by experimental space series and perception created especially for the exhibition and open to new experiences (Table 2).

When the context is considered, a wide variety of contents is found, ranging from traditional clothing to visual arts costume exhibitions, retrospective exhibitions of modern fashion designers and fashion icons, environmental concerns, and sustainable fashion designs. Rei Kawakubo's in-between exhibition, exploring the duality in the designs, which straddle the line between art and fashion, defined how new contents are produced with conceptual clothing-wearable art gaps.

Exhibition designs have evolved into impressive scenes with media technologies, auditory and visual multidimensional sensory-perceived exhibition spaces, where architectural form and exhibition designs overlap with the exhibition theme, as seen in the YSL Marrakech Museum, Christian Dior, or other examples. There are also chronological ethnography and fashion exhibitions in addition to these distinctive, themed fashion exhibitions, which draw interest in the new museology understanding. The idea of an exhibition, which can be experienced by moving closer and is created with installations, has replaced the idea of a glass showcase. Design components like the form, composition, space graphics, lighting design, and space colours of exhibition designs draw attention by guiding the movement in the space in historically significant examples like Modagalerie. As a result, it is evident that they are moving away from the archaic dull chronological exhibition design with the design showcases that take the place of the standardized glass showcase displays.

The educational role of modern museology comes to the fore when the visitor channels of communication are assessed. To provide details about the context and narrative of the displayed works, information labels and graphics, multimedia with videos, interactive touch screens, visual and auditory display techniques, and more are used. The visitor learns from these components. Different techniques are used to convey the exhibition theme in the samples that have been examined. Information is withheld in Kawakubo's in-between exhibition so as not to distract from the clothing on display, whereas, in the Traces exhibition, information graphics are used to illustrate the clothing's historical context.

When it comes to curatorial techniques, experimental exhibition layouts that invite interdisciplinary and collaborative experiences grab the spotlight. Interdisciplinarity is highlighted in the exhibition design, in which the clothing is not only seen as an exhibition object but also as the design, artistic, and conceptual ideas behind it, as well as the themes and contextual characteristics of the time. New fashion museology pays attention to intertextual readings of concepts, as in the Skin+Bones Parallel Practices in Fashion and Architecture Exhibition.

Table 2. Clothing and fashion exhibitions

Fashion Exhibitions	
Spatial	ethnography, city, history, contemporary art, fine and decorative arts, palace, and store museums palace-museums- authentic atmosphere white cubes experimental exhibition halls
Content	traditional clothing, regional costumes visual arts costume conceptual art- wearable art exhibitions retrospective, haute couture modern fashion-contemporary fashion sustainable fashion
Exhibition Style	chronological interdisciplinary interactions-tematic exhibition contextual exhibition multimedia, multi sensory interactive experiencing theatrical new museology

Fashion exhibitions from 1990 to the present are displayed within the framework of new museology concepts, open to interactive experiences, with the concepts behind the designs being transformed into stage shows presented with installations, according to Melchoir (2011), who examines fashion museums by dividing them into three thresholds. “Along with the concepts of virtualization, smart systems, and artificial intelligence, the way we perceive, experience, and sense space is also changing and transforming. Multi-sensory space experience has also influenced the design of fashion exhibitions” (Şimşek et al., 2022).

The study's classification includes subheadings for spatial, contextual, stylistic, and conceptual diversity in fashion exhibitions and museums, as well as interdisciplinarity, in which clothing is displayed alongside design, artistic, conceptual ideas, themes, and historical context details as well as an exhibition object. The exhibition's layout was made. By ensuring the integrity of the content, theme, and exhibition space, as well as by establishing communication with the visitors inside the exhibition space, fashion exhibitions piqued interest and curiosity. By integrating fashion aesthetics and dynamism, fashion exhibitions reflect the standards of contemporary aesthetics, design, and art. By incorporating intriguing exhibition themes, new museology, new technologies, and innovative space design, it offers visitors singular experiences thanks to its originality and uniqueness.

As a result, fashion exhibitions and museums preserve cultural and artistic heritage, heighten cultural sensitivity, glorify aesthetic and artistic values, express the styles and fashions of the time, reflect social life with its social, cultural, and economic dimensions, serve as information hubs with research opportunities, and exhibitions are crucial as sources of inspiration due to their aesthetic and technical values.

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The article complies with national and international research and publication ethics. Ethics Committee approval was not required for the study.

Author Contribution and Conflict of Interest Declaration Information

There is no conflict of interest.

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Co-Design of a Public Space and the Implementation: Atakent (Car) Park

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Abstract

Citizen Design Science is a new co-design strategy for urban and architectural systems that improves the planning, design, management, and renewal of cities, urban habitats, and architectural structures, using active design tools through citizens' observation, experience, and local knowledge. The aim of this study is to describe how Atakent Car Park Area is transformed into a public space design and implementation through both digital and analog active design tools in the co-design process that includes citizens' spatial experiences, needs, and desires through the method of citizen design science. The objective indicators and subjective perception applied in the study were combined in the co-design process to implement an urban design project. The experimental collaborative urban design process is realized on a democratic platform based on the tendencies and expectations of the participants. Two conceptual urban design projects were prepared with design science data including 178 local citizens' wishes, needs, and suggestions about the area, and participating citizens were asked to vote for the project democratically in the urban space. The selected conceptual design project was transformed into an implementation project in the urban area.

Keywords: *Citizen science, citizen design science, co-design, participatory urban design, hierarchical clustering analysis.*

Kamusal Alanın Birlikte Tasarımı ve Uygulaması: Atakent (Oto) Park

Öz

Vatandaş Tasarım Bilimi, kentlerin, kentsel yaşam alanlarının ve mimari yapıların planlanmasını, tasarımını, yönetimini ve yenilenmesini geliştiren, vatandaşların gözlem, deneyim ve yerel bilgisi aracılığıyla aktif tasarım araçlarını kullanarak kentsel ve mimari sistemler için yeni birlikte tasarım stratejisidir. Bu çalışmanın amacı, vatandaş tasarım bilimi yöntemiyle, vatandaşların mekansal deneyimlerini, ihtiyaçlarını ve isteklerini içeren birlikte tasarım sürecinde hem dijital hem de analog aktif tasarım araçları aracılığıyla Atakent Otoparkı'nın kamusal alan tasarım ve uygulamasına nasıl dönüştüğünü anlatmaktır. Çalışmada uygulanan nesnel göstergeler ve öznel algı, birlikte kentsel tasarımda birleştirilerek bir kentsel tasarım projesi uygulanmıştır. Deneysel birlikte kentsel tasarım süreci, katılımcıların eğilimleri ve beklentileri üzerinden demokratik bir platformda gerçekleşmiştir. 178 yerel vatandaşın katılımıyla alana dair istek, ihtiyaç ve önerilerini içeren tasarım bilimi verileri ile iki konsept kentsel tasarım projesi hazırlanmış olup, katılımcı vatandaşların projeyi kentsel alanda demokratik biçimde oylamaları istenmiştir. Seçilen konsept tasarım projesi uygulama projesine dönüştürülerek kentsel alanda uygulanmıştır.

Anahtar kelimeler: *Vatandaş bilimi, vatandaş tasarım bilimi, birlikte tasarım, katılımcı kentsel tasarım, hiyerarşik kümeleme analizi.*

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1. Introduction

Standardized production, repetition, uniformity, monotony and similarity negatively affect our cities, neighborhoods, buildings and urban environments. There is a gap between industrially produced components of small-scale prototypes and buildings, urban environments and cities (Verebes, 2015). Alongside other societal challenges such as migration, poverty and wider cultural or political crises, ubiquitous standards, uniform production in the construction industry and permanent solutions that no longer apply, lead to anonymous and distant lives in cities.

The participation of residents and other stakeholders in urban planning and design processes is crucial to create inclusive, safe, flexible, and sustainable cities and human settlements (United Nations, 2015). In the pursuit of resilient cities, establishing relevant communities for the operation of the system from the grassroots level is necessary to ensure social sustainability. In contemporary urban planning and design, community participation is fundamentally viewed to achieve sustainable development and inclusive decision-making within the context of resilience (Erdem, 2022). When citizens actively engage in the processes of planning, design, and implementation, plans and designs will align more closely with the needs, interests, and expectations of stakeholders and citizens. Citizen participation in urban planning and design has the potential to enhance outcomes and support implementation by bringing together knowledge, expertise, and skills from diverse backgrounds, facilitating mutual learning and personal development among participants, fostering a sense of ownership over the outcomes, reaching consensus on solutions, and achieving better results through collaborative efforts.

Trends focusing on societal and individual needs are ideal for the principles of co-design, which encourage user participation in the design and production of solutions tailored for specific audience or the entire community (Ardito et al., 2012; Trischler et al., 2019). Although these practices may seem novel, they have been in use for over fifty years (Önder, 2003; Sanders & Stappers, 2008; Gül et al., 2016; Topay, 2020; Dilaver et al., 2022). Collaborative design research initiatives have been established in Europe since the 1970s. Users, despite not necessarily representing a specific discipline, have become a vital component of the co-design process. Sanders, an American academic and designer specializing in co-design and production, explores the evolution of designers' understanding of humanity. Unlike the customers and consumers of the 1980s, users began to be referred to as participants and co-creators in the 1990s (Sanders, 2005). Furthermore, starting from the 1990s, the concept of governance, as opposed to management, became widespread globally, partly influenced by the political crisis faced by representative democracy. Thanks to participatory techniques of the 2000s, people are invited to actively engage in real design as co-designers. This profound transformation led to the development of a new understanding of participation, ushering in a participation approach that replaces the divine role and power traditionally associated with the designer's role (Sanches & Frankel, 2010) (Figure 1). Consequently, concepts such as grassroots planning, tactical urbanism, and pop-up urbanism have emerged.

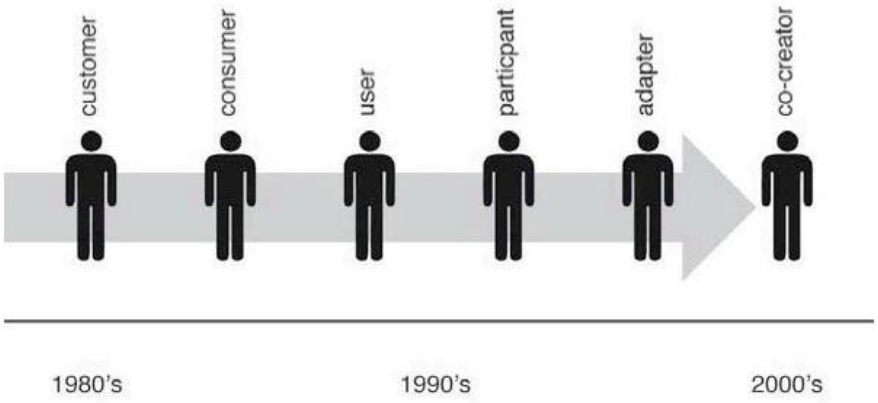


Figure 1. Changes in the way designers think about people (Sanches & Frankel, 2010)

It is a common scenario to break down the subject into different components when working on urban design projects. Decisions are often made without extensive public communication, either following widely used participatory formats or reverting to limited methods such as voting in traditional non-participatory approaches. However, especially the participation of vulnerable groups is frequently suppressed as mere symbolic gestures. It is essential to promote a new understanding of participation that not only provides information and ideas but also aims to involve participants in every stage of the process and assumes the role of a stakeholder as a planner/designer. The challenge here is to establish a common language based on continuous communication among the actors. It is therefore crucial for citizens to accurately reflect their needs or thoughts through co-design and enable its collaborative production.

Local governments are authorized institutions in the design and transformation of public space. Karşıyaka Municipality aimed to carry out a participatory study in the transformation of Atakent Car Park, which was selected from the inventory of left-over areas in Karşıyaka district prepared by Karşıyaka Municipality Urban Design Directorate. This study aims to co-design the public space through a common design language to be established with citizens and professional designers in the transformation of the irregular Atakent Car Park, which is one of the left-over urban areas on the border of Atakent and Yalı neighborhoods in Karşıyaka district of İzmir, into a qualified and multifunctional public space. The method used in the study is 'citizen design science' in which citizens actively participate in the design process and produce design science data.

2. Participatory Urban Planning and Design Method: Citizen Design Science

'Citizen Science' provides scientific data through public participation in scientific research (Irwin 1995). The method used in the study, 'citizen design science', was developed by Johannes Müller; Hangxin Lu, Chirkin Artem, Bernhard Kleina, and Gerhard Schmitt at ETH Zurich - Future Cities Laboratory in 2018 by combining active design and crowdsourcing methods. Instead of traditional participation practices such as public hearings, writing comments, citizen-based committees, participation of representations, etc., it is a method that includes innovative and active tools using today's information and communication technology in participatory design approaches in urban planning and development (Mueller et al., 2018). Citizen design science using urban design tools is a new approach to engage citizens in the urban design and planning process. The 'design science' data obtained through various analysis methods from citizens' local experiences and design proposals produced through active design tools are used in the design process of professional designers 'in the context of data-driven governance' (Mueller & Lu, 2017). Citizen design science is a synthesis of citizen science and design science that uses bottom-up data and information flows to improve the design and functioning of urban space (Lu & Schmitt, 2017).

Three key concepts make up this methodology: a) citizen science, which refers to the elements of participation and the type of data collection; b) citizen design, which refers to active design by citizens; and c) design science, which refers to translating citizens' design proposals into designs by expert designers (Figure 2).

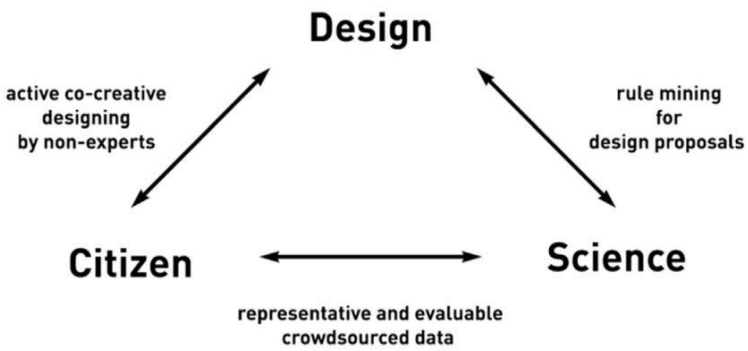


Figure 2. Concept of citizen design science (Mueller, Lu, Chirkin, Klein & Schmitt, 2018)

Citizens (users) are considered as non-expert designers and designers through primitive models of their environment. Cognitive toolkits show how citizens perceive and understand the design space through simple 3D models of the design space. Such tools encourage citizens to think about the design problem and express themselves (Mueller & Lu, 2017). Experts design urban planning and urban design projects based on data from citizens. In this method, citizens are actively involved in urban planning and urban design projects through design scenarios, not just being simple sensors. By strengthening the role of citizens, this initiative connects bottom-up and top-down decision-making processes in urban design. Citizens' competences and experiences have the potential to generate better strategies and plans for their neighborhoods (Mueller et al., 2018).

3. Description of the Study Site and Methodology of the Study

Based on the 'leftover space inventory' study of the Urban Vision Development Unit of Karşıyaka Municipality-Urban Design Directorate, Atakent Car Park, which is 4,400 m^2 in size, was selected as the study area, which is located in the borders of Atakent and Yalı Neighborhoods in Karşıyaka district. It is located in the north of Izmir city center and Izmir Bay, owned by Karşıyaka Municipality and is a Regional Storey Car Park Area in the zoning plan. In the nearest neighbor of Atakent Car Park Area; there are sports complex, hospital, high school, primary school, library for the visually impaired and the old stream bed water mark. In the north-east of the area, which currently has an irregular Car Park lot function, where passive green meets old trees, the amount of green is more than other streets (Figure 3).

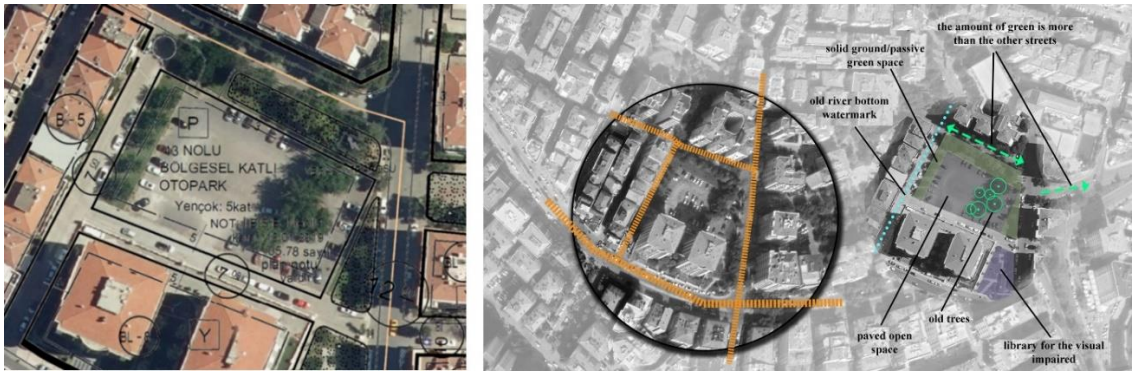


Figure 3. Atakent Car Park area and its near surroundings

In Atakent Car Park Area, the aim is to establish an inclusive, democratic, and transparent citizen participation through the methodology of design science. This approach integrates citizens into all stages of the design process, fostering a 'citizen consciousness' and strengthening the sense of belonging. The goal is to create a high-quality public space organization and implementation derived from spatial data related to citizens' needs, desires, and experiences. Consequently, this approach introduces a new organizational model in the production of public space through the methodology of citizen design science.

The co-design process relies on the communication between scientists, local residents, visitors, and the authority represented by Karşıyaka Municipality. This communication process involves local residents providing data about the area and its issues through a collaborative design tool with expert designers. During the implementation, individual active design suggestions are presented in the role of expert designers. Following the workshop, the structure of the communication consists of the expert designers and the authority evaluating the design science data.

The participatory process aims to document spatial organizational suggestions made by citizens who experience or visit the area through discussions about authority, needs programs, and rules in co-design, active design application, and a survey that includes demographic and experiential questions. The conducted 'pre-interview studies' focus on identifying issues related to the area and understanding how local residents envision the area in the future. These studies contribute to the authority's decisions regarding the vision and needs program of the area. The issues, suggestions, and evaluations documented in the study report are shared with the authority. Subsequently, during meetings with

the 'authority,' the vision of the area is evaluated based on this report, and the needs program, production process, and implementation guidelines for the active design phase within the workshop are planned. During the workshop, individual design drafts of participating citizens are recorded on an analog model. After the completion of the implementation, participants are directed to an experience survey containing demographic data, implementation experiences, and questions about issues related to the area. The design science data obtained from the analysis after the implementation and the experience survey are negotiated in 'roundtable meetings' with the 'authority' and 'professional designers,' leading to design decisions regarding spatial organization. With reference to the design decisions made, conceptual design alternatives are generated, and these design alternatives, along with all the design science data, are presented to participating citizens for voting. In the implementation of public space, the method of co-production is proposed, suggesting the application of selected urban objects, landscape, and graphic design practices in the area involving participating citizens and expert designers (Figure 4).

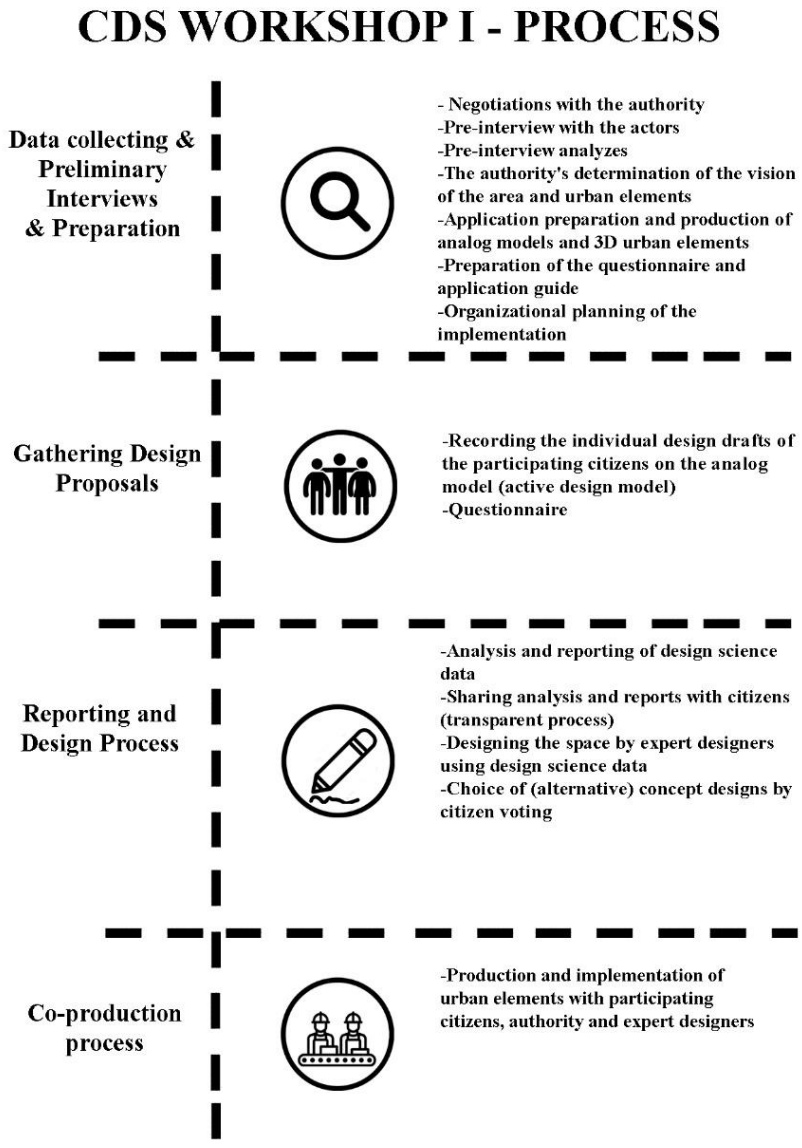


Figure 4. The process structure of citizen design science workshops (by Author)

As part of the study, landmarks in the vicinity of the Atakent Car Park Area were identified using Kevin Lynch's (1960) mind-map technique to facilitate the participation of visually impaired citizens in the design process. These landmarks were shared with the participants. The design elements involved in the workshop were produced in three-dimensional and relief formats, and participants' design drafts were recorded through the workshop coordinator (Figure 5).

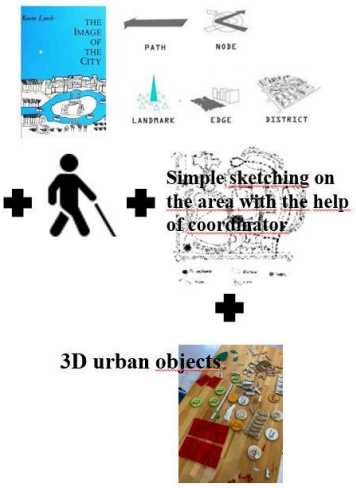


Figure 5. Co-design process for visually impaired citizens (by Author)

In contrast to traditional participatory practices, this dialogue, formed through the design science data actively produced by local citizens about their living or visited environments using active design tools, is essential and citizen-centered. The objective is to reach more local participants, establish close dialogues with citizens, and enable the participation of citizens with specific needs, such as users of the nearby Library, in the design process. After co-design, the second step of the study, the 'experience survey,' was conducted. This survey, consisting of 25 questions sensitive to the protection of personal data, aimed to understand demographic information, desires, and needs related to the study area, measure the experience of the implementation, and comprehend the participants' intentions regarding the co-production process. Within the scope of the study, an urban design application was conducted with 96 participants aged 15 and above.

4. Results and Discussion

After the conducted preliminary interview study, an evaluation was made in collaboration with the authority to assess the opinions gathered. The purpose was to establish the vision, design constraints, and the needs program for the area, and to make decisions regarding urban elements. Based on the perspectives of the local residents and shopkeepers, it was decided that up to 50% of the area would be allocated for car park use, while the rest would be dedicated to multifunctional, high-quality public space arrangements. Within the proposed urban elements for the area, an open object was suggested to accommodate functions proposed by the participants. Additionally, in the context of urban governance, the establishment of the 'Citizen Participation Unit,' a novel public initiative in municipal administration to facilitate citizen coordination, was decided upon. Guidelines for implementation were prepared for the participatory work in alignment with these decisions (Figure 6).

Figure 6. Brochures prepared for Atakent Car Park area, implementation guidelines, and preliminary interview study

Due to the participation of 178 local citizens through an open call, purposive sampling was employed in the study. In the initial phase of the collaborative design process for the Atakent Car Park Area, individual and spatial design suggestions were meticulously documented using photographs. The second phase involved the completion of the process of collecting design proposals for the area through an experience survey comprising 25 questions (Figure 7). The design principles to be embraced in the conceptual design project(s) were discerned through meticulous analyses considering the interrelations among spatial proposals.

Figure 7. Above: An example of a participant's design draft, the co-design process. Below: The implementation guidelines and the experience survey process (Photos: Pelin Özden)

Spatial cluster analysis and graphics of the documented individual design drafts of the participants and the analyses of the experience surveys have been prepared. The data were organized, classified according to urban object types, and dendrogram graphics related to user groups and urban objects were generated (Figure 8).

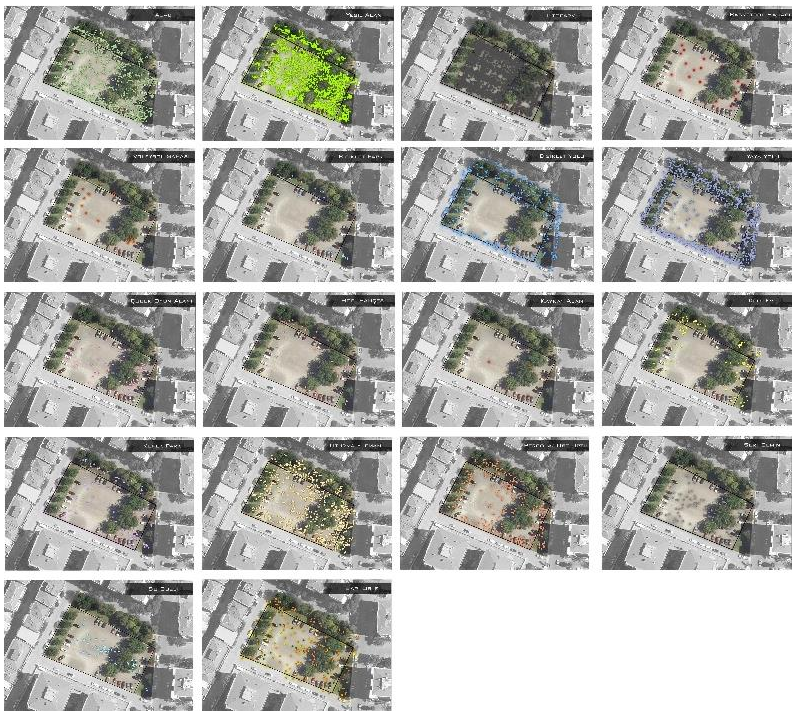
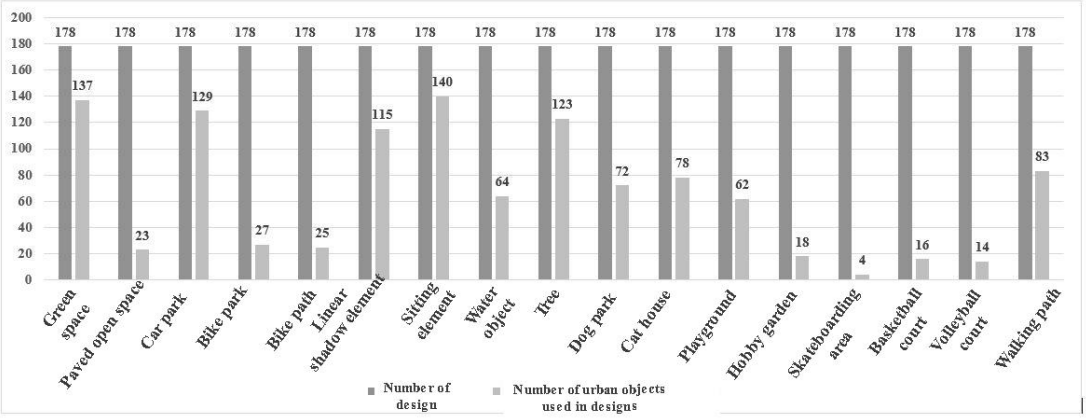


Figure 8. Hierarchical clustering diagram for each urban elements

In the co-design process involving 178 participants, a total of 9.497 urban objects were utilized. Table 1 illustrates the distribution of urban elements preferred by the participants.

Table 1. Graph showing the preference of urban elements used by participants in their design drafts based on user design counts



With reference to Table 1; the car park area ratio in the area is represented as 30% with a capacity of 0-20 vehicles, and 30% with a capacity of 60-80 vehicles. Additionally, within the scope of the study, which does not allow car park usage exceeding 50% density, the 'yellow cube' object, classified as an 'open' object, has been used by participants, constituting 11% of them, as a 'car park' object, envisioning 100% car park functionality for the area. This situation has been regarded as a *manipulative design tactic*.

In the study, participants utilized the 'yellow object', open object, 217 times. During the analysis, 97 objects related to technical needs and requests (such as lighting elements, garbage bins, rubber flooring, etc.) were excluded from clustering. The remaining 120 uses of the 'yellow object' were categorized into three distinct groups: (a) public function, (b) commercial function, and (c) artistic function. The analyses revealed a predominant presence of items with a public function, whereas proposals with a commercial function received the lowest preference. Hierarchically, suggestions were primarily focused on picnic tables, table tennis, and sports equipment.

In the context of the study, drafts of 'spatial proposals' and the 'questionnaire,' participant profiles, site data, and design information were systematically examined in relation to each other. The evaluation encompassed (a) infrastructure and technical requirements, and (b) spatial organization of urban elements and design principles. This comprehensive analysis was conducted in a 'round table meeting' format involving 'authorities,' 'scientists,' and 'professional designers.' The integrated analysis of the questionnaire and the examination of the open objects led to proposed solutions, including inadequate lighting elements, insufficient maintenance of the existing green infrastructure, and the recommendation of a permeable concrete surface for the hard ground due to significant water accumulation caused by heavy rainfall in the area.

Through the combined analysis of user profiles and urban element object data using base layers generated with Geographic Information Systems tools, the primary urban element, the car park facility, indicates 'regulation' based on its current function, along with additional public functions. The car park arrangement has been conceptualized in the northwest area of the site, with a maximum usage capacity not exceeding 50%. The urban element 'pedestrian pathway,' which is currently perceived by pedestrian users as a 'transit passage zone,' defines a walking route along the periphery of the area. The design concept of the 'pedestrian pathway,' incorporating suggestions from visually impaired citizens, has been approached as a textured surface system that appeals to the sense of touch and provides directional guidance. Thus, an inclusive design concept has been developed within the framework of the 'universal design' perspective.

After the evaluation, hierarchical clustering analysis graphs of urban elements and their spatial organization diagrams for two distinct alternative concept designs were shared with professional

designers. In the first alternative concept design project prepared by the Karşıyaka Municipality-Urban Design Directorate, the 'picnic table' element, suggested by the majority of participants, is represented, whereas in the second project, the 'table tennis' element represents the 'open object' (Figure 9).

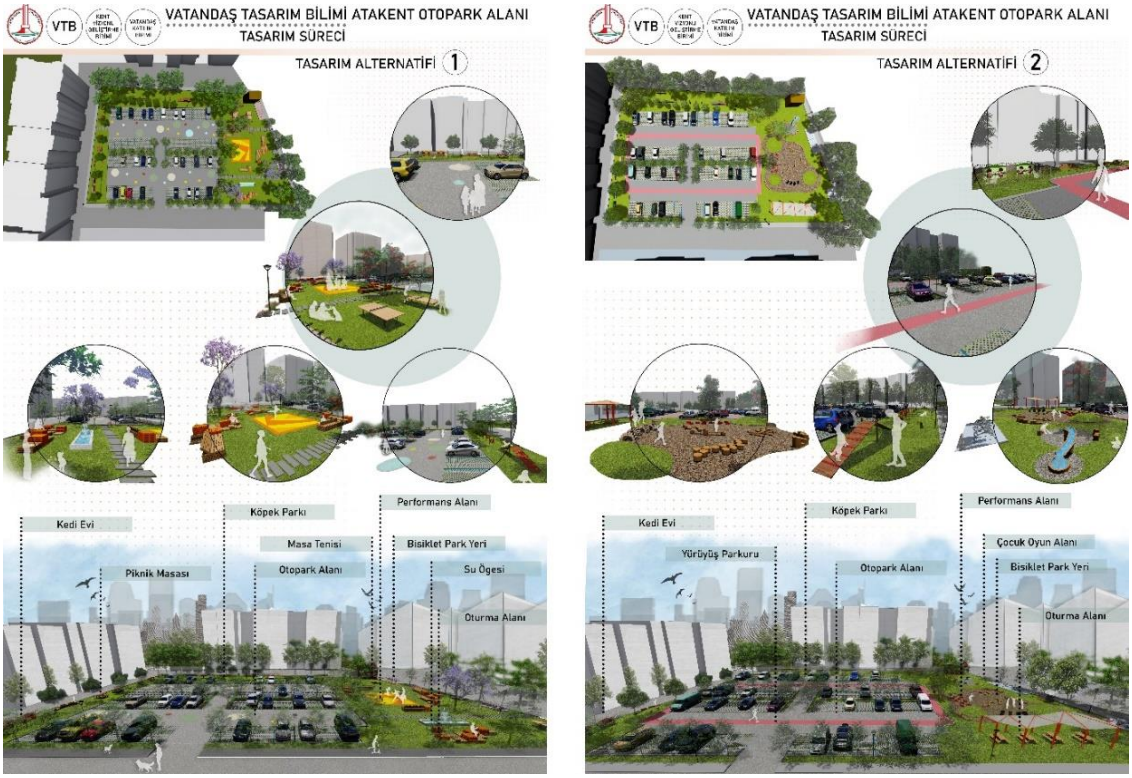


Figure 9. Left: Alternative concept design project 1, Right: Alternative concept design project 2, Karşıyaka Municipality-Urban Design Directorate

A voting process was conducted to select between the two alternative concept design projects prepared for the implementation of a high-quality public space in the Atakent Car Park Area. The voting structure included the transparent sharing of design science data from the co-design process, participants' voting on the alternative concept design projects, and a voting survey consisting of 5 open-ended questions regarding the reasons for their preferences and concerns about the voted project, which are fundamental in citizen science projects. Within the framework of citizen science methodology, projects were presented to the participants in the area during the voting process, where all processes and evaluated data were transparently shared with the participants. Participants voted for their chosen concept design project in the 'transparent ballot box', facilitated by the coordination between the City Vision Development Unit and the Citizen Participation Unit (Figure 10).

Figure 10. Voting process of alternative concept design projects in the transparent ballot box (Photos: Karşıyaka Municipality Press and Publication Directorate)

In the analog and digital voting process, where 73 citizens participated, 43 participants chose Alternative Design Project 1, while 30 participants chose Alternative Design Project 2. Based on the data from the process, the voting results of the citizens who participated in the co-design process indicate that Alternative Design 1 was chosen by democratic majority. Upon completion of the revisions in the project, urban furniture for the high-quality public space implementation of Atakent Car Park Area was produced in the municipal workshops, considering the municipality's production capacity, and then implemented (Figure 11-12-13).

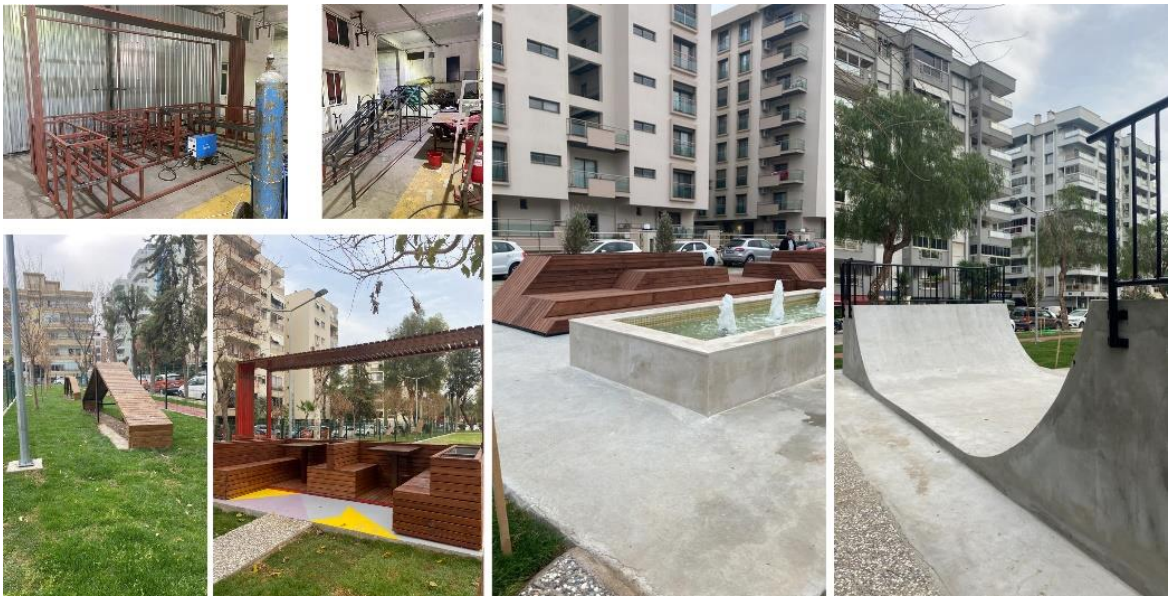


Figure 11. Visuals from the production and on-site implementation of urban elements (Photos: Pelin Özden)

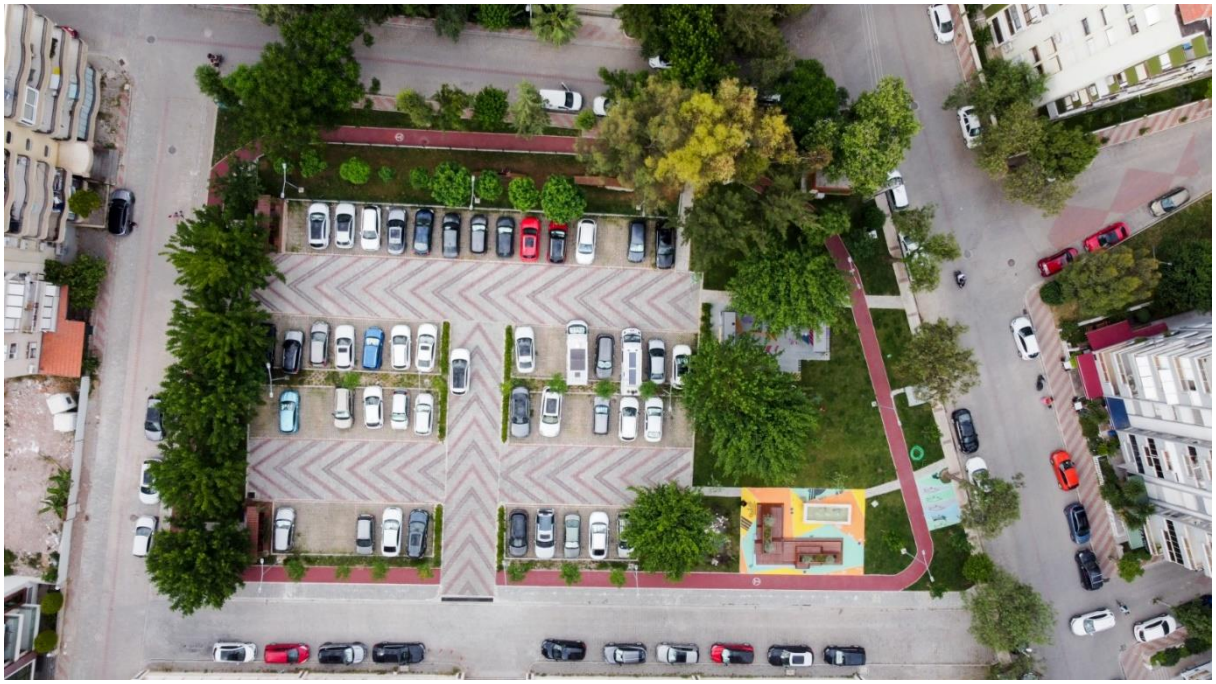


Figure 12. Top view of Atakent Car Park area after implementation (Photos: Karşıyaka Municipality Press and Publication Directorate)

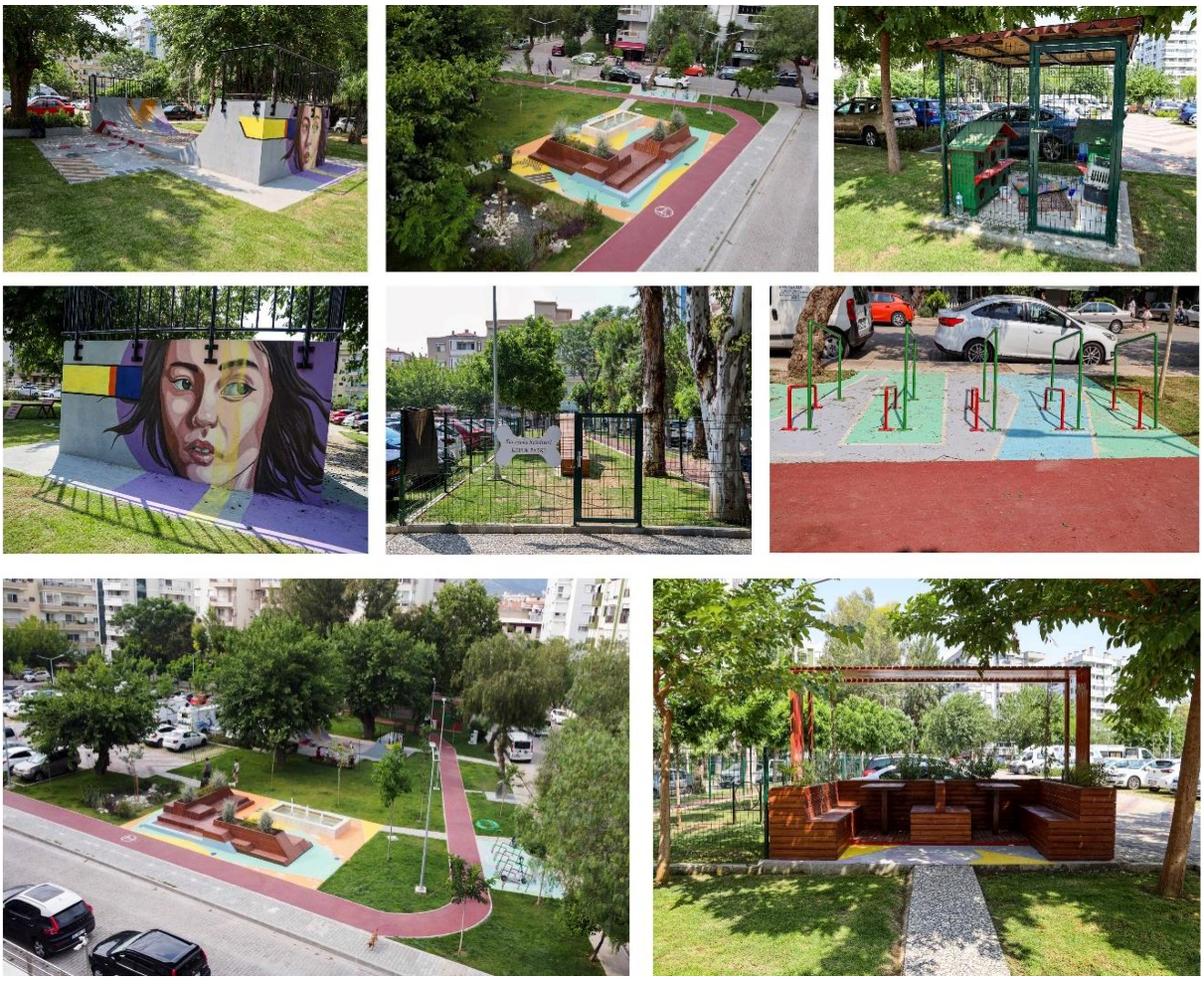


Figure 13. Atakent Car Park area after implementation (Photos: Karşıyaka Municipality Press and Publication Directorate)

5. Conclusion and Suggestions

A collaborative design process was conducted with 178 citizens in collaboration with the municipality to generate design data based on their experiences, needs, and desires for urban design. The most inspiring aspect of the study is the use of active design tools by a non-designer citizen to establish a common language and dialogue with a professional designer. The method also encompasses smart learning in the context of urban experience. The collaborative urban design process took place on a democratic platform based on participants' preferences and expectations.

In the study, unlike previous citizen design science studies (Sanches & Frankel, 2010; Klinsch, 2014; Mueller & Lu, 2017; Tomarchio et al., 2019; Mueller et al., 2020; Müller, 2021) diversity was enhanced by adding the yellow object tool set in addition to simplified design tools. This expansion allowed the identification of urban elements and functions that were not previously conceived by the authority or design experts. However, the yellow object, which turned into a design trick as in the case of the car park element, is an example of how conflicting ideas in participant-driven urban design approach can be distinguished from each other. To achieve consensus, the voting step was added to the process. The method also brings consensus through collective intelligence.

The remarkable aspect of this study lies in the engagement of a layperson without prior design knowledge in utilizing active design tools to establish a common language or discourse with a professional designer. Despite the efficacy of this common language facilitated by the tool, it has inherent limitations. Consequently, an augmentation in diversity was pursued by integrating a 'yellow object-open object' tool into the common language. The 'open object' represents a mechanism employed by participants to identify urban elements that align with their unmet needs and aspirations,

thereby enabling the definition of urban components and functionalities that were previously overlooked by authorities or design experts.

This inclusive approach also provided participants with a more nuanced means of expression within the urban design study. Furthermore, an examination of the open object analysis from the study predominantly focused on the proposed diverse urban functions.

The study elucidated that individuals with distinct or special needs have a pivotal role in the co-design process. This revelation underscores the imperative of revisiting the existing methodologies in citizen design science to foster inclusivity (Mueller & Lu, 2017; Mueller et al., 2020; ; Tomarchio, Hasler, Herthogs, Müller, & Tunçer, 2019). For instance, it facilitated the development of a three-dimensional and embossed model, a conventional design language tool, while contemplating the 'mind map' process in a manner accessible to visually impaired citizens. Thus, the diversified participant profile served as an experimental approach that advanced the methodology. Consequently, it became evident that participants with special needs, as encountered in the co-design process, may encounter challenges with digital design tools.

Within the scope of the study, participants with special or diverse needs had the opportunity to participate through the reevaluation of the toolset of the existing citizen design science method to make it more inclusive. A three-dimensional and embossed toolset, which serves as a common design language tool, was created to enable visually impaired citizens to perceive the 'mind map' process in a way they can comprehend. Therefore, the diversified participant profile has transformed the method into an experimental and tactical approach that enhances inclusivity. For participants with special or different needs, more process constructs can be created within the method. For instance, the involvement of visually impaired users through the digital participation tool is still a problem.

The citizen design science method, where design science data is generated as a participatory urban design approach, requires effective organizational collaboration in the context of its organization. In this regard, the municipal organizational structure has been expanded with the establishment of the 'Citizen Engagement Office'. Further organizational developments will be necessary for the implementation phase in collaboration with citizens as part of the ongoing co-design process.

Acknowledgements and Information Note

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Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to the article. There is no conflict of interest.

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Importance of Architecture in the Branding Process: An Evaluation on a Famous Brand

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Abstract

The term "brand", which is closely associated with the concepts of "branding," signifies the vision and identity surrounding a product during its design phase in the marketing sector. The most effective way to define a brand's identity is through its three-dimensional perception. The architectural space, acting as the storefront of the brand, holds significance in visually presenting the initial perception of the product. This study examines the interaction between the product design that has propelled the branding of a globally renowned handbag company and its spatial design, utilizing the method of observational analysis. The esteemed handbag brand, which has maintained its classical style for years, has been trying to attract attention by incorporating futuristic models since 2019, thereby rejuvenating its image. The study focuses on the examination of architectural design criteria that reflect the corporate identity.

Keywords: *Branding, architectural design, futurism, architecture in the branding process.*

Markalaşma Sürecinde Mimarinin Önemi: Ünlü Bir Marka Üzerinden Değerlendirme

Öz

Markalaşma kavramı ile yakından ilişkili olan marka kavramı, pazarlama sektöründe bir ürünün tasarım aşamasındaki vizyonunu ve kimliğini ifade etmektedir. Bir markanın kimliğini tanımlamanın en etkili yolu onun üç boyutlu algısından geçer. Markanın vitrini görevini gören mimari mekân, ürünün ilk algılanışını görsel olarak sunması açısından önem taşımaktadır. Bu çalışma, dünyaca ünlü bir çanta firmasının markalaşmasına yön veren ürün tasarımı ile mekânsal tasarımı arasındaki etkileşimi gözlemsel analiz yöntemini kullanarak incelemektedir. Yıllardır klasik çizgisini korumasına rağmen saygın çanta markası, 2019 yılından itibaren fütüristtik modellere de yer vererek dikkatleri üzerine çekmeyi başarmış ve bu sayede imajını tazelemiştir. Çalışma, kurumsal kimliği yansıtan mimari tasarım kriterlerinin incelenmesine odaklanmaktadır.

Anahtar kelimeler: *Markalaşma, mimari tasarım, fütürizm, markalaşma sürecinde mimarlık.*

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1. Introduction

The term "brand" has its origins in the act of "branding" to mark with red-hot iron or coral those deemed to be sinners, or to identify animals in animals. In the modern sense, the definition of brand has been made by the American Marketing Association. According to this definition, the brand is the name, term, sign, symbol, or combination of these used to define the goods or services and distinguish them from their competitors (İşcan, 2011).

Etymologically, the word "brand" is used in German as "Marc" meaning borderline, in French as "Marque" meaning product mark, and in Anglo-Saxon languages "Brand" - "Branding" meaning sign - burning. The transition of the "brand" to Turkish as a term came from the Italian "Marca". It has passed into Italian from the English word "Mark", meaning sign (Sağlam, 2019).

According to famous marketing guru Don Schultz, the brand is a summary of who created it, what they want to do, and how they want to do it. It contains the mission, product, goals, values, and promises of the institution that created it in the brand (Additional Booklet Capital Journal, 2004, p. 45). In a sense, the brand is the spirit and meaning that surrounds the product.

1.1. Brand Identity

Brand identity serves as a framework that helps determine the meaning, orientation, and purpose of the brand and encompasses the brand in all its aspects. It is about creating a strong brand and designing and executing an accurate and effective brand identity. The brand identity reflects the brand's spirit, vision, and what it hopes to achieve (Sevil, 2006).

1.2. Brand Personality

The concept of brand personality was expressed by Aaker as "the identification of human characteristics with brand attributes." Brand personality refers to the brand's behavior resembling that of a person and being perceived as possessing specific personality traits. This approach helps brands establish an emotional connection with consumers. Brand personality represents human traits associated with the brand's values, features, tone, communication style, and behavior. Thus, brands can create a unique identity, foster a deeper connection with consumers, and have a positive impact on the target audience (Aaker, 2009, p. 159). In addition, brand personality encompasses elements such as trust, care, excitement, inspiration, and core values, which are also found in human personalities (Ar, 2004, p. 74). In Aaker's work titled "Dimensions of Brand Personality" published in 1997, brand personality dimensions were identified as sincerity, excitement, competence, sophistication, and ruggedness (Aaker, 1997, p. 352).

1.3. Brand Image

According to Turley & Milliman (2000), brand image is defined as "the altered state of the totality of information that consumers derive from their experiences, hearsay, advertisements, packaging, and services related to a brand, influenced by selective perception, prior beliefs, social norms, and forgetting". Based on this definition, brand image is a concept that reflects consumers' perceptions, biases, and experiences related to a brand. Consumers' selective perceptions, prior beliefs, and social norms play a significant role in the formation of the image as they process information about the brand. Additionally, the process of forgetting indicates that brand image can change over time.

Brand identity, as a strategic planning framework, can design and control marketing communication decision mechanisms. In terms of brand management, brand identity is placed before the image. Brand image refers to the result of perceptions in consumers after these practices and decisions (Salzer-Mörling & Strannegård, 2004).

2. The Relationship Between Brand and Architectural Space

The brand is an effective marketing tool that symbolizes the current state of a space. For a place to exist with its brand in the future, it should be equipped with visually effective but strategically realistic details. Thus, these spaces become permanent and different for the targeted audience (Allan, 2004).

As a concept, the idea of space emerged in the early 1990s as a joint initiative of branding, interior architecture, and marketing. Interior architecture and marketing professionals have realized the effective role of space on brand perception because space serves to perceive the brand in three dimensions. The three-dimensional brand experience plays a vital role in the perception of customers and spokespersons of the brand. The effect of perception on the customer is long-term (Kemp et al., 2012).

In architecture, the concept of place is positioned in contrast to the objectifiable, measurable, and quantifiable notion of space in modern architecture. Therefore, the place carries a meaning that goes beyond the abstract frameworks of function, geometry, and program associated with space. The place is concerned with the meaningful world that emerges through the direct experiential relationship between individuals and the external environment (Koçyiğit, 2022, p.763).

With the rapid increase in consumer culture, spaces are becoming communication areas where brands can directly convey the messages they want to deliver to their users. Brands can present their products in a more striking and unique way by reflecting their identities in these spaces. The user's perception of a product is shaped by their perception of that product. Design plays a significant role in shaping user perception because visual differentiation is revealed through design (Çatak Oylum, 2014).

Therefore, space design plays a key role in creating customer perception of a product. The design allows the product to communicate with the customer and paves the way for differentiation. Here, space emerges as a visual communication platform.

2.1. Space Design and Brand

Space is an extremely broad concept that encompasses a variety of variables. In the retail sector, space can be understood as a 'commercial space.' The design of commercial spaces holds significant importance in managing customer perception. Given that many customers make purchasing decisions while in the store, the significance of the physical environment increases. Therefore, the store becomes a public space. The perception aspect of the store concept is a crucial topic of discussion when it comes to understanding the branding of the space. The perception of space is shaped through experiences, and the design plays a significant role in this process (Dağlı Curalı, 2019).

The fundamental requirements of branded spaces are listed as follows:

- Determining the needs, preferences, habits, and desires of the target audience.
- Creating a unique experience that aligns with the brand's positioning.
- Considering visual, auditory, olfactory, tactile, and thermal criteria related to the space.
- Understanding the psychological impact of light and light sources and considering energy efficiency whenever possible.
- Addressing the organization's needs to fulfill the brand objectives.
- Creating a sustainable, durable, easy-to-maintain, and clean space (Wheeler, 2017).

2.2. Space and Perception

The relationship that individuals establish with their surroundings can be regarded as perception. Perception reflects the equilibrium that humans establish with their environment (Aydıntan, 2001).

In its broadest sense, interior perception refers to the communication and interaction between individuals and the space they inhabit. Within the interior, individuals position themselves based on what they see, thereby creating their perception of that space. In the process of shaping interior perception, interior architecture and graphic design play a prominent role. The objective is to shape the customer's perception of the store's identity and image, wherein interior design components significantly influence the user's perception (Dağlı Curalı, 2019).

During the interior design process, it is essential to consider several design criteria, such as determining the brand image and its relationship with the user, identifying the brand's identity and image components, and deciding whether the store's design should be lean, mixed, or intensive (Figure 1).

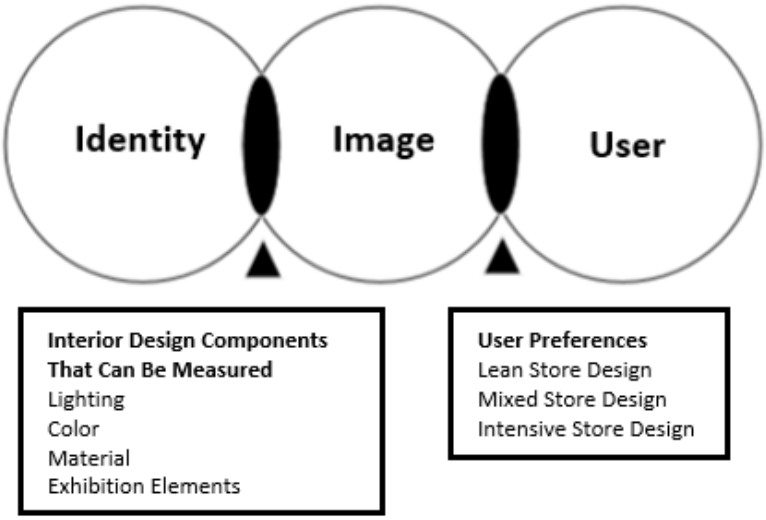

Figure 1. Interior design components (Yıldırım, 2015)

To create a distinct atmosphere in a space, brands leverage various parameters, both interior and exterior, as well as the arrangement of products and furnishings within the store. In the process of designing this experiential narrative, the selection of elements that align with the store's story and the message it intends to convey to users becomes a crucial criterion (Table 2).

The choice of location features that influence the brand image varies depending on whether the store aims to project a prestigious or discount image. This factor causes the selected criteria to differ.

Table 1. Product and furnishing order in the store with internal and external variable parameters (Turley & Milliman, 2000)

External Variable Parameters	Internal Variable Parameters	Product and furnishing orders in the store
Exterior View,	Indoor flooring,	Interior Design,
Entrance Gate,	Indoor Ceiling Material,	Product placement,
Building Size,	Lighting,	Circulation,
Shape of the Store,	Colors,	Full-empty areas,
Color,	Texture,	Case layout,
Windows,	Surface,	Space Composition
Exterior Cladding,	Sound,	Movement,
Location of the Building,	Heat,	Measure,
Form.	Lighting,	Proportion and scale.
	Material.	

Differences can also be observed among diverse types of spaces, which are influenced by factors such as ambiance, design, and social elements (Table 2).

In a study conducted by Yıldırım (2015), "prestigious" stores were categorized as "lean stores," whereas "prestigious (discount) stores" were classified as "busy stores" (Yıldırım, 2015).

Table 2. Space features that affect the brand image (Baker et al., 1994)

Parameters Ambiance	Prestige Stores	Discount Stores
Music	Classical	Top 20
Lighting	Soft	Bright
Design		
Floor Covering	Carpet	Concrete
Wall	Texture	Paint
Exhibition space	Decorated	Clear
Color	Gold, silver, black	Mixed
Ceiling	Gypsum Board and Decorative	Paint
Dressing Rooms	Special	Semi Private / No
Corridor	Large	Narrow
Scheme	Free layout	Angled

When considering the factors that influence the brand image in the categories of prestige and discount stores, it becomes evident that all parameters, including music and lighting, vary to align with the desired ambiance of the space.

In addition to the factors directly related to the brand image, certain elements that contribute to the overall ambiance must be carefully considered. These include aspects of the store's physical environment such as ventilation, temperature-humidity control, and noise management. Furthermore, architectural aesthetics play a significant role, with factors such as color selection, materials, details and accessories, material textures, comfort conditions, and functionality being the most prominent considerations (Baker et al., 1994).

3. Material and Method

The world's luxurious brands, particularly renowned for their iconic bag patterns, have established themselves as leaders in luxury consumption by offering a range of products such as ready-to-wear clothing, shoes, bags, watches, jewelry, and accessories. The present study utilizes an observational analysis method to examine the brand's space design.

The study focuses on the commercial areas where a well-known brand has been highlighting its products since 2019. It examines the impact of renovation and attention-grabbing efforts on the architectural design of the renowned bag brand, which has maintained its classic aesthetic for many years. The objective of this investigation is to identify the design criteria that effectively reflect the brand's corporate identity.

To that end, the study holds particular significance in terms of architectural ethics, as it addresses a fundamental design criterion for constructing commercial spaces with high brand value. It endeavors to create a design guide by exploring various aspects such as color, texture, surface, illumination, materials, occupancy space, space composition, structural location, movement, shape, size, ratio and scale, heat, and sound.

4. Findings and Discussion

Futurism became the first established art movement with defined rules, boundaries, and attitudes through the publication of the "Futurist Manifesto" by F.T. Marinetti in 1909. Additionally, this movement possesses the distinction of being named and recognized on the day it emerged, making it the first of its kind. Its significant characteristic lies in its glorification of modern technology,

mechanization, speed, violence, and destruction, almost deifying them, while simultaneously belittling Western civilization and its art (Akalın, 2019).

Futurism, an art movement that emerged at the beginning of the 20th century, embraces new life and technology as its subject. It focuses on movement and dynamism while aiming to challenge traditional rules. Futurism is rooted in a belief in a longing for the future and the continuous advancement of technology (Sant'Elia & Marinetti, 1991).

By placing the concept of speed at the core of their artistic approach, futurists equated modernity with the notion of speed. This association allowed them to develop a more distinct and revolutionary understanding of change and perception compared to many of their contemporaries (Sarıgül, 2008).

Technology holds a significant role in futurism. Futurists advocate for the use of materials such as reinforced concrete, iron, glass, cardboard, woven fibers, and other lightweight derivatives instead of traditional materials like wood and stone. This emphasis on flexibility and lightness is accompanied by a deliberate utilization of technology in their architectural designs (Figure 2).

Futurists place the concept of increasing speed, facilitated by modern technology, at the core of their ideology and artistic approach (Sant'Elia & Marinetti, 1991).

Figure 2. An example of futuristic architecture, Kunsthaus – Graz, Austria (Çay, 2014)

Futurism also extends to fashion design, encompassing predictions and visions of clothing styles that are yet to be adopted. Fashion designers, with their unique perspectives and creative abilities, embody future developments, changes, and inventions through their designs of futuristic clothing (Figure 3) (Öztürk, 2018).

Figure 3. Futuristic fashion examples (Öztürk, 2018)

The brand, analyzed within the scope of the study, ventured beyond its traditional style in 2019 and created a futuristic collection named '2054'. This collection depicted a glimpse of what the fashion house envisioned for the future, imagining the brand's progress 200 years after its foundation. The contemporary collection highlighted futuristic production techniques, prominently featuring 3D fabrics, metallic reflections, and monogram patterns. The brand incorporated the latest innovations in fabrics and materials to bring these elements to life (Altıntaş, 2021).

The brand adopts a futuristic approach in its design, while simultaneously preserving its classic monogram patterns. It began by incorporating this concept into a bag model and subsequently extended the idea across all its products. Importantly, the brand also implemented this futuristic theme throughout its entire commercial space, which serves as a representation of the brand's identity (Figure 4).

(a) The brand's classic bag model (left); **(b)** Bag model designed for futurist current (right)
Figure 4. Classic model and the new model (3d model made by the author)

Until the new collection design in 2019, the brand maintained the same architectural style for almost 200 years. However, it garnered attention with its new architecture, which complemented the collection, in 2019. The study analyzed the brand's longstanding classical architectural examples, which have been in existence for years (Table 3).

Table 3. The classical architectural examples of the brand

Building No	**A**	**B**	**C**	**D**
Building Photo				
Build Date	2005	2010	2010	2012
Location	Paris, France	Stockholm	Rome	Lugano, Switzerland.
References	(Moveandstay, 2019)	(123RF)	(123RF)	(Abloh and Ghesquiere, 2020)
Building No	**E**	**F**	**G**	**H**
Building Photo				
Build Date	2012	2013	2014	2016
Location	Beverly Hills, CA	Barcelona, Spain	Milan	Sydney, Australia
References	(123RF)	(123RF)	(123RF)	(123RF)

As depicted in Table 3, it is evident that the brand's building designs exhibit variations depending on the location, yet they maintain a classical architectural style. The brand tends to utilize plain colors and opts for materials such as stone, brick, and glass. As an architectural style, the brand incorporates elements like columns that accentuate the historical architecture of the region, as well as arched windows and doors.

While all the examined samples reflect the classical period, different architectural designs are evident in various regions. For instance, the store facade in Stockholm, constructed in 2010, features an arched design with brick as the chosen material. On the other hand, the store building facade in Rome, also built in 2010, showcases a columnar style using stone material. Examining the example in Beverly Hills from 2012, it is apparent that the facade reflects the historical architecture of the region, incorporating glass elements. The choice of materials and architectural features vary depending on the location, while still adhering to a classical architectural style.

The interiors of the examined classical architectural examples are designed to complement the facades. Predominantly using brown and white colors, the interiors adopt classical interior architecture. The selection of materials is in line with the classical style.

The brand analyzed in the scope of the analysis took a significant departure from its classical style in 2019 by introducing a futuristic collection called '2054'. Consequently, the brand embraced a futuristic architectural approach, demonstrating an innovative pursuit by completely replacing the classical architecture that had been employed in its buildings for nearly 200 years. This futuristic approach, adopted in 2019, not only manifested in the building facades but also extended to the store interiors. By designing a cohesive composition across its commercial venues, the brand aimed to narrate its story and draw attention to the futuristic approach showcased in its new collection. Table 4 examines the examples illustrating the futuristic approach embraced by the brand in 2019.

Table 4. The brand's 2019 futuristic examples

Building No	**1**	**2**	**3**	**4**
Building Outdoor Photo				
Build Date	2019	2019	2019	2019
Location	Paris, France	London	Chicago	NYC
References	(Astbury, 2019)	(Levy, 2019)	(Miller, 2019)	(123RF)
Building Interior Photo				
References	(Astbury, 2019)	(Levy, 2019)	(Miller, 2019)	(123RF)

Building No	**5**	**6**	**7**	**8**
Building Outdoor Photo				
Build Date	2019	2019	2019	2019
Location	Beverly Hills - United States	London, U.K	Taipei, Taiwan	Soho, NYC
References	(Başaran, 2019)	(123RF)	(Maison)	(Miller, 2019a)
Building Interior Photo				
References	(Başaran, 2019)	(Stock Editorial Ph., 2018)	(Louis Vuitton, 2019)	(Miller, 2019b)

As observed from the examples presented in Table 5, each store was meticulously designed, creating a harmonious composition between the interior and exterior spaces. When analyzing the architectural designs of the stores, it is apparent that they maintain the architectural style portrayed on the facades within their interiors. However, it is noteworthy that the architectural style may vary from region to region, reflecting the local context and influences.

The futuristic architectural approach adopted in 2019 established a set of fundamental design criteria that are crucial when creating commercial spaces with high brand value. These design criteria encompass aspects such as color, texture, surface, lighting, composition, shape, material, movement, ratio, and spatial fullness. The purpose of individually evaluating these criteria through the examined examples is to create a design guide for future studies. To achieve this, the structures listed in Table 4 were cross-referenced with Table 5 to assess whether the design criteria, which are essential for each building, were met.

Table 5. Evaluation of the design criteria of the examined samples

Building No	Design	Design Criteria									
		Color	Texture	Surface	Lighting	Composition	Form	Material	Movement	Ratio	Full-Empty
1	Interior		√	√		√					
	Exterior					√	√	√	√	√	
2	Interior	√			√	√		√	√		
	Exterior	√				√			√		√
3	Interior	√				√		√		√	√
	Exterior	√				√		√		√	√
4	Interior	√				√		√			
	Exterior	√				√		√			
5	Interior	√		√	√	√					
	Exterior	√				√			√	√	√
6	Interior	√		√		√		√			
	Exterior	√		√		√	√	√			
7	Interior				√			√			
	Exterior	√		√			√		√	√	
8	Interior	√		√	√	√		√	√		
	Exterior		√	√	√	√				√	

Upon examining the numbered sample structures in relation to the design criteria, it becomes evident that the color criterion plays a prominent role in the perception of the brand's stores, reflecting the futuristic approach. However, in example one, the color criterion did not stand out as much compared to the other examples. This can be attributed to the store's location in Paris, as well as the architectural design of the building by Frank Gehry. In this case, the architect's signature, and integration of the space with the architect's brand took precedence over highlighting the brand's commercial space. The brand's strategy was to emphasize the commercial space by enlisting the services of a renowned architect for the design.

It is apparent that the texture criterion, as one of the design criteria, is evident in two examples. The reason for this is that these examples aim to convey a specific narrative by multiple colors, materials, lighting, and other criteria. It is observed that suitable interior and exterior compositions were designed for all examples except the seventh building. The absence of this composition in the seventh building is attributed to its location within a shopping center, where the interior reflects the old classical architecture while the exterior is designed in accordance with the intended fiction.

The variation in the occupancy-void ratios on the building facades or in examples where the color criterion is most prominent can be attributed to the specific location of each building. While the brand aimed to rebrand the buildings with an innovative style, the regional architecture was also deemed significant. For instance, in the fifth example, the differentiation in lighting and surface selection on the facade is primarily influenced by the building's location in Beverly Hills. It was intended to create a desired composition that also harmonizes with the surrounding buildings.

Examples 3 and 4 demonstrate the differentiation of stores reflecting the brand due to their specific building locations. Located in Chicago and New York, respectively, these examples highlight the

exaggeration of the color criterion both indoors and outdoors. The emphasis on the brand's new collection is achieved by accentuating the color criterion and selecting materials that align with this criterion in the commercial space.

5. Conclusion and Suggestions

The globalization of the world economy, driven by unstoppable market forces, has led to the emergence of new and inevitable concepts in spatial design. One such concept, introduced in architectural literature, is the branding of space. In the pursuit of economic development and competitiveness, the branding of spaces has become crucial, as it transforms spaces into venues that capture attention with their distinct qualities and specializations. In order to thrive in a competitive environment and enhance performance and competitiveness, brands have adopted the concept of "branding of spaces," which has been adapted from the business jargon and integrated into the architectural discourse.

A brand is a distinctive combination of elements such as a name, word, symbol, design, sign, shape, color, or their combinations, utilized to identify and differentiate goods and services offered by a seller or group of sellers in the market. When it comes to space, it comprises both tangible aspects (such as the interior, facade, etc.) and intangible elements (such as values, image, identity, etc.) as a product. The target audience can positively or negatively perceive these components.

In the process of branding space, there are multiple stakeholders involved, including various institutions, and it encompasses the diverse perceptions of different target groups. Compared to marketing products or services, location branding is considerably more intricate. This complexity underscores the need to adhere to the principles of corporate branding rather than product or service branding within the realm of space branding literature.

The brand, which has maintained its classical architectural style for years, has embarked on a renovation to highlight its new futuristic models with the designs created in 2019. The examples of the futuristic architectural approach in the stores, reflecting the brand's corporate identity, are assessed based on fundamental design parameters.

When branding a space, key design criteria in architectural design include color, texture, surface, illumination, composition, shape, material, motion, ratio, and occupancy space. These parameters may vary depending on the location of the building. While ensuring that the samples align with the surrounding context, the planned composition is kept within defined boundaries.

From the examples, it is evident that the most important criterion in space branding is to achieve the desired composition in the design, both indoors and outdoors, which effectively communicates the intended message to the users.

Indeed, the relationship between branding and architecture is a significant topic that warrants further study and development. It is directly intertwined with the realms of marketing and architecture, with implications for both disciplines. Understanding and exploring this relationship can provide valuable insights into how brands can effectively communicate their identity and values through architectural design, as well as how architecture can contribute to the overall branding strategy.

Branding plays a crucial role in the marketing world, helping to differentiate products, services, and organizations from competitors. Architecture, on the other hand, provides the physical framework and spatial experience in which brands exist and interact with their target audience. The design of spaces, buildings, and environments can contribute to brand recognition, evoke specific emotions and associations, and create a unique and memorable brand experience.

By studying the relationship between branding and architecture, researchers and practitioners can uncover innovative approaches and strategies for creating cohesive and impactful brand identities. This may involve examining how architectural design elements can reflect brand values and personality, exploring the role of spatial experiences in shaping brand perceptions and investigating the influence of branding on architectural decision-making processes.

Overall, the study and development of the relationship between branding and architecture hold exciting potential for enhancing both fields and fostering innovative and effective approaches to brand communication and spatial design.

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All authors contributed equally to the article. We hereby declare that there is no conflict of interest.

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Discovery Process of the Zeytinburnu Mosaics Outside the City Walls

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Abstract

The Zeytinburnu Mosaics outside the City Walls were revealed between 2017 and 2020 on a lot belonging to the Kazlıçeşme Art Center which has been serving since 2019 in the Kazlıçeşme District of Zeytinburnu Region of Istanbul. The oldest documented data belonging to the Art Center goes back to the year 1828. At that time, the building was used as a military hospital of the Ottoman Era while later on during the Republic Era, it served as a dormitory, and military office and in 1956 was converted into a public bazaar hall. The building was transferred to Zeytinburnu Municipality property in 1984. During the restoration works of the 'Mayor Building' in 2015, Zeytinburnu Mosaics were discovered in the foundation blocks of the main part of the municipality building and around the area used as a carpark. The revealed findings are important for enabling additional data on historical-archeological features of Istanbul outside the City Walls.

Keywords: *Zeytinburnu mosaics, conservation, protection.*

Sur Dışındaki Zeytinburnu Mozaiklerinin Ortaya Çıkarılma Süreci

Öz

Sur dışında yer alan Zeytinburnu Mozaikleri; İstanbul ili, Zeytinburnu İlçesi, Kazlıçeşme Mahallesi, 2019 yılında Kazlıçeşme Sanat Merkezi olarak faaliyete geçen binaya ait parselde 2017-2020 yılları arasında yapılan kazı çalışmaları sonucunda ortaya çıkarılmıştır. Günümüzde Kazlıçeşme Sanat Merkezi olarak kullanılan yapıya ait en eski kayıt, 1828 yılına aittir. Belirtilen tarihte Osmanlı Devleti Dönemi'nde askeri hastane olarak kullanılan yapı, Cumhuriyet Dönemi'nde ise sırasıyla yurt, askerlik şubesi ve tanzim satış yeri olarak 1956 yılında yeniden işlevlendirilmiştir. 1984 yılında Zeytinburnu Belediyesi bünyesinde kullanılan yapının, 2015 yılında gerçekleştirilen restorasyonu sırasında 'Başkanlık Binası' olarak işlev gören ana kısmının temellerinde ve yapıya bitişik alanda yer alan otoparkta, 'Zeytinburnu Mozaikleri' ortaya çıkarılmıştır. Ortaya çıkarılan buluntular, İstanbul'un sur dışı tarihi-arkeolojik özellikleri hakkındaki literatüre katkı sağlamak bakımından önemlidir.

Anahtar kelimeler: *Zeytinburnu mozaikleri, konservasyon, koruma.*

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1. Introduction

Protection of the collections in cultural heritage buildings is as important as protection of cultural heritage itself (Tarım & Ünal, 2022). Buildings are architectural values that constitute cultural identity and urban memory. Buildings and other cultural values shape the historical fabric and constitute cultural heritage (Temur & Kurak Açıcı, 2022). The subject of this study, Zeytinburnu Mosaics, are the floor mosaics that were revealed during the excavations between 2017 and 2020 in the vicinity of the former Municipality Building of Zeytinburnu. The mentioned mosaic patterns were discovered in the foundation blocks of the main part of the municipality building so-named 'Mayor Building' and around the area used as carpark. The discovery was made during the restoration implementations of the municipality building in 2015. The patterns were located very close to the Via Egnatia (Figure 1).

Figure 1. The Via Egnatia beside the Adriatic Sea, reaching Durras from Istanbul (Viaeurasia, 2023)

The Via Egnatia (Greek: Ἐγνατία Ὁδός) is a road of approximately 1120 km long which was constructed by the Roman Empire in the 2nd century BC. The traces of the road, which used to pass through Iliria, Macedonia, and Thracian regions of the Roman Empire, might be currently seen in Albania, Macedonia, Greece, and Turkey lands. The road was constructed for the purpose of linking the Roman colonies starting from the Adriatic Sea and reaching the Bosphorus. The last part of the Via Egnatia is in Istanbul, starting from Durras of Albania and passing Thessaloniki. In this context, the revealed Zeytinburnu Mosaics has significance due to being located outside the City Walls of Istanbul yet being located very close to the last part of the Via Egnatia.

The mosaics, which are considered to belong to the Late Roman, and Early Byzantine Era, are differentiated from similar ones because of are located outside the City Walls of Istanbul. Most of the mosaic patterns inside the borders of the City Walls were revealed during the excavations and taken under protection after the 1935 Republic Era.

Even though there have been some clues about the existence of mosaics outside the City Walls depending on the ones revealed inside the Walls, there have been no detailed excavations outside the Walls. The reason for this might be the existence of historical Ottoman buildings under protection around the district.

This study handles the revealing process and features of the mosaic patterns that used to be placed on a lot of the Ottoman Era building -has been functioning as Kazlıçeşme Art Center since 2015- in Kazlıçeşme District of Zeytinburnu Region of Istanbul. The exact location is as 86 sheet number, 756 block number which is placed outside of the City Wall no 2.

The excavation process started with the discovery of some partial mosaics during the reinforcement of foundations of the corner room southwest of the Old Municipality Building from the Ottoman Era and was completed under the inspection of the Directorate of Archeological Museums of Istanbul

depending on the permission taken from the Directorate of Conservation Board by Zeytinburnu Municipality (Figure 2).

Figure 2. Revealed mosaics from excavations in Zeytinburnu, 2017-2019 (Zeytinburnu Municipalit Archives, 2019)

Mosaic means the arrangement of figurative, geometric, and herbal patterns in harmony consisting of hard materials such as colored stone, glass, terra cotta, and marble. It is an architectural element used for the cladding of floors, walls, and ceilings and has represented wealth in ancient history (Şahin, 2004).

Floor cladding mosaic patterns inside the City Walls of Istanbul have been discovered now and then which are similar especially to the ones in the Mosaics Museum of Byzantium Palace (Yücel, 2019).

2. Material and Method

The Zeytinburnu mosaics, as the subject of the research survived till the present despite several reasons such as the building/s on top, ground movements, and layers of soil of different eras which caused the mosaics partial collapsing, cracking, material missing and destruction along certain axes during road infrastructure works.

The methodology of the research is the site research among the quantitative ways. Following this method, observation on-site and comprehensive historical research were carried out. Content analysis was preferred for the research in which the historical analysis method was used. Regarding the method; the steps of scanning, classification, analysis, critiques, and synthesis are followed accordingly.

As for the detailed examination of culturally, socially, and economically important mosaics of Zeytinburnu, a documentation analysis was made on the region including the Via Egnatia of which we have less information compared to the part inside the Walls and thus the scanning step was achieved.

During the second step of the research, the data collected was classified according to the space, time, and subject references.

During the third step of the research, the mosaics were observed in-situ to have a closer look at the revealing process. In this context; regarding the conservation steps of the mosaics, after stating the situation, simple cleaning and documentation practices took place step by step. Afterward, a deterioration legend was arranged.

Before the inspection of mortar and movement of the cut plates, a pre-reinforcement way of fixing the parts under risk with the help of cloth was carried out, avoiding any damage to the mosaics.

The conservation process of Zeytinburnu mosaics was completed following the steps of removing the soil on top (10-20 m depth of sand and gravel layers) (Çömlekçi & Kahraman, 2022), designing the grid system of the plates, implementing of facing, moving, conservation methods and re-placement of the mosaics to the original locations. All conservation steps were taken according to the critiques

of the conservation report of the Directorate Central and Regional Restoration and Conservation Laboratory of Istanbul (Figure 3, 4, 5).

Figure 3. Conservation steps of Zeytinburnu Mosaics (Olcay Aydemir Archives, 2019)

Figure 4. Moving the mosaics after reinforcement and numeration to store them under protection during the conservation implementations (Olcay Aydemir Archives, 2019)

Figure 5. Conservation steps of Zeytinburnu Mosaics (Olcay Aydemir Archives, 2019)

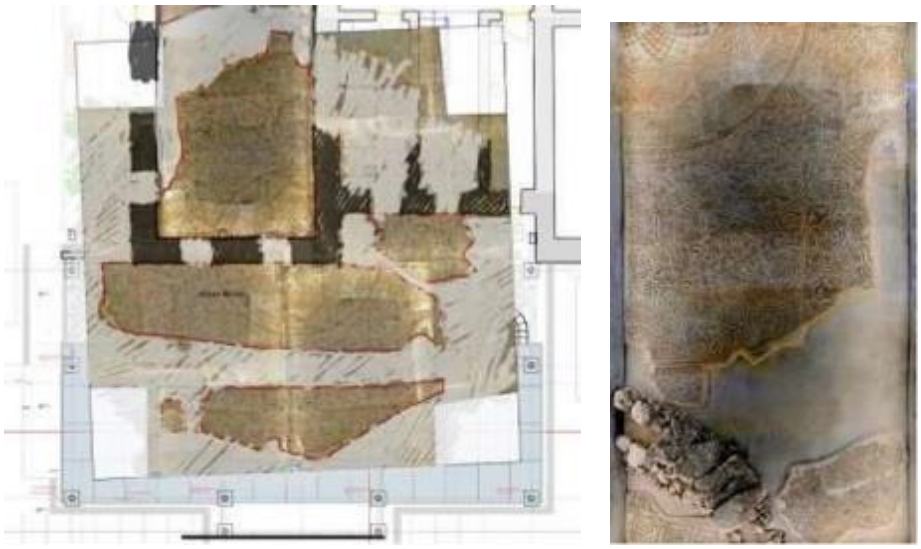

Figure 6. Interiors of Zeytinburnu Mosaics (Zeytinburnu Municipality Archives & Sketches of Celalettin Çelik, 2019)

3. Findings and Discussion

Zeytinburnu Mosaics are formed of geometric patterns on a mortar layer (of which analysis process is completed) which are an arrangement of triangles colored white, green, yellow, black, brown, orange, and red. Besides the assumption of the 5th-century date in terms of technical observation, it was understood that they belonged to the 5th-6th century during the excavations and depending on the coin of the 5th century found inside the foundation walls (Figure 7). In the following process, the floor mosaic plate was dated to the 4th century AD. The floor mosaics of Istanbul are dated from the 2nd century till the 6th century which are rarely discovered (Yalçın, 2022).

They were designed in the Opus tessellatum technique and as polychromed. An octagon main pattern is located in the center inside of a circle with borders of waves and braids. The composition is enriched with the surrounding node patterns of the main pattern, triangle and square combinations, and geometric patterns located inside the circles. Floral patterns are formed with green, orange, and purple triangles on a light background inside the circle in the octagon. Among the node patterns outside the main composition; patterns of cantharus, creeper, lotus, and clover are observed. Somolon's Node patterns are also observed (Çömlekçi & Kahraman, 2022).

Similar to those mosaics are the ones of Tivoli villa mosaics at the National Rome Museum and Dionysus villa mosaics in Knossos. Depending on this data, it can be considered that the Zeytinburnu Mosaics might belong to a villa as well. The mosaics were decided to be exhibited by in-situ protection method which was discovered during the restoration works of Kazlıçeşme Art Center (Kazlıçeşme Sanat, 2023).

Figure 7. View of vivid colored tessera modules after the cleaning (Zeytinburnu Municipality Archives, 2022)

Figure 8. The completed and exhibited part of the mosaics (Sibel Hattap Archives, 2022)

Figure 9. Exterior exhibition works of mosaics at Kazlıçeşme Art Center (Sibel Hattap Archives, 2022)

After completion of the excavations, the cleaning and conservation works were carried out and the mosaics were replaced for the exhibition and that part of the building was arranged as a museum (Figure 10, 11).

Figure 10. Current view of Kazlıçeşme Art Center (the exterior exhibition part) where the mosaics are exhibited (Sibel Hattap Archives, 2023)

Figure 11. Exhibition of the rest of the mosaics at semi-open part of the building (the exterior exhibition part) (Sibel Hattap Archives, 2023)

Figure 12. Exhibition of the circular forms of the mosaics at semi-open part of the building (the exterior exhibition part) (Sibel Hattap Archives, 2023)

4. Conclusion and Suggestions

The Zeytinburnu Mosaics are a collection of mosaics of approximately 400 m^2 which were revealed during the excavations inside a cultural heritage asset building. During the primary excavations, estimated data was revealed regarding the planning scheme, features, and construction date of the building whilst the following excavations gave more solid data regarding the entire building. The circular form of the building (Figure 12) and the design date of the mosaics depending on the coin were more likely to be estimated. The discovery of Zeytinburnu Mosaics helped to realize that there might be some serious heritage outside of the City Walls of Istanbul. These mosaics took their place in literature as physical evidence of inhabitance on the Via Egnatia. Hopefully, more urban areas are going to be discovered and documented outside the Walls in the future with the careful approach of local administrations and establishments.

Considering the mosaic samples all over the world, this important discovery succeeded in attracting locals of Zeytinburnu and Istanbul as well as local and foreign tourists. The discovery of mosaics in Zeytinburnu apart from the ones of the Great Palace Mosaics Museum, the magnificent mosaics of the Chora Mosque, and the mosaics of the Hagia Sophia has high importance in terms of the potential of cultural heritage assets and urban inhabitance. It is observed that the exhibited parts of Zeytinburnu Mosaics do not represent scenes of daily life or religious issues but mostly geometric patterns.

The rest part of the mosaics was also revealed and after the conservation steps, they were exhibited in a semi-open area. It is very precious and remarkable that some of the mosaics revealed in Zeytinburnu are exhibited in In-Situ at Kazlıçeşme Art Center which served as a military hospital and then as Zeytinburnu Municipality Building while the rest are exhibited under a semi-open structure outside the building as continuity of the interior ones.

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The article complies with national and international research and publication ethics. Ethics Committee approval was not required for the study.

Author Contribution and Conflict of Interest Declaration Information

Both authors contributed equally to the article. There is no conflict of interest.

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On Convex Space: Example of an Indoor Ski Center

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Abstract

This study, which examines the relationship between spaces within indoor ski centers, aims to investigate the effectiveness of spatial syntax in spatial organization. The study utilized spatial syntax as a qualitative research method. The floor plans of indoor ski centers were evaluated in two dimensions using a program called DepthmapX, which generated representation maps, enabling access to spatial data from these maps. The aim of this study is to emphasize the necessity of classifying spaces within indoor ski centers that exhibit different features in their layout arrangements. The findings and criticisms obtained from this study also serve as recommendations for researchers and designers. The study evaluated the relationship between the organization of space and the shell that determines the boundaries of the space from the perspective of space syntax. It also demonstrates that this method can be effectively used in the design of indoor ski centers. This method can be employed in future studies to meet user needs, circulation, and promote sustainability in the design of indoor ski centers.

Keywords: *Form, spatial organization, space syntax, convex space.*

Konveks Mekân Üzerine: Kapalı Kayak Merkezi Örneği

Öz

Kapalı kayak merkezlerini diğer yapılardan ayıran nesnel özellikleri kapsamında barındırdığı mekânlarını inceleyen bu çalışma; mekân organizasyonunda mekân dizimi yönteminin etkenliğini aramaktadır. Nitel bir araştırma yöntemi olarak bu çalışmada var olan mekân dizimi, kapalı kayak merkezi yapılarının tasarım değerlendirmeleri için kullanılmıştır. Söz konusu merkezlerin kat planları DepthmapX isimli programda iki boyutlu olarak değerlendirilerek temsil haritaları üretilmiş ve bu haritalar üzerinden mekânsal verilere ulaşılmıştır. Bu çalışmanın amacı, kapalı kayak merkezlerinin yapısal öğelerini anlamak ve doğru bir şekilde sentezlemek için bu merkezlerin yerleşimlerinde farklı özellikler sergileyen öğelerin doğru bir şekilde sınıflandırılmasının gerekliliğini vurgulamaktadır. Bu çalışmanın elde ettiği bulgular, kapalı kayak merkezi tasarımları için eleştirel bir araştırma sunmaktadır. Aynı zamanda da araştırmacılar ve tasarımcılar için bir öneri niteliği taşımaktadır. Mekân organizasyonu ile mekânın sınırlarını belirleyen kabuğun ilişkisini mekân dizimi perspektifinden değerlendirmiştir. Araştırma kapsamında incelenen iki merkez, mekân dizimi yönteminin kapalı kayak merkezi tasarımlarında etkili bir şekilde kullanılabileceğini göstermektedir. Bu yöntem, kullanıcıların ihtiyaçlarını karşılamak, güvenliği sağlamak, akışı optimize etmek ve kaynakları verimli bir şekilde kullanmak için de ileriki çalışmalarda kullanılabilir.

Anahtar kelimeler: *Biçim, mekân organizasyonu, mekân dizimi, konveks mekân.*

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1. Introduction

The design of a space is primarily concerned with the form of the space in parallel with spatial evaluations. Therefore, the design of a space encompasses the characteristics of the space's geometry. Just as forms come together in a cohesive manner, the proper alignment of a space's form with its function cannot be overlooked for the emergence of a space as a product. This study advances through analyses conducted to examine the coming together, coexistence, and formation of spaces resulting from the combination of forms, aiming to define the conceptual and theoretical boundaries of the emerged formal structure.

For social and economic needs, the disciplines of design and planning seek solutions to the technical and aesthetic requirements of spaces. The idea of creating an open and large-scale activity area within an enclosed space leads to spatial fragmentation, while also necessitating the exploration of the evolving requirements of structures that exist from the beginning of the design process and emerge over time.

This study aims to evaluate indoor ski centers, which are artificial snow-covered areas designed and planned by humans, instead of naturally snow-covered mountains, with increased resistance against melting. The evaluation is based on specific criteria to provide usable data for development practices. The study will include the identification of the formal and dimensional characteristics of the space, primarily focusing on physical attributes, in accordance with spatial organization requirements and towards environmental character and visual assessments. In this context, the spatial organization of the indoor ski centers within the scope of the study is examined through the method of space arrangement, and evaluated based on the analysis of convex space, which is one of the parameters of spatial arrangement.

The process of reading a space, which begins with visual perception, leads to the identification of differences and similarities after analyzing the data obtained through the syntax method in the study of spatial organization. The goal of the study is to gain insights for the practice of arrangement, design, and planning through the interpretations developed based on these examples.

In line with this effort, the study aims to objectively examine the movements of users and the relationships between spatial elements within a space, as intended by the method of space syntax. It also emphasizes how users come together in spaces and investigates the characteristics that spaces assume during this process. Since this emphasis will directly affect the potential design process, it is important for design practice to uncover the underlying meanings of spatial fragments.

2. Material and Method

Form is an attribute of an object that distinguishes it from other objects. However, form can only manifest itself in reality when it serves a function. Because formal expression encompasses not only physical characteristics but also relationships with the social and physical environment, it should be suitable for both individual needs and the requirements of the surrounding environment (Onat, 1995).

The subheadings proposed in Maki's "Some thoughts on collective form" provide different approaches to establishing relationships and connections among individual elements in architectural design. Alongside all these approaches to form, Maki's theory of collective form emphasizes the importance of establishing connections between individual elements in architectural design to achieve a coherent and cohesive whole (Maki, 2015).

In Ching's book "Architecture: Form, Space, and Order," various types of spatial organization and form are discussed, and different categories are used to analyze them. Each of these categories, in turn, represents a different approach to organizing space and utilizing form in order to create meaning and function in architecture. According to Ching, in every case, these elements and systems should be interconnected to form an integrated whole with a unifying or cohesive structure. The organization of the parts creates architectural order when it reveals their relationships with each other and with the entirety of the structure. When these relationships reinforce each other and contribute to the singular nature of the whole, it signifies a relational order (Ching, 2002).

The relationships between forms existing in a two-dimensional plane are realized through surfaces that give rise to the third dimension. Therefore, to achieve formal continuity and ensure functional transitions between spaces, the mentioned functional effects should be properly orchestrated. If the composition of space is the result of an organization, then coming together both in form and spatially and functionally means integration and coherence. This coming together creates intersections between spaces and defines boundaries at the points where different areas converge or intersect, thereby creating a sense of space. This is a design approach related to the division and delineation of space. At the intersections where areas with different functions come together, concepts such as boundaries and permeability become important. These points are defined by structural elements in a way that preserves the integrity of function and circulation. As a result, the spatial intersections that occur at these points create a distinct spatial effect and provide users with different experiences. This approach brings a different perspective to the division and delineation of space (Dinçer, 2005). The coming together of different geometric forms, which represent spaces, actually emerges in the process of creating spaces to meet different user needs. The volume, which represents the three-dimensional perception of space, the structure, which expresses the supporting system and structural integrity of a space, and the function, which refers to the design of a space for a specific purpose, come together in different forms to form this process.

Hanson (1988), based on the theory that spatial relationships can only occur through connections between two spaces, evaluates the relationship with a third space and argues that it will be through configuration. The analysis of these configurations is carried out through spatial syntax. This method aims to provide a scientific foundation to space by analyzing the configurations formed when spaces come together in various ways on a plane, using numerical and graphical expressions.

Space, in simple terms, is an environment in which physical and social amenities are enclosed by boundaries and traces of life are present (Demirci, 2017). Experiencing a space is related to the elements existing around the person experiencing it. It is as if they are at the center of the world, perceiving the space based on their own understanding and creating their own perception of the world or the space itself (Hesselgren, 1969). In each perception, they accumulate memories for that space, experiencing the space and also giving life to the space itself.

Design decisions arise from being experienced and measured by the user, serving as performance indicators that provide references for proper usage. These values are utilized in meeting the desired qualities of the system (Sanoff, 2016). Regardless of the scale of architectural design, performance values in design are directly associated with the physical environment. This is because the performance and quality of a structure are directly linked to its user, the actions taking place within it, and the physical formation that allows for such activities (Esin & Özsoy, 2003). When the concept of performance is equated with the entirety of design decisions we reach at the end of the process, it becomes clear that achieving the right design relies on effectively utilizing the components of the process (Demirci & Arabacıoğlu, 2022).

2.1. Analysis of The Space Syntax of Indoor Ski Centers

Nature, which has been attempted to be incorporated into enclosed spaces, meets users as an artificial environment in indoor ski centers. These centers are specifically designed to be used in locations and times when temperatures and snow levels may not be sufficient. They provide users with snow-based activity experiences throughout the year, regardless of the season.

The study focuses on the analysis of two indoor ski centers, ChillFactore in the UK and Snow Arena in Lithuania, based on the discussion of the key features of the space syntax method. The purpose is to apply the space syntax method to evaluate and improve the designs of indoor ski centers or provide data for new designs. By examining these two centers, it enables a discussion on the applicability of space syntax for evaluating and enhancing the designs of indoor ski centers.

The spatial configuration method is an approach that relies on spatial data for conducting structural analyses. It is used for the classification and comparison of the formal qualities of a space.

The starting point of spatial layout is the way people organize themselves within a space and use it as a tool for placement. This method, which is a way of reading a space, consists of a numerical model. It is used in the classification and comparison of formal features. Form is scientifically based on numerical data. As emphasized by Lynch, visual cues, including symbolic structures and boundaries, that assist humans in perceiving complex spaces have altered the perspective of many designers (such as urban planners, interior designers, or architects) regarding the identity of spaces (Lynch, 1960). Since then, numerous studies have been conducted to seek new significance beyond predictions and to further develop data following perceptual cues. Statistical approaches are used to obtain this data. By bringing together and analyzing these data, the ability to make decisions based on similarities, differences, and divergences can be acquired.

This study employs the parameters of the spatial syntax method to reach spatial evaluations by making inferences based on the similarities and differences found in two different indoor ski centers.

2.2. Convex Space Analysis in Spatial Syntax Method

Convex space analysis is believed to be effectively utilized for direction finding, routing, and visibility exploration for users in a closed ski center. This is because convex space analysis is fundamentally based on accessibility relationships dependent on human movement (Turner, 2006).

In convex space analysis, each center is represented by a single space (ski area). Then, these areas are associated with each other based on their transition relationships with other spaces. Once all these stages are completed, the software starts calculating various measurements and generating maps based on these measurements.

In the analysis, outdoor spaces were included for each center, focusing on the changes occurring within their internal structures. To ensure clear interpretation of the results and changes, the interior spaces of each center were compared by connecting the corner points within the scope of convex maps. In these maps, the spaces were positioned within a color range that tends to vary from red to dark blue based on their values.

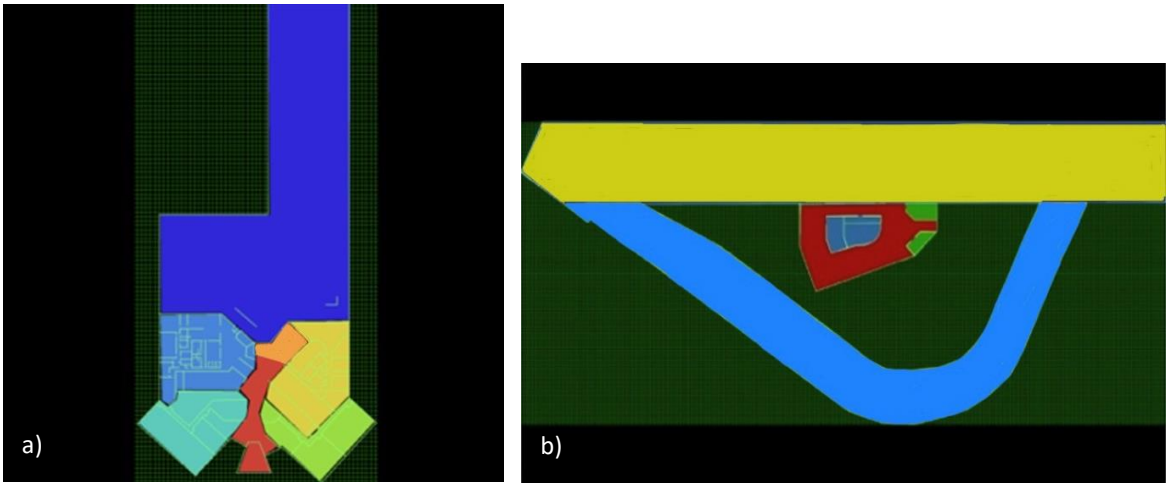

Figure 1. Convex space maps (a: Chill Factore-United Kingdom; b: Snow Arena-Lithuania)

As seen in Figure 1, both buildings exhibit a cohesive structure where the central atrium is surrounded by other spaces. Access to the spaces is provided through the central atrium. In these maps, the spaces are represented by a color range that varies from red to blue based on their accessibility levels. The color red represents the easiest accessible space, while dark blue represents the most challenging space in terms of accessibility.

2.3. Axial Maps Analysis in Spatial Syntax Method

Axial analysis is based on all possible straight walking lines within the structures of the ski center. These potential walking lines are initially drawn as straight lines on the floor plan and intersected with each other before conducting the analysis. Then, the complete line analysis is performed, revealing the accessibility characteristics. Additionally, a space is considered convex if straight lines can be drawn

within the space from any point to any other point within the space without crossing the boundary of the space. In this case, Chill Factore in the United Kingdom can be considered convex, while Snow Arena in Lithuania can be considered concave.

The higher the integration of an axis, the more it is colored in red, indicating that there are minimal changes in direction across all other axes in the space. Conversely, the lower the integration, the more the axis is colored in blue.

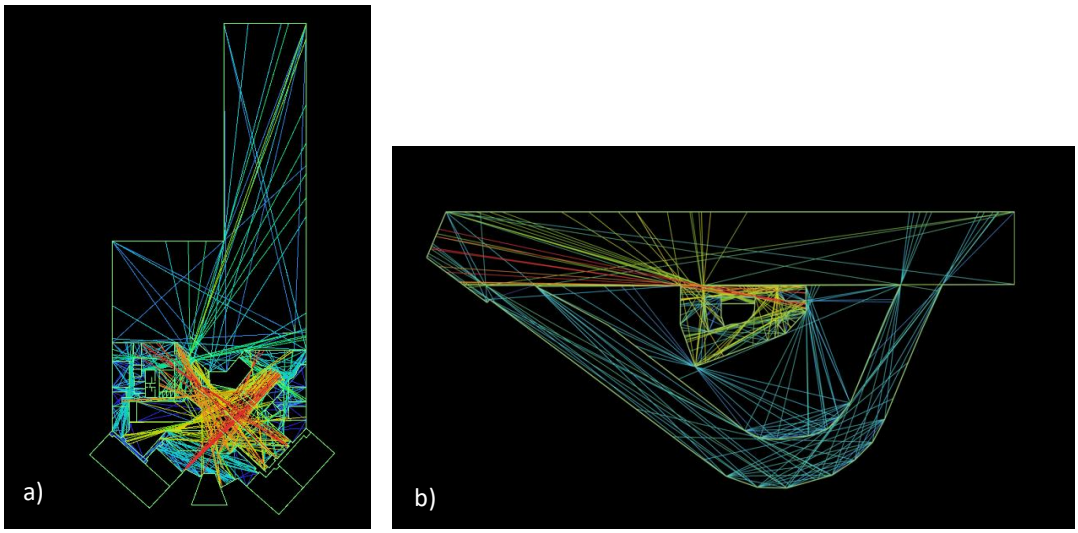

Figure 2. Axial maps. (a: Chill Factore-United Kingdom; b: Snow Arena-Lithuania)

In addition, as seen in Figure 2, the two-dimensional representation of the curve in Snow Arena, Lithuania does not consider the variations in elevation. It is observed that there is an increase in axial line density in areas with high circulation within the structure. Furthermore, when straight lines can be drawn from any point within a space to other points without crossing the boundaries of the space, convexity can be referred to. In the case of Snow Arena, if a line drawn from one point to another within the space passes through the exterior of the space, it is defined as a concave space. The analyses conducted also indicate that concave spaces exhibit higher integration and a more homogeneous distribution.

The comprehensibility of the area can be seen by looking at the axial maps graph. If the points in this graph go in a straight line from bottom right to top left below 45 degrees, the area is both interconnected and integrated. According to Hillier, in this case "the system is almost perfectly graspable". The local field, represented by clustered points, is "graspable". If the regression line for this cluster is steeper, within the whole system, as well as global and local integration are strongly correlated. This effect can be read from the cluster appearance of the points representing the area on the graph (1996).

As seen in Figure 2, the red axes show density in the space starting from the transportation area, passing through the ski preparation area, and then leading to the slopes.

2.4. Integration Analysis in Spatial Syntax Method

The connectivity and integration of a space with other spaces can be interpreted based on the depth of the space (Aksoy et al., 2020). Depth analysis was conducted for each closed ski center based on the depth levels in the transition graphs prepared for the designated study areas. In these analyses, the connectivity of spaces with each other was examined, considering two scenarios: one where the outdoor space is included and another where it is excluded. The spaces were arranged in a sequence starting from the root space in both cases. Following this sequence, depth values were assigned, and it was investigated whether the spaces were integrated into the system based on these values and whether they exhibited a tendency to separate from the system.

In the example of Chill Factore, the depth of the ski area is at the fourth level, while the average depth of the system is 2.869.

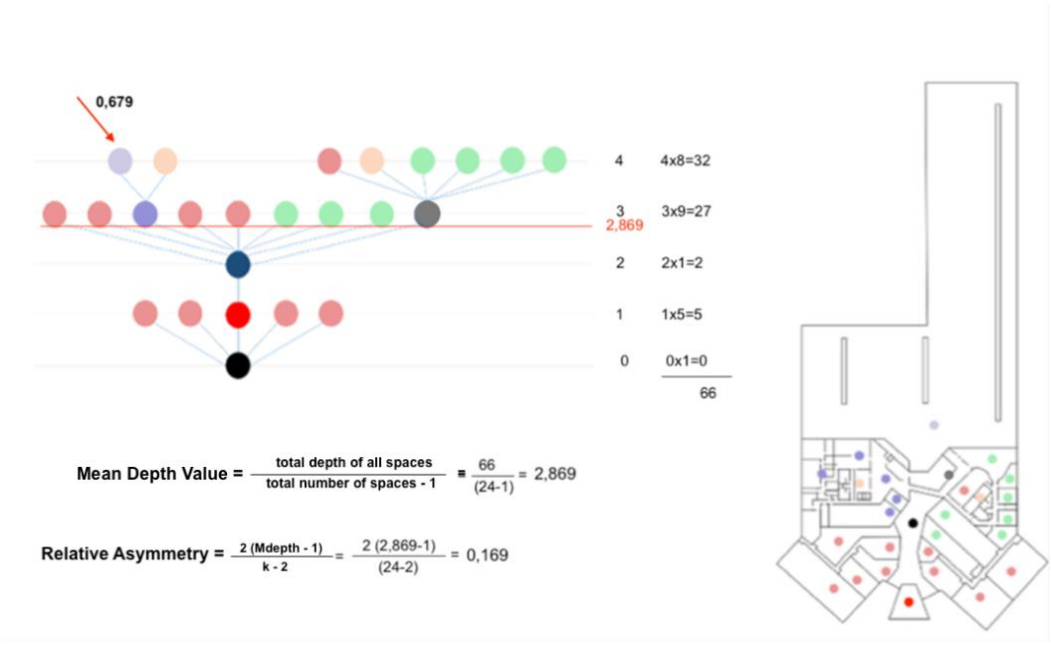

Figure 3. Depth analysis of Chill Factore, United Kingdom.

Therefore, as shown by the arrow in Figure 3, the ski area has a significantly high depth value. The integration of the space into the structure was obtained by multiplying the depth level with the relative asymmetry value.

In the case of Snow Arena in Lithuania, where depth is gained through an open skiing curve, as seen in Figure 4, the entrance area provides access to the toilet, dining areas, and ski preparation area. However, access to the open ski area is only possible through the closed ski area, resulting in the closed ski area being at the third depth level.

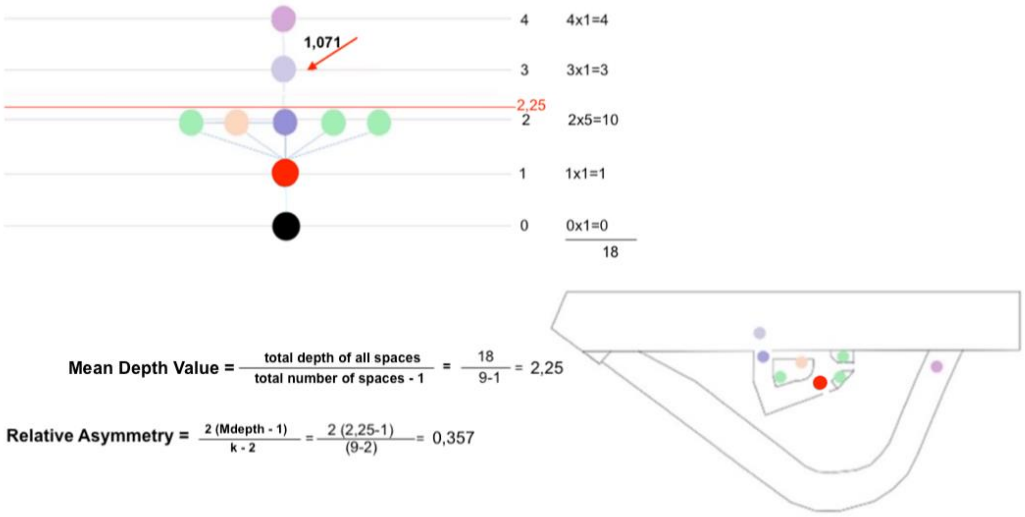

Figure 4. Depth analysis of Snow Arena, Lithuania.

Due to the relatively smaller number of spaces in the other closed ski center within the scope of the study, the high asymmetry value gained and the depth level of three contribute to achieving a high integration value for the space. In this case, the integration of the open ski area is 1.428.

3. Findings and Discussion

While interior design is defined as the process of organizing time, space, meaning and communication (Gür, 1996), it is also known that the built environment, environmental factors, the effects of people's lifestyles, their use of time and communication methods have an impact on interior design.

Configuration analysis, on the other hand, offers a systematic way of understanding the relationships between spaces and how they affect the overall experience of the environment (Hanson, 1988). This approach emphasizes the importance of considering the sequence and spatial relationships of spaces to create a coherent and meaningful experience for users.

McLean (1999), who evaluates the visitor experience through spatial satisfaction, mentions the importance of providing spatial organization with a functionally rational spatial layout, while also advocating the prediction of the experience to be obtained when this spatial layout is provided with numerical data. For this reason, the analysis of indoor ski centers as a place of experience has clearly shown that indoor ski centers have specific rules for their spatial organization. These rules determine the visitor experience and form the basis of the design. (Yuan & Wang, 2016). Moreover, these rules define the characteristics of indoor ski centers, which also have an impact on the human and environmental environment. Because with the method of space syntax, the design quality of buildings can be understood and how visitors use the building can be determined (Yeşildal, 2019). In fact, both design and analysis require a holistic approach. In both cases, the important thing is to reveal or define the common expressive power of architecture. The modern tradition is that geometric volumes are held together by the relevant literature (Thiis Evensen, 2020). herefore, uncovering the basic ideas underlying the coming together of geometric volumes is based on the act of accessing the terms in line with the purpose of this study and bringing them together in a correct and guiding way.

As Aksoy et al., (2020) emphasize, in order to define spatial relationships, it is necessary to have control over the connectivity and integrity of spaces. Within the scope of this study, convex maps diagrams were prepared to illustrate the spatial relationships of the analyzed structures. The generated convex maps for this analysis are designed to define the spatial relationships of both structures. Because in a convex map diagram, the sizes of the spaces are not important. This diagrams aims to determine spatial configurations by revealing the existence of spaces and their relationships with each other (Ostwald, 2011).

One of the analyses used in this study is spatial depth analysis. The mean depth analysis, referred to as "MD," is defined as calculating the area that needs to be traversed to reach from one point to another (Huang et al., 2019). A deeper area indicated that it had a higher influence compared to other areas. In other words, as the number of places or spaces that need to be passed through to reach a specific location increases, the level of influence also increases. Indeed, these analyses empower the user to have a say in the integration and coherence values of the spaces within the structure. By analyzing the spatial relationships, connectivity, and depth, users can gain a better understanding of how the spaces are integrated within the overall structure and assess their level of coherence.

Because according to the space syntax method, integration values not only demonstrate consistency with the circulation within the system but also serve as the primary determinant of circulation, even in very large systems where axes cannot be accurately identified. These measurements are localized integration measurements limited to calculations in the spaces where each axis is located. The connections of all parts of the structure with the system can be read through the integration map. This map is created to indicate where the most integrated axes are located and what is more important in densely integrated areas (Baç, 2012).

In the case of Snow Arena in Lithuania, integration develops around the functional use area of the space, there is a strong fictional differentiation between spaces, and there are strong spatial relationships with the outside, resulting in a more integrated interior space and a more integrated exterior space.

In the case of Chill Factore in the United Kingdom, unlike Snow Arena, integration with the outside is not established based on functional similarity, but it is considered within the values of the structure. Therefore, the integration is lower compared to Snow Arena.

Both ski centers exhibit a holistic structure formed by a central hall surrounded by other spaces. Access to the spaces is provided from the central hall. In these maps, the spaces are given a color range from red to blue according to their degree of accessibility. In these maps, spaces are located within a color range that tends to differentiate from red to dark blue according to their value, with red representing the easiest space in terms of accessibility, and dark blue representing the most difficult space. Although ski curves constitute the blue-colored spaces that are difficult to access due to the controlled entrances and the places that include the preparation phase for skiing, in the Lithuania-Snow Arena example, the limited number of total spaces in the center facilitated the accessibility of the ski curves.

The concept of integration, or coherence, is used in conjunction with the concept of depth and is mutually dependent. In other words, in order to define the concept of integration, it is necessary to first understand the concept of depth (Jiang & Claramunt, 2002). Additionally, within this concept, there is another fundamental analysis method that contributes to integration, which is Relative Asymmetry (RA).

Table 1. Comparison of depth values in closed ski centers.

	Total Number of Spaces	Mean Depth Value	Relative Asymmetry	Integration Value
İngiltere- Chill Factore	24	2,869	0,169	0,679
Litvanya- Snow Arena	9	2,25	0,357	1,071

The relative depth of a space in relation to other spaces within a graph is mathematically expressed as the "relative asymmetry" value, which indicates whether the space is unifying within the configuration. The RA value, similar to the MD value, varies according to the depth of all spaces from the entrance. The integration or isolation of a space within a system is represented by its RA value. The higher the RA value, the lower the integration value (Czerkauer-Yamu, 2010).

Table 1 shows the relative asymmetry values of the examined centers within the scope of the research. The relative asymmetry value will always take a value between 0 and 1. The magnitude of this value indicates the tendency of the organization towards integration or segregation (Hillier & Hanson 1984). Both centers fall within this range. In the case of Chillfactore in the UK, its value is closer to 0, indicating that it is internally integrated. On the other hand, Snow Arena in Lithuania is more differentiated. This situation suggests that Snow Arena has a more inward-focused structure.

The integration value, which reveals the value of the connection between a specific space and other spaces, has been described as the measure of controlling direct access to connected spaces (Klarqwist, 2015). This value is directly proportional to the spatial connectivity, meaning that as this value increases, the spatial connection also increases (Baç, 2012).

Based on this information, areas with high integration values obtained through spatial layout analysis have high mobility and are also perceived as more accessible. The integration value decreases from red to blue and is adapted to a Likert scale with colors ranging from red, orange, yellow, green, to blue (Körmeçli, 2022). It is also observed that red axes tend to concentrate in areas that contribute to circulation in the axial maps of the examined structures.

Relative Asymmetry (RA) is a value that allows for the comparison of the depth of the visibility axes map, depending on the concepts of depth and proximity therewithal (Özbek, 2018). From the perspective of circulation, this value can manage how easily different spaces can be interconnected and how the transitions take place. A higher relative asymmetry value may indicate a more complex circulation pattern with longer and winding paths between spaces. Conversely, a lower relative asymmetry value can indicate a more direct and faster circulation. In this case, the example of the

Snow Arena in Lithuania, being used and included in circulation during specific time periods, has led to an increase in the RA value of the open skiing curve.

Similar to relative asymmetry, average depth also varies from space to space within the system, depending on the depth of all other spaces from the original space. The depth degree of each space is determined based on how connected it is to the original space or to what extent it is directly connected to other spaces (Hillier & Hanson,1984).

The Relative Asymmetry value of the space also indicates whether this space is unifying within the configuration (Jiang et al., 2000). Relative asymmetry and mean depth values are the values from which spatial inferences can be made without the need for a systematic theory (Bafna, 2012). They are factors that affect the decisions to be taken in the design phase in order to be able to think in advance the genetic description of the structure as well as the phenotype, which is the realization of this genetic description (Hiller et al., 1987).

As seen in also Table 1, there is a direct proportion between the number of spaces in the structures and their average depths. It should be noted that the ski areas, which are the prominent interactive areas of the indoor ski centers, are not transformed into deep spaces in the overall design and direct access is provided. This is an inference that needs to be considered in this context.

The result of the design process of an architectural structure, its impact on people and the environment, shows that the final product also has an impact on human and environmental structuring (Kahn, 1998). Achieving this final product involves different qualities of decision-making stages and these stages define a process (Alexander, 1964).

Space designers, like other designers, feed on standards that can be "taken as an example or as a basis" and sometimes form the basis of standards (Arabacıoğlu, 2008). So, when a design product emerges, it is shaped according to the expectations and wishes of the user, and these expectations and wishes determine the decisions of this design.

At the same time, the analyses conducted in this study provided what Turner calls a heuristic method of spatial analysis (Turner, 2003). Using DepthmapX 0.50 (developed by Tasos Varoudis), the analyses reduced to a two-dimensional plan were evaluated as a representation of three-dimensional spaces.

Following these analyses, genotype research, that is, the search for compatibility in the defined organizational relationships (Bafna, 2012), was carried out by searching for similarities between the data obtained from the analyses. for this, various inferences were made based on the relatedness of the centers' organizations.

4. Conclusion and Suggestions

The findings of this study provide a critical investigation of the structural elements of indoor ski centers and the accurate classification of elements showcasing various characteristics of their locations. This research serves as a valuable resource for both researchers and designers in presenting a synthesis for the design of enclosed ski centers.

The comprehensive framework of this study has been established by arranging individual forms and emphasizing their organization with respect to two-dimensional plans. It has been revealed that the consistent and harmonious wholes are derived from the connections behind individual elements.

Here, the following question can be asked: Do the forms of spaces and their interaction with interior spaces support or hinder the connection with the user?

When answering this question, we can refer to the analysis of convex spaces, which involves discussing concavity and convexity. According to the analysis conducted on Snow Arena in Lithuania, it is determined that it has a concave form. The analysis also reveals that integration is higher in concave spaces and these spaces are homogeneously distributed. Therefore, it is found that both the form of the space and its interaction with interior spaces have an impact on the integration value, which consequently affects the relationship with the user.

According to the findings of the study, in the case of Chill Factore in the UK, the integration with the exterior is not established through functional similarity, but it has been considered within the values of the structure. It is located within a shopping center and does not have a direct connection with the outside.

In the case of Snow Arena in Lithuania, integration is developed around the functional use area of the space, and there are strong fictional differentiations between the spaces. The structure has strong spatial relationships with the exterior, which results in a more integrated interior space and a more integrated exterior space. The spatial evaluations of this structure have shown that additional spaces used in different time periods enhance the integration value of the structure.

Indeed, the additional space that also contributes to the concavity of the structure demonstrates the influence of temporal use on the design. This is particularly relevant in the case of Lithuania, which experiences winter seasons. The consideration of an open skiing area that can be used when snow is available during the design phase of the structure has led to the integration of the skiing curve with the space.

In other words, places with the same number of places, but integrated into higher depth levels and thus generating a higher average depth level, tend to segregate because they generate a high relative asymmetry value. However, ski preparation areas, which are passed before reaching the ski curve, create a connection between each other and thus raise the ski curve to a higher depth level. However, spaces that are directly connected to the ski curve (such as another ski curve) increase the depth of the space and make the value of the ski curve shallower. Since each different function creates a new characteristic and the organization of these functionally different spaces creates a different pattern, different genotypes are formed.

The emerging genotypes of indoor ski centers are not associated with their volumetric size. It was supported by the analysis of the relationships between the spaces in the plan plane. Analyzing the relationships between the functional tendencies of the spaces revealed that when these spaces are considered as a product, it is through these analyses that various design decisions can be reached to provide a new product. Which function will be integrated where in the organization, the effect of this integration on the overall value of the building can be predicted and design decisions can be implemented according to these predictions.

All these steps contribute to the research process, which involves the collection, analysis, interpretation, and discussion of data related to the design and operation of indoor ski centers.

With the idea that form is decisive in structuring the silhouette in the genotype-phenotype relationship, it is necessary to construct the coming together of forms in a coherent and coordinated manner. This takes the organization beyond the concept that expresses the boundaries of the shell -building envelope-.

Analyzing the struggle between differences in the context of the practice of sovereignty, this study focuses on explaining the spatial consequences of this struggle. Therefore, the maintenance and constant reproduction of difference is critical for the struggle to continue. It is important to see space not only as a system or image, but also as an element produced in interaction with users. With this interaction, user-oriented design, integration of space with society, user satisfaction, quality of life and sustainability can be effective and shed light on future studies.

It is thought that this process can be a guide for future Indoor Ski Center designs and can help minimize environmental impacts with new studies to be developed.

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Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to the article. There is no conflict of interest.

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The Contribution of Key Stakeholders and Funding Bodies in the Heritage-Led Regeneration Process: The Case of the Walled City of Nicosia

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Abstract

The availability of and eligibility for funding, and the engagement of key stakeholders are important factors in the progress and outcomes of the heritage-led regeneration of cultural heritage. In Cyprus, in the Walled City of Nicosia, there has been an ongoing process of heritage-led regeneration since two decades. The island's political issues have affected the regeneration process in different ways, especially as regards funding the conservation of cultural heritage. The main aim of this paper is to identify key funding bodies and resources in the conservation of cultural heritage, and to investigate their contributions through selected key stakeholders during the heritage-led regeneration process in the Walled City of Nicosia (northern part). The research adopts a case study approach and investigates these issues through 15 projects in the Selimiye Quarter because public space projects are dense in this area. The research reveals that implementation and management are two important factors in the success of the regeneration process and its outcomes.

Keywords: *Heritage-led urban regeneration, stakeholders, heritage management, funding bodies, Walled City of Nicosia.*

Miras Destekli Yenileme Sürecinde Temel Paydaşların ve Fon Sağlayan Kurumların Katkıları: Lefkoşa Surlar İçi Örneği

Öz

Finansmanın mevcudiyeti ve finansmana uygunluk ile kilit paydaşların katılımı, kültürel mirasın miras odaklı yenilenmesinin ilerlemesinde ve sonuçlarında önemli faktörlerdir. Kıbrıs'ta, Lefkoşa Surlar İçi'nde, yirmi yıldan beri miras odaklı bir yenilenme süreci devam etmektedir. Adanın siyasi sorunları, özellikle kültürel mirasın korunmasının finansmanı konusunda, yenilenme sürecini farklı şekillerde etkilemiştir. Bu makalenin temel amacı, kültürel mirasın korunmasında kilit finansman kurumlarını ve kaynaklarını belirlemek ve Lefkoşa Surlar İçi'ndeki (kuzey) miras odaklı yenilenme süreci sırasında seçilmiş kilit paydaşlar aracılığıyla bunların katkılarını araştırmaktır. Araştırma vaka çalışması yaklaşımını benimseyerek, kamusal alan projelerinin bu alanda yoğun olması nedeniyle Selimiye Mahallesi'ndeki 15 proje üzerinden bu konuları araştırıyor. Araştırma, dönüşüm sürecinin ve sonuçlarının başarısında uygulama ve yönetimin iki önemli faktör olduğunu ortaya koyuyor.

Anahtar kelimeler: *Miras odaklı kentsel yenileme, paydaşlar, miras yönetimi, fon sağlayan kurumlar, Lefkoşa Surlar İçi.*

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1. Introduction

Cities are dynamic organisms and they undergo economic, socio-cultural, physical and administrative changes and transformations over time. This dynamism in cities does not always develop in a positive direction. Throughout the world, after the Industrial Revolution, the cities that entered a new era of urban development had to handle with many problems. These problems were seen especially in old city centres as abandonment of areas and buildings, damage to employment opportunities, decline in social life and deterioration in environmental quality (Roberts, 2000; Couch, 1990; Akkar, 2006). This has led to urban regeneration which is a strategy, aimed at restoring abandoned spaces and buildings, revitalizing cities, creating facilities and employment, improving the physical environment, and increasing social welfare (Hall & Hubbard, 1996; Magalhães, 2015; Özden, 2016).

Urban heritage has an important role, as the contemporary problems of historic city centres are related to the culture and conservation of heritage (INHERIT, 2007). In order to empower economic dynamism in historic city centres, state policies encourage the reuse of heritage (Orbaşlı, 2000). Thus, conservation is not considered a restrictive concern in urban regeneration, but one which relates to revitalization and improvement (Doratlı, 2005). The conservation of heritage is a powerful tool which can be used to achieve economic, physical and socio-cultural growth, development, and sustainability (Özden, 2016). This integrated approach has enabled the conservation of cultural heritage to be used in conjunction with sustainable urban development and growth, and has brought the heritage-led perspective to regeneration (Said, Zainal, Thomas & Goodey, 2013).

The area based (location-specific) urban regeneration strategy starts with determining the objective and strategies of that specific region and continues with establishing implementation and management. Implementation and management includes mobilizing a large number of stakeholders, securing financial and other resources necessary, creating partnerships on local and regional basis, establishing monitoring and evaluation mechanisms to canalize the intervention. The critical issue in regeneration strategy lies in implementation and management because it provides visible evidence of changes in the roles of cities.

Cyprus is a divided island, where the southern part is the Greek Cypriot administered area and the northern part is the Turkish Cypriot administered area. There are two governments which are the Republic of Cyprus and Turkish Republic of Northern Cyprus (TRNC). The Walled City of Nicosia has been exposed to conditions that have caused physical degradation and socio-economic decline, population loss, unemployment and deterioration in its physical quality for many years (Oktay, 2007). This situation required a multi-dimensional regeneration strategy in order to ensure the sustainability of the city due to the strong relationship between the economic, physical and socio-cultural aspects (Petridou, 2003). The regeneration of the centre is significant due to its sustainable future as regards economic development, as well as the continuity of socio-cultural and architectural heritage. With the help of the United Nations Development Program (UNDP), and with the cooperation of the municipality of the northern and southern parts of Nicosia, the Nicosia Master Plan (NMP) was developed (UNDP-UNCHS, 1984). This general planning strategy focused on meeting the needs of the city. In the following years, the northern and southern parts of Cyprus prepared their master / local plans that were adapted to their regions based on NMP. There was an increase in the funds and support from the Greek Cypriot side when it became an EU member country, thus the regeneration process proceeded more rapidly in the southern half of the historical core. On the other hand, the northern part of Cyprus has tried to benefit from existing support in order to ensure the heritage-led regeneration of the other half of the historical core. However, it has been inadequate in providing funds and support because of its unrecognized condition internationally. Accordingly, although there have been some efforts towards cultural heritage conservation and broader regeneration in the northern part, the process is very slow (Menteş, 2015). In addition to this, the availability and eligibility of funding sources and the general policies of the funding bodies, stakeholders as well as the interconnections of these are complex. Furthermore, there has been a transformation of the spaces and uses of the historical buildings. However, the decision-making process and application of these changes are not clear and are debatable. In some cases, the administrative framework is insufficient

to provide a vivid picture of the reality. For this reason, examining the key stakeholders in northern part of Cyprus will provide important information about the administrative framework of the TRNC government. It is important to analyse and understand these issues to inform future decision-making on regeneration, especially in relation to key stakeholders and funding bodies. The limited number of financial sources and funding bodies mean that regeneration is dependent on their role and contributions.

In the Walled City of Nicosia, the historic centre of the divided capital city, there has been a continuing process of heritage-led regeneration since two decades. It is important to understand and identify the funding bodies or sources that financially support rehabilitation, restoration and reuse projects in heritage areas and their contribution to this process. For this reason, this paper focuses on the following question: How do key stakeholder and funding bodies contribute to the heritage-led urban regeneration process in the northern part of the Walled City of Nicosia? This research follows a qualitative approach. Literature review information collected included; the discourses of urban regeneration, cultural heritage, conservation, and sustainable development; the vision and the role of international organizations in cultural heritage conservation and regeneration through the investigation of selected completed projects. Fieldwork information collected included; review of documentation of the key stakeholders and funding bodies in the Walled City of Nicosia, analysis of completed buildings or projects, focusing on the Selimiye Quarter in order to understand the heritage-led urban regeneration process and the relationship between funding bodies and key stakeholders in northern part of the Walled City of Nicosia. Furthermore, this study investigates the implementation and management policies and processes of selected key stakeholder and funding bodies. Completed rehabilitation, restoration and reuse projects were identified according to a number of criteria based on the literature review and case specific issues explained in detail in further sections. This study aims to identify key funding bodies and key stakeholders in the cultural heritage conservation, understand the relationship between these organizations, and their implementation and management policies.

1.1. Urban Regeneration in the Heritage Context

The conservation of cultural heritage in all its forms and historical periods is rooted in the values attributed to the heritage (ICOMOS, 1994). The role of cultural heritage in supporting economic and regional development and growth (Tweed & Sutherland, 2007) has brought the concept of conservation to urban regeneration. It has only been in the second half of the twentieth century that there has been a growing awareness and understanding of the historic urban settling, its identification as heritage, and a request for area-based conservation (Orbaşlı, 2000). The conservation of cultural heritage provides continuity of the experiences and traditions that people have valued throughout history. In addition to this, it also ensures the correct establishment of a sustainable future since it offers new learning and development opportunities to people (INHERIT, 2007). Accordingly, the conservation of cultural heritage envisages continuous use through methods such as rehabilitation, restoration and adaptive reuse.

The management and conservation of cultural heritage resources, without separation from daily life, is the basic principle of urban conservation (ICOMOS, 1987). The concept of conservation has become the cornerstone of urban regeneration policy through the development of policies that relate to cultural heritage such as economic development, investment attractiveness and employment creation (Orbaşlı & Woodward, 2009). The multi-dimensional format of urban regeneration is closely related to the sustainable development phenomenon which aims to plan the future and puts forward strategies for these purposes just like urban regeneration (Özden, 2016). When it comes to heritage sustainability, urban regeneration and urban conservation are integral factors. Accordingly, the inclusion of heritage assets in regeneration programs provides a focus and catalyst for sustainable development (Thurley, Walley & Peace, 2013). Sustainable development is the best form of action whereby cities take their current and potential resources to the future along with their past experiences (WCED, 1987). For the sustainability of cities, the protection of cultural heritage should be encouraged, and this is emphasized in the UN document entitled “Transforming Our World: the 2030 Agenda for Sustainable Development”. To make the cities more attractive, creative and sustainable, it

states that it is necessary to integrate culture and cultural heritage for sustainable social and economic development (United Nation, 2015). Opening the path to heritage as the driving force of urban regeneration has led to the development of heritage-led regeneration, which creates fertile ground to roll out comprehensive and integrated approaches to the conservation and sustainable development of heritage (Said et al., 2013).

1.2. The Importance of Cooperation Between Key Stakeholders and Funding Bodies in the Regeneration Process

Depending on restructuring power of urban fabric, economic, physical and socio-cultural benefits of urban regeneration affect the strategy of transformation (Jeffrey & Pounder, 2000). In this way, strategies which are applied to local areas/regions become an integral part of their countries' national urban policies.

Successful urban regeneration is possible with an implementation strategy that recognizes and takes advantage of changes in economic and social activity, financing regimes, ownership, institutional arrangements, politics and emerging visions of urban life (Jacobs & Dutton, 2000).

According to the Guidelines for Urban Regeneration in the Mediterranean Region (2004), which was developed with the financial support of the European Commission, successful implementation and management includes various stakeholder partnerships, the availability of, and eligibility for, funding and other resources, the provision of the necessary organizational arrangements with governance and participation and the establishment of a mechanism for monitoring and evaluation. The sustainability of urban regeneration projects should be ensured through public participation and partnership, funding, governance and participation, monitoring and evaluation (Lichfield, 1998; Priority Actions Programme, 2004; Tanrıkul & Hoşkara, 2019).

Public participation and partnerships are essential elements of a contemporary urban implementation and management strategy, as they increase the quality of policy decisions and ensure a more effective implementation of local programs (EU, 2019). Mobilizing local communities and their stakeholders to share and contribute to a common vision to improve urban areas will contribute to the socio-cultural dimension of urban regeneration in particular (European Commission, 2019). Public participation is significant and usually supported by stakeholders who are public sector agencies, regional and national institutions, local authorities, the local community, NGOs, government agencies, and community-based groups and residents (Orbaşlı & Cesaro, 2020).Funding is a critical issue in the urban regeneration process because of the difficulties of sourcing long-term investment, with large funds often lacking and competition with other needs (Priority Actions Programme, 2004). It is also important to have sufficient financial resources to implement regeneration decisions (Çakır & Sağıroğlu Demirci, 2021).

In addition, partnerships are necessary to enable access to a large number of funds, as all relevant stakeholders must be involved to ensure that the regeneration process is efficient, holistic, and comprehensive, and to reduce the barriers to private financing in schemes where there are high risks (McCarthy, 2004). Urban policy initiatives driven by central government need to have a long-term and sustainable commitment rather than be a quick fix (Turok, 2005). Government and participants should ensure horizontal and vertical coordination between central and local government departments, and local coordination and increased community involvement should occur by changes in mainstream services (Tallow, 2010). Monitoring follows the identification of problems in economic, physical and socio-cultural spheres in the area where urban regeneration has taken place, (Tanrıkul & Hoşkara, 2019). On the other hand, evaluation provides the basis for understanding whether the implementation has been concluded in accordance with planned goals, after the requisite time has passed (Priority Actions Programme, 2004).

2. Material and Method

This research uses qualitative research methods. The reserach method includes two stages.

Firstly, (1) a literature review focuses on: a) urban regeneration in the heritage context, b) the importance of cooperation between key stakeholders and funding bodies in the regeneration process, c) examination of international regeneration projects with international organizations (EU and UNDP) as their main stakeholders. This part focuses on the vision and the role of international organizations in cultural heritage conservation and regeneration through the investigation of selected 6 completed projects. These cases were analysed through the key terms for the project aims, tools and outcomes of the projects.

Secondly, (2) a case study approach was followed with collection of documentation and site visits / building analysis which were carried out in 2020. Data collected included; (a) the key funding bodies / resources through completed projects in the Walled City of Nicosia in the northern part were determined, (b) key stakeholders in TRNC and their roles in cultural heritage conservation were determined, (c) funding bodies' contribution to heritage-led regeneration through an examination of 5 key stakeholders and 15 selected cases in the Selimiye Quarter were evaluated. Selected stakeholders included: Department of Antiquities and Museums, Foundation of Evkaf, Nicosia Turkish Municipality, TRNC Ministry of Tourism and Environment, and UNDP. Documents collected through stakeholders were analysed based on the project context/aims, tools and achieved regeneration outcomes. The projects, examined through the literature review, identified a framework for the evaluation of the primary case study of the research. The site visits focused on carrying out observations and taking photos of the current situations of the projects. The following sections highlight the detailed context of the material and methods.

2.1. Examination of Regeneration Projects with International Organizations as their Main Stakeholders

Many international organizations have played a significant role in preserving cultural heritage and transferring it to future generations. UNESCO, ICOROM, ICOMOS, Europa Nostra, EU and UNDP can be considered among the major international organizations. These organizations have undertaken important missions such as gathering and disseminating documents on the scholarly problems of conservation, supporting research in this field, supervisor technical problems, training technical staff and raising the improvement of rehabilitation / restoration / reuse practices. In addition, they prepare various laws, regulations and declarations within the scope of the creation and conservation of the world cultural heritage inventory and ensure the implementation of sanctions before the countries.

Culture and cultural heritage, which is tangible evidence of the traces of history in cities and civilisations, can be found in many policies of the EU. An example of this is the sustainable urban processes set for historical city centres in the specific framework of the Urban Agenda for the EU. In this context, the necessary guidelines were determined to minimize the problems that may arise during the implementation of the projects, as well as the protection and development of cultural heritage (EU, 2019). Interventions in the field of cultural heritage have expanded towards urban regeneration, with an emphasis on sustainable development potentials in the Urban Agenda for the EU perspective. In addition, the EU policies for conservation focused on a participatory interpretation and governance model that would broaden the participation of the private sector and civil society, and also focused on cultural heritage being part of the local community (European Commission, 2019).

EU provides financial support to European Union member states through a variety of programs to assist in their actions to conserve and promote cultural heritage in their cities. Local and regional institutions responsible for conserving and promoting cultural heritage in the EU member state can benefit from the financial support of the European Regional Development Fund (ERDF). Organizations and individuals that can apply for financing to the EU are listed as follows; small businesses; non-governmental and civil society organizations; young people; researchers and farmers and rural businesses. UNDP strives to provide the protection, preservation and promotion of cultural heritage through project activities and does so in accordance with any national or international legal documents that may be relevant to the use of cultural heritage (UNDP , 2019). In line with the 2030 Agenda for Sustainable Development adopted in 2015, UNDP has proven the necessity of sustainable development in cultural heritage areas. In this direction, UNDP aims at sustainability in the cultural

heritage site, taking into account the effects of sustainable development on the conservation of cultural heritage, link between the economic vitality, socio-cultural improvement and physical regeneration (UNESCO, 2016). Besides, UNDP attaches importance to establishing partnerships with EU and also helps countries to develop policies and institutions for sustaining their progress. UNDP projects are funded by donors such as member states, multi-national partners, non-governmental organizations, private and benefactor sectors, and financial institutions (UNDP , 2019).This research examined 6 examples of EU and UNDP projects, around the world, that support cultural heritage studies that relate to the implementation and financing of the regeneration of old cities (Table 1). Table 1 Legend provides the key terms for the project aims, tools and outcomes of the projects. For example, the first project's aims had involved; Physical Conservation (PC), Economic Improvement (EI), Social/Cultural Enhancement (SCE) and Preservation of Urban Identity (PUI). Project tools had included; Financial Support (FS), Rehabilitation/Restoration/Reuse (RRR), Strong Partnership (SP) and Community Participation (CP). Project outcomes had involved; Physical Regeneration (FR), Economic Regeneration (ER), Socio-cultural Regeneration (SCR) and Raised Awareness (RA). Project aims, tools and outcomes were grouped together as there is a consistent pattern. The colour scheme in the table represent this consistency. Location specific heritage-led regeneration strategies were evident through the differences in each project.

Table 1. International cultural heritage projects funded and managed by the UNDP and EU

No	Name	Funded By;	Project Aims	Project Tools	Project Outcomes
1	Regeneration of the historic centre of Málaga	EU	**PC**	**FS**	**PR**
			EI	**RRR**	**ER**
			SCE	**SP**	**SCR**
			PUI	**CP**	**RA**
Date: 2007 - 2013 (European Commission, 2005; European Commission, 2013)					
2	History has a Future in other Capital of Romania (Alba Iulia)	EU	**PC**	**FS**	**PR**
			EI	**RRR**	**ER**
			SCE	**SP**	**SCR**
			PUI	**CP**	**RA**
Date: 2007 - 2013 (European Commission, 2003; INHERIT, 2009)					
3	Revitalisation of Skopje Old Bazaar	EU	**PC**	**FS**	**PR**
			EI	**RRR**	**ER**
			SCE	**SP**	**SCR**
			PUI	**CP**	**RA**
Date: 2003 - 2010 (European Commission, 2010; Practical Guide, 2015)					
4	The Beautiful Crimea (11 cities)	UNDP partnership with EU	**PC**	**FS**	**PR**
			EI	**RRR**	**ER**
			SCE	**SP**	**SCR**
			PUI	**CP**	**RA**
Date: 2014 – 2020 (UNDP, no date; Racoviceanu, 2013)					
5	Safeguarding in Jerusalem	UNDP partnership with EU	**PC**	**FS**	**PR**
			CA	**RRR**	**PTR**
			PUI	**CP**	**RA**
Date: 2013 - 2018 (Carmi, 2017; Dawabsheh, 2017)					
6	Confidence Building in Kosovo (19 religious and cultural heritage sites in 5 cities)	UNDP partnership with EU	**CA**	**RRR**	**PTR**
			PUI	**CP**	**RA**
Date: 2016 – 2020 (UNDP (a), 2017; UNDP (b), 2017)					

LEGEND

Economic Regeneration **(ER)**	Promoted Tolerance-Respect **(PTR)**	
Rehabilitation/Restoration/Reuse **(RRR)**	Rehabilitation/Restoration/Reuse **(RRR)**	
Economic Improvement **(EI)**	Commercial Activities **(CA)**	
Physical Regeneration **(PR)**	Socio-Cultural Regeneration **(SCR)**	Raised Awareness **(RA)**
Financial Support **(FS)**	Strong Partnerships **(SP)**	Community Participation **(CP)**
Physical Conservation **(PC)**	Social /Cultural Enhancement **(SCE)**	Preservation of Urban Identity **(PUI)**

Project 1 (Regeneration of the Historic Centre of Málaga) brought sustainable solutions to urban problems by adding social and economic dimensions to physical rehabilitation in the historic site. This economic development has been achieved through tourism. One of the most important steps of the development strategy in this project was the establishment of an organization responsible for coordination, planning, monitoring and evaluation within the municipal administration, although there was no ministry dedicated to urban development. With this organization, the local authority had shown a strong commitment to establishing a strong citizen engagement process. This project is important because it provides all the dimensions of heritage-led regeneration with the goal of sustainability.

In Project 2 (History has a Future in other Capital of Romania /Alba lulia), social and economic dimensions were added to physical rehabilitation and sustainable development was provided in urban problems in the field of cultural heritage. This project is an example showing that tourism potential of the cultural heritage can provide serious economic development for the local community. Despite the lack of political support, the municipality had played a significant role as the local authority to provide sustainable development through the partnership with the local community. This project is important because it provides all the dimensions of heritage-led regeneration with the goal of sustainability.

Project 3 (Revitalisation of Skopje Old Bazaar) is similar to the previous projects. However, unlike Project 2, coordination was provided through government with initiatives for protection, regulation and revitalization. This project, had focused on attracting the attention of the public by enabling the development and marketing of commercial product lines and contributing to economic sustainability. This project had also focused on raising awareness of tolerance - respect for coexistence and conserving cultural heritage, as well as participation of the public in the heritage-led regeneration process in multi-ethnic environments. In other words, cultural heritage had been the driving force in bringing different communities together. The purpose of this project to bring together different stakeholders in cooperation, had proved the importance of public participation.

In Project 4 (The Beautiful Crimea), the cultural heritage had provided both economic development and socio-cultural sustainability, through physical rehabilitation without surrendering to the tourist attractions. In this project, cooperation had been established between the state and the private sector in order to develop the tourism sector. Participatory mechanisms were encouraged in planning, financing and implementation. In order to prevent the negative impacts that this integrated and participatory approach may create in urban planning, the capacity of the local government was strengthened.

In Project 5 (Safeguarding in Jerusalem), tangible cultural heritage rehabilitation was carried out to raise awareness of the protection of cultural heritage. In this regard, the project had created short and medium term job opportunities by taking advantage of the economic development with the power of cultural heritage. The main purpose in this project was to strengthen the cultural heritage identity and create awareness of cultural heritage.

Project 6 (Confidence Building in Kosovo) had focused on building inter-community trust and respect for identity in Kosovo, a multi-ethnic community in the heritage-led regeneration process. The tangible cultural heritages of each ethnic community were rehabilitated. The main aim was to provide economic growth and employment of Kosovo's rich cultural heritage.

When the selected EU and UNDP cultural heritage projects were evaluated, it became clear that physical rehabilitation, restoration and reuse is a driving force in ensuring economic development and socio-cultural sustainability (Table1: Project 1, Project 2, Project 3, and Project 4). In addition, multi-stakeholder, community participation, public-private and local government cooperation and coordination are factors that increase the success of projects in achieving their objectives.

It is evident that these UNDP and EU projects focus mainly on the conservation of cultural heritage as a driving force to connect different communities in cities with differences in origin, ethnicity or religion (Table 1: Project 3, Project 5, and Project 6). Furthermore, the projects raise awareness of the conservation of cultural heritage and encourage new initiatives at the governmental and local level.

Overall, these projects, examined through the literature review, identified a framework for the evaluation of the primary research case study.

2.2. The Case Study Area: Selimiye Quarter in the Walled City of Nicosia

Within the urban context, the historical core of Nicosia has changed and transformed under the sovereignty of different nations (Zetter, 1985; Oktay, 2007). However, the Selimiye Quarter has continued to be a religious centre for every nation and was developed with educational and commercial buildings. For this reason, the Selimiye Quarter was chosen as the focus of this study. It is located centrally within the historic walls, and is one of the most important historic areas of the Walled City of Nicosia (Petridou, 2003). Another reason for choosing Selimiye Quarter is that it has undergone significant public space rehabilitation as part of heritage-led regeneration, with a long-term goal to bring visitors back to the historic core (Figure 1, Figure 2).

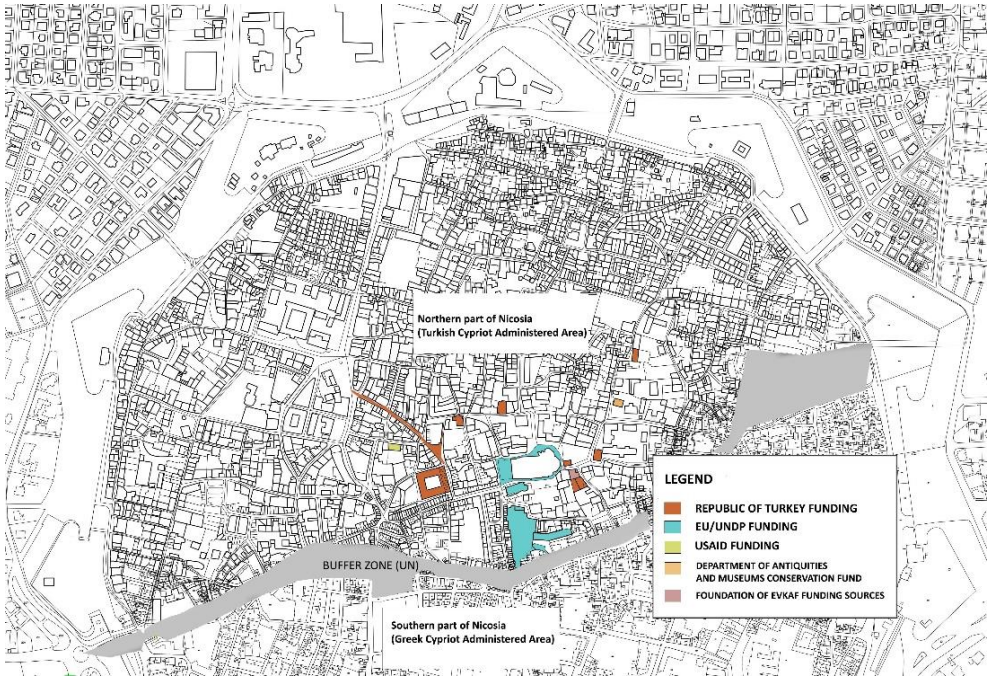


Figure 1. Completed rehabilitation/restoration/reuse projects funded by different funding bodies in the Selimiye Quarter in the Walled City of Nicosia, northern part, (Original Walled City of Nicosia Map by Nicosia Turkish Municipality, no date) adapted by Authors 2023.

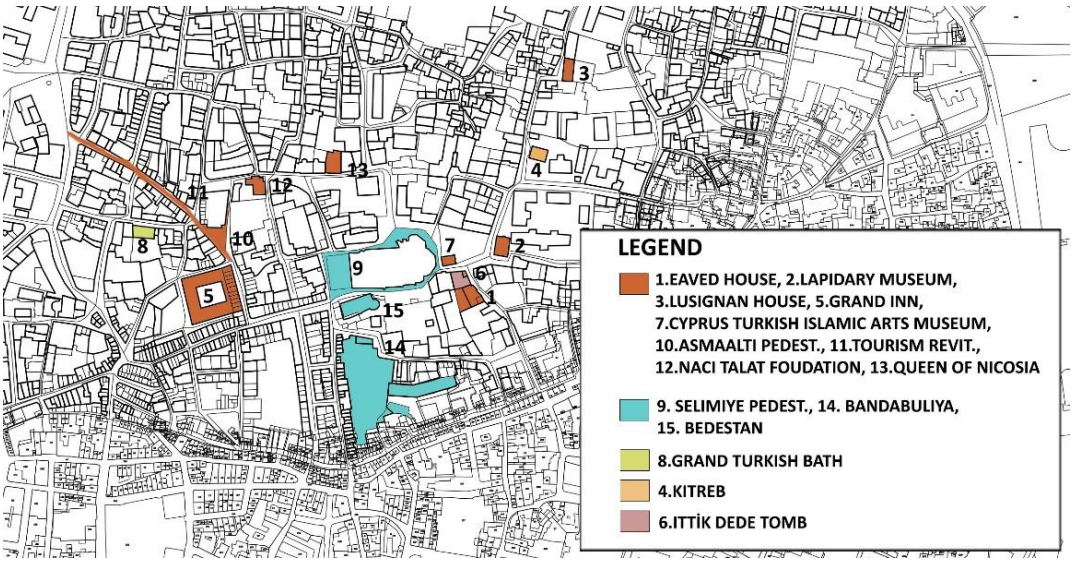


Figure 2. The names of the completed rehabilitation/restoration/reuse projects in the Selimiye Quarter in the Walled City of Nicosia, northern part, (Original Walled City of Nicosia Map by Nicosia Turkish Municipality, no date) adapted by Authors 2023.

2.3. Key Stakeholders in TRNC and their Roles in Cultural Heritage Conservation

The selected case study is the northern part of the Walled City of Nicosia, and this helps to evaluate the theoretical intuitions. Although TRNC does not have a policy directly related to urban regeneration, it has developed policies regarding conservation which are an integral part of urban regeneration in the cultural heritage context (Hoşkara & Doratlı, 2007). In the TRNC, the central government is the main authority on conservation, and there is a top-down process. However, one of the most important conditions for the sustainability of heritage-led regeneration is to ensure and encourage socio-cultural continuity and therefore local community participation (Court & Wijesuriya, 2015). One of the main reasons for the top-down approach could be related to the lack of understanding of conservation by the majority of the public (Hoşkara & Doratlı, 2007).

The TRNC Constitution contains provisions regarding the protection of historical and cultural heritage (Section 39 - Protection of historical, natural and cultural values). In fact, conservation of cultural heritage within the TRNC is the responsibility of three state institutions. These are: TRNC Town Planning Department - Ministry of Interior (55/1989 Town Planning Law), TRNC Department of Antiquities and Museums (60/1994 Antiquities Law) - Deputy Prime Ministry and Ministry of Foreign Affairs, TRNC Culture Office - Ministry of National Education and Culture (19/1986 and 23/1994 Cultural Office laws). While the TRNC Department of Culture has authority over intangible cultural heritage, the TRNC Town Planning Department and TRNC Department of Antiquities and Museums have authority over tangible cultural heritage. Conservation processes progress within the TRNC under these laws. Apart from these, there are institutions that are indirectly involved in the process. With the Law No. 51/1995, Municipalities and Local Governments are included in the conservation process. With the Foundations Law 73/1991, the Foundations of Evkaf takes part in the conservation process as a serious stakeholder. With the Tourism Sector Incentive Law 16/1987 and the Tourism Development Law 52/2011, the Ministry of Tourism and Environment is one of the ministries involved in the conservation process. 65/1988 Income and Tax Office Law and Income and Tax Office are among the institutions involved in the process. Tax cuts and exemptions for conservation projects are regulated under law. Under the 21/2005 KTMMOB (Union of The Chambers of Cyprus Turkish Engineers and Architects) law, chambers of architects, civil engineers, electrical engineers, mechanical engineers and city planners are involved in the process. With the law of 18/1998, Contractors are involved in the process as responsible persons for the construction of projects created in accordance with the rules. Organizations and legislations directly and indirectly related to the conservation of tangible cultural heritage, as well as the other relevant stakeholders are shown in Table 2.

Considering their contribution to the heritage-led regeneration process in Selimiye Quarter, key stakeholders selected from the legal framework are as follows; TRNC Department of Antiquities and Museums, Foundation of Evkaf, Nicosia Turkish Municipality, and the TRNC Ministry of Tourism and Environment. Although the TRNC Town Planning Department has the authority in heritage-led regeneration process, it was not included in this research as it does not deal with projects directly or it does not manage projects of its own. On the other hand, the UNDP is not included in the TRNC Legal framework, but it is an international organization which has supported the heritage-led regeneration process via different projects, as well as creating technical advice, supporting implementation and providing financial support in the Walled City of Nicosia. Therefore it was selected as one of the key stakeholders.

Table 2. Table of the Legal Framework of TRNC Related to Cultural Heritage Conservation (Gürdallı, Kızılduman, Gündüz, Uluğ, Feridun, Reis, & Davulcu, 2019) adapted by Authors, 2021

LEGAL FRAMEWORK		
Legislation Directly Related to the Conservation of Tangible Cultural Heritage	**Legislation Indirectly Related to the Conservation of Tangible Cultural Heritage**	**Relevant Stakeholders in the Conservation of Tangible Cultural Heritage**
Antiquities Law TRNC Department of Antiquities and Museums (Protection of Ancient Monuments and	**Streets and Building Regulation** Municipalities and Local Administration	**-Contractors Association** **-KTMMOB** (Chamber of Architects, Chamber of Civil Engineers, Chamber of Electrical Engineers, Chamber of Mechanical Engineers, Chamber of City Planners)
Town Planning Law TRNC Town Planning Department (Law and Regulations on Regional Town Planning and	**Law of Municipalities** Municipalities	
	Law of Evkaf Foundation of Evkaf	
	Law of Tourism Development TRNC Ministry of Tourism	
	Income Tax Law Income and Task Office and Environment	
	Fees and Wages Law **Property Tax Law** Land Office	

The information collected through the case study includes building/project analysis. The analysis is shown in Table 3. The aim was to examine the contributions of funding bodies or resources in the heritage-led regeneration process through 15 projects led by 5 key stakeholders. Four projects were selected from Department of Antiquities and Museums, 4 projects were selected from Foundation of Evkaf, 3 projects were selected from Nicosia Turkish Municipality, 2 projects were selected from TRNC Ministry of Tourism and Environment, and 2 projects were selected from UNDP. Some of the selected projects included the rehabilitation, restoration and reuse of monuments such as mosques, churches, bazaars, inns and baths that are used as public spaces. Some other projects involved the reuse of traditional residential buildings as administrative building, cafes or boutique hotels, whereas others involved the rehabilitation of the streets. A diverse range of projects were selected depending on which projects had received or requested financial support from funding bodies.

The rehabilitation, restoration and reuse projects in the Selimiye Quarter of the Walled City were selected according to the following key criteria:

- They were listed buildings or monuments or significant historic streets.
- They would help identify the diversity of funding bodies or resources in the organizations that support heritage-led regeneration in the Walled City of Nicosia, and show the relationships between stakeholder and financing institution or source.
- They would reveal what type of projects the funding body or source supported in the regeneration process.

Table 3. Table showing the selected projects in relation to key stakeholder (and their key responsibilities), and key funding bodies/resources

Key Stakeholders	Responsibility and Action	Key Reasons for Selection	Selected Projects	Funding Bodies / Resources
1 Department of Antiquities and Museums	Institution responsible for determining /listing the cultural heritage, conservation /planning, and approval / permitting on a project basis in accordance with the law on a project basis in accordance with the law.	**1. Significance:** -Listed buildings and monuments -Collective memory **2.Funding Source:** -Republic of Turkey funds - the Department of Antiquities conservation fund (1995-2006).	1.Restoration and Reuse of Eaved House	Republic of Turkey (1986-1994)
			2.Restoration and Reuse of Lapidary Museum	Republic of Turkey (2003)
			3.Restoration and Reuse of Lusignan House	Republic of Turkey (2013)
			4.Restoration and Reuse of Cyprus Turkish Tourist Guides Association (KITREB)	Department of Antiquities and Museums Conservation Fund
2 Foundation of Evkaf	An institution that provides financial support for the preservation and maintainance of tangible and intangible cultural heritage. Key landowner in the Walled City of Nicosia.	**1.Significance:** -Listed buildings and monuments -Collective memory **2.Funding Source:** -Republic of Turkey funds -Foundation of Evkaf -UNDP – ACT (1997-2016) -UNDP - PFF	1.Restoration and Reuse of Grand Inn	Republic of Turkey (1995-2002)
			2.Restoration of Ittik Dede Tombs	Foundation of Evkaf funding sources
			3.Restoration and Reuse of Cyprus Turkish Islamic Arts Museum	Republic of Turkey General Directorate of Foundations (2013)
			4.Restoration and Reuse of Grand Turkish Bath Restoration	USAID funding resources under the direction of UNDP ACT (2008-2010)
3 Nicosia Turkish Municipality	It is a local authority that aims to meet all kinds of municipal services that the city needs. Although it has serious influence in the conservation and monitoring process, its practise is complex.	**1.Significance:** -Collective memory **2.Funding Source:** -Republic of Turkey funds -UNDP – ACT (1997-2016) -UNDP - PFF	1.Selimiye Pedestrianization project	EU Funding via UNDP (2000 – 2001)
			2.Asmaaltı Pedestrianization project	Republic of Turkey Funding (2017-2018)
			3.Walled City of Nicosia Tourism Revitalization Project	Republic of Turkey Funding via KOBIGEM (2015)
4 TRNC Ministry of	An institution responsible for, to	**1.Significance**: -Collective memory	1.Restoration and Reuse of Foundation of Naci Talat	Republic of Turkey

	Tourism and Environment	increase the quality and diversity of tourism-oriented services, to help the creation of new tourism-oriented facilities and to support activities that will activate the tourism potential.	-Listed buildings **2.Funding Source:** -Republic of Turkey funds (Tourism Potential Development Partial Grant Program through KOBIGEM)	Funding via KOBIGEM (2015)
			2.Restoration and Reuse of Queen of Nicosia Boutique Hotel	Republic of Turkey Funding via KOBIGEM (2018)
5	**UNDP**	An institution that economically and technically supports interventions that will promote bi-communal and inter-communal dialogue and cooperation, and improve the economic, physical and social infrastructure in cultural heritage areas.	**1.Significance:** -Collective memory -Listed buildings and monuments. **2.Funding Source:** -UNDP-ACT (with USAID funds) (1997-2016) -UNDP-PFF (with EU funds)	1.Renovation of the Bandabuliya	EU/UNDP PFF (2004-2012)
				2.Restoration and Reuse of the Bedestan (St. Nicholas Church)	EU / UNDP PFF (2004-2006)/(2007-2009)

3. Research Findings and Discussion

3.1. Examination of Funding Bodies' Contribution to Heritage-Led Regeneration through an Examination of Key Stakeholders and Selected Cases

Tangible cultural heritage projects are implemented via certain permit processes. To proceed, the project will need to obtain the necessary permissions from the Department of Antiquities and Museums - High Council of Monuments, the Town Planning Department, the Municipality, the Tax Office, Property Owner (Generally Foundation of Evkaf in Walled City of Nicosia), the KTMMOB (the Chamber of Architects, the Chamber of Civil Engineers, the Chamber of Electrical Engineers and the Chamber of Mechanical Engineers). In addition, the organization that provides financial support to the project also has influence on the permitting process. Different professionals/bodies are involved in project implementation: architects, civil engineers, electrical engineers, mechanical engineers as well as the contractor, property owner, the funding bodies or resources, the Municipality, the Department of Antiquities and Museums - the High Council of Monuments. The control and approval process is under the control of the stakeholders (Gürdallı, Kızılduman, Gündüz, Uluğ, Feridun, Reis, & Davulcu, 2019).

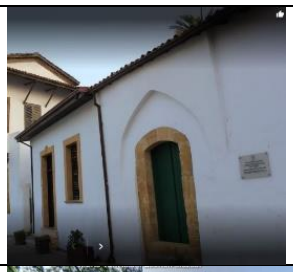
Public participation, partnership and governance are a legal part of the decision-making process and those processes are similar for all selected stakeholders. However, it is evident through the research that there is no organization for the Walled City of Nicosia (northern part) that will provide integrated heritage-led regeneration, ensure the cooperation of central and local governments, non-governmental organizationgü and local people. In addition, the organizations which were highlighted most in governance and participation were the contractors and developers. Overall there is lack of coordination among the stakeholders and/or lack of definition of what each stakeholder is responsible for (in the regulations related to conservation).

Table 3 shows the main responsibilities of the identified key stakeholders, the selected projects and the financing institution relationships. The contribution of the funding bodies through key stakeholders

are analysed through selected projects provided in Table 3. The project context/aims, tools and achieved regeneration outcomes are provided in Table 4. These projects are evaluated below.

Table 4. Table showing the case projects, context/ aims of the projects, project tools and achieved regeneration outcomes

	Project Name	Photo of the Project	Context/Aim of the Project	Project Tools	Achieved Regeneration Outcomes
1.Department of Antiquities	**1.Restoration and Reuse of Eaved House**		Conversion to a culture centre (exhibitions, events, permanent exhibition to view with entrance fee). Physical Conservation **(PC, SCE, EI, CA, PUI)**	**(FS) (RRR)**	Physical Regeneration **(PR)** Problems with Economic Regeneration **(ER**) and Socio-cultural Regeneration **(SCR)** (no living function)
	2. Restoration and Reuse of Lapidary Museum		Conversion to a museum. Stone artworks are exhibited in the museum. **(PC)**	**(FS) (RRR)**	**PR** Problems with **ER** and **SCR**
	3.Restoration and Reuse of Lusignan House		Conversion to an art gallery. **(PC)**	**(FS) (RRR)**	**PR** Problems with **ER** and **SCR**
	4.Restoration and Reuse of Cyprus Turkish Tourist Guides Association (KITREB)		Conversion to an administrative building. **(PC)**	**(FS) (RRR)**	**PR** Problems with **ER** and **SCR**
2.Foundation of Evkaf	**1.Restoration and Reuse of Grand Inn**		Conversion to a cultural centre which produces and sells local products. Creating a meeting point and socialization in the historic core. **(PC, SCE, EI, CA, PUI)**	**(FS) (RRR) (SP) (CP) (RRR)**	**PR ER SCR**

	2.Restoration of Ittik Dede Tombs		Restoration of the building. **PC**	**(FS) (RRR)**	**PR** Problems with **ER** and **SCR**
	3.Restoration and Reuse of Cyprus Turkish Islamic Arts Museum		Restoration of the building and 400 years old carpets and historic objects to be displayed in the building. **(PC, SCE, EI, CA)**	**(FS) (RRR)**	**PR** Problems with **ER** and **SCR**
	4.Restoration and Reuse of Grand Turkish Bath Restoration		Rehabilitating the building and continuing the original function. **(PC, SCE, EI, CA, PUI)**	**(FS) (RRR)**	**PR** Problems with **ER** and **SCR**
3.Nicosia Turkish Municipality	**1.Selimiye Pedestrianization project**		To host various special events, creating a public space to enable city's social activities (Social/Cultural Enhancement-**SCE**). The revitalisation of the Selimiye Square to gain economic and urban texture vitality by providing services (**CA, EI**) to domestic and foreign tourism. –(**PC**, **PUI)**	**(FS) (RRR) (SP) (CP) (RRR)**	**PR ER SCR**
	2.Asmaaltı Pedestrianization project		Bring vitality of urban texture with the new pedestrianized area and opportunities to increase commercial functions to the area. **(PC, SCE, EI, CA, PUI)**	**(FS) (RRR)**	**PR**

	3.Walled City of Nicosia Tourism Revitalization Project		Providing direction signs, informative signs, tourism office signage and blue lines to direct tourists to important historic areas and places. **(PC, PUI)**	**(FS) (RRR)**	**PR**
4.TRNC Ministry of Tourism and Environment	**1.Restoration and Reuse of Foundation of Naci Talat**		Conversion to a city museum and culture centre **(PC, SCE, EI, CA)**	**(FS) (RRR)**	**PR** Problems with **ER** and **SCR**
	2.Restoration and Reuse of Queen of Nicosia Boutique Hotel		Conversion to a boutique hotel to provide accommodation service in the historic quarter. **(PC, SCE, EI, CA)**	**(FS) (RRR)**	**PR** Problems with **ER** and **SCR**
5.UNDP	**3.Renovation of the Bandabuliya**		Rehabilitating the building and providing a safe and hygienic environment for users and visitors. **(PC, SCE, EI, CA, PUI)**	**(FS) (RRR) (SP) (CP) (RRR)**	**PR ER SCR**
	4.Restoration and Reuse of the Bedestan (St. Nicholas Church)		Conversion to a culture centre **(PC, SCE, EI, CA, PUI)**	**(FS) (RRR) (SP) (CP) (RRR)**	**PR ER SCR**

LEGEND

Project Aims	**Project Tools**	**Project Outcomes**
Physical Conservation **(PC)**	Financial Support **(FS)**	Physical Regeneration **(PR)**
Economic Improvement **(EI)**	Rehabilitation/Restoration/Reuse **(RRR)**	Economic Regeneration **(ER)**
Social/Cultural Enhancement **(SCE)**	Strong Partnership **(SP)**	Socio-cultural Regeneration **(SCR)**
Preservation of Urban Identity **(PUI)**	Community Participation **(CP)**	Raised Awareness **(RA)**
Commercial Activities **(CA)**		Promoted Tolerance-Respect **(PTR)**

The Eaved house has been transformed into a cultural centre with the funding provided by the Republic of Turkey. Different events such as conferences, exhibitions and social events are held there at different times of year. Income is sustained through events and an entrance fee, but its long-term economic sustainability is questionable. The Lapidary museum that was originally a Venetian house from the Venetian period, has been turned into a museum with Republic of Turkey funding. Stone artworks are exhibited in the museum. The Lusignan house has been transformed into an art gallery with Republic of Turkey funding. During research field trips, it was observed by Mısırlısoy & Günçe (2016) that the Lapidary Museum and Lusignan House attract very few visitors, so they lack a living function. The Cyprus Turkish Tourist Guides Association building was restored before 2007 at an unknown date with the Department of Antiquities conservation fund. It has been observed that this building also lacks a living function.

The Grand Inn (Büyük Han) has been transformed as a cultural centre for public use, and for tourism. Traditional Turkish Cypriot arts / craft / food are produced and sold there. It has been observed that the Grand Inn exhibits physical, socio-cultural and economic sustainability and provides economic vitality to the area (attracting tourists) (Menteş, 2023). Ittık Dede Tomb and the Cyprus Turkish and Islamic Arts Museum are examples where Foundation of Evkaf funding and Republic of Turkey General Directorate funding has provided financial support coordinated by Foundation of Evkaf. During the research visits, these structures were observed to attract very few visitors. Although physical sustainability has been ensured in both buildings, their socio-cultural and economic sustainability is controversial. After the restoration of the Grand Turkish Bath, it operated for a short time with the tender method of the Foundation of Evkaf and then closed again. When considering the sustainability of heritage-led regeneration and restoration, the economic and socio-cultural dimensions of this historical building should also be considered.

Three projects financed by different financing institutions or sources, in which the Nicosia Turkish Municipality is the main stakeholder, were examined. Selimiye pedestrianization project was supported by the UNDP with EU funds. The square, which hosts various special days, festivals and exhibitions, has been transformed into an area that enables the city's social activities. The vibrancy of the historic Selimiye Square has increased as it has encouraged domestic and foreign tourism through restaurants and cafes and the sale of locally produced handicraft. The Asmaaltı pedestrianization project has improved the vitality of both the economic and urban texture, with new commercial functions introduced to the area using the funds of the Republic of Turkey. The Walled City of Nicosia tourism revitalization project was financially supported by KOBIGEM. Municipal works were financed by this project such as the installation of direction, information and tourism office signage, and blue lines on the ground in significant streets to direct visitors around. As a result of field trips and observations, it was evident that the municipality gave priority to services in the touristy areas, and that the more residential areas were neglected.

Funds provided by the TRNC Ministry of Tourism and Environment encourage the development of tourism potential. The TRNC Tourism Potential Development Partial Grant Program is supported by funding resources provided by the Nicosia Embassy of the Republic of Turkey. However, cost efficiency has been an important factor in selecting projects as the funding resources are limited by the budget provided by the Republic of Turkey. For example, 4,000,000 TL (equating to approx. 135,300 Euros in August 2023) was allocated from the Republic of Turkey funds to the TRNC Tourism and Environment Ministry in 2018 (KKTC Turizm ve Çevre Bakanlığı, 2018). Accordingly, the Ministry selects the projects to be supported in line with the financial support provided. Naci Talat Foundation - Nicosia City Museum and Queen of Nicosia Boutique Hotel are the only two listed buildings and projects in Selimiye Quarter that have benefited from the partial grant program for restoration and reuse. There is no available statistical data on the contribution of tourism to the successful restoration and conservation of historical buildings which were reused as boutique hotels, restaurants, cafes or museums as a result of these funds.

As the TRNC government is not internationally recognized, EU financial resources provide funds for the conservation of cultural heritage under the direction of the UNDP. EU funded projects build on the EU

policy of conserving cultural heritage as a driving force to unite communities in cities with differences in origin, ethnicity or religion (European Commission, 2019). The Bedesten and Bandabuliya projects are examples where the EU has provided financial support under the direction of the UNDP. The aim of both projects is to consider the economic and socio-cultural sustainability of the buildings while ensuring their physical regeneration. In addition, these projects aim to contribute to strengthening the social connections between communities. The EU has chosen projects to finance by considering some specific criteria such as: physical, socio-cultural and economic sustainability, uniting different communities, providing economic vitality to the site (attracting tourists) and encouraging new initiatives at the governmental or local level.

While some projects have achieved success in all dimensions of heritage-led regeneration, others have been lacking. Of 15 projects, 4 projects (Grand Inn, Selimiye Pedestrianization project, Bandabulya, Bedesten) achieved success in all the dimensions of heritage-led regeneration, while 11 have only achieved physical regeneration. It is also important to highlight that, in the evaluation of the international cases (through literature review in Table 1) it was clear that the project aims, tools and outcomes were grouped together and these were consistent in the cases. However in the primary case study, these were only consistent in the two UNDP projects (Bandabulya and Bedesten) and two others (Grand Inn, Selimiye Pedestrianization project) which achieved success in all dimensions.

Because there is no institution that carries out monitoring and evaluation after the implementation of the project, its socio-cultural sustainability remains questionable. In some cases even its physical sustainability is uncertain (Turkish Tourist Guides Association, Grand Turkish Bath, Naci Talat Foundation, Queen of Nicosia). In these projects, economic income is sustained by services, activities and/or entrance fees, but the economic sustainability of the projects remain questionable. For this reason, it is not easy to determine which criteria to use to select projects for financial support. Only funds provided via the TRNC Ministry of Tourism and Environment had specific goals for funding.

It is evident that socio-cultural and economic sustainability is neglected in buildings that are only physically restored. After restoration work, there is no monitoring and no control mechanism of the reuse of the buildings and maintenance works. Therefore many tangible heritage buildings that have been restored have the threat to return to their previous abandoned state due to incorrect and incomplete policies implemented in monitoring and evaluation.

4. Conclusion and Suggestions

In the light of findings obtained from the analysis and evaluation conducted through the theoretical literature research, collected documentation and the main case study, this paper reveals that urban heritage has an important role in sustainable development, as the contemporary problems of historic city centres are related to culture and conservation of heritage. Investing in urban heritage ensures a link between sustainable development and urban regeneration.

Implementation and management are two important factors in the success of the regeneration process and its outcomes. Above all, the implementation of heritage-led regeneration requires financial resources. The financial support of international organizations is a trigger for the conservation and regeneration of cultural heritage. Non-profit organisations and NGOs should take the first steps in heritage conservation and heritage-led regeneration, in order to also encourage private investment. The results of this research show that implementation and management include mobilizing a large number of stakeholders, securing financial and other necessary resources and creating partnerships at a local and regional basis. The key to making the implementation and management visible is the provision of financial support.

Due to the embargo imposed on the TRNC, financial resources are insufficient for cultural heritage conservation; the heritage-led regeneration process has been negatively affected by slow progress. EU and Republic of Turkey funds are the two key funding bodies / resources in the conservation of cultural heritage in Walled City of Nicosia (northern part) (USAID funds ended after UNDP ACT closed in March 2016) that have ensured the continuity of the process and conservation. However, EU and Republic of Turkey funds were also observed to be affected by political policy. Therefore, for the heritage-led

regeneration of the Walled City of Nicosia, the TRNC government and the local government need to develop an urban policy in which they can use their resources in the most effective way. The lack of coordination among stakeholders may be due to the lack of a specific organization dedicated to the heritage-led regeneration of the Walled City of Nicosia. An organization should be established for the Walled City of Nicosia (northern part) that will ensure integrated heritage-led regeneration to provide the cooperation of central and local governments, non-governmental organizations and local people. This organization may take the form of establishing a department within the municipal administration responsible for coordination, planning, monitoring and evaluation, such as the process in international case in Section 2.1-Project 1 (Regeneration of the Historic Centre of Malaga). Realizing the power of municipalities to participate with local people (like in Project 2-History has a Future in other Capital of Romania /Alba lulia), implementing steps such as supporting public and private sector cooperation under municipal coordination (like in Project 4-The Beautiful Cremea) may also be useful factors that can enhance this organization. Furthermore, strengthening of Department of Antiquities and Museums would also be an important step for conservation in heritage-led regeneration process; by providing new funding bodies / resources, by providing architects specialised in cultural heritage (UNDP, 2019), by reviewing the laws to encourage local people to get permission(Gürdallı, et. al, 2019), and by controlling project implementations for sustainability of projects (Turok, 2005).

Funding bodies may influence and contribute to the development of cultural heritage, sometimes based on pre-determined criteria of what to fund (e.g. tourism, accommodation for tourism) and sometimes due to complicated criteria which are not pre-determined. At times, pre-determined criteria can relate to physical conservation while alternatively they can relate to socio-cultural and socio-economic aspects such as increasing awareness of the community (e.g. uniting different communities, providing economic vitality to the site, attracting tourists), and encouraging new initiatives at the governmental or local level. The research reveals that new functions, usage patterns and socialization methods in the Walled City of Nicosia are mainly determined by the direction of funding bodies or resources. Therefore, funding bodies or resources play a role not only in physical changes but also in the change of socio-cultural and economic structures. Attention should be paid that this reuse process should be coordinated with a master plan that considers the long-term physical, economic and socio-cultural sustainability of these places.

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Digital Approach in Conservation of Heritage: 3D Virtual Reconstruction Applications in Ancient Cities

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Abstract

Virtual reconstruction through digital methods should be implemented in the conservation process to obtain an accurate representation of cultural heritage, establish its value, and ensure the transfer of information to future generations through a secure, reversible, and cost-effective approach. A critical evaluation of fifteen virtual reconstruction applications will be performed regarding their objective, data collection and reconstruction methods, and visual representation outputs. The selected three studies will be analyzed in detail by their superiorities and competencies in reconstruction. The research performs a literature review on cultural heritage conservation, traditional and digital perspectives on conservation, and virtual reconstruction applications. The analysis intends to guide further studies, offering a deeper understanding and clarification of software preferences as virtual reconstruction becomes prominent in archaeology. The study enables the determination and assessment of methodological alternatives through outcomes by comparative review and, as a result, compiles and showcases the suitable techniques for the reconstruction process.

Keywords: *Virtual reconstruction, cultural heritage conservation, 3D modeling and visualization, complementary modeling in ancient cities, digital representation of the past.*

Mirasın Korunmasında Dijital Yaklaşım: Antik Kentlerde 3B Sanal Rekonstrüksiyon Uygulamaları

Öz

Kültürel mirasın aslına uygun şekilde tasvir edilmesi, kültürel değerinin korunması ve bu verilerin gelecek nesillere aktarılması amacıyla mirasın koruma sürecinde güvenli, geri dönüştürülebilir ve maliyet-etkin dijital yöntemlerle sanal rekonstrüksiyon teknikleri uygulanmalı ve yaygınlaştırılmalıdır. Çalışma kapsamında on beş farklı sanal rekonstrüksiyon uygulaması, görselleştirmenin hedefi, veri toplama ve rekonstrüksiyon yöntemleri ile görsel temsil yetenekleri bakımından değerlendirilecektir. Seçilen çalışmalar sanal rekonstrüksiyon alanındaki üstünlükleri ve yeterlilikleri açısından detaylı bir şekilde incelenecektir. Araştırmada, kültürel mirasın korunması, geleneksel ve dijital bakış açıları ve sanal rekonstrüksiyon uygulamalarına dair literatür taraması yapılmaktadır. Analizler, sanal rekonstrüksiyonun arkeolojide öne çıkmasıyla birlikte yazılım tercihleri hakkında daha derin bir anlayış sunarak gelecekteki çalışmalara rehberlik etmeyi amaçlamaktadır. Çalışma, karşılaştırmalı inceleme yoluyla metodolojik alternatiflerin sonuçlar üzerinden değerlendirilmesine ve belirlenmesine olanak sağlamakta ve sonuç olarak rekonstrüksiyon süreci için uygun teknikleri derleyerek sunmaktadır.

Anahtar kelimeler: *Sanal rekonstrüksiyon, kültürel mirasın korunması, 3B modelleme ve görselleştirme, antik kentlerde tamamlayıcı modelleme, geçmişin dijital temsili.*

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1. Introduction

Curiosity has always encouraged human beings to research and learn. An individual's curiosity about history, society, and the environment leads to discovering and improving the sense of memory. The consciousness of identity grows alongside memory and history with the support of spatial elements. Society establishes connections and identity with a sense of ownership through moral, physical, and spatial attributes. Due to the sense of identity, individuals have become more aware of their heritage, encouraging them to conserve historical structures and artifacts. The conservation of heritage is the beginning of a process that involves improvement. Rather than merely adapting to the passage of time, conservation is viewed as an ongoing and dynamic process, often involving intricate rebuilding operations to unite fragments into cohesive structures.

Integrating digital tools in archaeology has ushered in a paradigm shift from traditional approaches to conserving and reconstructing cultural heritage. Leveraging advanced technologies such as 3D modeling and rendering, archaeologists can digitally recreate ancient sites precisely, ensuring the preservation of historical artifacts and structures. This digital approach safeguards the integrity of fragile remnants and enables virtual exploration and analysis. Virtual reconstruction, the main focus of this study, facilitates interventions without physical disruption, offering a fresh perspective for visually and technically satisfactory outcomes.

With the widespread use of digital software, many designers and architects have attempted to reconstruct complementary models of ancient cities and relics. The process should be completed with a scientific approach and requires broad research, survey and scanning data, measurements, technical drawings, physical analysis, documentation, and comprehensive interdisciplinary work by archaeologists, architects, designers, and art historians. Although the abundance of these studies creates diversity in the literature, it may lead to methodologic confusion due to multiple disorganized data. Some of these inefficient applications are uncertain and may be intended solely to attract tourists, superficially reconstructed by emphasizing only visual aspects without considering historical consistency, lacking technical and appearance details, and having poor ability to represent the actual structure. The primary goal of digital heritage reconstruction should be to achieve a proper representation, similar to on-site restoration and reconstruction.

Within the scope of this paper, fifteen virtual reconstruction applications will be reviewed critically by comparison due to their objectives, methods, and outputs. The selected three examples -Ádám Németh's Ephesus Reconstruction, Gilbert J. Gorski and James Packer's Roman Forum, and Flyover Zone Production's Rome Reborn Project - will be analyzed by focusing on their representations, methodology, and research-based approaches. The cases are chosen due to their outstanding perspectives regarding sequentially realistic visual quality, accuracy and educational guidance, user engagement and up-to-dateness. Each application is remarkable and has the competency to preserve shape-wise, appearance-wise, and constitutive-wise historical accuracy on a large-scale area while comprehensively interpreting and implementing details with differentiating modeling-rendering software in a highly realistic approach to spatial environments that do not exist today, as well as being capable of setting an up-to-date example for future applications with hardware and software used. The study aims to examine the virtual reconstruction applications, clarify the mass of data of digital 3D outputs, and compare their ability to represent history and reflect the heritage accurately and ethically by reviewing the methods to point a direction to further studies.

1.1. Revival of the Past: History and Heritage

Memory and the history of humankind are built together, yet their connection remains unwritten for centuries. Once the need for historiography strikes, the rapid growth of the notion of memory ensures a reconsideration of historical connections (Malicki, 2017). Processing memory through physical spaces is a component of contemporary culture. Places where people establish a materialistic or moral relation are associated with a sense of belonging, ownership, identity, and heritage. Furthermore, a sense of the place corresponds to people's intense social perceptions of a specific space.

One of the places where a strong sense of identity and heritage can be perceived at a high level is the archaeological excavation sites. The ruins in the archaeological areas are the in-situ representatives of tangible heritage. Exhibiting the archaeological finds in situ and making them available to the public is crucial to understanding the heritage in the spatial context (Keskin & Tanaç Zeren, 2018). Archaeological research provides information about prehistoric cultures and, together with written sources, helps to read the past in a historical context. One of the most critical excavations in history is undoubtedly the Pompeii and Herculaneum excavations. The first excavation attempts in Pompeii and Herculaneum, which were under the ashes for 16 centuries, were carried out by Architect Domenico Fontana in the late 16th century. However, the excavations were damaged due to unconscious or poor reconstruction methods, undelivered conservation attempts, and the II. World War. Nevertheless, until the end of the excavations, the architectural, sculptural, painting, and mosaic heritage in Pompeii was unearthed, and archaeology, art history, and architectural data were still obtained. As the notion of conservation of cultural heritage gains importance, efforts have been made to reverse the damage received before (Kazma Çetiner, 2017).

Although heritage is directly connected to identity and collective memory, it can be transferred to a different country from where it was built and belonged due to political and diplomatic issues. As an example, the Pergamon (Zeus) Altar, which belonged to Pergamon, İzmir, was moved due to an agreement, which Turks realized its unfairness later, for benefiting the Prussian and Ottoman Empire at the end of the 19th century and reconstructed at the Pergamon Museum, Berlin (Bayrakdar et al., 2017). Although conserving cultural heritage thrived in the 18th century, many nations and empires, including the Ottoman Empire, could not understand its importance during this period, and unethical behaviors were realized, including artifact smuggling, illegal sales, and damaging artifacts not under the principle of protection.

In 1972, The World Heritage Convention (WHC) included a significant knowledge and method of heritage. Since then, there has been a considerable impact and development in terms of laws and policies, and it continues to frame the discourse about outcomes and the value of heritage. By highlighting the notion of humanity's shared heritage, the WHC has primarily concentrated on the topic (Smith & Akagawa, 2009).

1.2. Cultural Heritage and Conservation

Conservation of cultural heritage is not trying to catch up with time. On the contrary, it can be considered the start of a process and includes the progress of improvement. What is done to preserve the relics transforms into a rebuilding operation to assemble components into a complete unit (Samuel, 1994).

In terms of conserving cultural heritage, four different purposes can be discussed. First, history should be taught thoroughly to every community member to ensure cultural continuation. The second purpose is to seek to nationalize history and integrate it into communities. The natural desire to preserve beauty and meaning is the third reason for conserving heritage. On the other hand, since beauty and value judgments can change over the years, they cannot develop a clear judgment. The final purpose is to evaluate tourism commercially (Tekeli, 1989). The importance of the heritage of a different culture at a time when it did not belong may play a massive role in this case.

The correlation between cultural heritage and archaeology is indisputable. The subject of archaeology has a significant influence on the recreation of history (Harrison, 2013). In archaeology, conservation intends to preserve the excavation site from damage/destruction and necessitates interventions to keep visual accuracy intact. Proper conservation can be accomplished by both protective and restorative actions (Matero, 2008). According to the ICOMOS Venice Charter, after excavation in an archaeological site, these intervention steps should be pursued: Restoration, restitution, reconstruction, and anastylosis. *Restoration* is a procedure that requires adopting measures to maintain the structures' value by reinforcing the current framework to improve the findings' endurance. *Restitution* is defined as the representation of the initial state of a partially collapsed structure by technical drawings or models. *Reconstruction* relies on accessible documentation,

restructuring a finding that was entirely or partially demolished or remains in poor condition. Lastly, *anastylosis* is reassembling damaged or removed structural components (Öztürk, 2016).

Traditional reconstruction techniques provide physical authenticity and a tangible representation and allow for hands-on experience and interaction with the structure or city, promoting tourism and economic development in areas with historical or cultural significance. However, it is essential to note that poorly designed projects can crush or do massive damage to the existing heritage element. The process is costly, can cost thousands to millions of dollars, and is time-consuming, particularly for large or complex structures or cities. It also may not be feasible or appropriate for structures or cities that are too damaged or unstable. Furthermore, it may involve the destruction of existing structures or artifacts.

During the 1980s, the quickly developing research of computer modeling and representation started to be adopted by archaeologists as a means of exploring data from excavations (Beale & Reilly, 2015). Paul Reilly, an archaeologist and computer scholar, put the notion of "virtual archaeology" forward in 1990 to refer to the application of computer-based reproductions of historical investigations. Technological advancements generated an environment that may signal significant enhancement in the types and methods of historical substance collected, organized, analyzed, represented, and shared (Reilly, 1990). The various digital resources and methods that the researchers use have provoked a rapid increase in creative work that has completely transformed the field (Morgan, 2022). With the widespread digital approach in the last thirty years, heritage conservation and intervention techniques started to be applied with a digital perspective, at least in one of the data-gathering or reconstruction phases. Unlike traditional techniques, virtual reconstruction provides a safe, reversible, cost-effective alternative to actual reconstruction. The process generates quicker results and can create 3D models of ancient structures that may no longer exist or are difficult to access and simulate changes over time or under different conditions better to understand the evolution of the city or structure.

Overall, virtual reconstruction and actual reconstruction/restoration offer different benefits and drawbacks depending on the context and goals of the project; however, in the project scope, virtual conservation techniques will be analyzed. Before the broad acceptance and use of digital techniques, preservation actions stood out in the sites rather than reconstruction, and it was encouraged that integrated elements ought to be less outstanding than the majority. The modifications should be kept distinct and made with various textures. The strategy was to keep traces of remains as a component of the totality, and reconstruction is strongly discouraged when using traditional procedures (Ahunbay, 2010). Nonetheless, with the development of fully digitized conservation practices, it is now possible to apply virtually without physical intervention to the area, and these new approaches offer a new viewpoint and a field of application to the notion of conservation through visually and technically satisfactory digital outcomes.

1.3. Digital Approach in Conservation: Range-Based, Image-Based and Surveying Methods

Under the main aim of conserving cultural heritage artifacts in a virtual environment, digital approaches are effectively used for both two-dimensional and three-dimensional outcomes (Remondino & Rizzi, 2009, as cited in Korumaz et al., 2011). In order to analyze and apply many inputs and obtain tangible data within the study, an examination was performed of the virtual reconstruction interventions in digital conservation. The Principle of Seville explains virtual reconstruction as creating a model in a virtual environment to visually restore a structure constructed by previous civilizations from concrete proof and scientifically logical comparisons done by experts (Lopez-Menchero & Grande, 2011). In archaeological areas, there are more lost and destroyed items than protected ones, resulting in insufficient incoming data to see the general situation. To achieve enough data, comparison studies can be carried out in cooperation with other principles, not contented with hypotheses. With the development of technology, starting in the 21st century, virtual reconstruction can create satisfactory outputs and results by addressing the data deficit by applying different methodologies. Actual and virtual worlds constantly exchange information, encouraging innovative iterations of rational reflection and nurturing each other (Pietroni & Ferdani, 2021).

The systematic flow of the virtual reconstruction starts with data collection (surveying/scanning). The measurements are documented digitally, and the physical depiction of the structure is created digitally by using visual, photographic, point, survey, and many other data in various formats to relocate the tangible information to a computer-generated status (Korumaz et al., 2011). Afterward, all the information is managed, and interpretations are completed. Two- or three-dimensional theory is constructed according to data. Finally, a source map is added (Pietroni & Ferdani, 2021).

Two alternative approaches are used to generate digital reconstructions; the primary approach is a representation intended to demonstrate the layout and framework of the artifacts, which utilizes techniques that image and range data and survey are used to create actual 3D reconstructions. The other is creating a dynamic avatar that can be used to navigate the environment (Morgan, 2012). Precision, dimensions, mobility, applicability, competence, budget, primary aim, and outcome are considered when choosing which methods to integrate for data gathering (Remondino & Rizzi, 2009).

Image-based modeling (IBM) originated intending to detect the mathematical planes of sites/objects (El-Hakim, 2002) by adjusting two-dimensional images to collect three-dimensional data and measurements using a digital model with a camera model from different angles (Remondino & El-Hakim, 2006). In archaeology, IBM gathers statistical information about structural elements, visual input, mathematical definition, spatial position, dimension and form, surface qualifications, general features, and characteristics. The prominent data processing IBM software of recent years are Autodesk ReCap, COLMAP, Bentley ContextCapture, 3DF Zephyr (Figure 1), and IMAGINE Photogrammetry. IBM generates output as follows: First, thousands of photos are transferred to these programs. Based on these data, the common points in every visual and the distances between points in space are determined, and a point cloud that can be transformed into a three-dimensional mesh model is created. Sufficient visual data is an essential prerequisite for the software (Von Übel, 2021).

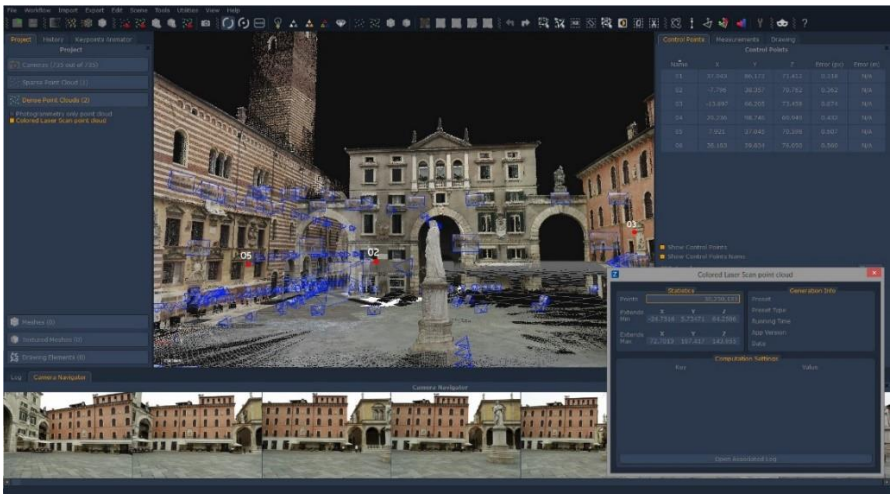


Figure 1. 3DF Zephyr (Alessi, 2016)

In Range-Based Scanning, point cloud data gathered by scanning is converted into a three-dimensional mesh surface created by triangular forms. Geometric precision, modeling that includes all features, affordability, mobility, and versatility of the methodology, can be counted among the beneficial results of the scanning process (Korumaz et al., 2011). While using the method, measuring incorrect sites results in significant inaccuracies (Almagro & Almagro-Vidal, 2007).

When using laser scanners, there are two distinct ways to create three-dimensional models from point cloud data: The initial technique, fundamental structures are determined directly and reconstructed on the cloud. The other approach entails using the point cloud data as a mesh with complicated structures (Chevrier & Perrin, 2008). In Range-Based Scanning, a model can be created by measuring with contact (e.g., Romer) or non-contact apparatus (e.g., LiDaR - Light Detection and Ranging or X-Ray) (Butnariu et al., 2012). To construct a model in three-dimensional format by using RBS, firstly, artifact digitization by gathering info with scanning should be completed. After that process, the monument is fully rebuilt in the artifact reconstruction phase.

Consequently, optimization is carried out to increase certainty by lowering the number of data. Lastly, in the metadata process, the data of the artifacts is organized and transmitted to VR software (recommended) (Neamtu et al., 2012). The hardware designed for Range-Based Scanning includes Airborne Hydrography AB, Bentley Pointools, Leica Geosystems, and RiSCAN PRO (Figure 2).

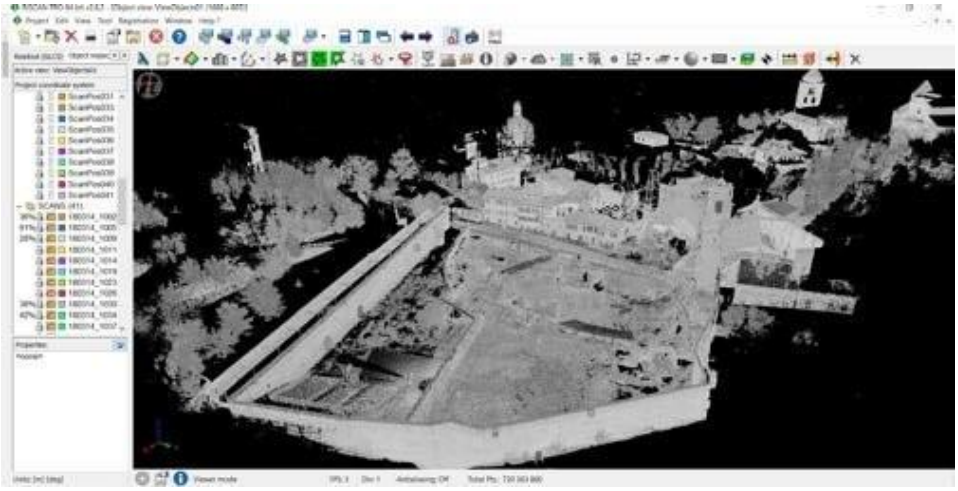


Figure 2. RiSCAN PRO (Malinverni et al., 2018)

3D Virtual reconstruction can be obtained by traditional or modern surveying techniques, which are now preferred. The modern surveying process starts with utilizing scanned data with measurement range as an initial step. After collecting sufficient data, they will be transferred to a digital environment. The point cloud mesh created in software (for the scanning method) will be transformed into a three-dimensional object (obj) that can be used with various programs for visualization. If the traditional surveying method is applied by adopting the necessary linear measurements, the model is created with layers in CAD/CAM modeling software such as Rhinoceros, Blender, Cinema 4D, SketchUp, Autodesk Revit, and others. For the visualization phase, which reflects the virtual representation of an actual artifact, with software such as Unity, Lumion, 3D Studio Max, Adobe Photoshop, and many other programs, renders are created in accordance with the platform, approach, and purpose of the representation.

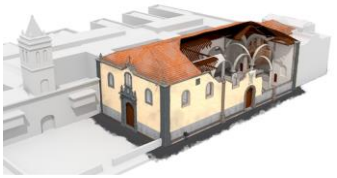
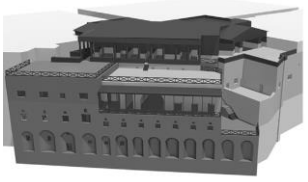
As data collecting and reconstruction methods developed and became more accessible, architects/designers began to create virtual copies of relics in all their projects. Nowadays, in most conservation initiatives, digital technologies are used by applying the mentioned software in at least one of the stages, such as measurement, documentation, 3D model design, visualization, and reconstruction. The advantages of being fast, reversible, risk-free, and affordable (compared to actual reconstruction techniques), requiring fewer human resources, and accurate both on tiny and huge scales make it more widespread day by day. However, numerous software/hardware and diversity in output and methodology can create confusion in the research and application process. The primary intention behind the application can be counted as the central aspect that causes this confusion. Although one group of studies proceeds entirely based on scientific data, the other group reaches conclusions far from reality in complementary modeling based solely on visuality and striking elements in detail. In the first group of applications, art historians, archaeologists, architects, and designers work together, and it is a comprehensive process that includes excavation data, literature searches, photographic data, scans, measurements, survey projects, restitution, reconstruction, and visualization stages. In projects that mainly intend to attract the viewer, far from scientific studies, artists generally produce eye-catching illustrations far from a historical basis, with the limited data they have accessed, without employing the crucial survey stages mentioned above and making comparative analyses.

Table 1 is prepared to examine the method-output correlation through 15 virtual reconstruction cases adopting the systematic research approach. They are analyzed in terms of the objective of the study, data collection techniques, methodology of reconstruction, and representation, and selected three projects will be determined deeply about their ability competence and approaches. The study aims to

standardize the outputs and results of various methods in this mixed and unarranged data pool in the digital environment with successful examples by considering cases.

Table 1. 3D Virtual reconstruction applications

Heritage	Objective of the Study	Data Collection	Methodology	Visual Representation
Casa di Caecilius Iucundus, Pompeii	Bringing a Significant Contribution to the Archaeological Analysis of Insula V	Archaeological Reports, Image Documentation, Analysis of the Structures and Laser Scanning	MeshLab and Cave Automatic Virtual Environment (CAVE)	
Castell de Vilademàger	Provoking Admiration with Visual Impact Through the Help of Collective Research	Photogrammetry	Blender	
Castellet de Bernabé	Enhancing Heritage Values by Allowing Intellectual Engagement to Cultural Heritage	Archaeological Survey, On-Site Images, Bibliographic and Comparative Research	ArcGIS, Autodesk 3D Studio Max	
Ephesus	Making History Interesting and Accessible for Everybody	Photogrammetry and Laser Scanning	Realworks, Cinema 4D, and Unity	
Kalan Temple in Mỹ Sơn	Suggesting optimized Procedures for Data Processing and Interpretative Methods	Laser Scanning	Rapidform, Modo, Polyworks, Geomagic, Leica Cyclone	
Lecce	Aiming the Realization of Different Outputs to Facilitate the Visit In Situ	Laser Scanning and Image-Based Scanning (SfM)	PhotoScan	
Pergamon or Pergamum	Informative Purposes for Museums and Exhibitions	Research in Collaboration with the Staatliche Museen zu Berlin	Panoramic Drawing and Painting Combined with Digital Installations	

Heritage	Objective of the Study	Data Collection	Methodology	Visual Representation
Perugia Fontivegge Station	Proposing to Use the New Devices for Visualisation	Laser Scanning and Photogrammetry	Autodesk 3D Studio Max, Unreal Engine	
Piazza delle Erbe	Providing a Multidisciplinary Approach to Construction	Laser Scanning, Photogrammetry and Historical Documentation	Rhinoceros 3D, Autodesk AutoCAD and Autodesk 3D Studio Max	
Roman Theatre of Fanum Fortunae	Proposing Specific Implementation Guidelines in the Field of Virtual Archaeology	Laser Scanning and Photogrammetry	Layar, GDXLib	
St Augustine Church	Recovering Dilapidated Structures and Creating an Interactive VR Environment	Topography and Terrestrial Photogrammetry	DStretch, Blender, and Unity	
Roman Forum	Providing a Topographically Arranged Series of Chapters that Present the History	Aerial Photography, Laser Scanning, Systematic Surface Collection, Magnetometry, Geochemical Survey	Autodesk Maya, Rhinoceros 3D, Form-Z, and Traditional Drawings Techniques	
Temple of Bel	Piecing Together the Individual 3D Models and the 3D Environment	Data gathering is completed via literature	Autodesk AutoCAD and Autodesk 3ds Max	
The Rome Reborn Project	Supporting New Scholarship by Making It Possible to Re-experience a Vanished Space	Real-world GIS data on ArcGIS	Autodesk 3D Studio Max and CityEngine	
The Sarno Baths in Pompeii	Providing a Quantitative Architectural Evaluation Of the Complex	Laser Scanning and Photogrammetry	Autodesk AutoCAD	

Note. The references are as follows in order: (Dell'Unto et al., 2013) (Resco, 2019), (Portalésa et al., 2016), (Németh, 2017), (Guidi et al., 2014), (Gabellone et al., 2015), (Asisi, n.d.), (Bianconi et al., 2023), (Apollonio et al., 2017), (Quattrini et al., 2015), (Soto-Martin et al., 2020), (Gorski & Packer, 2015), (Denker, 2017), (Frischer & David Massey, 2022), (Bernardi et al., 2019)

2. Material and Method

A literature review was conducted first within the scope of this paper, which is produced from a proficiency in art thesis focusing on 3D virtual reconstruction of a specific ancient city. The relationship between the past and cultural heritage, archaeological excavations, digital approaches to conservation, and visualization are acknowledged by compiling the information in the literature. Following the advent of the technological revolution during the past three decades, the usage of virtual reconstruction in conservation projects has increased rapidly. Obtaining entirely by digital methods or producing some parts of the project, such as data collection and modeling, in a virtual environment is an advantage in increasing the diversity of these studies. However, the fact that studies comparing methods with their advantages or disadvantages are insufficient to the diversity of digitally produced applications may create disorientation for those who make methodological compilations or those who will start a reconstruction project. At the same time, including inadequate studies and inappropriate methods in this data pool may make it challenging to detect meticulous applications.

In the virtual reconstruction process, the preference of the modeling and rendering software carries a crucial role depending on the objected outputs to represent the heritage. The study seeks to conduct a technical exploration of fifteen virtual reconstruction cases derived from rigorous scientific studies, employing a comparative methodology that scrutinizes the study's objectives, data collection methods, software applications, and resultant outcomes (Table 1). Within the subsequent chapter, three selected studies - Ádám Németh's Ephesus Reconstruction, Gilbert J. Gorski and James Packer's Roman Forum, and Flyover Zone Production's Rome Reborn – will undergo thorough critique, dissecting the individual components of the reconstruction tools and processes, including data collection, modeling and rendering languages, methods, and visualization techniques.

Ádám Németh's Ephesus Reconstruction Project is selected for this study due to his successful interpretation of eye-catching and striking coloration, although there is no study on the paints used in Ephesus. The study is among the most successful visual outputs of ancient city models. At the same time, the 3D models he created are millimetrically correct and definitive as he uses photogrammetry and scanning data from excavations. These astonishing representations were featured in the press (Tuna, 2017) and Visit Ephesus (a project of the Selçuk Chamber of Commerce). The realism of the designed model makes the viewer feel like a time traveler visiting Roman cities. His project objective is for public outreach.

Gorski and Packer's study is generally considered guiding and pioneering, regardless of the virtual reconstruction outputs. Gilbert Gorski and James Packer attempted to approach the Roman Forum as an architectural entity with their study, a manual explaining the connections among numerous monuments and structures. Their fundamental area of focus is on the provision of reconstruction drawings, and the objective of their study is educational. The study is among the most accurate representations due to the scientific research and knowledge in the background.

Flyover Zone Production (founded by Bernard Frischer) The Rome Reborn Project is the last selected project to be examined in detail. The first Rome Reborn (Rome Reborn 1.0) was created by Bernard Frischer again in 2007 (the project started in 1996). Rome Reborn 4.0 version of the application is remade with up-to-date digital reconstruction methods. The newest version has become superior due to the user-engaged and interactive approach created using virtual reality, digital tours, and flying simulations over the city to enhance the user experience. The objective of their study is research and discovery. The study is crucial for understanding changes in constantly evolving technologies in the virtual reconstruction process of ancient cities. Rome Reborn Project remains one of the most up-to-date applications for user engagement, steadily adopting advanced software.

The context of the critical evaluation includes the following components: Elaboration of data collection, encompassing the sources of historical data, archaeological surveys, or alternative methodologies employed to procure pertinent information; A comparative exposition provided on the software and digital tools utilized in the virtual reconstruction process, along with an examination of the features that impact the reconstruction; The rationale behind the selection of programming languages and their role in accomplishing the project objectives; How visualization techniques improve

the overall representation and contribute to the goals of the study; Specific criteria employed for the comparative assessment of methodologies, including accuracy, visual realism, historical authenticity, and other pertinent factors.

In essence, these cases transcend mere accuracy; they encapsulate a holistic and pioneering approach, making them invaluable for shaping the future of virtual reconstruction in archaeology. In light of these comprehensive analyses, it aims to perform comparative reviews and critical evaluation of the cases according to their methodologies and guide future studies by systematizing the methods while showcasing outputs applicable to the diverse purposes and designs of upcoming research endeavors.

3. Research Findings

As shown in Chapter 1.3 Table 1, although the data collection methods are the same, the outputs of the studies vary due to the study's objective and modeling-rendering methods being altered. This differentiation is valid for all three substances, which form integrity together, creating the final virtual reconstruction output. The applications selected within the scope of this study will be examined in detail from these perspectives.

The virtual reconstruction of the Ancient City of Ephesus by Ádám Németh is one of the most outstanding representations of an ancient city. The artist completed his year-long project by reconstructing numerous significant monuments from Ephesus, including the Library of Celsus (Figure 3), Terrace Houses, Curetes Street, Memmius Monument, Temple of Artemis, and many other monuments. As Németh himself mentioned on his official web page, his primary goal is to generate the past in an exciting way and make it accessible to people (Németh, n.d.). Németh's virtual reconstruction approach primarily focuses on using archaeological data to create exact 3D models of ancient cities. He builds thorough 3D representations of ancient sites by combining photogrammetry, laser scanning, and other 3D scanning methods. Methodology-wise, Németh's strategy seems to be built on an exacting and scientific procedure for gathering and analyzing data. His understanding of Roman architecture and civilizations allowed him to identify the missing features of the structures (Varga, 2021).

Figure 3. Library of Celsus (Németh, 2017)

Németh's method is noticeable for using advanced visualization techniques to build engaging and lifelike virtual environments. He used Realworks to process scanning data Cinema 4D to manage the polygons and transfer from meshes. Using an interactive approach, he could also utilize Unity to produce virtual tours and simulations of ancient cities. He created an application called Wonderful Ephesus with 3D interactive reconstruction that will be adapted to Virtual Reality. With the help of the simulations, users can explore the places in ways that are not conceivable with conventional 2D images or even actual trips to the locations. Regarding visual differences, Németh uses photorealistic textures to create environments close to the original. Although the pigment test was not performed on

monuments or structures, he notes that these pieces were believed to be coated in vivid colors and proposes a plausible possibility (Varga, 2021).

As can be seen in Figure 4, which demonstrates a wealthy family's house in Terrace Houses, there is a mosaic depicting a majestic lion with its head pointed in the direction of the viewer, surrounded by geometric patterns and floral motifs. The lion is represented in detail, with realistically sculpted musculature and fur. The mosaic is a prime example of the Roman technique of opus vermiculatum, where small pieces of colored marble and glass are used to create intricate and detailed patterns (Pekridou-Gorecki, 2013). Since the original work contains many finely elaborated mosaic details, its reconstruction must be done with the same care and meticulousness. Németh, in this case, almost gives the impression that all the mosaics and murals have been individual, piece by piece, restored, and reconstructed (Figure 5). To raise the structure, he used vivid colors in mosaics, murals, and material-related textures on walls. He enhanced the work by adding details containing clues about daily life, such as mattresses, chairs, household items, and more.

Figure 4. Terrace houses (Németh, 2017)

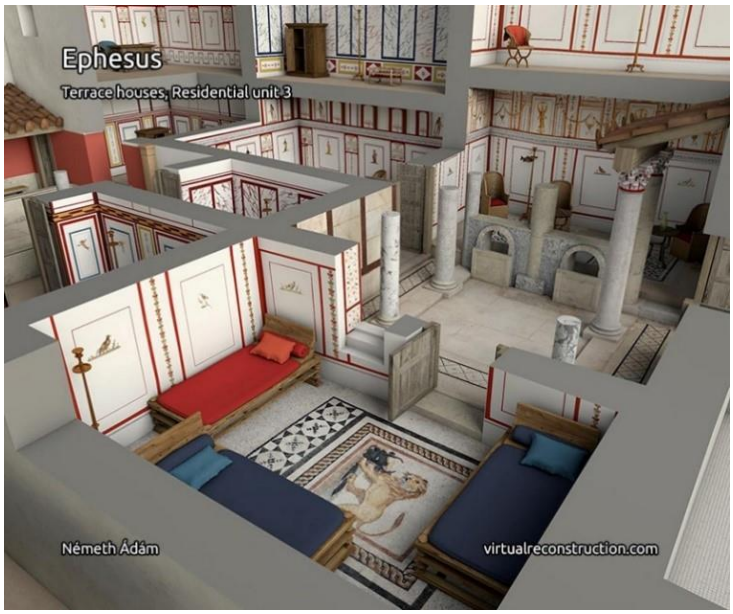


Figure 5. Virtual Reconstruction of terrace houses (Németh, 2017)

As the second example, the visuals created by Gilbert J. Gorski appeared in their books with James E. Packer entitled The Roman Forum: A Reconstruction and Architectural Guide (2015), successfully depict how The Roman Forum, most of its structures and monuments are in ruins today, looked years ago with virtual reconstruction techniques. Gorski and Packer's study on the Roman Forum stands out for its precision and educational value, prioritizing the provision of accurate reconstructions for various

monuments focused on architectural entities. The team used aerial photography, LiDAR, systematic surface collection(field-walking), geophysical survey (magnetometry), geochemical survey, and excavation data for data collection. Gorski generally uses Autodesk Maya and Rhinoceros 3D for modeling, including traditional drawing techniques and hand sketches, and Adobe Photoshop and Form-Z for coloring and rendering. He also recommends Houdini, 3ds Max, Cinema 4D, and Revit (Gorski, 2014). Even though they did not mention it in the scope of the text, it can be predicted that he used Maya and Rhinoceros for The Roman Forum to work efficiently on organic forms and Form-Z for rendering to manipulate the visuals. Gorski also prefers using dramatic and intense colors for interior and exterior spaces. He depicted the motifs on the column heads, the mosaics on the floor, and the murals on the walls by examining the historical sources for that period and the data available in a manner closest to reality. The rendered angles of interior spaces (Figure 6) help viewers understand the size and approximate dimensions of the space and its relation to the other structures outside. The human figures placed in the interior, looking at the drawings and talking, aim to give information about the clothing, appearance, and lifestyle of the people of that period.

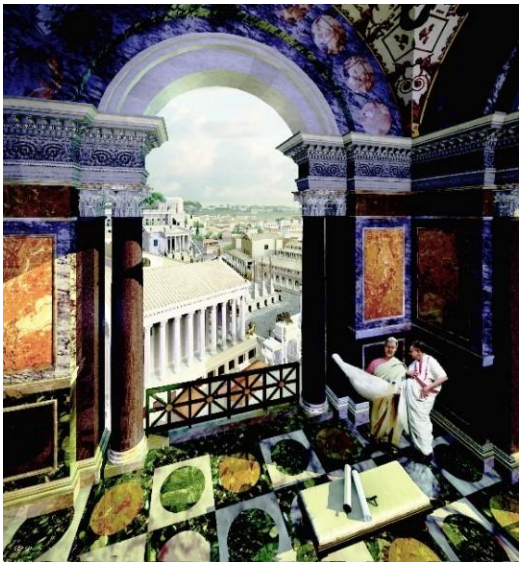


Figure 6. The Roman Forum interior render (Gorski & Packer, 2015)

The exterior renders (Figure 7) are taken at a large scale and from aerial angles that can fit many structures. At the same time, a realistic visual was created by adding the vegetation of the area and the structures that add depth to the background. Although it is created on a vast scale and wide angles, even small details of the sculptures can be seen in the renders.

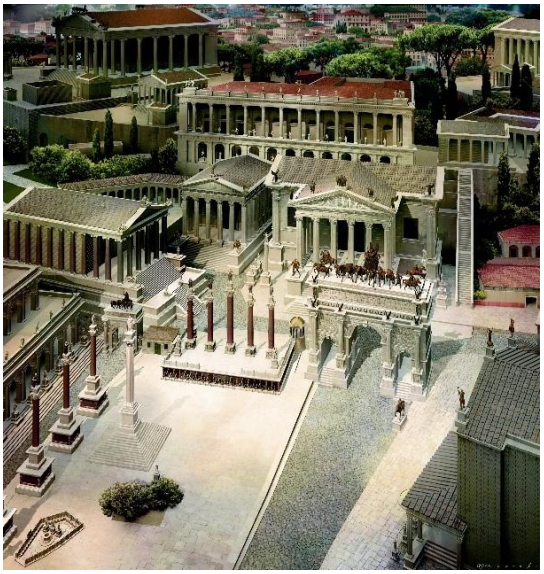


Figure 7. The Roman Forum exterior render (Gorski & Packer, 2015)

Gorski and Packer mainly focus on using virtual reconstructions as a tool for education and public outreach. The outputs serve the purpose of analyzing the relationship of structures for architectural improvement and explaining the background and nature of the structures to the audience by providing a more engaging and immersive experience, helping to promote an understanding and appreciation of ancient cultures. In Gorski's renders of The Roman Forum, he uses texture mapping and lighting to reveal the accurate depiction of the structures by paying attention to the small details to ensure that the models are nearly identical to the original. A supposedly neutral, or maybe "objective," perspective characterizes the stare into the reconstructed Forum, and weather and environment details provide life to the sights. However, selecting views and choices according to the particular moment of day or year results in an inherently subjective representation of the Forum. Within the scope of Gorski and Packer's study, they also explained the construction techniques and historical backgrounds of every architectural element, including foundations, columns, corinthian capitals, architrave/friezes and cornices, roofs, and other details, which makes it an excellent source for reconstruction projects.

The Rome Reborn Project was created by Flyover Zone Productions, founded by Bernard Frischer for the study' 3D Urban Models as Tools for Research and Discovery Two Case Studies of the Rostra in the Roman Forum Utilizing Rome Reborn' by Frischer & Massey (2022). The studies of Rome Reburn started in 1996, and the first version was released in 2007. The team used Autodesk 3D Studio Max and Multigen Creator to reconstruct the first versions (Dylla et al., 2010). In Rome Reborn 4.0, the designers/architects used real-world GIS data and produced a large-scale city using the software ArcGIS. They modeled the area using Autodesk 3D Studio Max and CityEngine, presented the city with advanced visualization techniques and real-time rendering, and adapted it to virtual reality. The software enables quick alterations to the city's architectural details and characteristics to quickly build a wide range of design possibilities using existing data. The renders are designed from the perspective of an observer in the ancient city rather than large-scale aerial photography. The perspective and camera angles can be controlled according to the detail intended to be portrayed in the render. As shown in Figure 8, the perspective is arranged for an observer of medium height, leaning against the wall of Regia in an x direction. The sight of the monument's exterior is restricted and requires elevating the head by 60 degrees. In the top right corner, CityEngine displays the scene as it might have seemed in ancient times by a person.

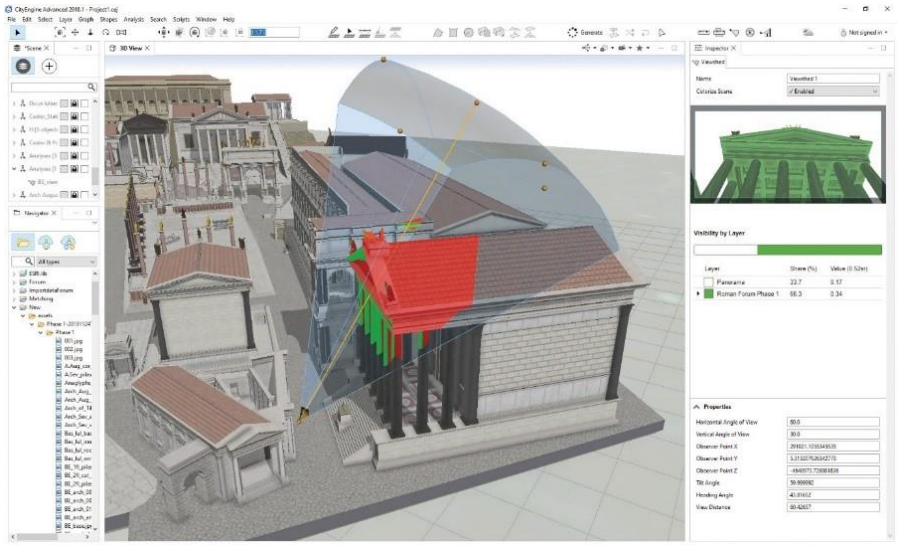


Figure 8. The model of the City of Rome in CityEngine (Frischer & Massey, 2022)

In the exterior renderings (Figure 9), the angle is designed to emphasize how magnificent and enormous the structures are compared to humans. The material differentiation in the structures and monuments can be easily detected as the gold, marble, and stone materials are depicted with textures and reflections of light rather than only colors. Furthermore, in addition to the other two virtual reconstruction cases, hyper-realistic 3D renders, videos, and animations were also created for The Roman Forum.

Figure 9. The Rome Reborn Project exterior render (Frischer & Massey, 2022)

Flyover Zone Productions created many virtual tours of reconstructed cities, such as the Acropolis in Athens, Tenochtitlan in Mexico, and the Tomb of Ramesses VI in Egypt. By taking advantage of gamification elements, the user experience is enhanced in virtual tours and simulations, allowing users to explore the ancient city fun and engagingly.

The selected studies mainly aim to serve public outreach by making heritage accessible for user engagement, using digital representation as a learning tool, designing a gamification element for virtual tourism and increasing interactive user experience. Regarding the three studies selected for this paper, visual outputs are highly rigorous and satisfactory in terms of the proximity to the actual state of the structure. Ádám Németh's approach focuses on coloring, decoration, and realism. In contrast, Gilbert J. Gorski and James Packer's approach is accurate, detailed, and guiding. Bernard Frischer (Flyover Zone Production) is outstanding due to its up-to-date and innovative approach. The data for the studies is gathered using Aerial Photography, Laser Scanning, Systematic Surface Collection, Magnetometry, Geochemical Survey, and Photogrammetry. For modeling and rendering, Autodesk Maya, Rhinoceros 3D, Trimble Realworks, Form-Z, Cinema 4D, Unity, Autodesk 3D Studio Max, and ArcGIS CityEngine are used which provide different prominent features, and each creates altering outputs and visuals compatible with the project objectives (Table 2).

Table 2. Method-result comparative analysis for selected cases

Selected Virtual Reconstructions	Software Preferences	Capabilities and Offerings of the Programs	Standout Features and Qualifications	Results and Outputs
The Ancient City of Ephesus by Ádám Németh	Trimble RealWorks, Cinema 4D, Unity	High-Quality Deliverables, 3D Toolset for Modeling, Motion Graphics, VFX, Powerful Renderings and Animations	Robust, Efficient, Flexible, and Adaptable for AR/VR	Realistic, Effectively Colored, and Adorned with Decorative Details, and VR adapted
The Roman Forum by Gilbert J. Gorski and James Packer	Autodesk Maya, Rhinoceros 3D, Form-Z	Advanced NURBS and Polygon Modeling, Creating and Modifying Animations, Compatibility with BIM, Parametric Design with Grasshopper	Limitless Complexity, Precise, Versatile, Interoperable, Solid and Adaptable to BIM	Accurate Model, Abundant Technical Details, and Guiding Reconstruction Process
The Rome Reborn Project by Bernard Frischer (Flyover Zone Production)	Autodesk 3D Studio Max and ArcGIS City Engine	Procedural Modeling, High-Quality Materials, Computer Generated Architecture, Large-Scale and Dynamic City and Urban Layouts, Customizable UI, Data Interoperability	Dynamic, Geospatial, Interactive, Creative Pipeline and Workflow	Up-to-date Techniques and Results, User Engagement, and Innovative Approach

The software mentioned above used for the data gathering and applications is sufficient to achieve the representational goals and outputs. In addition, Blender (standout for sculpting, retopology, modeling, curves), Solidworks (enables large assembly design, rapid prototyping, mold tool design), Autodesk Fusion 360 (parametric modeling, integrated simulation, cloud collaboration), Autodesk Recap (detailed models of real-world assets, expanded point cloud registration), Autodesk Revit (interoperability, generative design, cloud rendering) and many others can also be utilized during the reconstruction process regarding the compatibility to shape (geometry, size, spatial position), appearance (surface features), and constitutive elements (physical form).

4. Discussion and Conclusion

It is undeniable that virtual reconstruction gives successful outputs; however, several ethical and epistemological questions are involved in the process of virtual reconstruction, especially when determining what constitutes the "true" representation of the heritage. The theory of truth posits that a statement is true if it corresponds to a fact in the existing world. This theory emphasizes the relationship between language and reality and suggests that truth is independent of language but is defined through it (Günday, 2003). The visual representation can only be transferred accurately through appropriate software and design language.

Virtual reconstruction studies deal with different aspects of interdisciplinary fields, establish relationships, and examine the common aspects based on scientific principles of distinctive approaches. One of the main issues is the subjective nature of virtual reconstruction itself. Within the virtual construction process are collective decisions and confident choices about what to include or leave out and how to represent historical features. Architectural descriptions, including technical drawings, angled views, and three-dimensional models, are essential tools for conserving throughout the design stage of the building process methodologically. Modeling and rendering software, the environment, and the design of the structure can be counted as the aspects that affect perceptual accuracy. The design choices are mainly influenced by the assumptions, beliefs, or values of the people or teams undertaking the reconstructions that may lead to varying interpretations and representations of cultural heritage. Virtual reconstruction applications that overlook or downplay these variables risk misrepresenting or losing important historical information, which could diminish the meaning and relevance of heritage. For this reason, multidisciplinary teamwork and quantitative and qualitative testing of multiple software are also essential. No single "true" or objectively accurate view of the past exists. Several perspectives and interpretations of heritage can coexist. It is essential to assess how well virtual reconstructions can precisely and respectfully capture the complexity and diversity of the past while also conforming to various viewpoints and interpretations.

In contemporary conservation efforts within excavation sites, digital methodologies play an integral role in at least one process phase. The increasing prevalence of these methods daily has led to the emergence of rich but, at the same time, numerous and confusing data regarding reconstruction in which different methods are used. The study's objective is to provide precise methodological insights by systematically comparing and examining established practices, deriving appropriate outcomes from the intricate data pool associated with virtual reconstruction methods. In this context, a comprehensive comparison was conducted among fifteen virtual reconstruction applications, focusing on their objectives, data acquisition methods, and modeling-visualization techniques. After the initial comparative analysis of diverse applications, a more detailed examination focused on three specific projects, each distinguished for its expertise within its field. These extensive analyses unfolded across three distinct approaches, thoroughly assessing each project. The first approach delved into software preferences in virtual reconstruction, exploring differences in the selection of data gathering and modeling programs, intricacies, and functionalities. The second perspective aimed to uncover capabilities and offerings within selected programs, examining tools and features. Attention was given to software versatility, efficiency, and adaptability to virtual reconstruction requirements. Concurrently, the analysis focused on standout qualifications unique to each project, identifying attributes that set them apart and seeking innovation, pioneering technologies, or novel approaches to virtual reconstruction. Lastly, the third perspective scrutinized these projects' results and outputs,

emphasizing quality, accuracy, and overall effectiveness, evaluating how well these projects translated methodologies and capabilities into tangible outcomes. This analysis aimed to provide a comprehensive understanding of each project's strengths and competencies within the broader context of virtual reconstruction. A compilation of potential methodologies for future studies has been outlined based on the outcomes of the comparative reviews.

As our ability to see ourselves and the environment improves, the virtual and physical definitions constantly change. Marcel Proust defined virtual as "real but not actual, ideal but not abstract." Deleuze argued that the virtual is antithetical to the actual rather than real based on that description. He asserts that real and possible oppose one another (Deleuze, 1988). The virtual is just as real, despite not having a physical reality like the real. In the digital age, this distinction is crucial because it preserves the reality of what is seen or perceived on a digital screen (Buchanan, 2018).

In conclusion, virtual reconstruction can be a helpful tool for comprehending and interacting with cultural heritage. However, it is necessary to approach the subject with critical thinking and moral sensitivity, analyze it from different perspectives through interdisciplinary studies, identify the possibilities of representing the past through digital media, and use appropriate methods according to the objectives.

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Author Contribution and Conflict of Interest Declaration Information

There is only one author who contributed to the study. There is no conflict of interest.

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Unisexualization Trends in Public Spaces in the Cities of the Future

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Abstract

The fractures in gender preferences and the increase in the number of gender preference categories in world societies have deeply affected the basic approaches of public space designers and digital system designers. By now, single-sex has become the default design or coding setting in most robotic algorithms and smart city designs and systems. When we look at it from the perspective of urban sociology, which is the collective reflection of individual human psychology in urban areas, we see traces of it in both the digital infrastructure, macrostructures, and megastructure designs of smart cities. Especially in the film industry after 2000, the perception of gender either refers to free gender values or idealizes a unisex structure. Such things in the cities of the future offer designers an extremely practical solution in system designs and public space designs. We need to demonstrate that such designs are extremely constructive developments in preventing social and sexual violence. In our study, we will focus on the contribution of artificial algorithms, system designs, and space designs to social consensus in the digital infrastructure of smart cities of the future. The parameters of this contribution will be discussed from the perspective of urban sociology in terms of the sustainability of future cities.

Keywords: *Public space, urban culture and politics, desexualization, smart cities, genderless.*

Geleceğin Kentlerinde Kamusal Alanlarda Cinsiyetsizleşme Eğilimleri

Öz

Dünya toplumlarında cinsiyet tercihlerindeki kırılmalar ve cinsel tercih kategorilerinin sayısının artması, dijital sistem tasarımcılarının yanı sıra kamusal alan tasarımcılarının da temel yaklaşımlarını derinden etkilemiştir. Şimdiye kadar çoğu robotik algoritmada ve akıllı şehir tasarımında ve sisteminde tek cinsiyetlilik varsayılan tasarım veya kodlama ayarı haline geldi. Bireysel insan psikolojisinin kentsel alanlardaki kolektif yansıması olan kent sosyolojisi açısından baktığımızda akıllı şehirlerin hem dijital altyapısında hem makro yapılarında hem de mega yapı tasarımlarında cinsiyetsizleşmenin izlerini görüyoruz. Özellikle 2000 ve sonrası film endüstrisinde toplumsal cinsiyet algısı ya özgür toplumsal cinsiyet değerlerine gönderme yapıyor ya da cinsiyetsiz (unisex) yapıyı idealleştiriyor. Geleceğin şehirlerindeki bu tür ivmeler, sistem tasarımlarında ve kamusal alan tasarımlarında tasarımcılara son derece pratik bir çözüm sunuyor. Bu tür tasarımların toplumsal ve cinsel şiddetin önlenmesinde son derece yapıcı gelişmeler olduğunu ortaya koymamız gerekiyor. Çalışmamızda geleceğin akıllı şehirlerinin dijital altyapısında yapay algoritmaların sistem tasarımları ve mekân tasarımlarının toplumsal uzlaşmaya katkısı üzerinde durulacaktır.

Anahtar kelimeler: *Kamusal alan, kent kültürü ve politikası, cinsiyetsizleşme eğilimi, akıllı şehirler, cinsiyetsizleşme.*

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1. Introduction

"Stand a little less between me and the sun."
Diogenes (of Sinope) Diyojen

When we look at it from the perspective of urban sociology, which is the collective reflection of individual human psychologies in urban areas, we see traces of unisexualization in both the digital infrastructure of smart cities, macro structures and mega structure designs. Especially in the film industry after 2000, the perception of gender either explicitly refers to liberal sex values or idealizes the unisex structure. Especially after the epidemic, the forced digitalization in social life has significantly suppressed this sociological mentality transformation and made it a rising trend. (Sex is a multidimensional biological construct based on anatomy, physiology, genetics, and hormones. (These components are sometimes referred to together as "sex traits) (National Institutes of Health, 2023; European Institute for Gender Equality, 2023).

Although the national policies of the states are not very sympathetic to the concept of gender, with the influence of cinema and internet culture, the international arena has begun to produce solutions by either pacifying the masculine and feminine elements or overlooking these phenomena.

The most obvious of these are the abolition of the distinction between men's and women's toilets, seen in developed societies and multicultural places, and the genderless process in clothes and names, which have become complementary elements.

When we look at it from a sociological and psychological perspective, we can see that goodwill and fairness in human relations form the basis of sustainability. In addition, the key to sustainability in human-environment relations in public services and physical space designs is human and environmental ergonomics. In this respect, it is very important for social peace and environmental peace that states and/or organizations that produce public services focus on the service production that best suits human nature in maintaining these services in human and environmental interaction.

Throughout history, we see practices that do not attach importance to different sexes in common public space designs. In particular, in medieval latrinas, sex or gender was not seen as a taboo; on the contrary, latrinas were seen as places where people went to socialize enthusiastically and with pleasure and spent a lot of time. So much so that these places became the ones where the rules of etiquette began to form clearly. Similarly, baths seem to be another area of the same socialization process (Yegül, 2006, p. 20). We must state that perhaps the degeneration in these areas strengthened sex-related identities and the castes between these identities for that period. In the context of social dynamism, the growth and spread of an event can rationalize the reaction to it and give rise to reactionary developments or systems of life and thought in subsequent periods.

For a long time since homo sapiens evolved from homoerectus, the human race did not taboo sex. When people started to live collectively, the sexual difference intimidated females into indoor spaces due to the dominance of men's physical strength, and females saw retreating indoors as a chance for survival. "Male" and "female" roles began to be acquired as females initially retreated to indoors due to anxiety about life and with the beginning of social life. From a sexuality perspective, most of the time has passed with almost no female identity since humans moved to settled and social life. Even though female rulers were seen in some intermediate periods in ancient times, they did not become significantly widespread throughout the world.

From ancient times until the late Middle Ages, there was no clear awareness of "identity" and its defence. With the transition from slavery to wage slavery with the industrial revolution and women seen as individuals in business life, the concept of identity gradually began to form in the context of rights-based struggle. With the development of the service sectors, which started with the industrial age, continued in the 1950s, and grew especially after the 1970s, women and female identity began to take place both in life and in literature.

The actions and opposition movements that were previously required to refer to the social disadvantage of the female gender have been replaced by global ideological movements such as

"feminism". So much so that this movement has reached such a strength and level that it will not even accept positive discrimination in the future. In the last thirty years, LGBT+ organizations have divided the concept of gender into categories, starting from the definition of the concept, and have begun to make this accepted by the masses on a global scale by defining pluralistic distinctions regarding gender and sexuality (Herbert & Aylene, 1982, p. 15).

Since the 2000s, especially private sector organizations that provide public services have begun to present themselves as "LGBT+ friendly institutions", just like vegetarian or vegan friendly, and have begun to create their social service infrastructure by clearly applying this corporate image creation to public services.

The genderless solutions observed in public spaces and public services, the unisex perception in toilets or baths, have begun to be seen in most social areas, including religious institutions.

The tendency towards genderlessness is an approach that tries to place itself in the "human" identity in social life, free from all basic genders and intermediate genders that have diversified with the contribution of men and women and even LGBT+ organizations, and returns to peace and, in fact, to the "essence".

In the cities of the future, such examples offer designers an extremely practical solution in system designs and space designs. We need to demonstrate that such designs are extremely constructive in preventing social and sexual violence. In our study, we will focus on the system designs of artificial algorithms in the digital infrastructures of the smart cities of the future and the contribution of space designs to social consensus. The parameters of this contribution in terms of urban sociology and the sustainability of future cities will be discussed. We hope that our work will be useful to the scientific community.

1.1. The Concept of Gender, Genderlessness and Its Trend, Genderless Designs

In order to address genderless tendencies in public services, especially in urban areas, we will first need to define some concepts.

In order to define the tendency towards unisexualization, it is necessary to first define gender. For this reason, it is necessary to define the concept of sex. We can define sex in the context of animals and specifically humans, which emerge by integrating physical limb differences with mental differences. However, we must emphasize that the mental part of this definition is more specific to humans. Based on this context, a sense of belonging, identity or awareness on the term "gender" is required. Gender, in Akduran et al.'s book titled Gender Project, refers to "equal treatment and equal opportunities for women and men." For a detailed comparative analysis on this subject, Scott's work can be an example (Scott, 2003, p. 81). Gender equality refers to the provision of appropriate conditions for women and men to access equal human rights in contributing to and benefiting from political, economic, social and cultural developments (Akduran et al., 2018, p. 151). While Bouchard defines the concept of unisexualization as a situation that is indistinguishable on the basis of gender (Bouchard, 1998), Wikipedia defines it as not specific to gender (Wikipedia). Of course, tens of thousands of years of experience have accumulated on physical sexual differences. We can estimate how the physiological, sociological and psychological evolutionary process of perception, especially the asexualization trend that started in the industry 3.0 and Industry 4.0 periods, is at an early stage. We can easily say that despite all this, the increase in the awareness level of human beings is still developing at a geometric pace, despite the accumulation process I mentioned.

The concept of unisexualization, which we have been using for a very short time in Turkish, has begun to be used as "unisexualization" in the scientific language, English, and in many other languages. As the opposite of sexualization, unisexualization is defined as the rejection of gender, the rejection of being rigidly defined, and not being seen as a distinctive feature in the social and social environment (Kubar, 2017, p. 527). With this definition, this system of thought tries to neutralize the concept of sexuality, which is envisaged and taken for granted under male domination, from the masculine status of men, with an exponential approach, without putting it into feminine and other defined intermediate derivative molds. On the other hand, Illich sees unisexualization as a necessary

imposition of industrialization. (Illich, 1996, p. 26-28) Unisexualization is the tendency to prefer this structure and thought system in all areas of life, as well as the tendency to eat, dress, use urban services and equipment, and create organizational roles. The same orientation is expected to be maintained both inherently and extrinsically in the use of urban services in urban life.

When we look at unisexualization as a social and environmental whole that extends beyond the individual, this process (unisexuality) is very different from the definition of sex and identity that has changed and accumulated from the difference in physical status to the present day, and that people, structures, environment, systems and systematics are fundamentally affected by these elements without being registered to these elements. We can see it as something foreseen and designed. Although such structures, analysis and systematics may be seen or perceived as coercion and sometimes imposition, they will have much more practical and sustainable profits for human beings over the millennia. When we add to all this mental evolution of human beings in terms of technology and their development and/or evolution from the physical body to the etheric body, it will become much more meaningful as the gap between emotional integrity and physical sex opens and the phenomenon of reproduction begins to be separate from the concept of sex.

On the other hand, when we look at the effect of education, as well as the dominant effect of technological structures on the tendency towards unisexualization, we can see that there is a positive correlation between education and the environment. Although the research and research techniques on this subject are a bit weak, in Karatepe's master's thesis conducted on students (Karatepe, 2013, p.71) it was stated that the tendency towards unisexualization in the differences between education and urban areas is naturally more evident in urban areas.

On the other hand, in addition to the genderless structure in public spaces, the move away from homosexuality or heterosexuality seen in individual and sexual relationships is also seen as a threat to the reproduction of human beings (Hare & Hare, 1984, p.63-68).

Kamusal alandan konut yapılarına indiğimizde de konut tasarımlarının cinsiyetler arası bir mücadele alanı olarak görülebilmektedir (Erkarslan, 2004, p. 59-62; Kan Ülkü, 2018, p. 63-80).

1.2. The Phenomenon of Unisexualization in the Historical Process and Unisex Practices in Public Services

It is known that in the periods when people were just transitioning to social life, the concept of sex and masculine and feminine organs were not seen as taboos.

It is obvious that in the designs of public spaces in the Middle Ages, especially in the designs and functions of Latrinas, masculine and feminine organs were not seen as taboo even at that time (Figure 1, 2 and 3).

We can say that the most obvious example, both sociologically and psychologically, of the tendency towards unisexualization is the toilets and public toilets (latrinas) throughout the historical process.

The first toilet structures date back to between 2334-2279 BC. There were 6 toilets and an associated sewage system in the palace of Akkadian King Sargon I, who ruled in Mesopotamia, and there is more detailed information about this place (Baş, 2016). However, while such structures are found in palaces where very wealthy people live, it is seen that the lower and middle class use public areas. In fact, historical records show that large fines were paid for throwing feces from homes onto the streets.

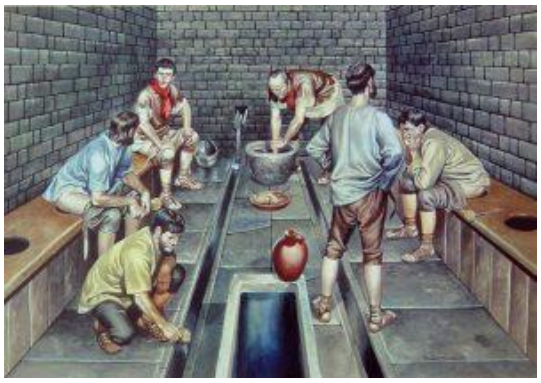


Figure 1. Latrinas and people using latrinas (antiktarih.com, 2018)

Figure 2. Indoor Latrinas (Baş, 2016)

Figure 3. Outdoor latrinas (Baş, 2016)

Latrina: “The introductory article of the Magnesia Ancient City, located in the Germencik district of Aydın province, begins with "32 people met their needs at the same time" (Mert, 2020).

On this subject, the ancient writer Suetonius relates to us a conversation between Emperor Vespasianus and his son Titus in his work titled The Lives of the Twelve Caesars, which was translated into Turkish. Titus considered some of the practices carried out by Emperor Vespasian to increase income as exaggeration. When Emperor Vespasian considered tax

It is another fact that Latrinas, which provide public and social services, have also been a source of taxes for states throughout history (Nuedecker, 1994).

The Romans, who either did not allow toilets in their homes or had very few examples, often met their toilet needs collectively and opened channels for them to carry out their cleaning. Even at that time, Cloacina was the common sewer goddess, Stercutius, the god of winding. When the canal was

blocked, this Goddess was prayed to (Erdemir, 2010, p. 114). Since the God of flatulence and feces is responsible for the channel Goddess, we can express in a tragicomic way that the Romans envisaged a distribution of gods based on gender equality in this regard.

It has been determined that the Romans, who were advanced in engineering, built a toilet at the top of the city wall in Notrhumberland, large enough to accommodate twenty people at a time. An important indicator of the (social) time spent in these places and the cohesion process is that war or expedition preparation plans are made while people use the toilets by sitting there (Erdemir, 2010). It has been determined that there were separate toilets for men and women in the Roman period, as well as toilets located within each other (Erdemir, 2010, p. 110).

The concept of "privacy" based on physical gender, which is felt more clearly in Eastern culture, did not find enough place in Hellenic and Roman societies. The technological designs which are the continuation of the same culture that designed today's technological movement (Western civilization) naturally designed technology beyond physical gender.

Unisexualization, desexualization or genderless trends seen in social and public spaces actually provide the ease of life of women, who have been in a disadvantaged position until today, in social life, as well as the ease of life of today's disadvantaged groups in public spaces (Yüksel, 2018, p. 311).

2. Material and Method

In our research, predictions were made regarding unisexuality tendencies in public spaces by observing the buildings and urban facilities in Turkey and especially in the world, and by examining the literature on the cities of the future.

In the study, interviews were held with anonymous people, sometimes with anonymization method due to the sensitivity of the subject, and their expectations and approaches towards trends in public structures were tried to be revealed.

The countries we identified in our world-scale research on unisexualization trends were not conducted by random sampling method, but in technology-intensive countries and cosmopolitan megapolises of the countries. In this context, while searching for documents, visuals and situations related to the subject, we sometimes used the terms "unisexualization" and sometimes "desexualization".

The subjects were asked about both of these terms together and it was tried to observe whether the subjects were aware of these two terms. We have also used the term "transgender" in our literature and/or case searches.

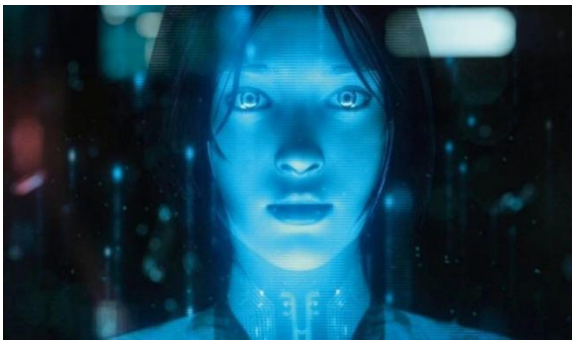
Observations and investigations have been made in at least 10 different countries in terms of the tendency towards unisexualization. On the other hand, unisexuality or genderless tendencies in public spaces have often been observed in non-gendered outbuildings offered in response to size, color and public needs, rather than visual differences**.** This situation alone shows that our research should be observation-based. It has also been observed that genderless designs in public spaces, outbuildings and/or furniture, in most cases, arise from space constraints and the requirements of urban concentration. These observations are systematized in Table 1.

Table 1. Genderless trends in public space by Country

N	Country	Unisexualization Samples
1	California (USA)	Pavement heights, Toilets, Clothing, Space colors
2	Shanghai (China)	Space Designs, Pavement heights
3	Sauo Paulo (Brazil)	Terminals, Space designs, Pavement heights, Toilets
4	Osaka (Japan)	Pavement heights, Venue colors, Shopping outbuildings
5	Havana (Cuban)	Entertainment venues, sidewalk height, legal regulations
6	Berlin (Germany)	Megastructures, Shopping venues Legal regulations
7	Rotterdam (Holland)	Clothing, Toilets, Space colors, Legal Order
8	Paris (France)	Clothing, Sidewalks, Toilets, Legal Order
9	Zurich (Switzerland)	Pavement heights, Clothing, Legal order
10	Valetta (Malta)	Entertainment venues, Clothing

Today’s Tendency and Public Service Designs

The trend is increasing rapidly, especially with the influence of the cultural contexts of the last twenty years, as its impact can be seen more among university students and young people. In addition, there is a co-directional relationship between the tendency to become unisexualized and socio-economic level. In addition, the tendency towards unisexuality is observed more strongly in those whose biological and defined sexual preference is female. There is also a master's thesis on this subject conducted on university students (Karatepe, 2013).



a

b

Figure 4 a-b. Microsoft character Cortana and Siri (polygon.com, 2023, eturbonews.com, 2018)

The demand for urban public services has gradually begun to be established as a right in international texts. In this context, **"access to urban public services**" has been envisaged, defined and conceptualized. In the mapping and monitoring study prepared by Akduran et al., this concept was defined as follows: "Equal access to the physical and social infrastructure in cities, in other words, the provision of local public services in a way that meets the needs of everyone and provides easy access." (Akduran et al., 2018, p.151).

Figure 5: Newbery, L. 2022) gender-neutral restroom at the University of Vermont in Burlington

Figure 6 Example of common restroom in Czechia 2018 Privet Album)

For example, yesterday's (30 years ago) young people who kept cattle in Turkey are today evolving into a Turkish Android generation that moves the primitive Renault Toros Brand 1985 model car with its voice and opens and closes its windows with simple digital remote-control. These evolutionary processes inevitably lead the people of tomorrow towards mental genderlessness or at least a tendency to think gender-neutral, with the genderless design motives potentially contained in technology.

In public service provision for public service demands, it should be envisaged that basic service delivery principles based on human rights should be designed to provide equal opportunities for genders in terms of inclusiveness, equality and openness, accessibility and competence. In this regard, the basic principles and measures are presented in more detail in the study of gender-based rights-based monitoring approaches prepared by Kurtoğlu & Tüzel (2021, p.14).

3. Unisexualization Criteria in Urban Public Equipment and Service Designs

Unisexualization in urban areas can be measured by the use, function and accessibility of urban facilities (Efe & Üstündağ, 2020, p.42-45). When we look at the common criteria in urban public services, we see that they also tend to be unisexualized. These are:

a. Physical and system accessibility

b. Susceptibility to equal use in public services,

c. Security

d. Multifunctionality (designs suitable for use by disadvantaged groups regardless of gender)

e. Adequate open green areas

In addition to Figure 5 and Figure 6, another example of gender-neutral toilets can be seen in Figure 7.

Figure 7. Example of common restroom on media (Openaccessgovernment.org, 2023)

If indifference is the default setting of human genetics, sexlessness is also the essential default setting of human genetics. Because the gender of living things often challenges perception and categorization, especially with the existence of self-reproducing species. The observation of hermaphroditic structures in plant species, animal species, and naturally in human species also manifests itself in sex and sexuality, as in every subject.

In fact, the problem arises in the first place when the feminine feature only as a reproductive device, and the masculine structures that take advantage of the time the female takes care of her child within the herd or community, begins to dominate life (in plants and animals) in their own way. Once dominance begins, roles and the acquisition/learning of these roles go back to the concept of "learned helplessness".

So why has gender neutralization become so important recently? The main reason for this is the reshaping of social structures mainly with technological effects, and in this shaping, especially the perceptions and tendencies in technological and artistic products that are unisex or not confined to sex.

Figure 8. Tawaf moment performed by Muslims around the Kaaba in Makka (islamtheultimatepeace.com, 2023)

Figure 9. England Alevi Cultural Center and Cemevi Semah Team (Oxford University, 5th Alevi Festival Opening Reception (youtube.com, 2022)

Some rituals of many religions, especially the religion of Islam, which has a dominant influence in Turkish-Islamic societies, and the coexistence and interconnectedness of men and women in the places where these rituals or worship are performed, require that some urban public services and equipment in these places be designed with a genderless logic. Men and women are intertwined during the circumambulation around the Kaaba. This situation is extremely normal for the relevant religion. A similar situation is also seen in the rituals and worship in Alevi Cem Houses.

In terms of unisex tendencies, both in urban public designs (macro designs) and micro (interior) designs, genderless spaces are produced by using oval designs together with Bauhaus designs with bevelled corners. This structural effect fuses feminine tendencies and lines with masculine lines. So much so that the standardization trend we use today in both home appliances and interior fittings is also another dimension of the genderless trend.

When viewed from the perspective of landscape architecture on a macro scale, the decrease in pavement heights over time, the elevations in the design and deployment of street furniture being lower than before, and the barrier-free structures and designs of cities and townspeople, which are parallel to the level of urbanization, are starting to bear more feminine and unisex lines than before. Of course, it is necessary to add the public pressure of disabled and disadvantaged groups to these developments.

In his study, Andersson stated that disadvantaged groups were seriously victimized, especially in the restorations of New York City and Bloomsbury Street, due to the concern of desexualizing and modernizing cities, and that urban lighting elements eliminated the ancient identity of the city and the street (Andersson, 2011, p. 1081-1082). It is important for urban equipment elements to be ergonomic, especially in terms of accessibility, and to reduce lighting and secluded places and blind areas in terms of security, in terms of urban unisexualization.

Figure 10. Circular oval style interior designs of Kaya Palazzo Golf Resort (projem.com, 2023)

Figure 11. Circular oval style outdoor designs of Kaya Palazzo Golf Resort (projem.com. 2023)

4. Categories of the Tendency to Unisexualization

Figure 12. Symbol expressing the integrity and transitivity of gender.

1. Unisexualization in technological structures and devices,

2. Transition from sex-focused approaches in artistic products to pluralistic gender perception,

3. Potential cost or difficulty of sex-based designs in architecture and public goods and/or service production processes,

4. Pragmatic ease and functionality in the presentation, sales and marketing of pluralistic gender-oriented products in fashion and design forms in the textile sector,

5. Social violent tendencies, especially the rise of masculine violent tendencies in underdeveloped or developing societies, and the search for solutions to these tendencies,

6. The practicality of integrated or plural sex analyses according to two-sex arrangements in legal structures,

7. With technological developments, the phenomenon of fertility has been freed from the label of "sacredness" and has become a technical detail,

8. Energy concentration based on mechatronic unisexualization, woven with technological expansions, has begun to be preferred over the physical, sexual-based, dual-dimensional feeling of "pleasure",

9. The influence of LGBT+ discourses, which continued their influence process especially after the 2000s, began to become accustomed to the social masses as they became widespread,

10. Breaking the psychology of learned helplessness over oppressive gender roles,

11. The process of anatomical adaptation as a result of the similarity of physical work conditions (the process of crossover and androgynization between the sexes),

12. The necessary change and development in women's clothing as a result of the increase in female employees in jobs requiring physical performance,

13. Androgenization and androgynization processes in social roles.

5. Trends in Urban Public Spaces

1. The psychology of integration resulting from the fusion and transition of sex-based phenomena in shrinking urban areas as they get closer to each other,

2. Strengthening the rules in organizational relationships and structures, and new role and mission designs from sex-oriented to mission-oriented,

3. Observing the ergonomics of the function of public service solutions such as "restrooms" in social life, especially in public living spaces, and the expansion of increasingly proportional genderless space and service designs,

4. The "digitalization" process in urban areas, gender-neutral algorithms of smartness (in the technological sense) in cities and urban areas,

5. Analyses regarding hetero gender contain potential social conflict impulses,

6. The development and consequences of positive discrimination against women in state policies in developing countries,

7. The repelling, developing and disseminating effects of the internal, external and private security guard profession and the subliminal perception in movies about them,

8. Functionality in the unisex design of individual and social wearable items,

When we look at the situation in terms of similarity in the urban life pattern, in the intertwining process of both individuals and social relations, we see that the strong, fast and functional perception, desire and preferences to act, which mostly emerge as women enter social life more, and the men of organizational environments who understand them better and empathize with them accelerated the process of unisexualization.

6. Findings and Discussion

The findings revealed by our research are presented below in the form of limitations and facilitating factors.

6.1. Limitations or Obstacles of the Unisexualization Process

1. Social life and business life are still dominated by men and this process is for the benefit of men,

2. The psychology of learned helplessness in women has still not been overcome globally,

3. Commercial organizations based on heterosexuality and sectors that profit from sexuality hope for a larger profit margin from the cake of heterosexuality,

4. Attempting to portray the asexualization and process of leading people of religious institutions and conservative groups as homosexuality (as if it were the same as homosexuality), (However, both concepts are very different in many respects in terms of their meanings and functions.)

5. Failure to update legal regulations on the subject in parallel with social mobility or dynamism.

6.2. Pushing and Promoting Factors on the Process of Unisexualization

1. The practical reality of genderless design of technology and technological products and the irreversible rapid development momentum in the appearance and operating systems of artificial intelligence and robotic systems,

2. More and more content that emphasizes genderlessness in global artistic and cultural media and films is being produced,

3. Increasing sensitivity and reactions to sexual-based social violence among the educated and cultured segments of society,

4. Gender-neutral designs and solutions in physical buildings and some public services are seen as much faster, cheaper, and more sustainable,

5. In the technology-intensive environment (in the technosphere environment), the indifference and indifference towards genderlessness that develops day by day due to people's machine learning and mirroring psychology.

6. Sameness psychosis in business life, as the services sector in the business world is still developing and the employees in the services sector are predominantly women,

7. Contents related to the structure and process of genderlessness in futuristic-themed science fiction films create a vision for individual perception and social perception,

8. Contents related to the structure and process of genderlessness in futuristic-themed science fiction films create a vision for individual perception and social perception,

9. Widespread and predominantly genderless production of clothing and wearable goods designs, especially in the textile industry.

6.3. Benefits of the Genderlessness Trend in Public and Private Spaces

1. Due to the nature of the concept, it causes a decrease in cases of sexual violence,

2. Sexual phenomena cease to be a taboo and repressed feelings about them disappear and surrender to the flow of the evolutionary process,

3. It leads public service providers to produce cheaper and more practical solutions,

4. Evolving the physical and social environment to a more sustainable point with this integration,

5. Strengthening the essentially “human” phenomenon by getting rid of all basic genders and intermediate genders that have diversified with the contribution of men, women and even LGBT+ organizations.

7. Conclusion and Suggestion

All humanity around the world must first of all be aware of this situation: genderlessness and a tendency toward it have begun, and it is not possible to reverse this tendency with references to feminine and masculine emotions and references to sacred texts. In this regard, technological designs, the forces and movements that prepare these designs have taken the social dominance and initiative in the hands of the conservative masses all over the world. In other words, (according to the tragicomic story told) the yellow ox was taken. The issue has entered a point of no return.Throughout history, the fact that public toilets were outside of homes had a delaying or complicating effect on the taboo of sex and sexuality. Throughout human history, toilets have not been inside houses, and places such as toilets and baths have served as the most popular places of socialization and mingling.

For a long time, especially until the last 100 years, living in an extended family, with at least 15-20 people living in a house, had the effect of eliminating or delaying sexual castes, even within the house. If there had been no such cultural movement, that is, if an individual life had existed from the beginning to the present, perhaps the tendency towards unisexuality in societies would have been seen even later.

When we look at the literature on gender, it is seen that gender and sexuality have a 50% effectiveness as a source that initiates the physical and medical phenomenon, but the acquisition, reinforcement, ingratiation of these roles and functions and the teaching of these perceived roles by the superego with a Freudian logic are at least 50% is of importance. In this case, although the physical gender structure remains constant under normal conditions, the rigid social-based gender perception is gradually loosening. Moreover, when we think about the reality of the atrophy of

unused or less used organs and emotions in the evolutionary process, under the influence of the tendency towards unisexualization in the social environment, the change in social perception and orientation will be experienced more dominantly in the near future. Developments regarding unisexualization have accelerated in the last hundred years, especially in the fashion industry. (Campbel, 2015)

The roles of androgynous individuals in the society, the designs of common living spaces and the legal spaces of the organizational structure with the influence of public spaces with this design have also been factors that develop / multiply each other to the point of being the cause and effect of each other.

Within the scope of the mirror theory, the multiplier factors in the above paragraph are constantly processed on the screens with different methods and techniques (movie movies, TV series, advertisements, fashion trends, magazine news, etc.) with subconscious and superconscious suggestions, and this becomes a phenomenon by creating a snowball effect towards the birth of such a psychosphere and sociosphere**.**

In this context, while the intertwining of these roles and the tendency towards genderlessness may cause painful and problematic crises in the short and medium term, it will have a positive impact on the well-being and peace of human beings on earth, especially in the long term, which is approximately 50 years. In fact, no one should be surprised that this trend has become a phenomenon recently.

Although the tendency towards gender neutralization may seem at first glance to be an extraordinary and even avoidable phenomenon according to normal and social value judgments, it is actually a very important evolutionary process for the well-being and peace of the people of the world.

We have stated the benefits and harms of the tendency towards unisexualization, as well as the limitations and/or obstacles of this process. If these articles are implemented, policy makers will be able to take a proactive perspective by benefiting from our research. It may be suggested that these people observe the future in the light of science and technology, combine the issues we have put forward, and establish a system accordingly.

Observations made in at least 10 different countries have shown that unisexualization tendencies in public structures are more developed and widespread in technology-intensive food, beverage and shopping venues.

Before finishing, we need to point out that local subjects, whose genderless tendency in people or society is revealed by making the local known in the context of belonging (glocalization), actually become the cosmopolitanist object of the global world. People will eventually become people of the world like Diogenes, who lived in Sinope between 404-323 BC. And again, in Diogenes' terms, after the year 2050, when he had no family left, the cosmopolitan youth became a cult domination.

The continued increase in the world population will, I fear, further accelerate this process. Unless a humane but radical measure is taken.

List of Legislation in Turkey in Parallel to the SubjectTable 1. National legislation affecting genderlessness

Legislation Type	Official Gazette Date and Number
International Legislation	
HABITAT – I. (1976). The Vancouver Declaration. BM. Vancouver, Kanada. https://mirror.unhabitat.org/downloads/docs/The_Vancouver_Declaration.pdf	The access link is below the legislation.
EIGE. (2015). Gender Equality Index 2015, Measuring gender equality in the European Union 2005-2012, Italy: EIGE. http://eige.europa.eu/rdc/eige-publications/gender-equality-index-2015-measuring-gender-equality-european-union-2005-2012-report. Source: September 10, 2022	The access link is below the legislation.
Charter of Athens, (1933). IV International Congress for Modern Architecture. https://portal.uur.cz/pdf/charter-of-athens-1933.pdf. Source, August 1, 2017.	The access link is below the legislation.
UN-Habitat. (2002). The Global Campaign on Urban Governangce (Urban Governance Index). United Nations Human Settlements Programme. (2002). The Global Campaign on Urban Governance: An Inventory. UN-HABITAT. Source, March 10, 2002.	The access link is below the legislation.
European Charter of Local Self-Government (1985). AB. https://rm.coe.int/european-charter-of-local-self-government-eng/1680a87cc3. Access Date: August 1, 2023.	The access link is below the legislation.
UN-Habitat. (2012). Urban Planning and Design –Gender Indicators). Kenya. United Nations Human Settlements Programme. htttps://unhabitat.org. Access Date: October 19, 2017.	The access link is below the legislation.
Aalborg Charter (1994). (European Cities Platform). https://sustainablecities.eu/sustainable-cities-platform/ http://portal.uur.cz/pdf/aalborg-charter-1994.pdf http://www.mo.org.tr/UIKDocs/aalborgsarti.pdf (Source: August 3, 2017.	The access link is below the legislation.
The Arcadis Sustainable Cities Index 2022, https://connect.arcadis.com/Sustainable-Cities-Index?origin_source=google&origin_medium=Search_ad&origin_campaign=Sci22&origin_content=NoData&_gl=1*axyjf*_up*MQ..&gclid=CjwKCAiAvdCrBhBREiwAX6-6Up6YNm4CrSmvYQV8IPFaJs69nLUvglu2c-8ReHs7K4XM4-0sijUSXxoCZkAQAvD_BwE	The access link is below the legislation.
The European Social Charter. https://www.coe.int/en/web/european-social-charter. In this regard, technological designs, the forces and movements that prepare these designs have taken the social dominance and initiative in the hands of the conservative masses all over the world. In other words, (according to the tragicomic story told) the yellow ox was taken. The issue has entered a point of no return	The access link is below the legislation.
European Bristol Accord. (2005). AB. https://www.eib.org/attachments/jessica_bristol_accord_sustainable_communities.pdf http://www.mo.org.tr/UIKDocs/bristolmutabakati.pdf.	The access link is below the legislation.
The European Charter for Equality of Women and Men in Local Life (2006) https://www.ccre.org/docs/charte_egalite_en.pdf	The access link is below the legislation.
European Urban Charter https://rm.coe.int/168071923d	The access link is below the legislation.
National Legislation	
T.C. Constitution **Article 10:** Everyone, language, race, colour, gender, political opinion, philosophical belief, religion, sect and are equal before the law, without discrimination for similar reasons.	09.11.1982-17863
In Türkiye National Legislation and Regulations: Law No. 5840 on the Equal Opportunities for Women and Men Commission	24.03.2009-27179

In Türkiye National Legislation and Regulations: Turkish Human Rights and Equality Institution Law No. 6701	20.04.2016-29690
In Türkiye National Legislation and Regulations: Accessibility Monitoring and Control Regulation	20.07.2013-28713
In Türkiye National Legislation and Regulations: Circular on Accessibility	05.05.2017-4419
Circular on KENTGES Action Plan	29.03.2017-7955

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Author Contribution and Conflict of Interest Declaration Information

The article has one author. There is no conflict of interest.

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Evolution of Commemorative Landscapes: An Analysis of Gallipoli Historical Site's Memorial Places

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Abstract

This study examines the development of memorial sites on the Gallipoli Historical Site, investigating the complex relationship between historical events, architectural structures, and landscape design. The research evaluates the evolution of designs by doing a literature analysis, selecting sites, and conducting examination. It emphasises a significant change from traditional monuments to modern landscapes that include nature. The unique characteristics of the Gallipoli Historical Site are crucial in developing cultural and national identities. The findings emphasise the significance of creating memorial places that are economically efficient, inventive, and respectful to the location. The study suggests integrating symbolic planting design features and recognises the ongoing discussion on memorial design, promoting nature-based landscapes that pay tribute to shared memories while adhering to contemporary design principles.

Keywords: *Commemorative sites, memorials, cultural heritage, Gallipoli Historical Site.*

Hatıra Peyzajlarının Evrimi: Gelibolu Tarihi Alanı'ndaki Anma Mekanlarının Analizi

Öz

Bu çalışma, Gelibolu Tarihi Alanı'ndaki anma mekanlarının gelişimini incelemekte ve tarihi olaylar, mimari yapılar ve peyzaj tasarımı arasındaki ilişkiyi araştırmaktadır. Araştırma, literatür analizi yaparak, çalışma alanlarının seçimi ve incelemelerde bulunarak bu alanlardaki peyzaj tasarımlarının gelişimini değerlendirmektedir. Geleneksel anıtlardan doğayı da içeren modern peyzajlara doğru önemli bir değişim yaşandığı vurgulanmıştır. Gelibolu Tarihi Alanı'nın benzersiz özellikleri, kültürel ve ulusal kimliklerin geliştirilmesinde önemlidir. Bulgular, ekonomik açıdan verimli, yaratıcı ve bulunduğu yere saygılı anma mekânları yaratmanın önemini göstermektedir. Çalışma, sembolik bitkisel tasarım özelliklerinin alanlara entegre edilmesini ve çağdaş tasarım ilkelerine bağlı kalarak ortak anılara saygı gösteren, doğal peyzajları da teşvik ederek anma mekanları tasarımı konusunda önerilerde bulunmaktadır.

Anahtar kelimeler: *Anma mekanları, anıtlar, kültürel miras, Gelibolu Tarihi Alanı.*

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1. Introduction

A memorial is a symbolic artwork that serves as evidence of the communal significance of a particular event, individual, or situation. In its most efficacious manifestation, it possesses enduring significance, establishing a connection between historical occurrences and the contemporary era as well as forthcoming developments (Dimitropoulos, 2009). Monuments are artistic creations that serve to establish and define the collective identity of individuals within a certain society. Public monuments fulfil several functions, including functioning as memorial symbols for significant events, serving as recollections of historical and social contexts, and improving the visual appeal of a certain location, encouraging the admiration of individuals. When exploring the historical trajectory of community monuments, it becomes evident that the primary impetus for their construction was to commemorate heroes and significant national events. Subsequently, the name "monument" gained more prevalence, with a particular focus on honouring individuals who perished in the context of World Wars I and II. The construction of these memorials was motivated by sad circumstances rather than by acts of honour. Subsequently, the focus of monuments transitioned from a national scope to a more localized, community-oriented approach.

Erbaş Gürler & Özer (2013) suggest that memorial sites may be characterized as tangible environments situated in public domains, with the purpose of safeguarding historical occurrences within the communal social consciousness. Memorial spaces encompass commemorative buildings that are specifically crafted to express reverence and tribute towards the memory of an individual or a significant event. The artifacts encompass a variety of items such as sculptures, trees, burial monuments, mosaics, fountains, and plaques that are typically positioned on benches, walls, or sidewalks. Memorial spaces refer to designated landscapes that serve the purpose of preserving historical events within the collective memory of residents, achieved via the physical manifestation of these events in public locations. Also, memorials have a further social impact through their roles as tourist attractions, sites for civic gatherings, and venues for everyday interactions.

The evolution of memorial design from the late nineteenth century to the present has resulted in a transformation of the connection between visitors and memorial places. The viewing viewpoint of the artifacts and figurative sculptures is designed to facilitate user interaction through several sensory experiences, including as occupying, touching, hearing, and participating in actions of commemoration (Attwa et al., 2022). There has been a growing desire for the development of memorial spaces as opposed to traditional standing monuments, accompanied by a shift in landscape architectural principles towards more modern approaches. The concept of a garden of commemorative sites pertains to a publicly accessible space intentionally created and designated to serve as a central location for the commemoration of specific memories. In several instances, these gardens have been established on the very grounds where a particular tragedy occurred (Gough, 2000).

In their study, Attwa et al. (2022) classified the aesthetic attributes of memorial landscapes into three distinct categories. The three types of monuments discussed in this context are referred to as "the invisible memorials," "on-ground memorials," and "ceremonial memorials (above-ground)."

According to Attwa et al. (2022), “The invisible memorials” In contrast to the conventional technique, which involves fully visible monuments, the structure of the monument is entirely concealed beneath the ground, rendering it inaccessible to the public and concealed from the visual field. “On-ground memorials” are memorials that are elevated slightly above the ground. They are considered on level with the human eye's cone of vision. Their height is usually lower than the human scale. “Above-ground memorials” are classified as visible memorials that are elevated above the ground. These memorials are situated at a significant height in relation to the human size and the cone of vision, therefore being exposed to the horizon. Additionally, they possess a monumental scale (Figure 1).

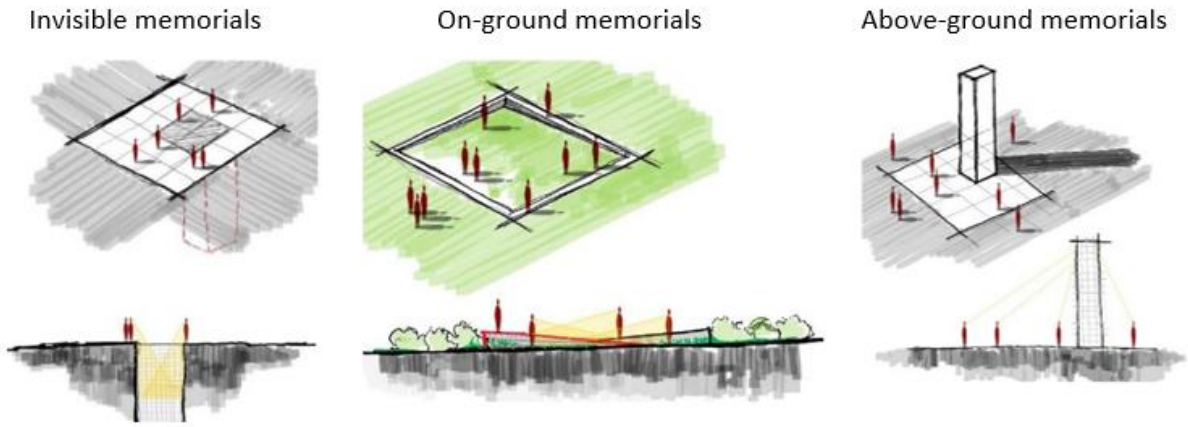

Figure 1. Memorial types according to their visual characteristics (Attwa et al., 2022)

Societies intentionally designate and memorialize landscapes to preserve and honour certain events, such as personal experiences, military wars, or deeply ingrained ideas. The forms and sizes of these assets exhibit considerable variation, ranging from discrete, independent elements to expansive, panoramic vistas. The described phenomena encompass the shared memory of social collectives and functions as a reservoir of symbolic importance for the broader populace.

Gallipoli Historical Site is distinguished by the significant conflict that occurred a century ago, giving rise to enduring tales. Additionally, its exceptional natural, agricultural, archaeological, and urban environment qualities are perceptible due to its stringent legal protection. Due to its universal character, this region has been designated as a protected area and is now listed in the Tentative Lists of The United Nations Educational, Scientific and Cultural Organization (UNESCO, 2023).

The Gallipoli Historical Site encompasses a multitude of significant levels of collective memory. The monuments and memorials on the Gallipoli Historical Site have greatly contributed to the construction of cultural and national identities for both Turkey and the Allied countries involved in the conflict. The creation of martyrs' cemeteries has consistently been a topic of discussion in relation to the Çanakkale Battles, which marked the front where the Ottoman Empire suffered the highest number of casualties.

The objective of this study is to evaluate the changing characteristics of commemorative sites located on the Gallipoli Peninsula. The study assesses the commemorative places and structures built on the Gallipoli Historical Site and examines how their architecture, placement, and integration with the surroundings contribute to Gallipoli's significance as a site of commemoration and national identity. The framework is based on the incorporation of history, architecture, and landscape design. The study entails a thorough examination of the historical evolution of the chosen sites, together with an evaluation of the present condition of the monument landscapes.

2. Material and Method

The area, which was established as the Gallipoli Peninsula Historical National Park in 1973, was removed as a national park in 2014, and the Directorate of Gallipoli Historical Site was established (ÇATAB, 2023). Covering a total area of 33,000 hectares, the historical site is located at the southern end of the Gallipoli Peninsula, on the European side of the Dardanelles (Figure 2). Reports and maps on tourism, transportation, and historical sites of the Gallipoli Historical Site were obtained from the Directorate of the Site.

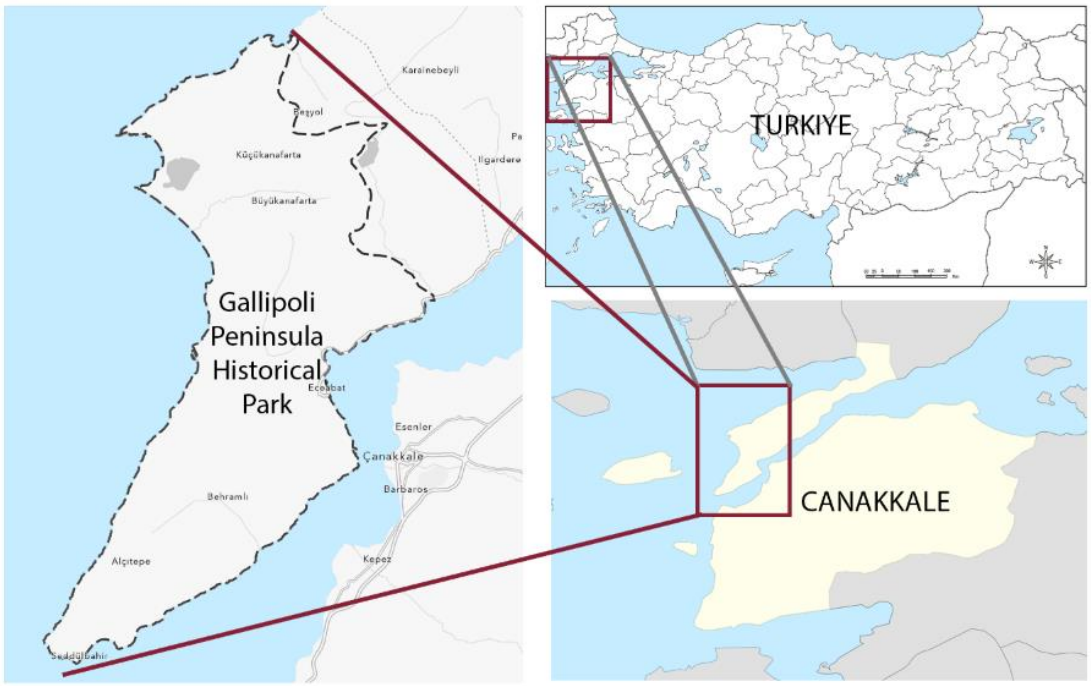

Figure 2. Location of study area

The Gallipoli Historical Site consisted of two battlefields, one located on the northern front and the other on the southern front. The losses incurred during the Çanakkale Battles were primarily focused on these two specific places. According to ÇATAB (2023), there are fifty-seven Turkish Memorial Sites and thirty-five Allied Memorial Sites on the Gallipoli Historical Site. The study analyzed four Turkish and four Allied memorial sites, which served as representations of the south and north fronts (Figure 3).

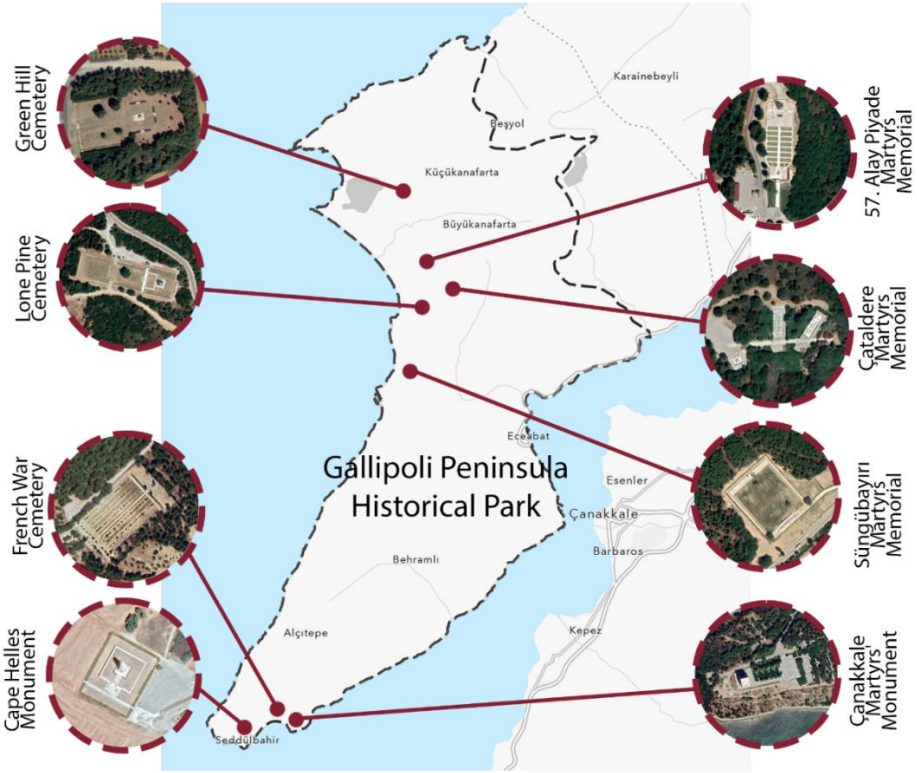

Figure 3. The researched map of selected memorial sites

The study region chosen for this research comprises the Gallipoli Historical Site, specifically focusing on the monuments and cemeteries associated with the Allied and Turkish forces. The selection of this location was based on two factors: the presence of high visitor density and notable architectural

variations among the sites. The study analyses the memorial spaces and structures built on the Gallipoli Historical Site and examines how their design, placement, and integration into the landscape contribute to Gallipoli's significance as a site of remembrance and national identity. It is based on a framework that incorporates history, architecture, and landscape design.

The study approach comprises three distinct steps. During the first stage, a comprehensive review and evaluation of relevant literature pertaining to the topic matter was completed. During the second stage of the study, a total of four Turkish Memorial Sites and four Allied Memorial Sites located within the Gallipoli Historical Site were chosen to represent sample sites. Subsequently, survey investigations were conducted within these designated areas. The significance of ensuring the long-term sustainability of the memorial sites within the Gallipoli Historical Site, which have a crucial role in shaping the national identity, was underscored in the last phase of the study. This was accomplished through an assessment conducted within the framework of landscape architecture planning and design research (Fig. 4).

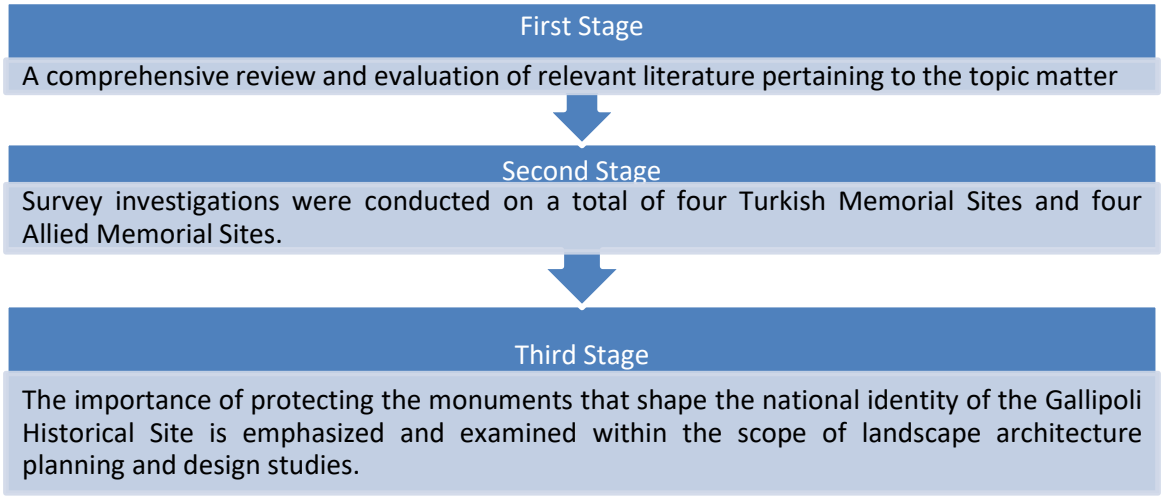

Figure 4. Method flow chart

3. Findings and Discussion

According to Marot (2003), the garden has served as a repository of cultural memory, functioning as a theatre that reflects its underlying narrative since ancient times. The focus of the memorial's design has transitioned from the creation of physical artifacts to the creation of a meaningful space (Rosenberg, 2007). The evolving interaction about monument design is believed to be indicative of the enduring connection between the monument and the garden. Memorial sites hold significant importance within the cultural landscape and contribute to the establishment of national cultural identity due to their essential function and the process by which they are created. These locations, which possess historical, artistic, documentary, functional, and cultural significance, warrant preservation and recognition as distinct areas and spaces within the field of landscape planning and design. Their inherent values should be evaluated and acknowledged, and their commemorative and/or symbolic importance should be safeguarded and accentuated, contingent upon the characteristics of the specific area or space (Günaçan & Erdoğan, 2018). Sites that retain remnants of a city's historical and cultural recollections serve to sustain their own presence and distinctiveness, while also transmitting the cultural memory and principles of the city to subsequent generations. Within this setting, locations of remembrance serve as prominent focal points that have evolved into symbolic representations of the urban environment, effectively preserving the collective memory of society.

Rosenberg (2007) introduced a transformative discourse in the design of the monument, wherein the conventional notion of a memorial as an item has been reimagined and reconfigured as a spatial construct. Lefebvre (2016) has also seen this shift in design in his work, “The Production of Space”. According to Lefebvre (2016), the advent of modernity has predominantly resulted in the

diminishment of the conventional signs and symbols inherent in architectural practices. This effect results in the erosion of spatial identity. The evidence indicates that the designed space has undergone a process of integration with transparency, resulting in the loss of its distinct characteristics. According to Micieli-Voutsinas (2017), the idea of "affective heritage" challenges conventional understandings of time and spatial boundaries by highlighting how the recollection of traumatic pasts by visitors in the present may significantly alter their physiological and psychological encounters with place, space, and time.

Landscape elements are delineated by a multitude of factors, including the positioning of the monument, the spatial configuration of the surrounding environment, the architectural morphology of the structures, and the composition and texture of the materials employed. Like urban environments, these components also contribute to the definition of the monument and its immediate vicinity. Designers employ many aspects, including water, flora, geography, and memorial components, to enhance and inspire specific feelings among visitors to these settings. Most historical monuments were intentionally crafted to illustrate the extraordinary significance of notable individuals and evoke a sense of appreciation for their accomplishments.

3.1. Turkish Memorial Sites

Çanakkale Martyrs' Monument

In 1944, the Ministry of National Defense initiated a project competition for the building of a selected project. However, the commencement of work for the winning project was delayed owing to economic constraints. In 1952, the "Grand Committee" made a series of decisions about the construction of the winning project on Hisarlık Hill and the procurement of the required financial resources from the country (Figure 5). The Çanakkale Martyrs' Monument, established in 1954, was made accessible to the public in 1960 (Atabay, 2016).

Figure 5. Çanakkale martyrs' monument (author)

The structure constructed on Hisarlık Hill, situated at an elevation of about 50 meters above sea level, stands at a height of 41.70 meters. The Martyrs' Monument, in the words of its architect, the symbolizes the unified elevation of our fallen heroes from all regions (ÇATAB, 2023). The feet of the entity in question are adorned with relief sculpture that depict several significant incidents from the conflict. Annually, on the 18th of March, individuals, and officials from many regions of the nation convene at the monument ceremony location to partake in commemorative rituals. The Çanakkale martyrs' monument comprises two helipads, a Turkish garden, symbolic graves, relief sculpture, statues, a ceremony area, a square, seating spots, a mosque, and a fountain. The monument features symbolic graves situated at its rear. The planting design of the area primarily consisted of *Chamaecyparis lawsoniana, Pittosporum tobira 'nana', Rosa sp., Buxus sempervirens 'rotundifolia', Nandina domestica, and Lavandula sp.* (Figure 6).

Figure 6. (a) Çanakkale martyrs' monument and surroundings (author) and (b) Turkish symbolic cemeteries (author)

Çataldere Martyrs Memorial

The path of stairs leading to the site is constructed using granite blocks and is situated on the incline, providing a vantage point overlooking the Çataldere Valley (Fig. 7). Memorial was made accessible to anyone on April 25, 2005. The cemetery has a total of 2835 individuals who are recognized as martyrs (The Legend of Gallipoli, 2012). The memorial situated at Çataldere Valley was constructed in 2006 as a commemoration of the martyrs. An inclined terrain necessitates the use of a stone-block staircase to access the location. The planting concept incorporates species such as *Rosmarinus officinalis L., Juniperus horizontalis,* and *Euonymus japonicus 'Aureo-marginatus',* seamlessly blending with the natural landscape.

Figure 7. Çataldere martyrs memorial (Kültür Envanteri, 2023)

Süngübayırı Martyrs Memorial

The martyrdom, which was established in 2022, implemented the monument concept as outlined in the Martyrdom Regulation. The monument and informally constructed tombstones, which symbolize the martyrs, were arranged in a disorganized manner. *Cupressus sp.* was chosen as the boundary element in the planting design of the area (Figure 8).

Figure 8. Süngübayırı martyrs memorial (ÇATAB, 2023)

57th Infantry Regiment Memorial

The construction of the 57th Infantry Regiment Memorial, which was created by architect Nejat Dinçel, took place in the year 1992. The complex is comprised of many key components, namely a centrally located fountain, an expansive area designated for prayer, a primary burial space, and a prominent monument (Figure 9) The primary substance employed in the act of martyrdom is calcareous stone (ÇATAB, 2023). This monument has representative cenotaphs and a relief sculpture. The vegetative design includes a lawn area between the cenotaphs and *Buxus sp.* as a delimiting element. There is also *Thuja orientalis* along the pathways at the entrance of the site.

Figure 9. 57th Infantry regiment memorial (ÇATAB, 2023)

3.2. Allied Memorial Sites

Most of the memorials and cemeteries affiliated with the Commonwealth and the French were constructed during the period from 1919 to 1926. In juxtaposition to the solitary French memorial and cemetery complex constructed in 1926, the Commonwealth War Graves Commission (CWGC) currently oversees a total of 33 cemeteries and 3 memorials, encompassing the burial sites of troops hailing from many national backgrounds (Yılmaz, 2014). Some of these are Lone Pine Cemetery, Cape Helles Monument, French War Cemetery, Green Hill Cemetery (Figure 10). The Lone Pine Cemetery takes its name from a *Pinus pinea* tree that serves as its symbol. The Lone Pine and Green Hill Cemetery include expansive lawns adorned with various plant species, including *Rosa sp., Lavandula officinalis, Pittosporum tobira 'Nana', and Santolina chamaecyparissus,* which are used among the gravestones. Cape Helles Monument has a large lawn area with *Santolina chamaecyparissus* around the monument. In the French War Cemetery, in *Arbutus unedo, Cupressus sp., Rosmarinus officinalis L., Thuja orientalis was predominantly used.*

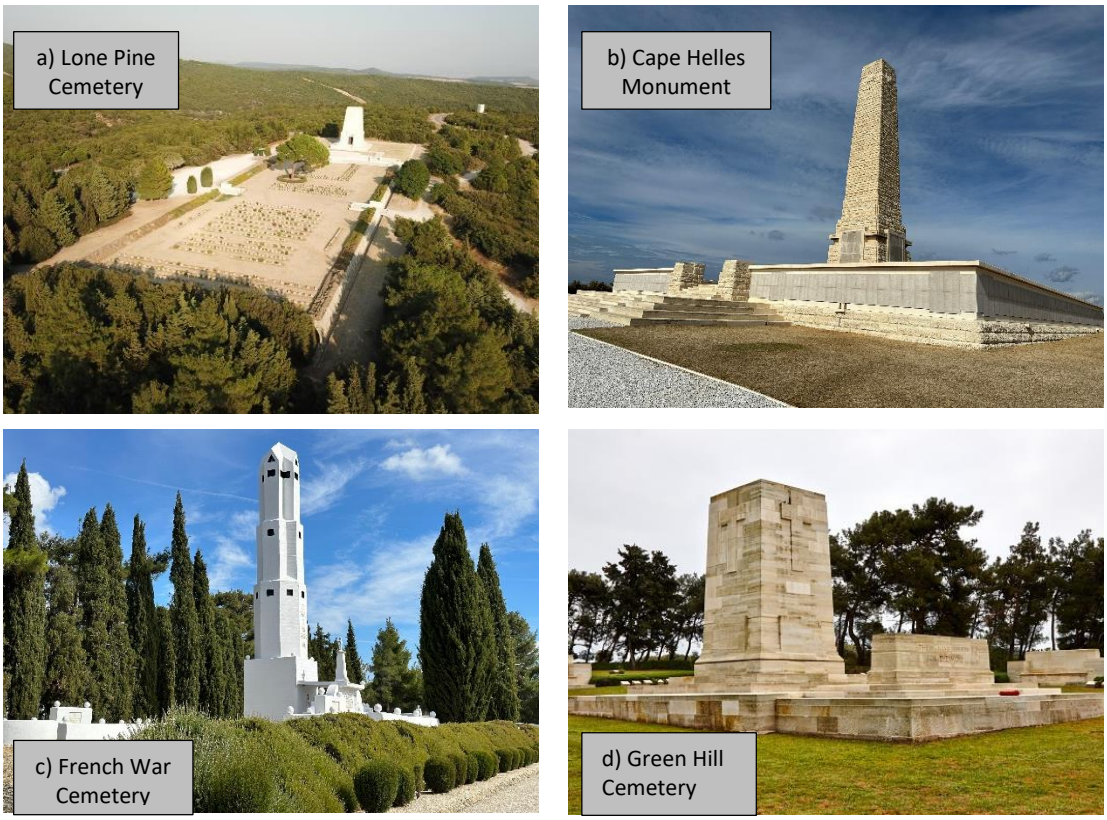

Figure 10. a) Lone pine cemetery (ÇATAB, 2023), b) Cape helles monument (author), c) French war cemetery (author) d) Green hill cemetery (ÇATAB, 2023)

The utilization of visual components within monuments to engage with the surrounding environment and historical events can serve as a means of symbolism, so enhancing the association between memory and location. Upon examination of the sample regions, it becomes evident that obelisks, which represent one of the first manifestations of monumental architecture, have a prominent position. The construction of obelisks in Allied cemeteries and memorial sites took place throughout the 1920s, whilst Turkish martyrs memorial and monuments exhibited a preference for obelisks from the 1960s to the 2000s. In the post-2000 era, there has been a noticeable shift towards the prevalence of contemporary landscape designs and on-ground approach monuments in the construction of commemorative structures. The prevalence and prominence of obelisk-shaped monuments within their respective locales may be attributed to their vertical structure, which positions them as the primary focal point and visual centrepiece.

4. Conclusion and Suggestions

According to Gül et al (2019), the establishment of local identity necessitates a comprehensive, inclusive, organized, and enduring methodology, which should be integrated into the realm of cultural tourism. In this context, preservation of cultural heritages should be undertaken with the objective of safeguarding their authenticity, while also establishing meaningful connections among them in a comprehensive manner. Furthermore, it is imperative that cultural heritage places are understood and developed in alignment with the local identity structure, distinctive values, and way of life. To establish a distinct local identity, it is important to assess the values associated with the local holistic identity. Furthermore, it is crucial to prioritize fundamental values based on their perceptual significance.

The International Council on Monuments and Sites (ICOMOS), an organization that provides guidance for world heritage protection, operates under the premise that a monument is intrinsically linked to the historical events it has seen and the surrounding environment in which it is situated. In this context, it is important to acknowledge that the Gallipoli Peninsula was the site of the Çanakkale Battles and, as a result, its physical characteristics have been influenced correspondingly. The Gallipoli Historical Site serves as an exemplar that demonstrates the role of landscape in conveying memory, identity, and history to the general population.

The geographical significance and behavioural limits of a monument are determined by its shape and physical characteristics, which can range from intricate to conceptual. The utilization of simplified design forms and symbolic messaging facilitates enhanced user engagement and comprehension of the memorial's underlying concept and intended purpose.

The main objective in the conceptualization of memorial sites situated on the Gallipoli Historical Site ought to be the development of economically efficient, innovative, and structurally robust environments that harmonize with present-day memorials, while simultaneously integrating pragmatic, imaginative, and contemporary methodologies.

Plants also fulfil a significant function inside memorial settings, acting as potent representations of vitality and renewal. These features serve as uniting factors, providing individuals with a platform for self-expression and fostering a feeling of inclusion. Hence, it is imperative to allocate greater consideration to the incorporation of planting design elements in memorial sites, with a particular emphasis on the development of designs that effectively convey symbolic meaning through the expressive capabilities of plants. It is suggested to use lighting features, directional signs, and trash cans that exhibit minimal designs and are seamlessly blended with the surrounding environment. Due to the water shortage in the historic area, rainwater harvesting can be considered a sustainable and environmentally friendly practise, especially for the irrigation of green areas. As a result, it can contribute to water conservation, reduce dependency on external water resources, and encourage sustainable practises in the historic area.

This study showed an evolution in the design of commemorative sites within the Gallipoli Historical Site, where the focus has transitioned from creating materials to creating spatial environments or locations. Furthermore, it has been ascertained that there is a discernible shift in the choice of materials employed in monument design, with a steady transition from industrial substances to more organic components such as wood, grass, and water. Therefore, it is imperative to consider these concerns while designing new memorials within the Gallipoli Historical Site. The evolving discourse around memorial design contributes to the transition of memorials from urban landscapes to nature-based landscapes, wherein the explicit representation of a commemorative monument or sculpture is integrated into the natural environment of the memorial place.

In summary, the memorial landscape is regarded as a complex interplay between the commemorative aspects and the urban characteristics of space. Additional investigation may be undertaken to quantitatively assess the physical components and sensory perceptions of users, with the aim of designing a modern memorial landscape that is suitable for the specific memorial occasion and the available spatial constraints.

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The article complies with national and international research and publication ethics. Ethics committee approval was not required for the study.

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Investigation of Components Forming the Spatial and Landscape Character of Amasya University Yeşilırmak Campus

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Abstract

In this study, the study area was chosen as Amasya University Yeşilırmak Campus, located within the borders of Amasya province central county. The aim of the study was to investigate the components comprising the spatial character (buildings, roads and paths, parking areas, equipment elements, sports areas, social areas) and landscape character (topography, presence of plants) in terms of function, current status, environmental and aesthetic features. In line with this aim, the components comprising the spatial and landscape character of the campus were identified with field observations and the functions of the components were defined. An orthophoto for the campus was created using an unmanned aerial vehicle (UAV) and maps for the current spatial character, landscape character, social areas and parking areas were obtained. At the conclusion of the study, it is observed that, despite a significant portion of the campus surface being covered by wooded areas, the structures within the campus, such as buildings, parking areas, and vehicular and pedestrian pathways with hard surface materials, are more extensively utilized by the campus users, while the wooded areas remain largely unused. Findings revealed the current status of the campus, and recommendations were made to create a campus with distinctive identity that will be more livable and chosen more frequently by students.

Keywords: *Campus identity, campus character, campus landscape, Amasya University Yeşilırmak Campus.*

Amasya Üniversitesi Yeşilırmak Yerleşkesinin Mekânsal ve Peyzaj Karakterini Oluşturan Bileşenlerin İrdelenmesi

Öz

Çalışmada, Amasya ili Merkez ilçe sınırları içerisinde yer alan Amasya Üniversitesi Yeşilırmak Yerleşkesi çalışma alanı olarak seçilmiştir. Çalışmanın amacı, yerleşkenin mekânsal karakteri (yapılar, araç ve yaya yolları, otopark alanları, donatı elemanları, spor alanları, sosyal alanlar) ile peyzaj karakterini (topoğrafya, bitki varlığı) oluşturan bileşenleri işlevleri, mevcut durumu, çevresel ve estetik özellikleri açısından irdelemektir. Bu amaç doğrultusunda yerleşkenin mekânsal ve peyzaj karakterini oluşturan bileşenler arazi gözlemleriyle tespit edilerek bileşenlerin işlevleri tanımlanmıştır. İnsansız hava aracı (İHA) kullanılarak yerleşkenin ortofotosu üretilerek yerleşkenin güncel mekânsal karakteri, peyzaj karakteri, sosyal alanlar ile otopark alanları haritaları elde edilmiştir. Çalışmanın sonucunda, yerleşke yüzeyinin büyük bir bölümünü ormanlık alanı kaplamasına rağmen yerleşke kullanıcıları tarafından bu alanın kullanılmadığı yerleşke içerisindeki yapılar, otopark alanları, araç ve yaya yolları gibi sert zemin yüzeylerin daha fazla kullanıldığı görülmektedir. Bulgular dâhilinde yerleşkenin mevcut durumu ortaya konularak daha kimlikli, daha yaşanabilir ve öğrenciler tarafından daha tercih edilebilir bir yerleşke olmasına yönelik önerilerde bulunulmuştur.

Anahtar kelimeler: *Yerleşke kimliği, yerleşke karakteri, yerleşke peyzajı, Amasya Üniversitesi Yeşilırmak Yerleşkesi.*

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1. Introduction

Universities are teaching institutions producing knowledge required by society, transferring the produced knowledge to future generations, and contributing to the continuous development of society. With the increase in demand for scientific research and professional educational activities, universities have become small towns meeting the need for social activities and housing, in addition to containing educational buildings.

The word university combines 'universitas magistrorum et scholarium' meaning union of students and teachers and 'universitas literarum' meaning union of sciences (Kortan, 1981). Universities are not just a system where knowledge is transferred to students to allow them to gain a profession, they are also a system contributing to shaping society by producing science and culture (Köroğlu, 1988). Universities, which are communities of researchers (Karakaş, 1999), have three basic functions of education-teaching, research-application and social services (Türeyen, 2002).

Though the concept of a university dates to very old times, the Middle Ages is accepted as the period of first institutionalization. Comprising a single independent building in the Middle Ages (Kortan, 1981), the first example of a university campus emerged with the founding of Princeton University in the USA in 1746. Universities were located within certain boundaries until the 20th century while the boundaries of universities have expanded since the 20th century, and they can be distributed in different locations within a city (Turner, 1995). Due to the inadequacy of land in cities, universities began to transform into university towns meeting all the needs required by students by being in large land areas outside of cities (Özer, 2008; Erçevik & Önal, 2011). However, as universities are in continuous interaction in socio-cultural and economic terms with the city and contribute to the economic, physical, and social development of the city, along with the development of society through scientific study, it is necessary to plan universities by considering the present status, features and needs of the city (Erkman, 1990; Özen, 2005).

With the distribution and development of universities over larger areas, the term campus began to be used. Campus is a multifunctional educational area including the educational buildings in the university, student dormitories, lodgings for teaching staff, social facilities and units connecting these like roads, paths, green areas, internal courtyards, and squares (Turner, 1995). University campuses fulfill education-teaching, research, housing, transport, application, health, relaxation, and recreational functions. The location, size, and open- green areas for common use in university campuses, accepted as a small-town model, direct the spatial development of the city, and affect the city identity (Erkman, 1990; Türeyen, 2002). Displaying development and transformation over time, university campuses gain a dynamic structure (Lidsky, 2002). Campuses are a part of the current ecosystem and are in large areas in natural or artificial environments (Tuna, 2006). According to Türeyen (2002), with the increase in academic functions and interdisciplinary relationships of universities, construction of campuses emerged due to the need for units comprising the campus to be located close to each other.

Universities are successful in terms of the quality of the environment they offer to their students as well as their academic and administrative staff. As a result, university campuses, fulfilling many functions with education-teaching, housing, research, social, commercial, and cultural purposes, should be founded and grow in line with certain planning and design principles (Anonymous, 2002; Gül et al., 2016). For selection of appropriate land for a university campus, the size of the land, opportunity for development, topographic features, geological features, geomorphological features, technical connections like electricity, water and sewage, available facilities and natural elements, climate features, visual character value like views and plants, and environmental effects like noise and odor should be noted (Erkman, 1990). Before beginning planning and design studies for university campuses, all natural data from the land should be investigated in detail and buildings should be associated with outdoor space use like sports areas, rest areas, squares, botanic gardens, and amphitheaters. The spatial sizes should be determined in line with the needs of the users and spaces should be built in easily accessible locations in the campus (Booth, 1990). Especially when selecting locations for campuses to be built within city centers, the qualities of the units to be

included in the campus should be considered and there is a need for planning and design studies from upper scale to lower scale (Türeyen, 2002).

The studies in the national and international literature about planning and design of university campuses are summarized as follows:

Tolon (2006), in a master's thesis entitled "Outdoor Space Design Principles for University Campuses and Landscape Design of Ankara University Gölbaşı Campus", identified the deficient points by assessing natural data through on-site observation from within the campus. They investigated the landscape design for an ideal university campus and created a landscape design for Ankara University Gölbaşı Campus.

A master's thesis study by Ayvacı (2009) was entitled "A Research on the Determination of the User Requirements in Open Spaces Design for University Campuses". They used observations of outdoor space use and survey studies to contribute to social and physical development to meet the needs of İstanbul Technical University Ayazağa Campus and Ege University Bornova Campus users.

A study by Ertekin & Çorbacı (2010) called "Landscape Planning at University Campuses (The Landscape Project Case Study of Karabük University)" made recommendations by proposing a landscape project to transform Karabük University Campus into a space that meets the academic, social, cultural, artistic, and sporting requirements of users. Within the scope of the study, the needs of campus users were listed, and a survey study and land use analysis were completed.

A master's thesis study by Koç (2011) entitled "University of Determination Iğdır Campus Landscape Planning and Design Principles" investigated examples of campuses from Türkiye and around the world and performed a survey study and land use analysis. A comparison was made between the location, settlement, and access in Iğdır University Campus according to design criteria with other university campuses and design recommendations were developed for the campus.

A study entitled "The Examination of The Spaces for Common Use in University Campus Settlements: Selcuk University Aleaddin Keykubat Campus" by Büyükşahin Sıramkaya & Çınar (2012) developed recommendations by assessing the campus according to planning criteria determined within the literature review and suggestions were developed.

Atabeyoğlu (2014) performed survey and status assessment studies for the Social Sciences Vocational College Campus located in the city center linked to Ordu University in a study entitled "Landscape Design and Application Study for the Campus of Vocational School of Social Sciences". The structural and plant materials in the area and the relationship between these materials and users were investigated and landscape design assessed.

A study called "Landscape Design of a Campus Outdoor Spaces: Süleyman Demirel University Faculty of Forestry Building" by Yılmaz (2015) determined the needs of academic and administrative personnel and students using the area around Süleyman Demirel University Faculty of Forestry and analyzed with on-site observation technique natural and cultural landscape data. Based on the obtained data, a landscape design for the surroundings of Süleyman Demirel University Faculty of Forestry was created by visualizing semantic, syntactic, and pragmatic aspects.

Düzenli et al. (2017), performed a study called "Determining the Usage Purposes of University Campus Open Spaces by Youth". They performed spatial analysis of Karadeniz Technical University Kanuni Campus and classified buildings and open spaces according to function. A survey study was completed to determine open space use by campus users and the common recreational areas most frequently used by young people on campus were identified.

Eminağaoğlu & Arslan Muhacir (2018) assessed Artvin Çoruh University Seyitler and City Campuses, with different morphological characteristics, in terms of planning and design principles determined within the literature review in a study entitled "Evaluation of Artvin Coruh University Campus Areas in the Scope of Planning and Design Principles".

A master's thesis entitled "Exterıor Design Prıncıples Campuses Terms Evaluatıon; the Example of Işık Ayazağa Campus" was completed by Şahin (2019). They identified on site and field analysis the status of structural and plant materials in Işık University Ayazağa Campus, located in Sariyer county in İstanbul, to assess the landscape design.

A master's thesis by Ünal (2020) called "Landscape Planning at University Campuses the Landscape Project Case Study of Bandirma Onyedi Eylül University" considered the university campus and city as a whole. They redesigned the campus by investigations within the scope of urban planning and design principles determined within the literature review.

A study by Türker & Deneri (2021) called "Evaluation of Usak University Campus in Terms of Planning and Design Principles" performed a literature scan, data collection and analysis studies. They assessed Uşak University 1 September Campus in line with planning and design principles. Solutions were proposed considering the obtained data.

Şahin Körmeçli (2022)'s study titled "Evaluating Transportation Network of University Campus by Using Space Syntax and GIS: Çankırı Karatekin University Uluyazı Campus Case Study" the university campus and the city were considered as a whole, and the transportation network of the campus was analyzed by the spatial syntax method. Design suggestions were proposed considering the obtained data.

The studies conducted within the scope of the examined national and international literature related to the planning and design of university campuses provide detailed discussions on the concepts of campus, campus identity, and campus landscape. Literature review, site analysis, and on-site observation techniques are identified as employed methods. In this context, the aim of the study is to scrutinize the spatial character and landscape components that constitute the character of the Green River Campus of Amasya University in terms of their functions, current state, and environmental and aesthetic features. In this context, the aim of the study was to investigate the components comprising the spatial character (buildings, roads and paths, parking areas, equipment, sports areas, social areas) and landscape character (topography, presence of plants) of Amasya University Yeşilırmak Campus in terms of function, status, environmental and aesthetic features. The spatial character of the campus is shaped by the structures, vehicular and pedestrian pathways, parking areas, equipment elements, sports areas, and social spaces within the campus. The landscape character of the campus is determined by the topography and plant presence. The reason for selecting these two components in the study is that, based on the studies conducted in the literature on the planning and design of university campuses, they are identified as fundamental elements constituting the campus landscape. In this study, the current state of the spatial character and landscape character of the campus is detailed through fieldwork, and an updatable infrastructure is established in the ArcGIS 10.5 program within a GIS environment. It is anticipated that this study will contribute to the literature by serving as an example for the planning and design process of other university campuses and the creation of an updatable infrastructure system in the GIS environment.

2. Material and Method

In the study, dealing with the campus concept considered to be a small-scale urban model, the study area was chosen as Amasya University Yeşilırmak Campus located within the central county of Amasya province, Türkiye.

Amasya province is in the Middle Black Sea section of the Black Sea region between 35°00' and 36°30' longitude and 40°15' and 41°03' latitude north, covering 5,690 km^2 area. It is surrounded by Tokat and Yozgat provinces to the east, Samsun to the north, Çorum to the west and Tokat to the south. The province generally has elevation 1,150 m above sea level, with the provincial center located at 412 m above sea level (Anonymous, 2010; Kurt, 2013).

Amasya University is a state university founded in Amasya on 17 March 2006. Amasya University includes 3 institutes (Sciences Institute, Health Sciences Institute, Social Sciences Institute), 8 faculties (Medicine Faculty, Education Faculty, Theology Faculty, Architecture Faculty, Science-

Literature Faculty, Health Sciences Faculty, Engineering Faculty and Merzifon Economics and Administrative Sciences), 1 college of foreign languages and 8 vocational colleges (Design VC, Suluova VC, Merzifon VC, Social Sciences VC, Technical Sciences VC, Taşova Yüksel Akın VC, Gümüşhacıköy Hasan Duman VC and Sabuncuoğlu Şerefeddin Health Services VC). Due to the topography and transportation in Amasya province, Amasya University is generally distributed in sections in the province in general, instead of in a single campus. Amasya University has 8 campuses of Hâkimiyet Campus, Ipekköy Campus, Yeşilırmak Campus, and the Faculty of Medicine Campus in the central county, Gümüşhacıköy Hasan Duman VC Campus in Gümüşhacıköy county, Merzifon Campus in Merzifon county, Suluova VC Campus in Suluova county and Taşova Yüksel Akın VC Campus in Taşova county (Amasya University, 2021a-2021c). Since the day of its founding, the university has contributed to Amasya in social, cultural, and economic terms. Due to the topography of Amasya, campuses are generally distributed throughout the province, rather than in a single campus.

The Yeşilırmak Campus, chosen as the study area, is located on Kemal Nehrozoğlu Avenue. The campus comprises the Faculty of Architecture-Design VC, Faculty of Engineering A-B-C blocks, Faculty of Theology, Technical Science VC, Social Sciences VC, College of Foreign Languages-Distance Education Application and Research Center, Machinery-Automotive Laboratory, Central Workshop, central canteen, semi-Olympic indoor swimming pool, indoor sports center and sports fields. The Yeşilırmak Campus is surrounded by 201,781.49 m^2 forestry area and covers a total of 332,850.26 m^2 (Fig. 1). It is located 4 km from the center of Amasya city. The city center can be reached by motor vehicles in about 10 minutes on Kemal Nehrozoğlu Avenue, which is within walking distance of the campus.

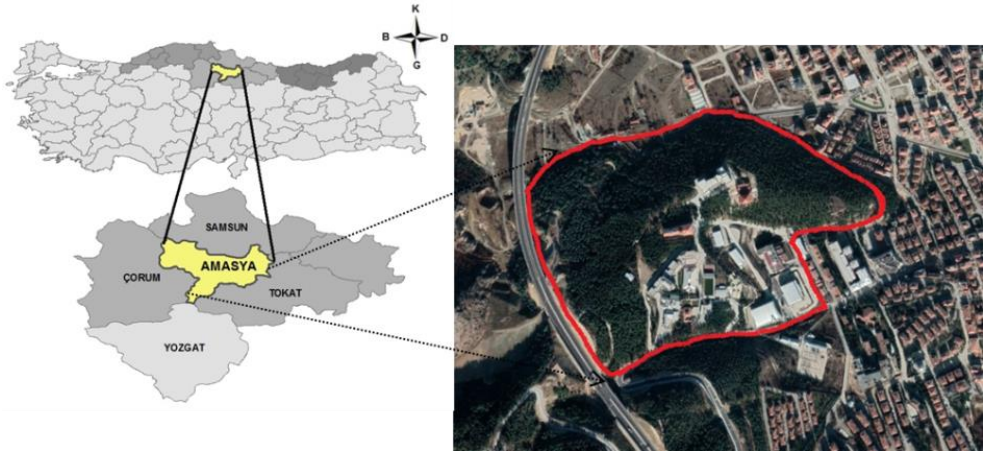

Figure 1. Study area boundaries

The reason for choosing Yeşilırmak Campus in this study is the larger areal size compared to other campuses, the difference in elevation between buildings/areas within the campus, and the excess diversity of users due to the combination of different units together in the campus allowing for different uses. When this study is successfully completed, it will represent an example for other campuses within the university.

In the study, answers to the following questions were sought:

Research Question 1: What are the components and functions comprising the spatial and landscaping characters of Amasya University Yeşilırmak Campus?

Research Question 2: What are the environmental, functional, and aesthetic features of components comprising the spatial and landscape characters of Amasya University Yeşilırmak Campus?

In line with the research questions and purpose, the steps followed in the study are summarized as follows:

• First step: General information about the planning and design concepts for the university, campus and campuses comprising the basic foundation of the study was acquired.

• Second step: Field studies were completed to determine the status of Amasya University Yeşilırmak Campus. The functions of buildings comprising the spatial character of the campus, area covered by buildings and social areas, width of roads and paths, capacity of parking areas, relationship of buildings to the surrounding environment, disabled accessibility of buildings, social use areas in buildings (type and number of equipment elements) and functions of open-green areas comprising the landscape character of the campus and surrounding the buildings and topography were identified on site and photographed from different angles. Photographs were taken using a Canon 600 D digital camera.

• Third step: As there was no digital substrate in Amasya University for the study area, an Anafi Parrot unmanned aerial vehicle (UAV) was used to take overlapping photographs during field studies which were combined using Photoscan Agisoft Professional software to produce an orthophoto of Amasya University Yeşilırmak Campus. A total of 20 control points were used in the study area with the UTM coordinates of these points identified with a GNSS receiver. Flights were completed at 80 m height with 75% transverse and 75% longitudinal overlap rates used. This digital substrate was uploaded to the GIS environment and the ArcGIS 10.5 program was used to create maps of the spatial character, landscape character (green areas), social areas and parking areas in the campus.

• Fourth step: Results obtained from the previous steps were discussed and the status of the campus was revealed in detail. Recommendations were developed about landscape planning and design for the campus.

The process followed in the study is summarized in Figure 2.

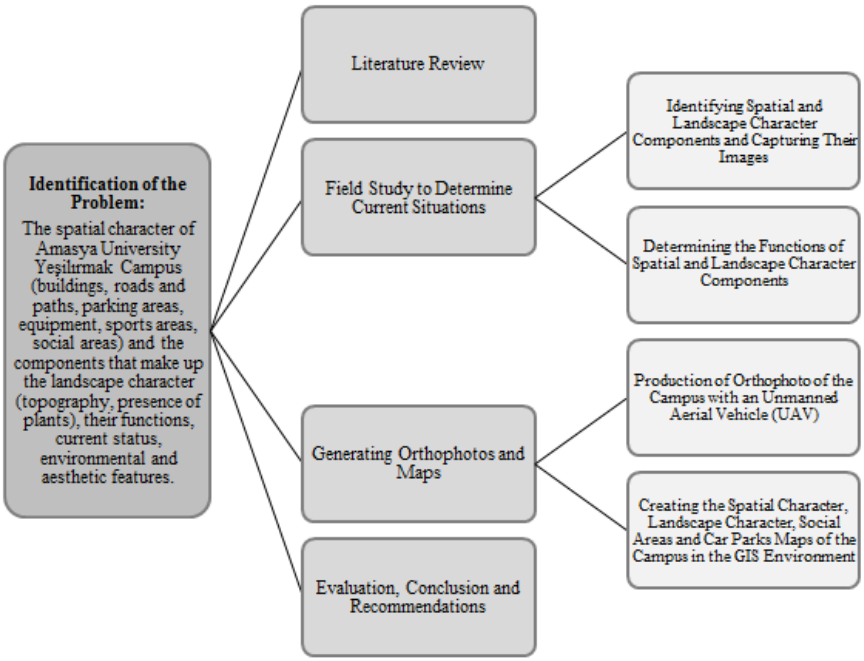

Figure 2. Work-flow chart of the study

3. Research Findings

The Faculty of Theology, Faculty of Theology Mosque, Technical Sciences VC, Faculty of Engineering, College of Foreign Languages-Distance Education Center, Social Sciences VC, library and academic café, canteen, workshops, Faculty of Architecture-Design VC, indoor sports center, indoor swimming pool buildings and car parks, sports grounds, roads, and paths around the buildings comprise the spatial character of Amasya University Yeşilırmak Campus. The buildings comprise the spatial character of the campus and green areas remaining outside these areas comprise the landscape character of the campus (Fig. 3). The functions of the buildings comprising the spatial character of the campus are given in detail in Table 1.

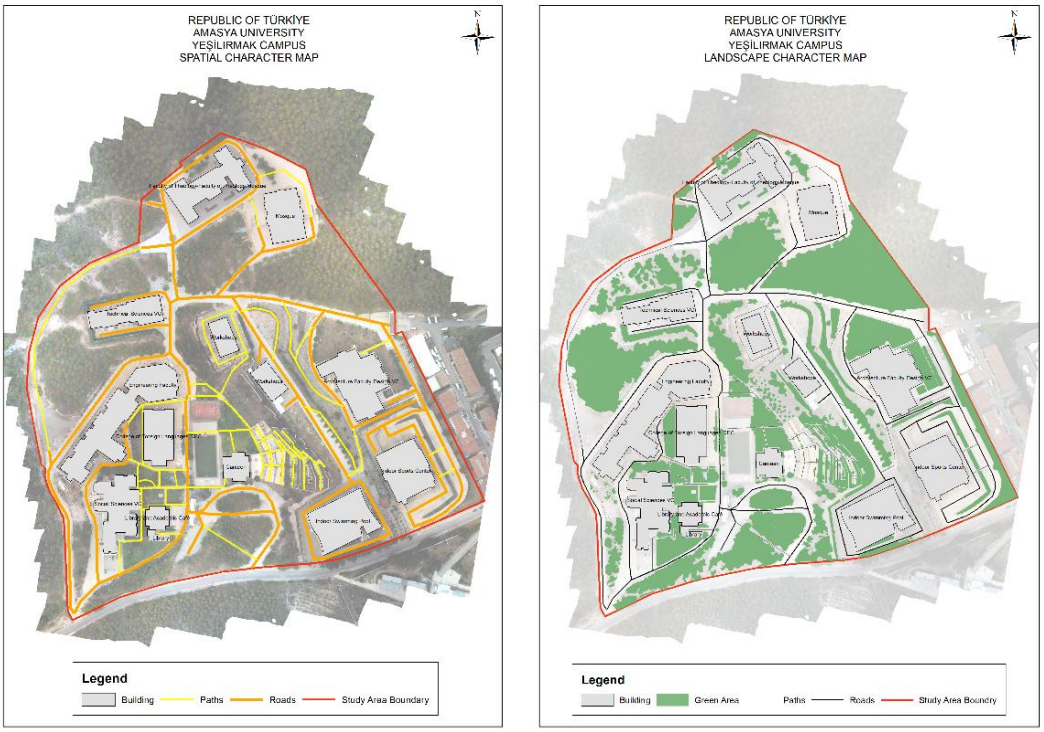

Figure 3. Map showing spatial and landscape character of Amasya University Yeşilırmak Campus

Table 1. Functionality of buildings in Yeşilırmak Campus

Buildings in the campus	**Functionality of buildings**
Faculty of Theology-Faculty of Theology Mosque	Education and Worship
Technical Sciences VC	Education
Engineering Faculty	Education
College of Foreign Languages-Distance Education Center	Education
Social Sciences VC	Education
Library and Academic Café	Socialization
Architecture Faculty-Design VC	Education
Sports Grounds	Socialization
Workshops	Socialization
Indoor Sports Center	Socialization
Indoor Swimming Pool	Socialization
Canteen	Socialization
Viewing Terraces	Socialization

With size of 332,850.26 m^2, Yeşilırmak Campus comprises 201,781.49 m^2 forested area, 23,823.61 m^2 green areas, 23,318.22 m^2 buildings, 1,435.82 m^2 sports grounds, and 82,491.12 m^2 hard surfaces in open areas (roads and paths, parking areas, social areas, etc.) (Table 2) (Fig. 4).

Table 2. Area covered by buildings and social areas in Yeşilırmak Campus

Buildings in the Campus	**Area covered by buildings and social areas**	
Faculty of Theology-Faculty of Theology Mosque	2.023,97 m^2 + 1.797,37 m^2	467 m2 + 860 m^2
Technical Sciences VC	1.509,08 m^2	350 m^2 + 140 m^2
Engineering Faculty	4.135,28 m^2	150 m^2
College of Foreign Languages-Distance Education Center	1.584,72 m^2	190 m^2 + 30 m^2
Social Sciences VC	2.701,43 m^2	150 m^2
Library and Academic Café	691,23 m^2	15 m^2
Architecture Faculty-Design VC	2.666,96 m^2	650 m^2 + 1700 m^2 + 750 m^2
Sports Grounds	942,22 m^2	2.600 m^2
Workshops	735,91 m^2 + 712,07 m^2	50 m^2 + 50 m^2
Indoor Sports Center	1.850,05 m^2	100 m^2
Indoor Swimming Pool	2.490,08 m^2	400 m^2
Canteen	500 m^2	250 m^2
Viewing Terraces	1.300 m^2	1.300 m^2

Access is provided for both pedestrians and vehicles from 3 main entrances to Amasya University Yeşilırmak Campus located on Kemal Nehrozoğlu Avenue (Fig. 4). The spine of the campus is shaped by the main axis providing access between the main entrances to buildings/spaces within the campus shaped around this main axis. Linked to needs of the campus and increase in student numbers in recent years, the campus has grown with development toward the north with the construction of new units. The main road used within the campus has a slope and does not have pavements on both sides.

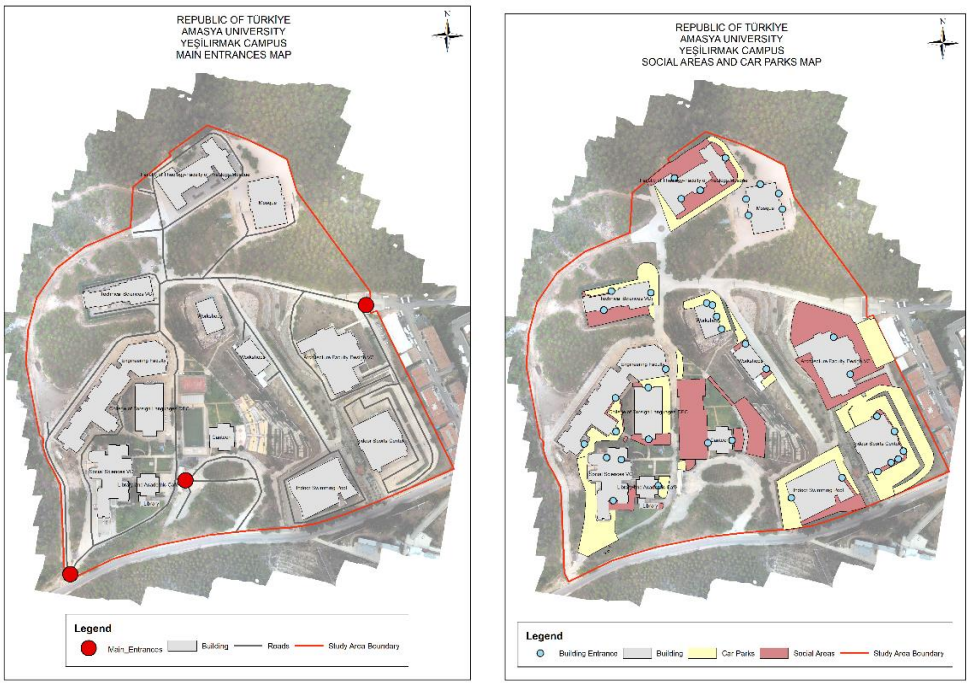

Figure 4. Map showing social areas and car parks along with main entrances for Amasya University Yeşilırmak Campus

Comprising the spatial character of the campus and ensuring circulation within the campus, paths are 2 m wide, while roads are 10 m wide. The total length of road is 1640 m, with all made of cast concrete, apart from the road close to the Faculty of Architecture-Design VC building. The area around the Faculty of Architecture-Design VC is covered with interlocking paving stones.

The total number of parking spaces close to the educational buildings in the campus is 230. When the car parking capacity for buildings within Yeşilırmak Campus is investigated, there is space for 100 cars near the indoor sports center, 60 cars near the Faculty of Theology-Faculty of Theology Mosque, 50 cars near the Social Science VC, 40 cars near the workshops, 40 cars near the Faculty of Architecture-Design VC, 30 cars near the Technical Sciences VC, 21 cars near the College of Foreign Languages-Distance Education Center, 20 cars near the Indoor Swimming Pool, 20 cars near the Faculty of Engineering, and 9 cars near the library and academic café. There is no parking near the viewing terraces, canteen, and sports grounds. There is a hard surface area in front of the indoor sports center and indoor swimming pool that could be converted to a car park if desired.

As there is 5 m elevation difference between the College of Foreign Languages-Distance Education center building and the Faculty of Engineering building in the campus, there is a path dominated by steps. There is 3 m elevation difference between the Faculty of Architecture-Design VC building and the indoor swimming pool. Due to the elevation differences in the campus in general, ramps are used on roads and steps are used on paths. This situation causes difficulty for pedestrian accessibility within the campus for students, especially for disabled individuals.

The entrances to buildings comprising the spatial character of the campus and relationship to their surroundings are given in Table 3.

Table 3. Relationship between buildings and close surroundings in Yeşilırmak Campus

Buildings in the Campus	**Relationship of buildings to surroundings**
Faculty of Theology-Faculty of Theology Mosque	Faculty of Theology building has 4 entrances, Faculty of Theology Mosque has 5 entrances, with surroundings and social areas near the buildings comprising hard ground.
Technical Sciences VC	Technical Sciences VC building has 3 entrances, with surroundings and social areas near the building comprising hard ground.
Engineering Faculty	Faculty of Engineering building has 4 entrances, with surroundings and social areas near the buildings comprising hard ground.
College of Foreign Languages-Distance Education Center	College of Foreign Languages-Distance Education Center building has 2 entrances, with surroundings and social areas near the buildings comprising hard ground.
Social Sciences VC	Sosyal Sciences VC building has 3 entrances, with surroundings and social areas near the building comprising hard ground.
Library and Academic Café	Library and Academic Café building has 1 entrance, with surroundings and social areas near the building comprising hard ground.
Architecture Faculty-Design VC	Architecture Faculty-Design VC building has 2 entrances, part of the front garden and back garden of the building consists of hard ground, part of the front garden and side garden of the building consists of green area.
Sports Grounds	There are football and basketball fields and floor chess, and the immediate surroundings and social areas of the sports fields consist of hard ground.
Workshops	Each workshop building has 1 entrance, with surroundings and social areas near the building comprising hard ground.
Indoor Sports Center	Indoor Sports Center has 5 entrances, with surroundings and social areas near the building comprising hard ground.

Indoor Swimming Pool	Indoor Swimming Pool building has 2 entrances, with surroundings and social areas near the building comprising hard ground.
Canteen	Canteen building has 2 entrances, with surroundings and social areas near the building comprising hard ground.
Viewing Terraces	The social areas of the viewing terraces are composed of hard ground.

The disabled access to buildings comprising the spatial character of the campus, was assessed as presented in Table 4. The appearance of some ramps near the buildings is shown in Figure 5.

Table 4. Disabled access to buildings in Yeşilırmak Campus

Buildings in the Campus	**Disabled access to buildings**
Faculty of Theology-Faculty of Theology Mosque	Access with 5% slope ramp at front entrance of Faculty of Theology, access with 6% slope ramp at first entrance, access with 5% slope ramp at third entrance and access with 6% slope ramp at fifth entrance to Faculty of Theology Mosque, entrance at back of building is at same level as the road.
Technical Sciences VC	Access with 7% slope ramp at front entrance of Technical Sciences VC, access with 19% slope ramp at east entrance of building, building entrance at back of building at the same level as the road.
Buildings in the Campus	**Disabled access to buildings**
Engineering Faculty	Access with 11% slope ramp at dining hall entrance to the Faculty of Engineering, access to all other building entrances with steps with no ramp for use by disabled persons.
College of Foreign Languages-Distance Education Center	Access with 5% slope ramp at front entrance of College of Foreign Languages-Distance Education Center.
Social Sciences VC	Access with 8% slope ramp at front entrance of Social Sciences VC, access with 9% slope ramp at east entrance of building, building entrance at back of building at the same level as the road.
Library and Academic Café	Access with 12% slope ramp at front entrance of Library and Academic Café.
Architecture Faculty-Design VC	Access with 9% slope ramp at front entrance of Architecture Faculty-Design VC, building student's entrance at the same level as the road.
Sports Grounds	Some entrances of the sports grounds are accessed by stairs, the level of some entrances and the road level are at the same level and there is no ramp for the use of disabled.
Workshops	Workshops' building entrance at the same level as the road.
Indoor Sports Center	Access to the Indoor Sports Center building is provided only by stairs and there is no ramp for the use of the disabled.
Indoor Swimming Pool	Access with 5% slope ramp at front entrance of Indoor Swimming Pool building.
Canteen	Access with 12% slope ramp at back entrance of canteen building, building entrance at front of building at the same level as the road.
Viewing Terraces	Access to the viewing terraces is provided only by stairs and there is no ramp for the use of the disabled.

Figure 5. Some ramps near buildings in Yeşilırmak Campus

The social use near buildings comprising the spatial character of the campus was assessed and shown in Table 5. It appears the number of social areas in the campus is inadequate for the number of campus users.

Table 5. Social use areas in buildings in Yeşilırmak Campus

Buildings in the Campus	**Social use areas**				
	Seating unit	**Pergola**	**Picnic table**	**Under tree seating unit**	**Sitting step**
Faculty of Theology-Faculty of Theology Mosque	15	2	-	-	-
Technical Sciences VC	20	2	2	-	-
Engineering Faculty	13	-	-	-	-
College of Foreign Languages-Distance Education Center	6	1	1	-	-
Social Sciences VC	9	1	1	6	-
Library and Academic Café	7	1	1	-	-
Architecture Faculty-Design VC	18	5	-	-	1
Sports Grounds	3	-	-	-	-
Workshops	5	-	-	-	-
Indoor Sports Center	-	-	-	-	-
Indoor Swimming Pool	2	1	-	-	-
Canteen	-	-	-	-	-
Viewing Terraces	4	-	-	-	-

The 201,781.49 m^2 forested area comprising the landscape character of the campus provides ecological contributions, while the 23,823.61 m^2 green areas provides aesthetic/visual effect. The open-green areas close to buildings in the campus and forming the landscape character of the campus was assessed in terms of design principles like creating spaces in open-green areas, ecological contribution, camouflage, creating a focal point, and providing aesthetic/visual effect. Results are given in Table 6.

Table 6. Assessment of open-green areas near buildings in Yeşilırmak Campus

Buildings in the Campus	**Assessment of open-green areas located near buildings**
Faculty of Theology-Faculty of Theology Mosque	The garden in front of the Faculty of Theology building has no green area, while the green area at the back provides aesthetic/visual effect.
Technical Sciences VC	Green areas in the front and back of the Technical Sciences VC building camouflage the walls at the end of the garden and provide aesthetic/visual effect.
Engineering Faculty	The green area in front of the Faculty of Engineering provides aesthetic/visual effect.
College of Foreign Languages-Distance Education Center	The green area in front of the College of Foreign Languages-Distance Education Center provides aesthetic/visual effect and there is no green area in the backyard of the building.
Social Sciences VC	The green area in front and side garden of the Social Sciences VC provides aesthetic/visual effect.
Buildings in the Campus	**Assessment of open-green areas located near buildings**
Library and Academic Café	The green area in front and side garden of the Library and Academic Café provides aesthetic/visual effect.
Architecture Faculty-Design VC	The green area in front and side garden of the Architecture Faculty-Design VC provides aesthetic/visual effect.
Sports Grounds	The green area in the immediate vicinity of the sports grounds provides an aesthetic/visual effect.
Workshops	The green areas in the immediate vicinity of the workshop buildings provide an aesthetic/visual effect and hide the level difference.
Indoor Sports Center	There is no green area in the immediate vicinity of the Indoor Sports Center building.
Indoor Swimming Pool	The green areas in the side garden of the Indoor Swimming Pool Building provide border effect and aesthetic/visual effect.
Canteen	The green area in the immediate vicinity of the canteen building provides an aesthetic/visual effect.
Viewing Terraces	The green areas on the viewing terraces immediate provide an aesthetic/visual effect and hide the level difference.

4. Discussion and Conclusion

University campuses accepted as a small-town model, direct spatial development of a city with their location, size, and open-green areas for common use and affect the urban identity. University campuses are successful to the degree that they provide education-teaching, research, housing, transport, application, health, relaxation, recreation, and shopping functions to both academic and administrative personnel and to students. As a result, university campuses and campus landscaping should be in line with certain planning and design principles.

Studies by Tolon (2006), Özer (2008), Ayvacı (2009), Ertekin & Çorbacı (2010), Koç (2011), Büyükşahin Sıramkaya & Çınar (2012), Atabeyoğlu (2014), Düzenli et al. (2017), Eminağaoğlu & Arslan Muhacir (2018), Şahin (2019), Ünal (2020), Türker & Deneri (2021) and Şahin Körmeçli (2022) about planning and design of university campuses were investigated to develop the methods (step 1: literature review, step 2: field study to determine current situations, step 3: generating orthophotos and maps, step 4: evaluation, conclusion and recommendations) used in this study. In contrast to the studies found in the literature, this study integrates field and observational work with a technological

infrastructure by establishing an updatable digital infrastructure in the GIS environment using the ArcGIS 10.5 program. Within the scope of the study, the status of Amasya University Yeşilırmak Campus landscape planning and design was assessed in detail in terms of environmental, functional, and aesthetic aspects.

Within the scope of the study, the components of the spatial character and landscape character of Amasya University Yeşilırmak Campus were assessed in detail in terms of function, status, environmental and aesthetic features. The Faculty of Theology, Faculty of Theology Mosque, Technical Sciences VC, Faculty of Engineering, College of Foreign Languages-Distance Education Center, Social Sciences VC, library and academic café, canteen, workshops, Faculty of Architecture-Design VC, indoor sports center, indoor swimming pool buildings and parking areas, sports grounds, roads, and paths around these buildings comprise the spatial character of the campus. The green areas remaining outside areas of the buildings, comprising the spatial character of the campus, form the landscape character of the campus. According to the map in Figure 3, there are 23,318.22m^2 buildings, 1,435.82 m^2 sports grounds, 82,491.12 m^2 hard surfaces in open spaces (roads and paths, parking spaces, social areas, etc.), 201,781.49 m^2 forestry area with a total of 225,605.1 m^2 green areas in the campus. The sizes of these areas have been calculated using the digital base map of the current orthophoto of the campus in the GIS environment with the ArcGIS 10.5 program. The 201,781.49 m^2 forestry area comprising the landscape character of the campus provides ecological contribution, while the 23,823.61 m^2 green areas provide aesthetic/visual effect. These contributions were identified through on-site observations in the light of the principles of landscaping design studies conducted by Yıldızcı (1988), Erkman (1990), and Seçkin (2011). The car parking and social areas in the campus appear to be inadequate based on the number of users of the campus. A current orthophoto of the campus was produced with the aid of a UAV and this digital underlay was used to obtain maps of the spatial character, landscape character, social areas and parking areas of Amasya University Yeşilırmak Campus in the GIS environment using the ArcGIS 10.5 program. With this study, an updatable digital infrastructure of the campus was created in the GIS environment with the ArcGIS 10.5 program. This study can be used in the creation of the campus information system that is planned to be built in the future. It is also thought that this study will be an example for the planning and design process of other university campuses and the creation of a campus information system in the GIS environment.

In light of the findings obtained in the study and studies about planning and design of university campuses in the literature (Tolon, 2006; Özer, 2008; Ayvacı, 2009; Ertekin & Çorbacı, 2010; Koç, 2011; Büyükşahin Sıramkaya & Çınar, 2012; Atabeyoğlu, 2014; Düzenli et al., 2017; Eminağaoğlu & Arslan Muhacir, 2018; Şahin, 2019; Ünal, 2020; Türker & Deneri, 2021; Şahin Körmeçli, 2022), the following recommendations are made to improve the landscape planning and design of Amasya University Yeşilırmak Campus.

• A transport system prioritizing pedestrian access should be created within the campus

• Design of planting along paths and roads providing circulation within the campus should be made attractive during the four seasons, with planting design providing aesthetic/visual impact, as well as having directive features

• Green areas within the campus should be redesigned in line with planting design principles to create spaces, provide ecological contributions, camouflage, create focal points and ensure aesthetic/visual effect.

• The hard ground proportion within the campus should be reduced with quality planting design

• Plant taxa to be used within the campus should be appropriate for Amasya city climate

• Seating units placed in the campus should be brought together to create spaces allowing for socialization

• Ground covering should be chosen allowing easy access for all campus users and not creating a risk of trips within the campus.

• A bicycle path should be designed in accordance with slope and standards within the campus and connecting both the city and other campuses

• Ramps should be created with appropriate slopes 0-6% for use by individuals with disability at all building entrances and in social areas within the campus

• As the riser heights of steps located at building entrances and in open-green areas in the campus are very different, they should be adapted to standard measurements like 15 cm.

• The number of social areas in common areas of the campus and close to buildings, number of sports grounds and recreational activity diversity should be increased according to the number of campus users

• As the riser heights of seating steps around sports grounds are very different, they should be adapted to standard measurements

• Considering the number of campus users, parking areas near buildings should be increased in accordance with standard measurements

• Ground covering of viewing terraces with beautiful views should be repaired, they should attract all campus users by creating spaces with equipment and planting design

• Water features, statues and artistic objects should be used to reflect the campus identity in common areas of the campus

• In addition to educational functions of the campus, the campus should be adapted to be able to meet the needs of users like shopping, entertainment, and recreation.

In the development of the proposed applications to enhance the landscape planning and design of Amasya University Green River Campus, the idea of addressing issues in components that constitute the spatial character of the campus (buildings, vehicular and pedestrian pathways, parking areas, equipment elements, sports areas, social spaces) and improving the active use of sports and social areas by students has proven effective. It is anticipated that the implementation of suggested practices for quality landscaping design will lead to a reduction in the proportion of hard surfaces on the campus by approximately 5-20%.

This study is considered to act as a guide for landscape planning and design studies related to the campus in the future by revealing the current landscape status of the campus. Maps obtained within the scope of the study and proposed solutions will contribute to making the campus more livable, more modern with a more defined identity chosen more by students. Recommendations will ensure that users spend quality time in the campus.

Acknowledgements and Information

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Author Contributions and Conflict of Interest

All authors contributed to the article equally. The authors report there is no conflict of interest.

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Analyzing the Effects of Urban Sustainability Assessment Tools on City Branding: YeS-TR Case

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Abstract

Increasing competition between cities has led to the acceleration of branding efforts and to be treated as a commodity. In order to create a strong city brand, it is important to analyze the city well and shape all city components in a symbolic way. This is recognized as a challenging and costly process in dynamic, complex and multifaceted cities. Urban sustainability assessment tools allow cities to be addressed in a systematic, holistic and controlled manner. At the same time, it allows to reach a city that has adopted the principles of sustainable development and is resistant to climate change with an objective approach. Many urban sustainability assessment tools such as LEED, BREEAM, DGNB have been developed around the world. One of these assessment tools is YeS-TR, which has been developed in our country. Within the scope of this study, the effects of YeS-TR urban sustainability assessment tool on city branding are examined.

Keywords: *City branding, city ıdentity, urban sustainability assessment tools, YeS-TR.*

Kentsel Sürdürülebilirlik Değerlendirme Araçlarının Kent Markalaşması Üzerindeki Etkilerinin İrdelenmesi: YeS-TR Örneği

Öz

Kentler arasındaki artan rekabet markalaşma çalışmalarının hız kazanmasına ve meta olarak ele alınmasına neden olmuştur. Güçlü bir kent markasının oluşturulabilmesi için kentin iyi bir şekilde analiz edilmesi ve tüm kent bileşenlerinin sembolik biçimde şekillendirilmesi önem taşımaktadır. Dinamik yapıdaki, karmaşık ve çok yönlü kentlerde bu zorlu ve maliyetli bir süreç olarak kabul edilmektedir. Kentsel sürdürülebilirlik değerlendirme araçları; kentlerin sistematik, bütüncül ve kontrollü bir şekilde ele alınmasına olanak tanımaktadır. Aynı zamanda objektif bir yaklaşımla sürdürülebilir kalkınma ilkelerini benimsemiş, iklim değişikliğine dirençli bir kente ulaşmaya olanak tanımaktadır. Dünya üzerinde LEED, BREEAM, DGNB gibi birçok kentsel sürdürülebilirlik değerlendirilme aracı geliştirilmiştir. Bu değerlendirme araçlarından bir tanesi de ülkemizde geliştirilmiş olan YeS-TR'dir. Bu çalışma kapsamında YeS-TR kentsel sürdürülebilirlik değerlendirme aracının kent markalaşması üzerindeki etkileri irdelenmiştir.

Anahtar Kelimeler: *Kent markalaşması, kent kimliği, kentsel sürdürülebilirlik değerlendirme araçları, YeS-TR.*

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1. Introduction

Cities are dynamic areas formed by the interaction of complex physical and social environments throughout history. Although the meaning of the concept changes over time, its definition often emphasizes population size, economic function and political/administrative status (Topal, 2004). Today, cities, which host more than half of the world's population, stand out as commercial actors (United Nations, 2018; Bilgili, 2021). Cities, which include tourism, trade, industry, urban residents and workforce, are in a position to shape the world economy and be directly affected by global changes (Bilgili, 2021). Cities, which are accepted as the basic building block of globalization, help to ensure sustainability and the continuity of quality living conditions for future generations (Merino-Saum et al., 2020).

With the widespread use of mass media, globalization has had a more significant impact on our lives (Yaylı, 2012). Although the most important role in globalization is considered to be capital and informatics, it is accepted that cities also have an important role in this issue (Paganomi, 2015) and the global system causes changes in the structure of cities. Although this change initially started in large cities, it has started to come to the agenda even in small settlements over time (Dinnie 2010; Noori & De Jong, 2018).

While cities that have succeeded in highlighting their unique qualities while developing economically can be integrated into the global system, others remain in the background (Akturan & Oğuztimur, 2016; Bilgili, 2021). For this reason, city authorities and leaders have started to carry out marketing and branding activities that will increase incentives to the city by creating a unique city identity while highlighting the natural and cultural assets they have in their cities. The basis of marketing strategies is to emphasize what is different and to ensure that the product is preferred. Therefore, the main purpose of branding can be defined in this way (Dinnie, 2011).

Urban authorities and leaders today also prefer urban sustainability assessment tools that can provide a controlled approach to complex urban problems and address components holistically (Dawodu et al., 2021). Urban sustainability assessment tools are systems that adopt the principles of sustainable development; provide ecological, economic and sociocultural benefits to the city in the long term; focus on the priorities of the region; and have an impartial and objective approach. Within the scope of this study, the contributions of urban sustainability assessment tools, which provide ecological, economic and sociocultural contributions in cities, to the branding efforts carried out in order to highlight the unique values of the city, were examined. As a result of the studies carried out, it has been determined that they contribute the most to city branding.

1.1. Theoretical Foundations

1.1.1. City Branding

Beyond abstract concepts such as "quality, image and loyalty", branding is defined as an emphasis that requires an analytical and strategic approach, responds to people's needs, and adds value to its components functionally and/or symbolically (Papatya et al. 2015).

City branding is the totality of the perceptions that the city's characteristics and advantages portray in the minds of the stakeholders in question and the efforts to gain a competitive identity (Zeren, 2019). As a result of branding efforts, the city's reputation, living standards, tourism and investment potentials are aimed to increase and gain identity (Paganomi, 2015). This process (Figure 1) is long and challenging and requires significant investments.

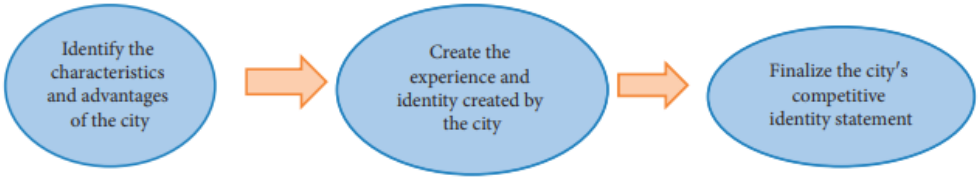

Figure 1. Organic and strategic approaches of city branding (Vahabian et al., 2021)

Macrofactors affecting place branding are classified as demographic forces, economic forces, socio-cultural forces, technological forces, ecological forces, and political forces (Vahabian et al. 2021). As it is often mentioned in the branding process; whatever the future brings us, it is not possible to produce a global brand without always understanding people's needs, wants and passions locally (Hollis, 2012). For this reason, in a city-scale branding movement, it is important to consider the physical, administrative, historical, sociocultural and functional elements of the city in detail and develop strategies accordingly.

City branding consists of 5 elements: physical, administrative, historical, sociocultural and functional. According to Zeren 2019;

- Physical elements are divided into two as natural and artificial. It is the presentation and highlighting of the physical elements of cities in an attractive way. This element includes natural components such as climate, topographical features, vegetation or artificial components such as architectural structure.
- Administrative elements; the decisions and behaviors of the administrators responsible for city development affect the branding process. It should not be ignored that city branding is a multi-actor structure including local (public and private sector), regional, national and international actors. At the same time, local people should be included in the process.
- Historical elements; creating a strong direction by highlighting the history of all cities and the civilizations that host them.
- Sociocultural elements; this is an element that includes a wide field of study covering the communication, lifestyle and culture of the society with each other.
- Functional elements; cities that have succeeded in becoming a center of attraction in many fields such as art, culture, sports, education, entertainment and industry will increase their brand value considerably. At the same time, one of the ways that cities use for branding today is the internet (Paganoni, 2015).

1.2. Urban Sustainability Assessment Tools

Initially developed at the building scale, assessment tools have been developed at the urban scale due to the recognition of the inadequacy of the interactive infrastructure of the assessment tools to address buildings holistically and the introduction of many different parameters at the urban scale (Berardi, 2015; Komeily & Srinivasan, 2015). Urban sustainability assessment tools support the achievement of sustainability and development in ecological, economic and sociocultural contexts with an unbiased and objective approach by addressing cities at a systematic and scientific level. There are more than 60 urban sustainability assessment tools worldwide (Criterion Planners, 2014). The most preferred assessment tools are LEED (Leadership in Energy and Environmental Design) developed in the USA, BREEAM (Building Research Establishment Environmental Assessment Method) developed in the UK, and DGNB (Deutsche Gesellschaft für Nachhaltiges Bauen E.V.) developed in Germany. In Turkey, YeS-TR was developed in 2017. Although urban sustainability assessment tools have been developed for common purposes, they have different criteria and approaches.

1.2.1. YeS-TR settlement

YeS-TR is an assessment tool developed with the contributions of the Ministry of Environment, Urbanization and Climate Change, 32 academicians from 11 different science working groups from 7 universities and many experts (Özçevik et al., 2018). In the development process, it is aimed to be a system that can compete with internationally recognized systems and can be applied all over the world and is the local assessment system of our country. In its first version, a guideline was prepared that allows application in both building and settlement areas. YeS-TR Settlement consists of 6 themes, 21 categories and 77 criteria. The main themes are regional and immediate environment profile, sustainable land use, ecology and disaster management, transportation and mobility, urban design, social and economic sustainability. 11 criteria are mandatory, some of which can also be scored. YeS-

TR additionally has an innovation theme. The innovation theme has 2 categories and 3 criteria. It is possible to obtain an additional 10 points from this theme, but the points obtained are not added to the evaluation process. It only provides prestige and efficiency to the project. All themes correspond to 100 points, but each theme has a weighted credit coefficient (Table 1). At the final evaluation stage, the score obtained from the theme is multiplied by the corresponding value (Ministry of Environment, Urbanization and Climate Change, 2021).

Table 1. YeS-TR weighted credit coefficient (Ministry of Environment, Urbanization and Climate Change, 2021)

Theme	Regional and Near Environment Profile	Sustainable Land Use, Ecology and Disaster Management	Transportation and Mobility	Urban Design	Social and Economic Sustainability	Ino_Settlement
Weighted Credit Coefficient	0,08	0,26	0,25	0,21	0,20	0,10

Regional and Near Environment Profile: It aims to define the size of the subject area, to provide the requirements at legal, administrative and planning levels, to reveal the project development plan and implementation and financial process, and to ensure participation and communication with project stakeholders. 8 points can be earned with a weighted coefficient of 0.08. 2 themes, 5 criteria (Ministry of Environment, Urbanization and Climate Change, 2021).

Sustainable Land Use, Ecology and Disaster Management: It aims to ensure integrity between the scales studied. In the site selection of the area subject to the certificate; it provides sensitivity to protect ecological values against flora and fauna approach. It enables the most appropriate location decisions to be taken in planning with energy efficient approaches and the evaluation of the natural and physical characteristics of urban areas. Adopts a general environmental management approach to urban infrastructure. It evaluates the land with the most appropriate techniques through land use and transportation decisions. It aims to increase public interaction. Addresses the issue of urban disaster management in a sensitive, realistic and feasible manner. It can earn 26 points with a coefficient of 0.26 and has the highest score in the certificate. It has 5 themes and 14 criteria (Ministry of Environment, Urbanization and Climate Change, 2021).

Transportation and Mobility: Improves existing transportation networks to prioritize pedestrian connections, pedestrian facilities and pedestrian priority transportation. It also includes approaches to improve public transportation systems to reduce car dependency. It creates healthy, active cities and positively affects the quality of life by indirectly ensuring emission control. 25 points can be earned with a coefficient of 0.25. It has 4 themes and 21 criteria (Ministry of Environment, Urbanization and Climate Change, 2021).

Urban Design: In the process of creating green settlements, it is aimed to create healthy and sustainable environments with the urban design criteria determined. It encourages the creation of a local language in the project area by creating an urban design guide. Ensures the protection of the historical heritage and culture of the design. Organizes the project participation process. It aims to create barrier-free, safe and attractive spaces. It ensures designs that are resilient to climate change and restrict factors that negatively affect the quality of life and the environment. 21 points can be earned with a coefficient of 0.21. It has 6 themes and 20 criteria (Ministry of Environment, Urbanization and Climate Change, 2021).

Social and Economic Sustainability: It protects the natural and cultural environment by ensuring integrity across scales, ensures social equity, increases economic welfare, and aims to improve the quality of life. It also encourages sustainable production and consumption and enables a competitive, eco-efficient economy. It aims to achieve an innovative and knowledge-based society that respects fundamental rights and cultural diversity. 20 points can be earned with a coefficient of 0.20. It has 2 themes and 11 criteria (Ministry of Environment, Urbanization and Climate Change, 2021).

Ino_Settlement: It aims to incorporate information and communication technologies into the project in order to improve the quality of life of individuals and society and to ensure sustainability. It

encourages innovative and continuously traceable planning and design practices. With this criterion, additional points are awarded that do not affect the final result. The maximum number of additional points that can be earned is 10. It has 2 themes and 3 criteria (Ministry of Environment, Urbanization and Climate Change, 2021).

The evaluation of the system is based on 100 points. A 5-level rating is possible, including application (4 points and above), passing (25-39 points), good (40-69 points), very good (70-84 points) and national superiority (85 points and above), but the criteria expected to be fulfilled at each level are limited (Koçak & Topay, 2022). Similar to BREEAM, a gradual progression is encouraged.

2. Material and Method

Urban sustainability assessment tools that enable ecological, economic and sociocultural gains at the city scale are related to the physical, administrative, historical, sociocultural and functional elements of city branding. Within the scope of the study, YeS-TR urban sustainability assessment tool, which was developed in our country, was preferred because it was compared with globally accepted tools such as LEED and BREEAM at the preliminary stage and it was determined that YeS-TR provided the strongest benefit to city branding.

This study was developed in line with the assumption that "YeS-TR urban sustainability assessment tools can provide gains such as city reputation, high living standards, increased tourism and investment potential, and city identity targeted by city branding.

In the methodology phase of the study, the problem was first defined. Then a detailed literature review was conducted. In the next stage of the study, the YeS-TR evaluation guide was examined and the requirements of the system in each theme were listed. In this list, the results expected to be achieved if YeS-TR is implemented in a settlement area and the requirements of the system are taken into consideration. The list of 44 items under 6 themes was transformed into a questionnaire according to the four-point Likert scale. Likert scale is preferred because it is one of the most preferred scales to learn the participant's attitude on a subject (Arıkan, 2018). The meanings of the numbers in the Likert scale used in the questionnaire are as shown in Table 2.

Table 2. Meanings of the numbers on the Likert scale

1	2	3	4
Strongly Disagree	**Partially Disagree**	**Partially Agree**	**Completely Agree**
(No Impact)	(Partially No Impact)	(Partially Impacted)	(Fully Impacted)

Ten people, including landscape architect (2), interior architect (1), architect (1), environmental engineer (1), urban regional planner (1), sociologist (1), strategic marketing specialist (2), mechanical engineer (1), who have knowledge on both urban branding and YeS_TR, participated in the survey. 8 of the survey participants also have YeS_TR expertise. In the findings and discussion section of the study, the items in the questionnaire and the approaches of the experts were analyzed. In the last stage, the results are interpreted based on the data obtained.

3. Findings and Discussion

3.1. Regional and Near Environment Profile

In the theme of regional and near environment profile, 3 questions were identified. The items and the number of answers given by the surveyed experts are as given in Table 3.

Table 3. Regional and near environment profile theme survey items and expert responses

YeS-TR Assessment Criteria/Indicators	Value of the Effect on City Branding on Likert Scale			
Demographic, economic and social analysis of the project area and its immediate surroundings	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*2*	*1*	*7*
Examination of regional and strategic decisions that may affect plan decisions	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*1*	*2*	*7*
Involving all local stakeholders before, during and after the project	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*1*	*3*	*6*

Involving the local community and an interdisciplinary team in the entire project process positively affects the managerial elements of brand city formation. The detailed analysis of the project area and its immediate surroundings also enables the identification of the aspects to be highlighted in the city. YeS-TR regional priorities criteria support the branding process. It is seen that the majority of the respondents found the questions completely relevant.

3.2. Sustainable Land Use, Ecology and Disaster Management

In the sustainable land use, ecology and disaster management theme, 9 questions were identified. The items and the number of answers given by the experts participating in the survey are as given in Table 4.

Table 4. Sustainable land use, ecology and disaster management theme survey items and expert responses

YeS-TR Assessment Criteria/Indicators	Value of the Effect on City Branding on Likert Scale			
Establishment of protection decisions for the project area	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*1*	*3*	*6*
Restoration of at least 30% of the land and roof surfaces in appropriate conditions with native plant species	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*2*	*5*	*3*
Conducting settlement suitability studies for the protection of agricultural lands	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*1*	*1*	*3*	*5*
Assessment of erosion risk and preparation of measures	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*3*	*2*	*5*
Meeting at least 10% of energy needs from renewable resources	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*1*	*4*	*5*
Increasing open and green areas by approximately 30%	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*0*	*3*	*7*
Developing a disaster resilience plan	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*1*	*3*	*6*
Reuse of rain and wastewater	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*2*	*1*	*7*
Ensuring urban waste recycling	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*1*	*2*	*3*	*4*

When the physical elements that positively affect brand city formation are examined, there are indicators such as turning climatic data into an advantage, increasing natural vegetation cover,

reducing urban pollution, and highlighting topographical features. Sustainable land use, ecology and disaster management themes contribute to the fulfillment of these elements. Survey respondents were fully engaged with questions on approaches to conservation decision-making in the region, protection of green spaces and soil, disaster resilience and water management. When the answers are analyzed, the positive impact of the adopted approach on branding is supported. Protection of agricultural land and waste management were deemed irrelevant by one respondent each.

3.3. Transportation and Mobility

In the transportation and mobility theme, 5 questions were identified. The items and the number of answers given by the experts participating in the survey are as given in Table 5.

Table 5. Transportation and mobility management theme survey items and expert responses

YeS-TR Assessment Criteria/Indicators	**Value of the Effect on City Branding on Likert Scale**			
Promotion of mixed land use	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*1*	*5*	*4*
Improving public transportation facilities and encouraging their use	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*1*	*4*	*5*
Promoting cycling and walking access	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*0*	*3*	*7*
Reducing carbon emissions by at least 20%	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*1*	*4*	*5*
Increasing opportunities for the use of non-motorized and/or electric vehicles	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*1*	*6*	*3*

Among the city branding elements is the criterion of increasing public transportation opportunities. Reducing air pollution is also among the criteria. Mixed land use, encouraging walking and cycling, and increasing the use of non-motorized and electric vehicles allow for the reduction of air pollution. Providing transportation by walking and cycling and mixed land use increase mobility in the city. Survey participants responded that they are fully interested in questions that include approaches such as improving public transportation, increasing bicycle and pedestrian access, and reducing carbon emissions. The fact that the YeS-TR criteria directly adopt these approaches was also taken into consideration by the survey participants.

3.4. Urban Design

In the theme of urban design, 14 questions were identified. The items and the number of answers given by the surveyed experts are as given in Table 6.

Table 6. Urban design theme survey items and expert responses

YeS-TR Assessment Criteria/Indicators	Value of the Effect on City Branding on Likert Scale			
Ensuring the participation of city residents in the project process	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*2*	*4*	*4*
Identifying the local architectural identity in the city, ensuring the continuity of cultural and historical features	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*1*	*1*	*3*	*5*
Promoting the use of local materials	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*1*	*4*	*5*
Improving the connections of public spaces with walking paths	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*0*	*6*	*4*
Conducting crime risk assessment and creating safe spaces in public areas	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*2*	*5*	*3*
Creation of recreation areas of various types and sizes in public spaces to encourage social interaction and physical activities	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*1*	*4*	*5*
Development of agricultural lands in the city	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*6*	*0*	*4*
Increasing the number of green certified buildings	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*1*	*4*	*5*
Providing diversity in housing types to bring together different social and economic classes	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*4*	*3*	*3*
Designs that adapt to climate change	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*1*	*3*	*6*
Reduction of the heat island effect	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*1*	*4*	*5*
Reduced noise pollution from transportation and industry	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*1*	*3*	*6*
Lighting to reduce light pollution	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*1*	*6*	*3*
Selection of the least polluting materials in the open space	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*1*	*5*	*4*

Preservation of the historical urban fabric and strengthening tourism opportunities are possible with the criteria in the urban design theme. At the same time, an urban design guide is created to create a local architectural language. Encouraging the use of local plant species and local materials while creating a local architectural language provides both ecological and economic benefits. The creation of agricultural lands in the city contributes both to the city having its own unique food and to the development of the city's product and service opportunities. Reducing environmental problems that negatively affect climate change is related to the physical elements of city branding. Survey respondents stated that the criteria are completely relevant to approaches such as preserving local architectural identity, diversifying public spaces, increasing the number of green certified buildings, designing in harmony with climate change, and reducing pollution. The impact of the sustainable and

local movement adopted in cities on branding was supported by the majority of respondents. No criteria were not mentioned as being irrelevant to branding.

3.5. Social and Economic Sustainability

In the theme of urban design, 11 questions were identified. The items and the number of answers given by the surveyed experts are as given in Table 7.

Table 7. Social and economic sustainability theme survey items and expert responses

YeS-TR Assessment Criteria/Indicators	Value of the Effect on City Branding on Likert Scale			
Adherence to demographic needs and priorities	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*4*	*1*	*5*
Public services are equal and accessible for city residents	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*1*	*1*	*8*
Training opportunities for residents for the realization of economic development	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*3*	*2*	*5*
Establishing strategies for residents to adapt to the economic and social differences that will occur with the realization of the project	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*1*	*5*	*4*
Increasing employment opportunities	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*2*	*2*	*6*
Financial evaluation of the profit expected to be obtained as a result of the applications to be carried out in the city	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*4*	*0*	*6*
Increasing the value and future prospects of the study area by conducting detailed analysis of the study area and its immediate surroundings and identifying competitive situations	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*2*	*3*	*5*
Developing strategies that will enable the development of the targets set in development plans and contribute to increasing regional production and competitiveness	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*2*	*1*	*7*
Increasing the number of visitors coming for tourism purposes, the time spent by visitors in the city and the number of revisits to the city	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*2*	*2*	*6*
To enable city dwellers to live in healty, happy and peaceful areas	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*0*	*3*	*7*
Promoting local production in urban and hobby gardens and meeting the food needs of residents	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*4*	*2*	*4*

YeS-TR has adopted many economic approaches to ensure local and regional development. At the same time, the promotion of local production in the city and hobby gardens directly affects both the response to the needs of the local people and the quality of life of the urban residents. Identifying the competitive situations and evaluating the expected financial profit after implementation contributes positively to many indicators under the managerial elements of city branding. The adaptation of the residents to the changes expected to occur during and after the implementation contributes to the formation of cultural unity and a sense of urbanity. Survey respondents responded that the criteria are fully relevant to approaches such as identifying demographic priorities, accessibility of public services, promoting economic development, providing educational opportunities, increasing the level of

employment, and identifying the competitive situation. No irrelevant answer was given for any question. This supports the assumption that YeS-TR will contribute positively to the branding process from a socioeconomic perspective.

3.6. Ino_Settlement

In the ıno_settlement theme, 2 questions were identified. The items and the number of answers given by the experts participating in the survey are as given in Table 8.

Table 8. Ino_settlement theme survey items and expert responses

YeS-TR Assessment Criteria/Indicators	Value of the Effect on City Branding on Likert Scale			
Utilizing information technology to improve quality of life	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*1*	*1*	*3*	*5*
Obtaining data from all kinds of consumer devices in order to create an informed consumer profile	**1**	**2**	**3**	**4**
Number of responses of experts who participated in the survey:	*0*	*3*	*4*	*3*

Utilizing information technologies for a sustainable approach in urban areas brings many benefits. Survey participants also believe that utilizing information technologies can contribute positively to the branding process.

4. Conclusion and Suggestions

Cities, which consist of many components such as natural and cultural urban features, social development, politics, and economy, are now considered as a commercial brand with the effect of globalization (Koçyiğit & Aktan, 2020). City branding created with a systematic, persuasive, strong, and consistent approach not only creates a sense of belonging but also strengthens the city's credibility and positive image.

Urban sustainability assessment tools have been found to contribute to the city branding process. The assessment tools give the city the title of 'green'. YeS-TR includes approaches to highlighting topographical features, increasing the amount of green space, preventing pollution, providing adequate accommodation, increasing public transportation facilities, and improving infrastructure. It also supports the creation of urban identity and the use of local plants and materials. YeS-TR enhances regional and local development, increases employment capacity, promotes a sense of cultural cohesion and involves all stakeholders in the process. There are criteria to increase the number of visitors for tourism purposes, the time spent in the city and the frequency of visits by protecting historical values. YeS-TR aims to ensure social justice and increase the level of education and quality of life. In addition, incentive programs are expected to be created to improve product and service offerings.

Cities planned by utilizing urban sustainability assessment tools both support sustainable development goals and benefit the brand city process in many ways.

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The article complies with national and international research and publication ethics. Ethics Committee approval was not required for the study.

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All authors contributed equally to the article contributed. There is no conflict of interest.

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Investigating the Geoenvironmental and Climatic Impacts on the Facades of Historical Houses in Killit (Dereiçi) Village, Mardin

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Abstract

Killit (Dereici), which is largely abandoned today, is an Assyrian village thought to have a population of more than 20,000 spread around the world. The Kilit (Dereiçi) village of Savur stands out as a rare example in the world with its multi-identity structure. The street façades of this Assyrian village, which has such cultural importance, can be clearly seen today, due to various factors. The aim of the study is to investigate the damage patterns and the factors affecting the durability of Kilit (Dereici) street facades (Old Bazaar). For this purpose, observational detection method was used and the findings were presented based on the dictionary of stone deterioration patterns prepared by ICOMOS-ISCS,2008. As a result of the study, the most intense deteriorations observed on the street facades; cement-induced faulty repairs made between the joints of the stone blocks on the facades and 'crack, disintegration, erosion, 'missing part, discolouration' on the stone surfaces exposed to climate impact for a long time.

***Keywords:** Geoenvironmental and climatic impacts, stone deterioration, disintegration, restoration, Killit (Dereiçi) Village.*

Mardin Killit (Dereiçi) Köyü'ndeki Tarihi Konutların Cephelerinde Jeoçevresel ve İklimsel Etkilerin Araştırılması

Öz

Killit (Dereiçi), bugün büyük ölçüde terk edilmiş bir köy olup, dünya çapında yayılmış 20.000'den fazla nüfusa sahip olduğu düşünülen Süryanilerin bir köyüdür. Savur'daki Kilit (Dereiçi) köyü, çok kimlikli yapısıyla dünyada nadir bir örnek olarak öne çıkar. Kültürel öneme sahip bu Süryani köyünün sokak cephe tasarımları, çeşitli faktörlere bağlı olarak bugün net bir şekilde görülebilir. Çalışmanın amacı, Kilit (Dereiçi) sokak cephelerinin (Eski Çarşı) hasar desenlerini tespit etmek ve bozulma süreçlerine etki eden faktörleri araştırmaktır. Bu amaçla, gözlemsel tespit yöntemi kullanılmış ve bulgular, ICOMOS-ISCS, 2008 tarafından hazırlanan taş bozulma desenleri sözlüğüne dayanılarak sunulmuştur. Çalışmanın sonucunda, sokak cephelerinde en yoğun bozulmaların gözlendiği noktalar; cephe taş blokları arasındaki derzlerde yapılan çimento kaynaklı hatalı tamirler ve uzun süre iklim etkisine maruz kalan taş yüzeylerde 'çatlama, ayrışma, erozyon, parça kaybı, renk değişimi' gibi durumlardır.

***Anahtar kelimeler:** Geoçevresel ve iklimsel etkiler, taş bozulması, ayrışma, restorasyon, Killit (Dereiçi) Köyü.*

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1. Introduction

The facades of historical buildings are open-air museums that exhibit the building materials and construction techniques of the region in which they are located (Türkeri, 2021). Investigation of how environmental conditions and external factors affect the facades of historical buildings and what kind of deterioration patterns they cause is particularly important in ensuring the sustainability of historical buildings (Karkaş & Acun Özgünler, 2022; Karataş et al., 2022).

Studies have been conducted in different parts of the world to examine the damages on the facades of historical buildings and the factors that cause these damages. In the studies, it has been determined that the most important cause of the damages on the facades is the effect of water (Umaroğulları & Kartal, 2021). These studies emphasize that the effect of water causes erosion on the surface of the stone, mıssıng parts and mortar melting between the joints. In addition, the liquid entering the stone; It can make the stone a suitable environment for the transport and deterioration effects of agents such as salts, biological agents and various water-soluble substances (Alves et al., 2021). According to Iucolano et al. (2019) the limestones change color as a result of exposure to sunlight and condensation cycles. Ergüler & Shakoor (2009) reported in their experiments on different stone types that there were intense weathering on stones with wetting-drying cycles. Beck & Al-Mukhtar (2014) observed that there is a significant erosion in the limestone with wetting-drying cycles. Bustamante et al., (2020) found a mass loss of more than 14% on stone surfaces that are heavily exposed to water. Winkler (1997) observed that the side exposed to rain shows significant erosion in stone structures, while the material is preserved on the protected side. Bonazza et al., (2017) and Gulotta et al., (2018) showed that rain has an abrasive effect especially on low porous carbonate rocks in their study on marble, one of the stone material types, and they emphasized that erosion occurs on the stone surface.

Another cause of damage to facades is faulty repairs. Duffy et al., (1993) and Arroyo et al., (2013) determined in their studies that the composition of the mortars used in the previous repairs in the buildings was rich in sulfate and this material caused the stones to deteriorate. Specifically, in the studies conducted in Mardin Province in Turkey, it is reported that the damages on the facades are mostly caused by faulty repairs caused by water and cement acting heavily on the stone (Dal & Öcal, 2017).

Earthquake is another factor that causes damage to façades (Caglar et al.,2023; Erberik et al., 2008). According to Khalil et al. (2016) the effects of strong ground shaking on the stability of the Step pyramid. Ahmed (2021) showed the earthquake-induced effects for all faces of the pyramid structure. According to Karatas et al., (2023) the damage caused by the earthquake on the facades of the historical Antep Castle and its walls in Gaziantep, Turkey, and finally explained which parts on the facades of the historical Antep castle and its walls were damaged by the earthquake.

As described above with examples from the literature, many studies emphasize that the deterioration factors in sedimentary rocks are not solely dependent on environmental factors, but also largely influenced by their physical and chemical properties. It is emphasized that among the chemical and physical destructive agents, the factors leading to the dissolution or alteration of the rock's nature must be identified (Patil et al.,2021). Based on this requirement highlighted in the literature, this study differs from similar studies conducted in Mardin and its surrounding geography by proposing a systematic approach that not only identifies the types of rock deterioration occurring in the structures but also reveals the types of factors that contribute to the deterioration or influence its intensity.

The Kilit (Dereiçi) village of Savur stands out as a rare example in the world with its multi-identity structure. It is seen that there are still places of worship belonging to three Christian denominations in the village, namely Orthodox, Catholic and Protestant. The street façades of this Assyrian village, which has such cultural importance, can be clearly seen today, due to various factors. The aim of the study is (1) to discuss the damage models of Qillit Village Street Facades (Old Bazaar) and the factors affecting their durability with on-site observations and (2) to present a scientific conservation proposal for use in the restoration phase of the structures. In order to achieve all these goals, damage detection and durability problems factors were investigated by using observational analysis techniques in the study. The conducted study will contribute to the literature by proposing a method that will assist researchers

in systematically identifying the types of factors that contribute to the deterioration of stone cultural heritage structures, in addition to the types of deterioration. This method will also help determine the factors that can influence the intensity of the deterioration or damage.

1.1. Description of Killit (Dereiçi) Village

When we look at the history of Mardin, it is noteworthy that it has a district that is very similar to it with its city structure. Savur district, which has a settlement and history approximately 1000 years older than the city of Mardin to which it is affiliated, is an area that lies at the intersection of two valleys. Located 7 kilometers east of Savur town centre, the village of Killit, with its new name Dereici, is an interesting residential area hidden in the interior of the mountains. It is called by this name today because a stream flows through it (Kudeb, 2023). The valley between Savur and Mardin also forms the Mardin-Midyat highway. The city, which preserved its population thanks to this road, lost its importance after the change of the Mardin-Midyat road route and started to emigrate (Alp, 2015).

Savur, which used to be the largest vegetable, fruit and timber producer in the region, even hires seasonal workers, but today, with the change of road, perhaps it is experiencing one of the quietest periods in its history. The village is currently abandoned. Today, it attracts attention with its stone structures and worship structures that offer cultural diversity. The village, which was a large and important Assyrian settlement before emigration; It has three churches and three monasteries belonging to orthodox, protestant and catholic communities. At this point, Killit Village of Savur stands out as a rare example in the world. Grapes are still produced near the village, which is also famous for its wines, and the tradition of vintage is continued. Many TV series, movies and documentaries have been shot with the village in the recent past (KVTB, 2023). Although the multi-identity structure of the village is important, not only different peoples such as Assyrians, Muslims, Turks, Arabs, Kurds and Armenians, but also different sects of the same religion have lived in this small geography in an undisturbed harmony for centuries. The harmonious lifestyle and the unity of identities have made Kıllıt Village a rare place in the world.

The original main building material of the historical houses in Dereiçi (Kıllit) village is stone. Smooth limestone was used in the arch stones, around the window and door openings, and at the junction corners of the facades. Except for the south facade, the other facade stone masonry follows this principle. Some facades made of smooth limestone exhibit protruding profiled stone ledges. In the rubble stone courtyard walls, there is a circular rubble stone masonry entrance gate that provides access to the courtyard(Figure 1).

Figure 1. Killit (Dereiçi) Village silhouette

2.Material and Method

Considering the size of the area, specific parcels were selected to systematically examine the facade issues. In the findings section of the study, material deteriorations on these parcels were explained through facade photos. The selected areas within the scope of the study are parcels 1-2-3-4-5-6 of plot 179(a), parcels 1-2 of plot 182(b), and parcel 1 on plot 186(c) observed (Figure 2). Under the findings section, material deteriorations identified on the facades during the research are illustrated and explained with photos.

Figure 2. The locations of the parcels being worked on in the Killit (Dereiçi) Village (KVTB, 2023)

To investigate the deterioration patterns on the facades and the processes influencing the deterioration, a research strategy was adopted, which involved literature review, field studies, on-site observations, and analysis of climate data specific to the Savur region. The following steps were followed in the research:

2.1. The Types of Stone Deterioration

Firstly, in the study, a table was prepared based on the stone deterioration pattern dictionary prepared by ICOMOS-ISCS (2008) to characterize and classify the deterioration patterns that occurred on the facades of the old bazaar section of the Dereiçi District. The stone deterioration patterns in the table were directly taken from the dictionary to present the types of deterioration in universal terms to the literature. Additionally, library studies were utilized to categorize the types of damage and factors influencing stone deterioration, and the factors that can affect the severity of damage were categorized within each deterioration type. The prepared table serves as a reference for the detection and documentation of stone material deterioration (Table 1). On-site observations were conducted to characterize and classify the deterioration patterns on the facades of the buildings. The buildings were observed in situ, and the types of deterioration detected on the facades were marked on the deterioration assessment tables prepared specifically for limestone.

The stone deterioration types defined in the ICOMOS-ISCS (2008) dictionary is arranged into 5 families: Crack and deformation, Detachment, Features induced by material loss, Discoloration and deposit, Biological colonization. The descriptions of the stone damage types defined in the stone deterioration pattern dictionary prepared by ICOMOS-ISCS (2008) are provided below.

I. Crack and deformation:
   - Crack: A linear fissure or break in the stone surface.
   - Deformation: The alteration or distortion of the stone's original shape or form.

II. Detachment:
   - Blistering: The formation of blister-like elevations or bubbles on the surface of the stone, often caused by trapped moisture or gas.

- Bursting: The sudden rupture or breaking open of the stone surface, typically due to internal pressure or expansion.
- Delamination: The separation or splitting of layers within the stone, resulting in a loss of cohesion between them.
- Disintegration: The gradual breaking down or crumbling of the stone material, often resulting in the loss of structural integrity.
- Fragmentation: The breaking or fragmentation of the stone into smaller pieces or fragments, often due to external forces or weathering.
- Peeling: The separation or detachment of thin layers or flakes from the surface of the stone.
- Scaling: The detachment or removal of larger sections or scales from the surface of the stone, often due to weathering or impact.

III. Features induced by material loss:

- Alveolization: The formation of small cavities or pits on the surface of the stone, resembling honeycomb-like structures.
- Erosion: The gradual wearing away or removal of the stone surface by natural processes such as wind, water, or chemical reactions.
- Mechanical Damage: Physical harm or injury to the stone caused by external forces, such as impact, cutting, scratching, or abrasion.
- Microkarst: Small-scale dissolution or erosion of the stone surface due to the action of acidic water or other chemical processes.
- Missing Part: The absence or loss of a portion or fragment of the stone, resulting in an incomplete or damaged structure.
- Perforation: The presence of small holes, perforations, or penetrations on the surface of the stone, often caused by decay, corrosion, or mechanical damage.
- Pitting: The formation of small depressions or pits on the stone surface, typically due to chemical reactions, weathering, or biological activity.

IV. Discoloration and deposit:

- Crust: A hard, brittle, and usually thin layer that forms on the surface of the stone, often as a result of chemical reactions, mineral deposits, or weathering processes.
- Deposit: The accumulation or buildup of foreign substances, such as minerals, salts, pollutants, or biological matter, on the surface of the stone, which can alter its appearance and contribute to its deterioration.
- Discolouration: The change in color or hue of the stone's surface, often caused by various factors such as oxidation, biological activity, pollution, or exposure to environmental elements.
- Efflorescence: The white, powdery or crystalline deposit that forms on the surface of stone or masonry due to the migration of salts and their subsequent crystallization.
- Encrustation: The formation of a hard, crust-like layer on the surface of the stone, often caused by the accumulation of minerals, organic matter, or other substances over time.
- Film: A thin layer or coating that covers the surface of the stone, which can be caused by various substances such as dust, pollutants, or organic matter.

- Glossy Aspect: The shiny or reflective appearance of the stone's surface, often resulting from polishing or the presence of a protective coating.
- Graffiti: Unauthorized markings, inscriptions, or drawings that are intentionally applied to the surface of the stone, typically using spray paint, markers, or other materials.
- Patina: The natural or acquired thin layer that forms on the surface of stone over time due to weathering, oxidation, or other chemical reactions, which can impart a characteristic color or texture.
- Soiling: The accumulation of dirt, dust, pollutants, or other substances on the surface of the stone, resulting in a dirty or discolored appearance.
- Subefflorescence: A secondary deposit that forms below the surface of the stone due to the migration and crystallization of soluble salts, which can lead to internal deterioration and surface damage.

V. Biological colonization:

- Biological colonization: The process by which living organisms, such as algae, lichens, mosses, molds, or plants, establish and grow on surfaces, including stone. It involves the colonization and growth of these organisms, which can have an impact on the appearance and deterioration of the substrate.
- Alga (Algae): Simple, photosynthetic organisms that can be found in aquatic environments or on moist surfaces. Algae come in various forms and colors and can contribute to the biological colonization of stone surfaces.
- Lichen: A composite organism resulting from a symbiotic relationship between a fungus and algae or cyanobacteria. Lichens can grow on various substrates, including stone, and can have a crust-like or leafy appearance. They play a role in the biological colonization and can contribute to the deterioration of stone surfaces.
- Moss: Small, non-vascular plants that thrive in damp and shady environments. Mosses have leafy structures and can grow on stone surfaces, particularly in areas with moisture and suitable conditions. They can contribute to the biological colonization and can impact the appearance and deterioration of the substrate.
- Mould (Mold): Fungi that can grow on organic materials, including stone surfaces, under conditions of high humidity or moisture. Mold growth on stone can occur in the presence of organic matter or in damp environments. Mold colonization can lead to discoloration and degradation of the substrate.
- Plant: A multicellular organism belonging to the kingdom Plantae. Plants can include various types such as grasses, shrubs, or trees. In the context of biological colonization, plants refer to the growth of higher plants, such as weeds or other vegetation, on stone surfaces. The presence of plants can contribute to the deterioration of the substrate and alter its appearance.

2.2. Geoenvironmental Data Analysis

In the second phase of the study, climatological information and environmental data specific to the Savur region were obtained. The climatological information was derived from climate data obtained from the database of the Meteorological Institution. Environmental data, on the other hand, was collected through on-site observations. The following details describe the climatological information and environmental data pertaining to the Savur region:

Mardin's geological texture I.-IV. the interior of the masses dated to the Geological Time forms the erupted material and the rocks formed as a result of their change. II. In the Geological Time, calcareous lands were formed in the northeast. Looking at the general view of the Qillit Village Street Facades, it is almost impossible to distinguish the structures, mostly of local stone, from each other. Straw-yellow

cut stone material attracts attention in almost all of the buildings. The same practice can be observed on all its walls (Alioğlu, 1996).

In Savur, the summers are hot, arid, and clear and the winters are very cold, snowy, and partly cloudy. Over the course of the year, the temperature typically varies from 27°F to 98°F and is rarely below 18°F or above 103°F. The hot season lasts for 3.3 months, from June 9 to September 17, with an average daily high temperature above 86°F. The hottest month of the year in Savur is July, with an average high of 97°F and low of 66°F. The cold season lasts for 3.6 months, from November 24 to March 13, with an average daily high temperature below 53°F. The coldest month of the year in Savur is January, with an average low of 27°F and high of 42°F (Figure 3).

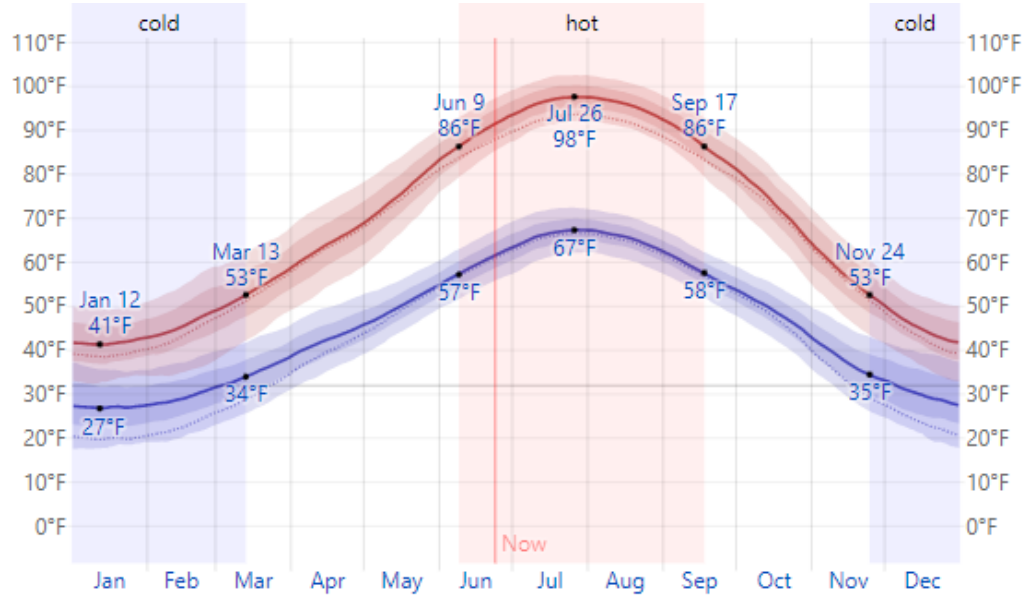

Figure 3. Average high and low temperature in Savur (T.C. Çevre, Şehircilik ve İklim Değişikliği Bakanlığı Meteoroloji Genel Müdürlüğü, 2023)

A wet day is one with at least 0.04 inches of liquid or liquid-equivalent precipitation. The chance of wet days in Savur varies throughout the year. The wetter season lasts 6.8 months, from October 23 to May 16, with a greater than 14% chance of a given day being a wet day. The month with the most wet days in Savur is February, with an average of 7.2 days with at least 0.04 inches of precipitation. The drier season lasts 5.2 months, from May 16 to October 23. The month with the fewest wet days in Savur is August, with an average of 0.1 days with at least 0.04 inches of precipitation. Among wet days, we distinguish between those that experience rain alone, snow alone, or a mixture of the two. The month with the most days of rain alone in Savur is March, with an average of 6.6 days. Based on this categorization, the most common form of precipitation throughout the year is rain alone, with a peak probability of 23% on April 2 (Figure 4).

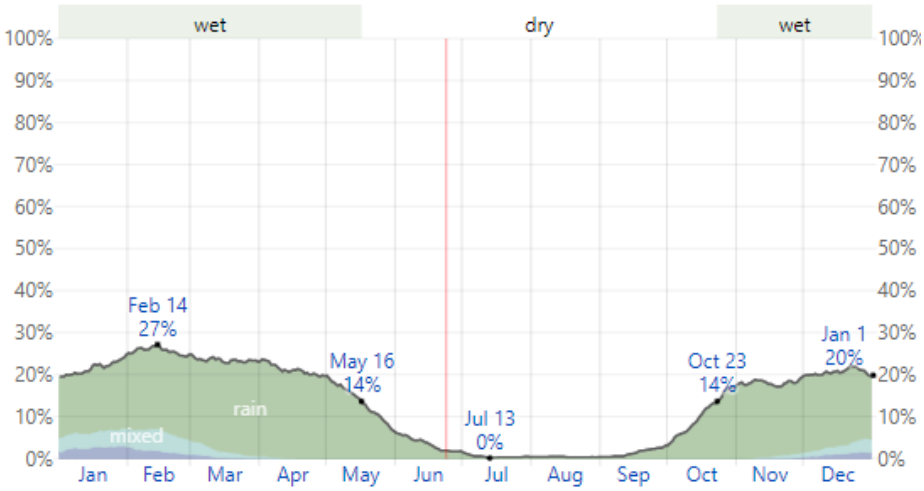

Figure 4. Daily chance of precipitation in Savur (T.C. Çevre, Şehircilik ve İklim Değişikliği Bakanlığı Meteoroloji Genel Müdürlüğü, 2023).

The length of the day in Savur varies significantly over the course of the year. In 2023, the shortest day is December 22, with 9 hours, 34 minutes of daylight; the longest day is June 21, with 14 hours, 46 minutes of daylight (Figure 5).

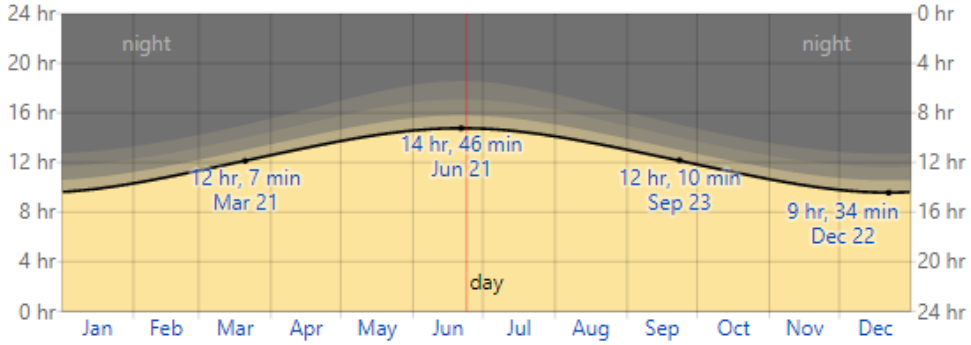

Figure 5. Hours of daylight and twilight in Savur (T.C. Çevre, Şehircilik ve İklim Değişikliği Bakanlığı Meteoroloji Genel Müdürlüğü, 2023).

The perceived humidity level in Savur, as measured by the percentage of time in which the humidity comfort level is muggy, oppressive, or miserable, does not vary significantly over the course of the year, remaining a virtually constant 0% throughout (Figure 6).

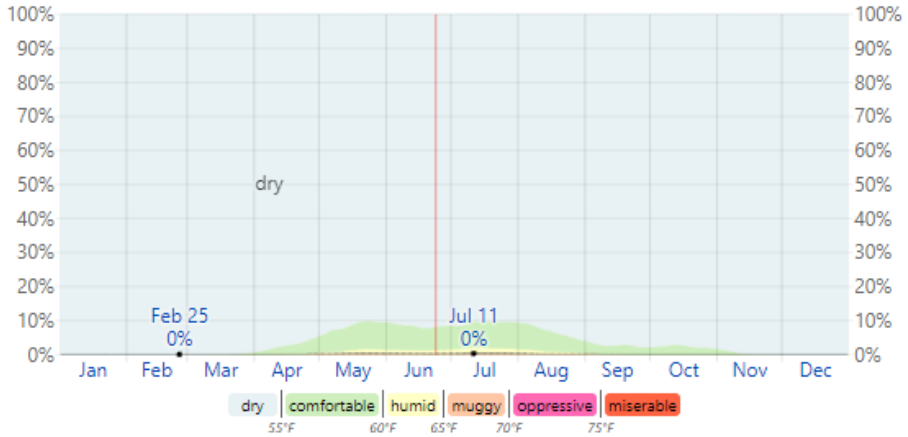

Figure 6. Humidity comfort levels in Savur (T.C. Çevre, Şehircilik ve İklim Değişikliği Bakanlığı Meteoroloji Genel Müdürlüğü, 2023).

2.3. Stone Deterioration Types and The Factors Influencing The Deterioration Process Detection Table

Lastly, in the study, the deterioration types of the structures identified during the on-site visits were interpreted in comparison with the climatological and environmental data obtained for the area. The obtained results, which include the types of factors that can cause material deterioration processes on the building facades, are marked on the table. The table below presents the chart indicating the deterioration types and factors related to the structures (Table 1).

Table 1. Stone material damage types and causal factors of damage types identified on the facades of historical houses in Killit (Dereiçi) Village

		Damage Type Causal Factors						
Stone Material Damage Type		water penetration	relative humidity	cement mortar salt	temperature fluctuations			climate of the region
					thaw-freezing cycles	the wet and dry cycles	daily and seasonally changes of the moisture	
CRACK & DEFORMATION	CRACK	x		x		x	x	x
	DEFORMATION							
DETACHMENT	BLISTERING							
	BURSTING							
	DELAMINATION							
	DISINTEGRATION	x		x		x	x	x
	FRAGMENTATION							
	PEELING							
	SCALING							
FEATURES INDUCED BY MATERIAL LOSS	ALVEOLIZATION							
	EROSION	x				x	x	x
	MECHANICAL DAMAGE							
	MICROKARST							
	MISSING PART							
	PERFORATION							
	PITTING	x		x		x	x	x
DISCOLORATION & DEPOSIT	CRUST							
	DEPOSIT							
	DISCOLOURATION							x
	EFFLORESCENCE							
	ENCRUSTATION							
	FILM							
	GLOSSY ASPECT							
	GRAFFITI							
	PATINA							
	SOILING							
	SUBFLORESCENCE							
BIOLOGICAL COLONIZATION	BIOLOGICAL COLONIZATION							
	ALGA							
	LICHEN							
	MOSS							
	MOULD							
	PLANT							

3. Findings and Discussion

In this section, the obtained results are presented based on the comparative interpretation of deterioration types observed on the structures identified during on-site visits, along with the climatological and environmental data obtained for the area. These results are documented on the

damage assessment chart. In the study results, it has been determined that the most commonly observed types of deterioration on the facades of historical structures are 'crack, disintegration, erosion, missing part, and discoloration'. Significant cracks running along the facades can be observed.

3.1. Deteriorations Observed on Parcel 1-2-3-4-5-6 of Plot 179

The main building material of structures, which is stone, features smooth limestone used in the arch stones, window and door openings, and facade corner joints. Four of the upper-level window openings on the south facade of the parcels have wrought iron railings, and the surroundings of the window openings are adorned with material made of smooth limestone. The upper right part of the south facade is enriched with facade ornamentation and decorative elements using smooth limestone. Additionally, this part of the facade is terminated with a profiled sill and parapet stone made of smooth limestone. Iron railings that deviate from the original texture are used on the windows of the south facade of the parcel. A garden gate made of wood that deviates from the original texture is seen in the garden wall. On the ground floor of the parcel, on the left side, there is a wooden door with an ornate stone arch. Next to it, passing through a pointed-arched eyvan, there is a low-arched wooden door. On the upper floor, there are four circular-arched windows with smooth limestone. The upper floor is terminated with a row of sill and parapet stone. There are three decorative elements on the facade surface. On the protruding rubble stone wall between the entrance floor and the first floor, plant formations can be observed. The stone surfaces exposed to atmospheric conditions for an extended period show darkening. Cement-based material has been used in the joints on the facades (Figure 7). Corrosion is visible on the iron railings that have reached the present day. Large-scale disintegration is observed on the facades of the structures. Advanced levels of erosion issues are observed on the stone surfaces (Figure 8).

Figure 7. Deteriorations observed on parcel 1-2 of plot 179

Figure 8. Deteriorations observed on parcel 3-4-5-6 of plot 179

3.2. Deteriorations Observed on Parcel 1-2 of Plot 182

The arch stones, window and door openings, and facade corner joints of the structure are made of smooth limestone. There is one door opening on the ground floor of the south facade of the parcel. On the upper floor, there are four circular and six rectangular window openings. The joinery and railings of the first two windows on the left side have disappeared over time. Concrete-based lintel applications have been applied to the structure. The courtyard on the right side of the building is covered with sheet metal and surrounded by iron railings. Access to the upper floor is through this balcony.

In the Savur region on the facades of the structures, there is a significant occurrence of mortar voids between the joints and the problem of 'missing parts' on the facades. The walls of the structures exhibit a significant issue of "discoloration." Additionally, the street facades on the northern side, which do not receive direct sunlight, show a lesser extent of deterioration. Another observed form of deterioration is the use of cement mortar to connect and fill the large cracks and missing parts in many of the stone blocks used in some facade walls (Figure 9).

Figure 9. Deteriorations observed on parcel 3-4-5-6 of plot 179

3.3. Deteriorations Observed on The Facade of Parcel 1 on Plot 186

The original main building material of the structure is stone, with smooth limestone used in the arch stones, window and door openings, and facade corner joints. Two circular-arched wooden veneer doors with double wings are observed on the facade surface. The upper-level window openings on the south facade of the plot have wrought iron railings, and a smooth limestone frame has been built around the window opening. The right side of the south facade is covered with smooth limestone, featuring decorative elements at the facade and window edges, as well as between two windows. Additionally, this part of the facade is terminated with a profiled sill and parapet stone made of smooth limestone. On the left side of the facade, there is a window that deviates from the original texture,

opened at various times. On the east facade of the structure, there is a circular-arched window opening with a straight lintel. Furthermore, there are three window openings that deviate from the original texture, opened at various times on this facade. On the right side of this facade, there is a pointed-arched eyvan with rubble stone masonry. Passing through this section leads to the staircase section ascending to the upper floor. In the lower right corner of this facade, a rubble stone masonry wall is observed.

The examined parcel is currently not in use. Discolorations are observed on the stone surfaces exposed to atmospheric conditions for an extended period on the facade. Cement-based material has been used in the joints on the facades. Collapses are observed in the staircase leading to the upper floor. Corrosion is visible on the iron railings that have reached the present day. Damage and deteriorations are observed in the wooden veneer doors. Unqualified fillings are observed inside and around the structure. Poorly executed window openings have been added later to the east facade of the structure. Two iron doors that deviate from the original texture have been installed. Window railings that do not conform to the original texture have been applied on the facade surfaces. Large-scale disintegration is observed on the facades of the structures (Figure 10a). Particularly, these damages are more prominently observed at the junction points of the walls and at the highest points (Figure 10b).

(a) (b)

Figure 10. Deteriorations observed on the facade of parcel 1 on plot 186

4. Discussion

The aim of the study is to identify the stone material deterioration patterns and the factors causing deterioration processes on the facades of Qillit Village Street Walls (Old Bazaar). The study results have revealed that the most commonly observed types of deterioration on the facades of historical structures are 'crack, disintegration, erosion, missing part, and discoloration'.

The obtained results suggest that the main cause of stone deterioration on the facades of historical houses in Killit (Dereiçi) village is the region's climatic conditions. Based on the climatic and environmental analyses conducted in the region, Mardin's Savur area exhibits distinctive climatic characteristics with annual and daily temperature variations. Throughout the year, there is a significant temperature difference between seasons. While the summer months can be extremely hot, the winter months are dominated by cold weather. Daily temperature fluctuations are also significant, as there can be noticeable changes in temperature throughout the day. Additionally, the annual precipitation amount in the Savur region is an important factor. The area generally has a dry climate with low annual rainfall. Rainfall is concentrated mostly in the winter months, while it decreases during the summer months. The historical structures in the region are located in an environment characterized by hot and dry summers, and the effects of rain during the cold seasons and high temperature fluctuations lead to significant physical deterioration. The maximum and minimum temperature differences (averaged throughout the year) in the region are approximately 35 °C, and the temperature variations in the Savur region are relatively significant. These variables, along with the heterogeneous structure that enhances the weathering process and its speed, have contributed to the formation of climate-induced

issues such as 'crack, disintegration, erosion, and discoloration' on the facades, affecting the physical deterioration of the stone blocks (Sandrolini et al., 2011; Khanlari et al., 2014; Derluyn et al., 2018).

Due to the significant temperature variations, cracks initially form in the stones of the structures, which are further exacerbated by the absorption of water and the penetration of water into the cracks, leading to dissolution-freezing cycles and contributing to the physical weathering process. In later stages, these developing cracks transform into the problem of 'disintegration'. The crack type provides suitable conditions for water to penetrate into the stone structure, eventually leading to disintegration and detachment after several cycles of dissolution-freezing (Odom, 1984). This is the main reason for the high density of deterioration observed, especially in the eastern and western facades of the monument, in the stone blocks used in the construction of the walls.

The stone material used in the buildings in the region is limestone. Limestone is a material that easily dissolves in water. This characteristic is a significant factor in the rapid deterioration of the limestone-based stone used on the facades, especially during the winter season when rainfall is prevalent, and its destructive effects manifest as 'erosion' on the surface. The impact of water on the stone has led to mass losses on the stone surface and mortar voids between the joints in the Savur region, resulting in the problem of 'missing part'. Several studies have highlighted the detrimental effects of water on limestone-based materials, including surface erosion, mortar voids, and missing parts (Alves et al., 2021; Ergüler & Shakoor, 2009; Bustamante et al., 2020; Iucolano et al., 2019; Beck & Al-Mukhtar, 2014; Bonazza et al., 2017; Gulotta et al., 2018).

Another form of deterioration is the "discolouration" observed on the surfaces of certain blocks in the walls of the structures, resulting from the intense exposure to sunlight. Furthermore, due to variations in the intensity of sunlight on different sides of the façade, less deterioration of this type is found on the north-facing street façades that do not receive direct sunlight. This phenomenon is related to temperature fluctuations on the facades and supports the formation of condensation on the shaded side due to lower average temperatures on the façade. On the other hand, on the southern side of the building, where the destructive effects of temperature differences are more pronounced, a higher incidence of "discolouration" issues is observed. This finding aligns with the results of the study by According to Fahmy et al. (2022), demonstrating that surfaces exposed to greater sunlight tend to exhibit more "discolouration" compared to sheltered areas.

Another type of deterioration identified is the use of cement mortar to fill and repair large cracks that have formed in many of the stone blocks used in some wall facades due to temperature differences. However, the repair mortar used in restoration should exhibit high compatibility with historical materials in terms of physical, chemical, and mechanical properties to ensure the long-term durability of the brick structure. Compatibility criteria are determined by the characteristics of the original mortar, but the quality and performance of the repair mortar are often not evaluated after its application to the wall. At this point, the repair mortars specific to historical mortars and brick structures should be examined chemically, mineralogically, and physically to ensure compatibility (Karataş et al., 2022). Additionally, aesthetic, mineralogical, physical, and mechanical characterization should be considered to assess overall performance. Material compatibility and workability should also be taken into account (Duffy et al., 1993; Arroyo et al., 2013; Türkeri, 2022; Dal et al., 2016).

Restoration and conservation interventions require planning and documentation. Restoration experts and conservation scientists emphasize that more than half of the interventions carried out today result in damage due to inappropriate conservation measures. In this context, integrating HBIM (Historic Building Information Modeling) tools into the obtained data is recommended in our study, enabling continuous monitoring of material damage in the structures for future work. Our study suggests expanding the field damage assessment with 3D documentation studies to create a database in the HBIM environment. Today, material deterioration and damage assessments can be easily documented in 3D using laser scanning methods. The importance of having such a database lies in determining the condition of historic buildings and assisting in decision-making regarding management, reuse, and maintenance.

5. Conclusion and Suggestions

Determining the damage on the facades is necessary in order to carry out the restoration work on the street facade of the building. For this reason, in this article, the damage assessments of the Killit Village Street Fronts (Old Bazaar) and the factors causing the damage were investigated. In the results, it was determined that the most intense deteriorations on the street facades were 'crack, disintegration, erosion, missing part, discolouration' on the facades. In addition, it has been observed that the joinery and balustrades of most windows on the facade surfaces have disappeared today, and PVC-based window joinery and non-original iron doors, which are contrary to the original texture, have replaced them. On some facades, unqualified window and door openings can be seen, and unqualified fillings can be seen inside and around the building. Within the scope of these problems, intervention suggestions for the repair of the structure are presented below.

During the cleaning phase, the dirt and darkening on the stone surfaces will be cleaned with low pressure water and air. If it is not sufficient, mechanical cleaning methods will be recommended. Dirt and darkening on soft limestone surfaces should be mechanically cleaned by dry cleaning method. The application will be made using soft hard plastic brushes. The cleaning of the developed and developing palnt formations on the building elements should be done as a priority. For the herbaceous and woody structures of these plant formations, mechanical methods (herbicides) should be intervened (Lazarini & Tabasso, 1986). All stone surfaces will be cleaned of cement-based joints, exposed surfaces will be repaired with joint mixture ratios determined according to the analysis results or with hydraulic lime. Repairs made with unqualified materials on the wall surface will be scraped away from the building. Concrete-based repairs and attachments seen on the facade surface will be carefully dismantled. The original iron railings will be cleaned using mechanical methods (soft wire brushes). It will be protected by applying two coats of anticorrosion and using metal paints with galvanic and cathodic protection in black color (Asthurst & Dimes,1998).

Cracks formed in the wall during the consolidation phase, cracks up to 0.5 cm will be repaired with binder mortar injection. Cracks larger than 0.5 cm will be repaired by sewing method. During the reconstruction phase, all the doors and windows seen on the façades will be dismantled and renewed according to the detail project. Electrical installation will be drawn on the facade surface in accordance with the electrical project. These productions must be in a quality and workmanship that will not disturb the original structure of the structures under the supervision of the supervision. Square and road arrangement will be made in accordance with the restoration project (Eskici, 1997; Dal & Öcal, 2017). During the completion phase, the stones spilled from the façade surface and the stones that have lost their stability will be completed based on the original stone dimensions, type, construction technique and knitting style. Original stone will be used primarily in the restoration. Deformations up to 5 cm will not be touched, and distortions of more than 5 cm will not be imitated. If the deteriorated stones create a static problem, they will be removed from the surface by the decay method and completed based on the original stone dimensions, type, construction technique and knitting style. Concrete-based repairs and annexes seen on the façade surface will be carefully dismantled during the add-ons to be removed. All iron-based repairs against the original texture will be dismantled (railing, door, etc.). Unqualified fillings in and around the project area will be removed from the project area (Capponi & Vedovello, 2000).

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Author Contribution and Conflict of Interest Declaration Information

1st Author % 50, 2nd Author %50 contributed. There is no conflict of interest.

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