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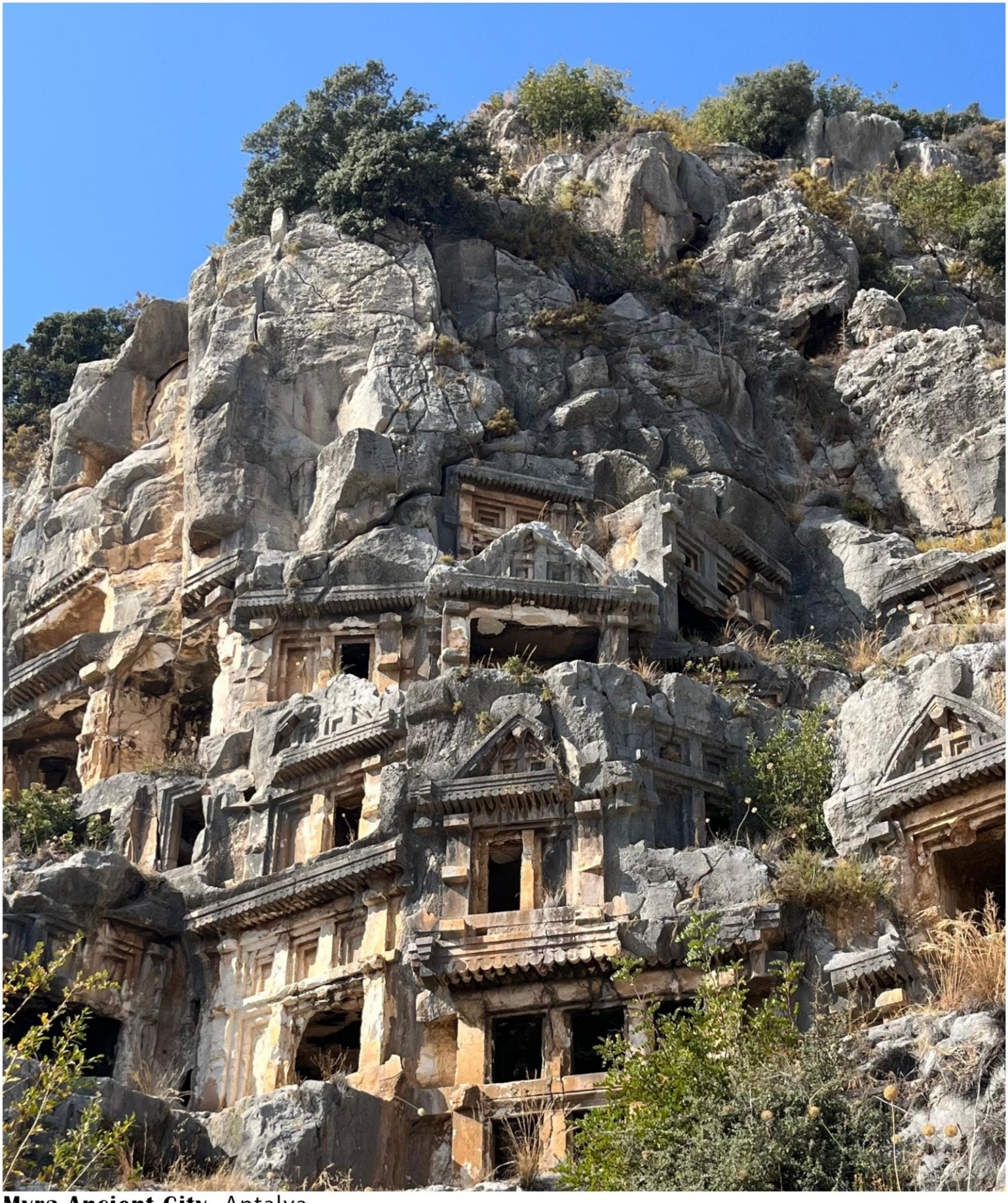

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CONTENTS

Journal of Architectural Sciences and Applications
J A S A
2024, 9 (1)
e-ISSN: 2548-0170
https://dergipark.org.tr/en/pub/mbud

Journal of Architectural Sciences and Applications
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2024, 9 (1)
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Comparison of Cold-Formed Steel and Reinforced Concrete Construction Systems Efficiency in Context of the Pandemic Hospital

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Abstract

The study aims to compare cold-formed steel (CFS), which is the construction system for emergency hospitals are quickly completed and used in an epidemic in Türkiye and the reinforced concrete (RC) construction system, which is the most preferred in Türkiye. This comparison includes criteria such as time, cost, sustainability, sound and thermal isolation, mechanic ventilation, instalment, transportation and production of building elements, natural lighting, disassembly-reassembly, and spatial flexibility. Projects were created based on the plan of Prof. Dr. Feriha Öz Emergency Hospital, built in Türkiye during the COVID-19 period. This comparison is made with the scientific Cost-Benefit Analysis method. Epidemics are the subject of many studies. However, researching the construction system will be more effective in the context of Türkiye, which is a unique and nationally valuable topic. It is essential to examine. The findings show CFS is more effective than RC in Türkiye during an epidemic. This situation parallels the preferred construction system for hospital applications in Türkiye.

Keywords: *Cold-formed steel construction system, reinforced concrete construction system, Covid-19 pandemic outbreak, pandemic hospitals, cost & benefit analysis.*

Hafif Çelik ve Betonarme Karkas Yapım Sistemlerinin Etkinliğinin Pandemi Hastanesi Bağlamında Karşılaştırılması

Öz

Araştırmanın amacı salgın durumunda Türkiye'de hızla tamamlanıp hizmete sunulan acil durum hastanelerinin yapım sistemi olan hafif çelik ile Türkiye'deki yapılarda en çok tercih edilen betonarme karkas yapım sisteminin karşılaştırılmasıdır. Karşılaştırma hız, maliyet, sürdürülebilirlik, ses ve ısı yalıtımı, mekanik havalandırma, tesisat, yapı malzemelerinin taşınması ve üretilmesi, doğal aydınlatma, sökülüp kurulabilirlik ve mekânsal esneklik kriterleri bağlamında yapılmıştır. Araştırmanın kapsamını, Covid-19 döneminde Türkiye'de inşa edilmiş olan hastanelerde tercih edilen hafif çelik yapım sistemi ve betonarme yapım sistemi oluşturmaktadır. Bu çerçevede Covid-19 döneminde Türkiye'de inşa edilmiş olan Prof. Dr. Feriha Öz Acil Durum Hastanesi'nin planı örnek alınarak projeler oluşturulmuştur. Bu yapım sistemleri bilimsel bir yöntem olan Fayda-Değer Analizi ile karşılaştırılmıştır. İnsanlık için tehdit oluşturan salgınlar birçok araştırmaya konu olmuştur. Fakat Türkiye bağlamında daha etkin olacak yapım sisteminin araştırılması özgün ve milli değer taşıyan bir konudur. Bu anlamda araştırılması önemlidir. Araştırma sonucunda salgın durumunda inşa edilecek hastane fonksiyonlu bir yapı için Türkiye şartlarında hafif çelik yapım sisteminin betonarmeye göre daha etkin olduğu saptanmıştır. Bu durum Türkiye'de uygulanan salgın hastaneleri için tercih edilmiş yapım sistemi ile paralellik göstermektedir.

Anahtar kelimeler: *Hafif çelik yapım sistemi, betonarme karkas yapım sistemi, Covid-19 pandemisi, acil durum hastanesi, fayda-değer analizi.*

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1. Introduction

Throughout human history, many epidemic situations occurred. In recent history, unprecedented pandemic outbreaks such as severe acute respiratory syndrome (SARS) coronavirus (SARS-CoV), Middle East respiratory syndrome (MERS) coronavirus (MERS-CoV) was occurred. COVID-19 is the latest example of a devastating pandemic disease (Morens et al., 2020a; Morens et al., 2020b).

As the pandemic outbreaks have effects worldwide, they also have significant effects across each country. Every country needs to use its resources most effectively and get through the pandemic periods healthily. One of the most critical steps in architecture and construction is to design and build pandemic hospitals. It is necessary to treat only positive cases during the pandemic. But existing hospitals cannot provide adequate health services to patients who are negative for Covid-19. Uninfected individuals also need to go to the hospital due to different ailments have a significant risk of being infected with this disease. Even if the existing hospitals convert into pandemic hospitals, they do not have sufficient capacity for positive cases. This situation not only disrupts societal welfare but also can severely damage the health infrastructure of the country. Since this research is carried out for the conditions of Türkiye and aims to determine a more effective construction system, it seeks to reach the result by using our country's resources and potential most efficiently.

Epidemics have had a significant impact on all humanity in many ways. Also, Covid-19 has affected society in many areas, such as socio-cultural, health and economic. This situation involving social life has substantial effects on the fields of architecture and engineering. While the epidemic was in effect, there was a need for places to treat the infected individuals in isolation from society. To solve this problem, pandemic hospitals, produced with different construction systems, have been established in many countries. Some of these include; Rafah Field Hospital, built by masonry construction in Gaza; Field Hospital, built by steel construction in Russia; triage and treatment units built by pneumatic system in Italy; Huoshenshan and Leishenshan Hospitals, built by container-type prefabricated units in China. In Türkiye, Prof. Dr. Murat Dilmener Emergency Hospital and Prof. Dr. Feriha Öz Emergency Hospital were designed and constructed by cold-formed steel construction. It was completed in forty-five days and has 1008 bed capacity (Öztürk & Savaşır, 2020). COVID-19 disease emerged in China at the end of 2019, but the declaration of a pandemic by the WHO (World Health Organization) and the first official case detection in Türkiye took place on March 11 (Republic of Türkiye Ministry of Health, 2020).

Within the scope of this study, cold-formed steel (CFS) construction and reinforced concrete (RC) construction systems, the preferred construction system for pandemic hospitals built in Türkiye during the pandemic period, are compared. The RC construction constitutes most of the building stock in Türkiye. However, during the pandemic, CFS construction was preferred over the RC construction system. This article investigates the reasons for this situation and compares these two construction systems using the Cost-Benefit Analysis (CBA) method. Istanbul was the preferred application area of emergency hospitals during the Covid-19 pandemic. In the study, Izmir is the application area.

This research aims to compare CFS construction, the construction system of Türkiye's emergency hospitals to be quickly completed and used during the pandemic, and Türkiye's most preferred RC construction. More than %90 of the structures built during and after the pandemic is RC construction (Turkish Statical Institute (TUIK, 2020). CBA method scientific method determined which of the two construction systems is more effective/appropriate in the conditions of Türkiye.

Compared to other hospitals, different design criteria and construction methods are used for pandemic hospitals. In this respect, it is crucial to examine the world and Turkish literature on this subject and to investigate the solutions developed by the world's countries to overcome this situation. As Türkiye, it is vital to seek a solution to this problem with its resources and innovative methods.

Due to the increase in positive cases since the beginning of the Covid-19 period, hospital capacities have been questioned. The emphasis is on the changed needs and that new arrangements should be possible in existing hospitals to treat Covid-19 patients (McCabe et al., 2020). One of the first hospitals built during the pandemic was Leishenshan Hospital in Wuhan, China. The Xiaotangshan Hospital, built

in Beijing during the 2003 SARS pandemic, was taken as a model in the design and construction of this hospital. Xiaotangshan Hospital was effective in the 2003 pandemic and has been influential in determining a safe hospital strategy for China for future pandemics. The construction of Leishenshan Hospital, which was in this context, is also a model for many pandemic hospitals built in different countries. The structure of this hospital was with a prefabricated modular system and had a capacity of 1600 patients. In addition, one of its most important features is that the construction took only 12 days. The shortness of the construction time depends on the technological methods used. Leishenshan Hospital is one of the two hospitals whose design and construction were completed quickly with BIM technology. The hospital is said to have worked very actively in the treatment and reduced mortality rates in this process (Luo et al., 2020).

These studies contain information about the hospitals used during the pandemic period. This information is for use this research. However, the research aims to examine the construction systems of the hospitals with the CBA method and to determine a more effective construction system in Türkiye's conditions.

Some studies emphasize the significance of the CBA method. It is argued that products made with the prefabrication method will be more efficient. In this context, the prefabricated construction system should be encouraged by investigating the cost and benefit of prefabricated structures in real building projects (Hong et al., 2018). Studies show that people working on construction projects waste a lot of time to collect data. Hence, manual execution of data collection reduces efficiency and offers less effective project management. The CBA method applications in this context achieved the most effective results and saved time (Vaughan et al., 2013).

The CBA method was used in the above mentioned studies. There is no research conducted on calculating the construction systems of epidemic hospitals with the CBA method and the most effective construction system. Although there are many articles written in the field of health in the literature, there are only a few publications worldwide on the examination of the construction systems of hospitals built during the pandemic periods. For this reason, the research subject is significant and valuable.

2. Material and Method

This research uses the CBA method, which was used in various scientific studies for a long time. The CBA method is a method that is used in the case of choosing among many alternatives and aims to determine the value provided by these alternatives. The benefit value is formed by evaluating the benefits provided by the system parts of an alternative one by one. The method depends on a value system related to the goal system and the decision maker's preferences, not as a tangible size of goal-related utility (Tapan, 1980).

This research analyses two construction systems regarding their positive or negative features. The data obtained at the end of the study, which have different units, are converted into a single value system. Then, the success points obtained by the construction system according to its distinct characteristics are collected by considering their importance level. These points amount to the benefit each building system has. The use of this method for the research can be explained in detail as follows.

The scope of the CBA, the research first started with a literature review. The architectural space designs and construction systems of the pandemic hospitals built in Türkiye were examined. After these examinations, the construction system applied in pandemic hospitals was determined. For comparison, the most preferred construction system was also determined. In this context, two construction systems were determined to be compared CFS construction and RC construction systems.

In the second stage, the criteria such as construction period and construction cost etc., which are effective in the design and construction of pandemic hospitals, are determined. These criteria play a decisive role in comparing the preferred construction systems in hospitals. A survey study including the criteria was carried out, and the importance coefficients of these criteria were determined with the help of the survey. The questionnaire was applied to architects, civil engineers and contractors involved in designing and constructing the pandemic hospitals. The questionnaire asked how to

determine the importance level (between 1 and 5) of the predetermined criteria (construction speed, cost, etc.). Importance coefficients were assigned to the criteria according to the survey data obtained. While tangible results were obtained with mathematical calculations for some criteria, sub-criteria were created. Even though the importance coefficients of the main criteria were determined with the help of questionnaires, the importance coefficients of the sub-criteria were evaluated by the authors of this article and in light of some foreseen technical results.

After completing the survey with the relevant people, the data obtained were compiled for use in the following steps. After this process, the performance calculations of each construction system were based on each evaluation criterion. Since these performance calculations obtained have different units (cost is obtained in "TL", construction period is obtained in "hours or days", etc.), they must be converted to a standard unit of value. The performance values of each construction system are obtained by converting to a standard unit.

As a final step, the importance coefficients obtained with the survey data and the performance values of the construction system were multiplied. After this step, which was repeated for both construction systems evaluated in the research, the cost-benefit of each construction system was determined. The CBA of both construction systems were compared, and the construction system with the higher success score was determined as the more effective one. In this way, the most effective result aimed at the research is achieved. With this feature, the research subject is essential and has an original quality. It is of great importance in bringing criticism to the emergency (pandemic) hospitals built in Türkiye and being a pioneer in terms of benefit value for the emergency hospitals planned to be built from now on (Figure 1).

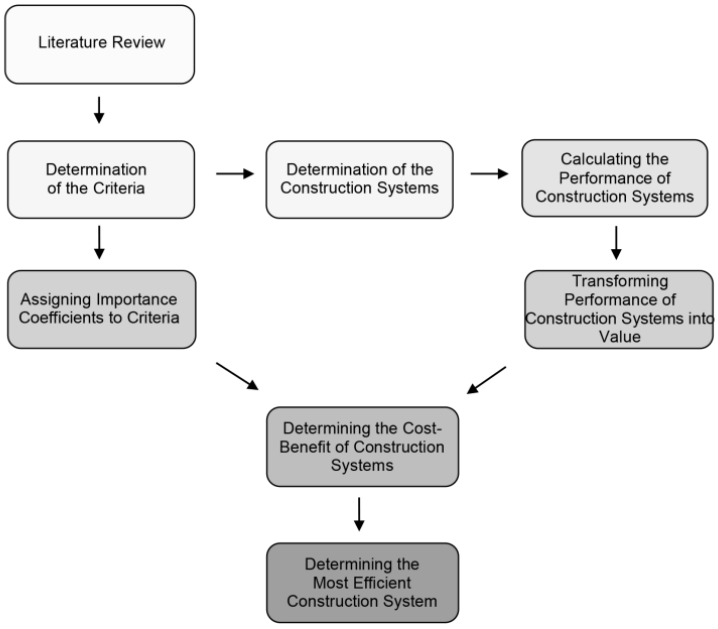


Figure 1. Cost-benefit analysis steps used in research (Öztürk & Savaşır, 2022)

3. Findings and Discussion

Two different architectural projects were prepared with cold-formed steel and RC construction systems. Prof. Dr. Feriha Öz Emergency Hospital was a model for the cold-formed steel structure. It was completed in forty-five days and has 1008 bed capacity. The project was designed and applied with units that repeat each other (Öztürk & Savaşır, 2020). In this research, a unit of the built pandemic hospital was taken as a model, and projects were designed within this framework. The net usage area in the projects for both construction systems has been determined as 135 sqm as in the model hospital. With the help of these projects, the bill of quantity was taken, the cost was determined, and the construction time was obtained with the help of the bill of quantity.

In addition to cost and time that can be determined by mathematical calculations, criteria such as mechanical ventilation and spatial flexibility, which can be given values with the help of questionnaires,

have also been determined. Benefit values are obtained with the importance coefficients given to the criteria. With these data, comparisons and evaluations can be made cost-benefit analysis.

3.1. Architectural Projects

Architectural projects were designed with two construction systems within the scope of the research. The pandemic hospital is one story. Technical information about RC construction and CFS construction systems is given.

3.1.1. Reinforced Concrete Construction System

As a result of the research conducted in the world and Turkish literature, the RC construction system was not preferable in the design of the pandemic hospital. However, the RC construction system is one of the two construction systems included in the research. This is because, more than %90 of the structures built regardless of their function, are RC construction.

As in the plans of Prof. Dr. Feriha Öz Emergency Hospital, built in Istanbul during the Covid-19 period and used as a model. There is the same foundation system for both construction systems. The foundation design is a raft foundation. For the most efficient foundation design, the ideCAD program calculated the data to carry the maximum load (Taşdelen, M. personal communication, December 20, 2022). While comparing the construction systems, the calculations of the structure's foundation were not included in the cost and construction time. The same raft foundation was designed for both. Because it is a comparison, it does not affect the result. The unit comprises four patient rooms, four buffer zones and a corridor connecting all these spaces (Figure 2).

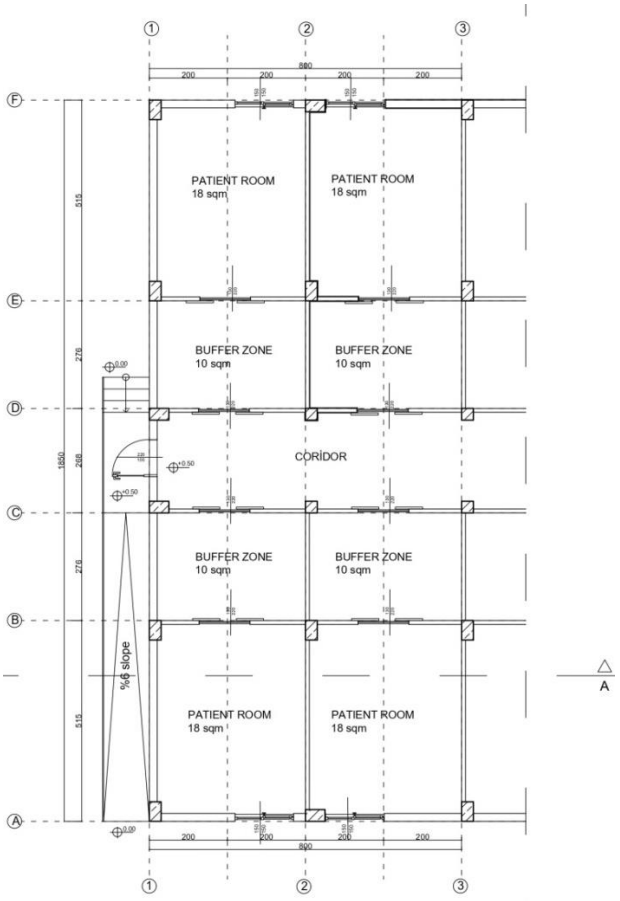


Figure 2. Floor plan of the project

3.1.2. Cold-Formed Steel (CFS) Construction System

Prof. Dr. Feriha Öz and Prof. Dr. Murat Dilmener, two emergency hospitals were built and opened on May 29 and May 31 (Öztürk & Savaşır, 2020). The CFS system is the construction system of both hospitals and has been included in the research within this framework. In this research, the hospital

built in Istanbul was a model for the structure designed with a CFS system. Both designs used the same foundation system. The unit comprises four hospital rooms, four buffer zones and a corridor connecting all these spaces (Figure 3).

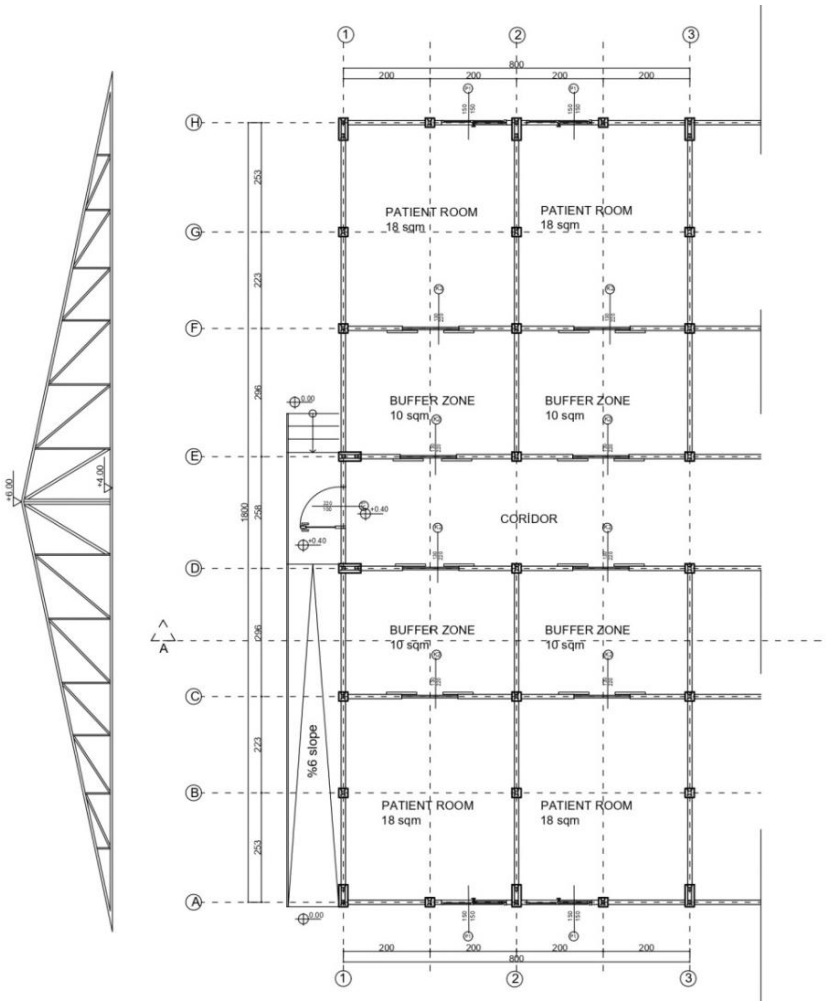


Figure 3. Floor plan of the project

3.2. Criteria (C)

While examining the world and Turkish literature, the similarities and differences between the applied construction systems were investigated. Considering the pandemic situation, the construction systems were compared. At this stage, it has been seen that different construction systems are advantageous or disadvantageous based on different factors. For example, CFS construction is faster to build than RC construction. These factors constitute the 'criteria' within the framework of the research. As mentioned in Chapter 2, a criterion such as the cost, which tangible results can be obtained, has been determined. At the same time, the criteria, which have been converted into concrete values after obtaining results with abstract expressions, have also been determined. In addition, sub-criteria have been created for more efficient evaluation of some main criteria. These criteria are 'twelve' in the research (Table 1).

Determination of criteria is based on construction systems and building materials. The positive aspects of materials and construction systems were analysed. Since the positive properties of some materials are negative compared to others, a holistic research has emerged. Information has been compiled. In this context, Savaşır (2008) compiled the criteria with this method in his thesis. By combining all this information, twelve criteria were created. Determination of these criteria also has significant impact on this research. As an example, construction time is inevitable criterion. In pandemic situation, it is significant to build a hospital rapidly. So, construction systems and its materials that can be constructed quickly are more advantageous.

Table 1. 'Main Criteria' determined within the framework of cost-benefit analysis

Criteria	
$C_{1:}$ Construction Time	C_7: Ease of Instalment
C_2: Construction Cost	C_8: Ease of Transport of Building Material to and from Construction Site
C_3: Suitability For Sustainable Architecture	C_9: Production Prevalence of Building Elements
C_4: High Sound Insulation Capacity	C_{10}: High Natural Lighting Capacity
C_5: High Thermal Insulation Capacity	C_{11}: Suitability for Disassembly and Reassembly
C_6: Mechanical Ventilation System	C_{12}: High Spatial Flexibility Capacity

3.3. Importance Coefficients

The importance coefficients (IC) were determined by considering the importance levels after the criteria were determined. As mentioned in Chapter 2, a survey was conducted with architects, civil engineers and contractors to determine the coefficients. Architects and civil engineers include both academicians and the private sector. It was emphasized to the questionnaire respondents that the pandemic conditions should be considered when determining the importance of the criteria.

The results were evaluated by considering occupational groups separately. Architects constitute 40% of all responders. For this group, the same results are obtained compared to the whole responders. Civil engineers constitute 40% of all responders. Also this group, the same results are obtained compared to the whole responders. Contractors constitute 20% of all responders. Also this group, the same results are obtained compared to the whole responders. So, the number of questionnaire respondents has been determined as 100. As the number of people increases, the sensitivity of the IC increases. However, there are minimal changes in the IC after a particular value. If this value is less than 100 people, there is a risk that accurate results will not be obtained since it will appeal to a very small number of respondents. It is important to obtain the same results in a survey conducted on people with technical knowledge. This proves the reliability of the results. After the questionnaires, the results were evaluated, the arithmetic average was taken, and the IC was assigned. As a result, the maximum value of 5 was the most important of the 12 criteria determined, and the minimum value of 1 was the least important. The other ten criteria were given relative values according to the results (Table 2).

Table 2. Importance coefficients of each criterion

Importance Coefficient (1<IC<5)	**Main Criteria (The most important 4 points, the last 1 point)**
IC_1: **4.42**	$C_{1:}$ Construction Time
IC_2: **3.18**	C_2: Construction Cost
IC_3: **3.20**	C_3: Suitability For Sustainable Architecture
IC_4: **2.95**	C_4: High Sound Insulation Capacity
IC_5: **3.74**	C_5: High Thermal Insulation Capacity
IC_6: **4.20**	C_6: Mechanical Ventilation System
IC_7: **3.58**	C_7: Ease of Instalment
IC_8: **3.29**	C_8: Ease of Transport of the Building Material to and from the Construction Site
IC_9: **3.51**	C_9: Production Prevalence of Building Elements
IC_{10}: **3.28**	C_{10}: High Natural Lighting Capacity
IC_{11}: **3.54**	C_{11}: Suitability for Disassembly and Reassembly
IC_{12}: **3.18**	C_{12}: High Spatial Flexibility Capacity

3.4. Performance Calculation and Scoring

At this stage, scores were based on criteria considering both construction systems; CFS and RC. There are two types of criteria, main and sub. Sub-criteria were created by detailing the main criteria. The formula in Table 3 calculates each main criterion's value. In this study, twelve main criteria were determined. The formula in Table 3 is used to calculate the value of each main criterion. The formula also includes the importance coefficient and value of the sub-criterion of the primary criterion (Table 3).

Table 3. The formula used within the framework of cost-benefit analysis (Öztürk & Savaşır, 2022)

$$B_j = \frac{\sum_{i=1}^{m}(V_{(i,j)} \times IC_i)}{\sum_{i=1}^{m} IC_i}$$ [j=1,2,…,n; (i=1,2,…,m)]	
B: Benefit of main criteria	IC: Importance coefficient of sub criterion
In this study m=12 (criteria), n=2 (construction systems) was taken.	V: Value of sub criterion

3.4.1. Construction time (C_1)

Different methods were used to obtain the construction times of the two construction systems. For the RC construction system, the unit price list published annually or semi-annually by the Ministry of Environment, Urbanization and Climate Change has been used (Republic of Türkiye Ministry of Environment, Urbanization and Climate Change, 2023). The calculations are based on working times. These times are in the pose numbers, selected according to the work done and the materials used. This way, the Gantt Diagram was created to obtain the total construction time. This study used five-person craftsmen teams, including one carpenter, a cold blacksmith, a concrete worker, a mason and two plasterers (Figure 4). For the comparison, one team of each two systems was used. For the CFS construction system, a proforma invoice was received from the manufacturer based on the designed architectural plan (Figure 5).

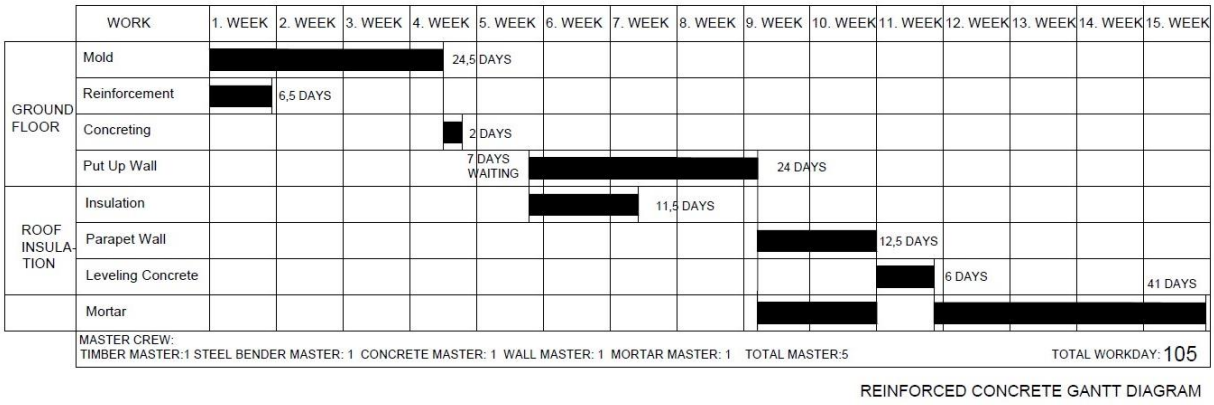
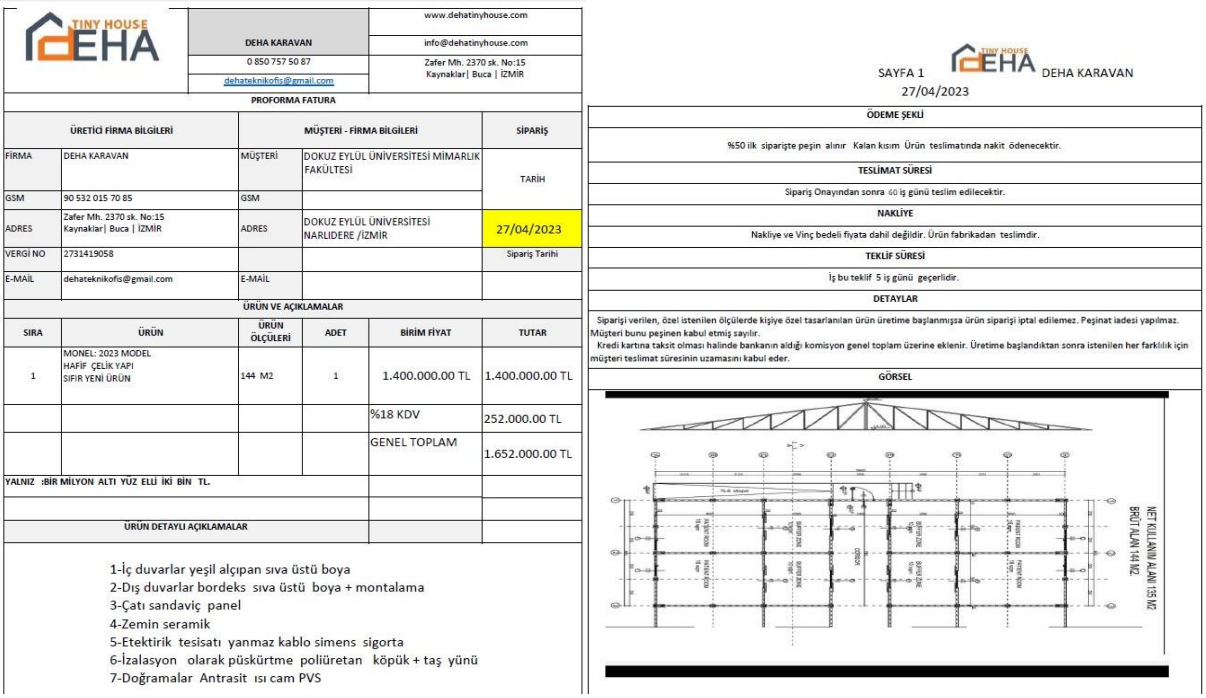


Figure 4. Gantt diagram of reinforced concrete construction



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PROFORMA FATURA

ÜRETİCİ FİRMA BİLGİLERİ		MÜŞTERİ - FİRMA BİLGİLERİ		SİPARİŞ
FİRMA	DEHA KARAVAN	MÜŞTERİ	DOKUZ EYLÜL ÜNİVERSİTESİ MİMARLIK FAKÜLTESİ	TARİH
GSM	90 532 015 70 85	GSM		
ADRES	Zafer Mh. 2370 sk. No:15 Kaynaklar| Buca | İZMİR	ADRES	DOKUZ EYLÜL ÜNİVERSİTESİ NARLIDERE /İZMİR	27/04/2023
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ÜRÜN VE AÇIKLAMALAR

SIRA	ÜRÜN	ÜRÜN ÖLÇÜLERİ	ADET	BİRİM FİYAT	TUTAR
1	MONEL: 2023 MODEL HAFİF ÇELİK YAPI SIFIR YENİ ÜRÜN	144 M2	1	1.400.000.00 TL	1.400.000.00 TL
				%18 KDV	252.000.00 TL
				GENEL TOPLAM	1.652.000.00 TL

YALNIZ :BİR MİLYON ALTI YÜZ ELLİ İKİ BİN TL.

ÜRÜN DETAYLI AÇIKLAMALAR

1-İç duvarlar yeşil alçıpan sıva üstü boya
2-Dış duvarlar bordeks sıva üstü boya + montalama
3-Çatı sandaviç panel
4-Zemin seramik
5-Etektirik tesisatı yanmaz kablo simens sigorta
6-İzalasyon olarak püskürtme poliüretan köpük + taş yünü
7-Doğramalar Antrasit ısı cam PVS

SAYFA 1 TINY HOUSE DEHA DEHA KARAVAN
27/04/2023

ÖDEME ŞEKLİ

%50 ilk siparişte peşin alınır Kalan kısım Ürün teslimatında nakit ödenecektir.

TESLİMAT SÜRESİ

Sipariş Onayından sonra 60 iş günü teslim edilecektir.

NAKLİYE

Nakliye ve Vinç bedeli fiyata dahil değildir. Ürün fabrikadan teslimdir.

TEKLİF SÜRESİ

İş bu teklif 5 iş günü geçerlidir.

DETAYLAR

Siparişi verilen, özel istenilen ölçülerde kişiye özel tasarlanılan ürün üretime başlanmışsa ürün siparişi iptal edilemez. Peşinat iadesi yapılmaz. Müşteri bunu peşinen kabul etmiş sayılır.
Kredi kartına taksit olması halinde bankanın aldığı komisyon genel toplam üzerine eklenir. Üretime başlandıktan sonra istenilen her farklılık için müşteri teslimat süresinin uzamasını kabul eder.

GÖRSEL

Figure 5. Proforma invoice of CFS construction (Deha Karavan, 2023)

As a result of the Gantt Diagrams, the construction period was 105 days for the RC construction system. For CFS construction system, the proforma invoice received from the manufacturer determined the construction period as 60 days (Table 4). The CFS construction system is %43 faster to build than the RC construction.

Table 4. Comparison of construction time of two systems

Criterion	Construction Systems	
	Reinforced Concrete Construction	Cold-Formed Steel Construction
C_1: Construction Time	105 Days	60 Days

3.4.2. Construction cost (C_2)

As the construction period, the construction costs of the two construction systems were obtained by different methods. The stages for the RC construction and bill of quantities were calculated based on the project. The unit price list was from the annual publication by the Ministry of Environment, Urbanization and Climate Change (Republic of Türkiye Ministry of Environment, Urbanization and Climate Change, 2023). In this way, the total construction costs were calculated. For the CFS construction, based on the project, the offer in the proforma invoice received from the manufacturer was used (Figure 5). In order to make an efficient comparison, the 2023 unit price list for the RC construction was used. The manufacturer submitted a bid for the CFS structure according to the current 2023 prices. According to the calculations, the RC construction cost was 711.423.56 Turkish liras (TL), and the CFS construction cost was 1.652.000.00 Turkish liras (TL). The RC construction is %56.8 cheaper than the CFS construction (Table 5).

Table 5. Comparison of the construction costs of two systems

Criterion	Construction Systems	
	Reinforced Concrete Construction	Cold-Formed Steel Construction
C_2: Construction Cost	711.423.56 TL	1.652.000.00 TL

3.4.3. Suitability for sustainable architecture (C_3)

In order to determine the value of the main criterion, five sub-criteria were determined. These sub-criteria are in Table 6. First, the importance coefficients of the sub-criteria are assigned by the authors of this study, considering the pandemic conditions and the hospital function. In this process technical evaluations were done, and authors foresaw results. Each was foreseen separately; then an arithmetic average was taken.

Afterwards, comparative values are given for both construction systems. Within the definition of the criterion, a value of '1' is given to the lower performance of the two construction systems. A comparative value is determined for the other construction system (Table 6). Values are determined based on performance for each criterion. Values for the main criteria are calculated by replacing the values determined in Table 6 in the formula given in Table 3.

Thus was the valuation process for the main criteria that do not need to create sub-criteria. The values of the first, second and fifth main criteria, such as cost, construction time and thermal insulation criteria, can be reached as concrete data with the help of mathematical calculations. There is no need to create sub-criteria for these main criteria. Giving the comparative values to the sub-criteria, the main criteria values can be determined. Authors foresaw all of the sub-criteria's value after technical evaluations. Also, each was foreseen separately, and then the arithmetic average was taken.

Table 6. Third criterion's value for two systems

Sub-Criteria of the Third Main Criterion	Importance Coefficients of Sub-Criteria	Values of Sub-Criteria	
		Reinforced Concrete Constr.	Cold-Formed Steel Constr.
$C_{(3.1)}$- Whether it is harmless to the environment	$IC_{(3.1)}$- 1.0	$V_{(3.1)}$- 1.0	$V_{(3.1)}$- 1.75
$C_{(3.2)}$- Using local material	$IC_{(3.2)}$- 1.25	$V_{(3.1)}$- 1.1	$V_{(3.1)}$- 1.0
$C_{(3.3)}$- Low amount of waste products at the end of the construction process	$IC_{(3.3)}$- 1.0	$V_{(3.1)}$- 1.0	$V_{(3.1)}$- 2.5
$C_{(3.4)}$- Whether the material is reusable after demolition	$IC_{(3.4)}$- 1.0	$V_{(3.1)}$- 1.0	$V_{(3.1)}$- 2.5
$C_{(3.5)}$- Whether the demolition process harms the environment	$IC_{(3.5)}$- 1.0	$V_{(3.1)}$- 1.0	$V_{(3.1)}$- 2.25
Values for Both Systems		V_{R3}- **1.02**	V_{C3}-**1.95**

3.4.4. High sound insulation capacity (C_4)

It is crucial to examine this criterion, especially in the context of a pandemic. To determine the value of the main criterion, three sub-criteria were determined. These sub-criteria are in Table 7. Calculation of the main criteria values was by replacing the values determined in Table 6 in the formula given in Table 3.

Table 7. Fourth criterion's value for two systems

Sub-Criteria of the Fourth Main Criterion	Importance Coefficients of Sub-Criteria	Values of Sub-Criteria	
		Reinforced Concrete Constr.	Cold-Formed Steel Constr.
$C_{(4.1)}$- Good insulation against external sound	$IC_{(4.1)}$- 1.75	$V_{(4.1)}$- 1.0	$V_{(4.1)}$- 2.0
$C_{(4.2)}$- Good soundproofing between rooms for patient privacy	$IC_{(4.2)}$- 1.0	$V_{(4.1)}$- 1.0	$V_{(4.1)}$- 2.2
$C_{(4.3)}$- Good sound insulation for devices that produce noise by air conduction	$IC_{(4.3)}$- 1.5	$V_{(4.1)}$- 1.0	$V_{(4.1)}$-1.0
Values for Both Systems		V_{R4}- **1.0**	V_{C4}-**1.69**

3.4.5. High thermal insulation capacity (C_5)

Thermal insulation calculations of both construction systems are based on TS 825 'Thermal insulation requirements for buildings' Turkish Standard. In this research, wall sections of both construction systems are examined based on layers. In calculations, the 'thickness' (d) and 'thermal conductivity calculation value' (λ_h) data for each building material used must be known. The 'thermal conductivity calculation value' of the building materials used in the RC construction system is in TS 825. The values of some building materials used in the CFS construction system were obtained from different sources (Dalsan, 2019). The result of the calculations is the 'total thermal transmittance coefficient' (U) value. TS 825 has recommended (U) values according to regions in Türkiye. As mentioned in Chapter 1 because Izmir is in the first region (TS 825 Thermal Insulation Requirements in Buildings, 2008) (Table 8).

Table 8. U values that can be maximum according to regions (TS 825, 2008)

	U_D (W/m^{2}K)	U_T (W/m^{2}K)	U_t (W/m^{2}K)	U_P (W/m^{2}K)
1.Bölge	0.70	0.45	0.70	2.4
2.Bölge	0.60	0.40	0.60	2.4
3.Bölge	0.50	0.30	0.45	2.4
4.Bölge	0.40	0.25	0.40	2.4

The research was in the context of walls, so the critical value is 0.70 in the first region, as highlighted with a red rectangle (Table 8). According to the data obtained, the thermal insulation capacity of RC construction was 1.25 W/m^{2}K, and the thermal insulation capacity of CFS construction was 0.38 W/m^{2}K. The CFS construction has % 69.6 higher thermal insulation capacities than the RC construction (Table 9). The U value of the RC construction system should be max. 0.70. To reach this value, 2 millimetres of XPS material is necessary.

Table 9. Comparison of thermal insulation capacity of two systems

Criterion	**Construction Systems**	
	Reinforced Concrete Construction (U value)	**Cold-Formed Steel Construction (U Value)**
C_5: High Thermal Insulation Capacity	1.25 W/m^{2}K	0.38.W/m^{2}K

3.4.6. Mechanical ventilation system (C_6)

The sixth criterion is also essential as Covid is an airborne disease. Its spatial design reflects the analysis of a pandemic hospital. For the value of the main criterion requires four sub-criteria. These sub-criteria are in Table 10. The main criteria calculations were by replacing the values determined in Table 6 in the formula given in Table 3.

Table 10. The sixth criterion's value for two systems

Sub-Criteria of the Sixth Main Criterion	**Importance Coefficients of Sub-Criteria**	**Values of Sub-Criteria**	
		Reinforced Concrete Constr.	**Cold-Formed Steel Constr.**
$C_{(6.1)}$- Problems arising from the construction system encountered during the construction/installation process of the ventilation system	$IC_{(6.1)}$- 2.0	$V_{(6.1)}$- 1.0	$V_{(6.1)}$- 2.75
$C_{(6.2)}$- The negativities brought by the maintenance and repair of the ventilation system to the construction system	$IC_{(6.2)}$- 2.0	$V_{(6.1)}$- 1.0	$V_{(6.1)}$- 2.5
Values for Both Systems		V_{R6}- **1.0**	V_{C6}- **2.62**

3.4.7. Ease of instalment (C_7)

The instalment criterion is also vital during and after the construction of a building that has a hospital function. Renovation works can be done as needed. To examine this criterion, it is essential to analyse it in detail.

To determine the value of the main criterion, two sub-criteria were determined. These sub-criteria are in Table 11. Values for the main criteria are calculated by replacing the values determined in Table 6 in the formula given in Table 3.

Table 11. Seventh criterion's value for two systems

Sub-Criteria of the Seventh Main Criterion	Importance Coefficients of Sub-Criteria	Values of Sub-Criteria	
		Reinforced Concrete Constr.	Cold-Formed Steel Constr.
$C_{(7.1)}$- Easy laying of plumbing under construction	$IC_{(7.1)}$- 1.5	$V_{(7.1)}$- 2.75	$V_{(7.1)}$- 1.0
$C_{(7.2)}$- Easy to make plumbing repairs during use	$IC_{(7.2)}$- 1.0	$V_{(7.1)}$- 3.0	$V_{(7.1)}$- 1.0
Values for Both Systems		V_{R7}- **2.85**	V_{C7}- **1.0**

3.4.8. Ease of transport of the building material to and from the construction site (C_8)

The transportation of building materials to the construction site is an important criterion. For example, since the container prefabricated system is the factory's final product, it is difficult to transport on the road due to its huge dimensions. Due to the size of the building materials arriving at the construction site, it may be difficult to transport them within the construction site. There may be insufficient workforce to transport construction materials within the site.

In order to determine the value of the main criterion, five sub-criteria were determined. These sub-criteria are in Table 12. Values for the main criteria are calculated by replacing the values determined in Table 6 in the formula given in Table 3.

Table 12. Eighth criterion's value for two systems

Sub-Criteria of the Eighth Main Criterion	Importance Coefficients of Sub-Criteria	Values of Sub-Criteria	
		Reinforced Concrete Constr.	Cold-Formed Steel Constr.
$C_{(8.1)}$- Ease of transportation from the production site to the construction site	$IC_{(8.1)}$- 1.5	$V_{(8.1)}$- 1.1	$V_{(8.1)}$- 1.0
$C_{(8.2)}$- Simple to put building materials and components in place	$IC_{(8.2)}$- 1.0	$V_{(8.1)}$- 1.1	$V_{(8.1)}$- 1.0
$C_{(8.3)}$- Difficulty in transporting building components within the construction site due to weight and quantity	$IC_{(8.3)}$- 1.0	$V_{(8.1)}$- 1.15	$V_{(8.1)}$- 1.0
$C_{(8.4)}$- The possibility of damage, deterioration or breakage of the building components during transportation to the construction site or when they are unloaded at the construction site.	$IC_{(8.4)}$- 1.0	$V_{(8.1)}$- 1.0	$V_{(8.1)}$- 1.1
$C_{(8.5)}$- Road transport difficulty due to the dimensions of the components to be transported	$IC_{(8.5)}$- 1.5	$V_{(8.1)}$- 1.75	$V_{(8.1)}$- 1.0
Values for Both Systems		V_{R8}- **1.25**	V_{C8}- **1.01**

3.4.9. Production prevalence of building elements (C_9)

The use of local materials is important because the research was conducted in the context of Türkiye. In case of a pandemic, each country must first use its resources effectively. So the prevalence and capacity of production of building materials in Türkiye is essential. To determine the value of the criterion, two sub-criteria were determined. These sub-criteria are in Table 13. Values for the main criteria are calculated by replacing the values determined in Table 6 in the formula given in Table 3.

Table 13. Ninth criterion's value for two systems

Sub-Criteria of the Ninth Main Criterion	Importance Coefficients of Sub-Criteria	Values of Sub-Criteria	
		Reinforced Concrete Constr.	Cold-Formed Steel Constr.
$C_{(9.1)}$- Widespread production of building components throughout Türkiye	$IC_{(9.1)}$- 1.0	$V_{(9.1)}$- 2.5	$V_{(9.1)}$- 1.0
$C_{(9.2)}$- High annual production capacity of building components	$IC_{(9.2)}$- 1.25	$V_{(9.1)}$- 2.5	$V_{(9.1)}$-1.0
Values for Both Systems		V_{R9}- **2.5**	V_{C9}- **1.0**

3.4.10. High natural lighting capacity (C_{10})

According to Asyary & Veruswati (2020), it has been determined that natural lighting positively affects the immune system of Covid-19 patients and enables them to recover faster. In this sense, having a high natural lighting capacity is important.

Daylight creates a better visual environment than artificial lighting due to its varying intensity according to the time of day and seasons. It provides a dynamic interior environment and improves the users' experience in visual comfort, aesthetics and space perception. Also, it plays a vital role in promoting human health and well-being (Abidi & Rajagopalan, 2020; Ullah, 2014). Considering these, daylight can be considered as a potential measure in building design to reduce human health risks against the adverse effects of the quarantine process that we are closed (Sipahi & Yamaçlı, 2021).

Only one sub-criterion was determined to find the value of the main criterion. This sub-criterion is in Table 14. Values for the main criteria are calculated by replacing the values determined in Table 6 in the formula given in Table 3.

Table 14. Tenth criterion's value for two systems

Sub-Criteria of the Tenth Main Criterion	Importance Coefficients of Sub-Criteria	Values of Sub-Criteria	
		Reinforced Concrete Constr.	Cold-Formed Steel Constr.
$C_{(10.1)}$- The window can be opened at the desired rate for natural lighting	$IC_{(10.1)}$- 1.25	$V_{(10.1)}$- 2.75	$V_{(10.1)}$- 1.0
Values for Both Systems		V_{R10}- **2.75**	V_{C10}- **1.0**

3.4.11. Suitability for disassembly and reassembly (C_{11})

This criterion is an important criterion that should be examined for sudden, unexpected processes such as pandemics. To determine the value of the main criterion, two sub-criteria were determined. These sub-criteria are in Table 15. Values for the main criteria are calculated by replacing the values determined in Table 6 in the formula given in Table 3.

Table 15. Eleventh criterion's value for two systems

Sub-Criteria of the Eleventh Main Criterion	Importance Coefficients of Sub-Criteria	Values of Sub-Criteria	
		Reinforced Concrete Constr.	Cold-Formed Steel Constr.
$C_{(11.1)}$- Being a system that can be installed and applied easily and in a short time	$IC_{(11.1)}$- 1.0	$V_{(11.1)}$- 1.0	$V_{(11.1)}$- 3.0
$C_{(11.2)}$- Temporary structures designed for temporary periods such as pandemics	$IC_{(11.2)}$- 1.0	$V_{(11.1)}$- 1.0	$V_{(11.1)}$-3.0
Values for Both Systems		V_{R11}- **1.0**	V_{C11}- **3.0**

3.4.12. High spatial flexibility capacity (C_{12})

Since the pandemic is sudden, the need for space must be met urgently. Therefore, idle structures with different functions can be converted into pandemic hospitals (Öztürk & Savaşır, 2020). At the same time, additions can be made to the hospital structure as the process progresses. Therefore, spatial flexibility is an important criterion that needs to be examined. To determine the value of the main criterion, two sub-criteria were determined. These sub-criteria are in Table 16. Values for the main criteria are calculated by replacing the values determined in Table 6 in the formula given in Table 3.

Table 16. Twelfth criterion's value for two systems

Sub-Criteria of the Twelfth Main Criterion	Importance Coefficients of Sub-Criteria	Values of Sub-Criteria	
		Reinforced Concrete Constr.	Cold-Formed Steel Constr.
$C_{(12.1)}$- In case of being permanent, it is appropriate to use it with a different function.	$IC_{(12.1)}$- 1.5	$V_{(12,1)}$- 1.0	$V_{(12.1)}$- 1.5
$C_{(12.2)}$- Since it is created with a modular system, it can provide integration in case of adding or removing from the structure.	$IC_{(12.2)}$- 1.0	$V_{(12.1)}$- 2.25	$V_{(12.1)}$-1.0
Values for Both Systems		V_{R12}- **1.5**	V_{C12}- **1.3**

Importance coefficients and values of twelve main criteria created in comparing light steel and RC construction systems were determined. A Gantt chart was created for the first criterion, the construction time and a proforma invoice was received. In the context of the obtained mathematical data, it has been concluded that the CFS construction system can be applied 43% faster than RC. For the second criterion, cost, quantities with unit prices were calculated, and proforma invoices were received. The results showed that the RC construction system was 56% less costly than CFS. Within the scope of the third criterion, sustainability, it was concluded that the CFS construction system is 91% more sustainable than RC. For the fourth criterion, the sound insulation capacity, it has been determined that the CFS construction system is 70% better than the RC. For the fifth criterion, the thermal insulation capacity, it was determined that the CFS construction system was 69% better than the RC. The CFS construction system is 162% more advantageous than RC for mechanical ventilation, the sixth criterion. The RC construction system is 185% more advantageous than CFS for the installation system, which is the seventh criterion. The RC construction system is 24% more advantageous than CFS for transporting the building elements, the eighth criterion. For the ninth criterion, the prevalence of production, it was determined that the RC construction system was 150% more advantageous than CFS. The RC construction system is 175% more advantageous than CFS for natural lighting, the tenth criterion. The CFS construction system is 200% more advantageous than RC for the eleventh criterion, disassembly and reassembly. The RC construction system is 15% more advantageous than CFS for spatial flexibility, the twelfth criterion (Table 17).

The benefits of both construction systems are found separately according to the formula in Table 3. In this context, as stated in Section 3.4, criteria, construction systems, importance coefficients, and values are the elements needed for the calculation. As a result of all these processes, the benefit of the RC construction system was 1.52. In contrast, this benefit was 1.58 for the CFS construction system. When the benefits of these two construction systems are compared, the CFS construction system is approximately 5% more effective than the RC construction system (Table 17).

Table 17. Benefits of the construction systems

Main Criteria	Importance Coefficients of Sub-Criteria	Values of Sub-Criteria	
		Reinforced Concrete Constr.	Cold-Formed Steel Constr.
C_1: Construction Time	IC_1- **4.42**	V_{R1}- **1.0**	V_{C1}- **1.43**
C_2: Construction Cost	IC_2- **3.18**	V_{R2}- **1.56**	V_{C2}- **1.0**
C_3: Suitability For Sustainable Architecture	IC_3- **3.20**	V_{R3}- **1.02**	V_{C3}- **1.95**
C_4: High Sound Insulation Capacity	IC_4- **2.95**	V_{R4}- **1.0**	V_{C4}- **1.69**
C_5: High Thermal Insulation Capacity	IC_5- **3.74**	V_{R5}- **1.0**	V_{C5}- **1.69**
C_6: Mechanical Ventilation System	IC_6- **4.20**	V_{R6}- **1.0**	V_{C6}- **2.62**
C_7: Ease of Instalment	IC_7- **3.58**	V_{R7}- **2.85**	V_{C7}- **1.0**
C_8: Ease of Transport of Building Material to and from Construction Site	IC_8- **3.29**	V_{R8}- **1.25**	V_{C8}- **1.01**
C_9: Production Prevalence of Building Elements	IC_9- **3.51**	V_{R9}- **2.5**	V_{C9}- **1.0**
C_{10}: High Natural Lighting Capacity	IC_{10}- **3.28**	V_{R10}- **2.75**	V_{C10}- **1.0**
C_{11}: Suitability for Disassembly and Reassembly	IC_{11}- **3.54**	V_{R11}- **1.0**	V_{C11}-**3.0**
C_{12}: High Spatial Flexibility Capacity	IC_{12}- **3.18**	V_{R12}- **1.5**	V_{C12}- **1.3**
Benefits of the Construction Systems		**B_R- 1.52**	**B_C- 1.58**

4. Conclusion and Suggestions

Within the scope of the architectural project developed within the framework of the prepared scenario, two construction systems were compared within the framework of twelve criteria. According to the analysis results obtained in Table 17, while the RC construction system is more advantageous for six criteria out of twelve, the CFS construction system is more advantageous for the other six criteria.

Among the twelve criteria, the three criteria with the highest importance coefficient are construction time, mechanical ventilation and thermal insulation capacity. Importance coefficients take values between 1 and 5 in this article. Construction time and mechanical ventilation are the criteria with more than 4 importance coefficients. The CFS construction system is more effective and suitable than the RC for these three criteria, with the highest importance coefficient. The three criteria with the lowest importance coefficient are sound insulation capacity, spatial flexibility and construction cost. Only the sound insulation criterion was below 3 as an importance coefficient among all the criteria. The other least critical criteria were spatial flexibility and cost, with importance coefficients slightly above 3. The RC construction system was more effective and suitable for these three least important criteria than CFS construction. The other six criteria have significance levels between 3.58 and 3.20. In conclusion, RC construction was more effective for four criteria, and CFS construction was more effective for two criteria.

Among the 12 criteria, the RC construction system in six criteria and the CFS construction system in six criteria received higher importance coefficients. However, since each criterion is not equally

important, there is no equality between the construction systems. At this point, the conditions for determining the importance coefficients are adequate. The framework of this article took the pandemic situation and hospital design factors into account. The significance levels of the coefficients have been evaluated in this context.

The total success scores of both construction systems, which were reached as a result of the calculations, were compared. While the benefit of the CFS construction system was 1.58, the benefit of the RC construction system was 1.51. With an average of 5% difference, the CFS construction system is the more efficient construction system. 5% difference is an important result. In the research, a feasibility study is being carried out on two construction systems.

Feasibility means that it is the analysis of the economic, technical and financial probability of investment projects that will provide long-term benefits (Aydın et al., 2018). As a result, if an alternative is more advantageous than the other, it is more preferable. The result achieved is important because every country must use its resources most efficiently.

In this scenario, the conclusion is that it would be more efficient to construct the CFS structure. As it is known, the CFS construction system was preferred in Türkiye during the COVID-19 pandemic in the recent past. The results of this research show parallelism with this situation. The technical results obtained with the comparisons made within the framework of this article support the application of the pandemic hospital in Türkiye.

Thanks and Information Note

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Author Contribution and Conflict of Interest Disclosure Information

The first author contributed %60 and the second author contributed %40 to the article. We declare that there is no conflict of interest.

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Temporal and Spatial Evolution of Architecture

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Abstract

Architectural styles are dynamic phenomena in which different walks of life work together to find common ground. Trends, directions, innovations or the waning interest in old styles have led to the emergence of new styles over time. In this way, relationships between culture, influences, region, and time could be established after considering them chronologically and regionally. In this research, the transformations and changes of architectural movements over time and space were examined. In addition, influential historical events are given in relation to the periods in which the movements emerged in order to form an idea. In order to do this, 76 major architectural styles, 4 urban planning principles that influence architecture, 2 philosophical approaches in architectural theory, and 4 significant architectural practices in the world were brought together, listed chronologically, and the geographical locations where they emerged and developed were evaluated. For this reason, architectural movements were examined on the basis of design patterns, locations and time period. However, it was intended to draw attention to important historical events in the periods when architectural movements emerged. In addition, scenarios for possible future architectural styles were created.

Keywords: *Architectural styles, architectural characteristics, architectural development, trend.*

Mimarinin Zamansal ve Mekânsal Evrimi

Öz

Mimari stiller, farklı yaşam kesimlerinin ortak bir zemin bulmak için birlikte çalıştığı dinamik olgulardır. Trendler, yönler, yenilikler veya eskilere olan ilginin zamanla kaybolması, yeni tarzların ortaya çıkmaya başlamasına neden olur. Kültür, etkiler, bölge ve zaman arasındaki ilişkiler kronolojik ve bölgesel olarak incelendikten sonra kurulabilir. Bu araştırmada, mimari akımların zaman ve mekân içinde geçirdiği dönüşüm ve değişimler incelenmiştir. Ayrıca, etkili tarihsel olaylar, bir fikir oluşturması açısından akımların çıktığı dönemler ile ilişkilendirilerek verilmiştir. Bunu yapabilmek için, dünyadaki 76 büyük mimari akım, mimariyi etkileyen 4 kentsel planlama ilkesi, mimarlık teorisinde 2 felsefi yaklaşım ve 4 önemli mimarlık pratiği bir araya getirilmiş, kronolojik olarak sıralanmış, ortaya çıktıkları ve geliştikleri coğrafi konumlar değerlendirilmiştir. Bu nedenle mimari akımlar, tasarım kalıpları, konumlar ve zaman dilimi bazında incelenmiştir. Bununla birlikte, mimari akımların ortaya çıktığı dönemlerdeki önemli tarihsel olaylara dikkat çekilmek istenmiştir. Ayrıca, gelecekte ortaya çıkması muhtemel mimari akımlara ilişkin senaryolar üretilmiştir.

Anahtar kelimeler: *Mimari akımlar, mimari karakteristikler, mimari gelişim, eğilimler.*

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1. Introduction

Historical events and circumstances influenced the development of the characteristics of architectural styles. Moreover, some of the styles emerged either with the development of the construction and production methods used as a reaction to another style or as an improved version of an earlier style. This diversity contributed to improvements in living spaces in terms of standards, comfort, and aesthetics.

According to Leach (2017), art lives longer than artists and architecture lives longer than architects. Art and style have always been the indisputable expression of the ideal of beauty of a productive age. The usual task of artists is to create new forms that reflect the artistic forms of their era, based on the forms they have inherited (Wagner, 2019). However, there is a shift between the history of architecture and plastic visual arts. This is even more pronounced today. This is because old styles are imitated much more carefully (Sitte, 2020). However, any criticism of architectural will, no matter how obsessively repeated, falls into romanticism if there is no formal style or method (Karatani, 2006).

The development curves of the different eras of the world do not necessarily coincide. People and generations differ from each other. Slower development in one place is faster in another. Directions can fork and one direction can evolve. The parallelism between the individual arts is not exactly a parallel (Wölfflin, 2018). Architecture is shaped by legislation, technology, preferences, tradition, and usage. Therefore, it provides assessments for the broader historical conditions under which they were produced and used (Leach, 2017).

This study aims to compare all globally significant or commonly recognized and used architectural styles and movements chronologically and regionally according to their motivation for their emergence to the present day. The aim is to examine both how the architectural styles concerned have influenced each other and how they have been influenced by each other, historical events, and regional conditions. The mutual influences of the styles and cultures relevant to architecture and cities are therefore presented in this article. An analytical approach to architectural cultural trends in a temporal and regional context has been chosen.

2. Material and Method

According to Ching et al. (2017), our post-19th-century tendency to view history through the lens of the nation-state often complicates our understanding of such global imagery. Moreover, the tendency of historians, and often architects, to nationalize, localize, regionalize, and even microregionalize history - perhaps as a significant act of resistance — can blind us to historical synchronicity and interconnectivity in the face of today's increasingly hegemonic global economy. For this reason, the study looks at architectural movements from a global scale and framework.

Important references in architectural history research have examined the history of architecture in terms of chronological and the same and differentiating characteristics of architectural styles. However, these references have mostly focused on the historical development of architecture, detailed descriptions of architectural movements, or examples thereof. These sources do not contain such a concentrated and comprehensive comparison of architectural movements. This study presents comparisons based on chronology and architectural trends. In addition, it presents the relationships of the architectural movements to each other, their interaction with the time periods of the movements, and the impact of the movements on possible future trends from a collective perspective. However, it provides a comprehensive and complete comparison of the architectural movements with their publication dates, origins, motives, brief characteristics, keywords, and events in their time period.

Various sources also made different assessments and classifications of periods and trends in different ways. One source classifies the classical tradition and the Renaissance, classicism, neoclassicism and the Enlightenment, the 19th century and industrialism (Collective, 2019). Monier (2006) examined them from primitive architecture through tradition, classical antiquity, the Middle Ages, modernism, neoclassicism and contemporary architecture. Dempsey (2019) has examined art movements such as avant-garde, modern art, new order, new disorder and beyond the avant-garde.

In this study, 76 globally significant or widely recognized architectural styles, 4 urban planning principles that influence architecture, 2 philosophical approaches in architectural theory, and 4 significant architectural practices are evaluated. In selecting architectural trends, preference was given to dominant trends that have been influential in most parts of the world, are still influential today, and have an important place in the history of architecture. In this context, the styles were examined in terms of the periods and places in which the architectural styles emerged. They were also compared in chronological order, taking into account the countries in which they emerged and the time periods. In this study, five steps were taken to analyze all the data.

First, to understand and evaluate the architectural styles in this study, the period in which they flourished, the region in which they emerged, the motivation, and the characteristics of the styles were analyzed in chronological order. Charts were created to examine all styles based on these categories that influence architectural styles (Table 1).

Based on the data obtained in the study and the information from the literature, the motivations and characteristics of the architectural styles were identified as follows. There are 11 motivations. The motivations of architectural styles: development, learning, necessity, reaction, religion, preservation, revitalization, architectural quest, recycling, cultural curiosity, and economy. There are 47 characteristics. The characteristics of architectural styles; monumental, classical, cultural, exotic, avant-garde, transitional, natural, historic preservation, blend, universal, modern, high-tech, traditional, eco-friendly, nostalgic, simple, asymmetrical, symmetrical, harmonious, geometric, proportional, chaotic, dramatic, functional, sustainable, climatic, practical, abstract, flexible, order, stylized, nostalgic, simple, dynamic, formal, structuralist, exotic, rational, irregular, transitional, unpredictable, eco-friendly, universal, pure, unique, novel, rich.

Secondly, the styles were evaluated according to the region in which they flourished. All countries in which architectural styles are native were represented with the numbers of how many styles emerged from the country of origin (Table 2). In this way, the distribution of all styles, the contribution of the countries to architecture, and the connection between them were determined. Thirdly, it showed how many architectural styles emerged in the same period and how they were distributed. (Table 3). Next, we examined how the styles were influenced by historical events, taking into account 50-year periods (Table 4). In other words, events that were influential worldwide during these fifty years and their effects were discussed.

Finally, after all major architectural styles are categorized and they are thoroughly reviewed on a global scale, assumptions are made on the future architectural styles based on the trends so far. Within this context, seven different future scenarios are prepared within the six determined titles of important historical events that occurred in the past, motivation, reaction, development, style characteristics, and countries. There is no specific statistical analysis to provide an answer to a question about future trends and styles. So, all the assumptions, frequencies of the data, and percentages are calculated and interpreted thoroughly to create the assumptions for scenarios according to all-time (all periods) information and the highest percentages of the data.

3. Overview of All Architectural Styles in the World

3.1. Chronological Overview

The styles are presented in Table 1 in chronological order according to their date of origin and the period in which they were used. Based on the evaluations, it can be seen that there are a certain number of countries that are home to some architectural styles that were very influential over a long period of time in wide areas. When styles are examined chronologically, symmetrical, detailed, and monumental features were considered significant in the earlier phases of history. Ancient Roman and Greek architecture, dating back centuries, is commonly considered a classical style. It is worth noting that the idea of classical architecture originated years ago, has been used for centuries, and is still as influential as ever. This shows that classical styles were designed in response to people's needs, taking into account perception, genius loci, perceived esthetics, and usability as well as functionality. Thus, architectural endeavors that respond to needs and expectations in an adaptive manner became

architectural styles and influenced large areas in different parts of the world. Moreover, today it can be seen that the new styles are far removed from details and esthetic aspects and focus more on functions and meeting needs. The newer styles are also more focused on the world, nature, and the environment (Wölfflin, 2018).

People developed and perfected all forms according to their abilities, expressions, and views until they corresponded to the ideal of beauty of their time. Each new style was based on the previous one. However, it combined new constructions, new materials, new tasks, and designs of people with the existing ones. In this way, the styles developed step by step until they created new forms (Wagner, 2019).

People do not only enjoy what is obvious. Because after a short time, people move away from what is obvious and demand what is never backed up with concrete information. Many eras have moved away from each other in this way (Wölfflin, 2018).

Table 1. Chronological list of architectural styles

(Aymelek & Yıldırım, 2015; Eleishe, 1994; Çizgen, 2012; Lampariello, 2018; Chapman et al., 2014; Designing Buildings, 2024; Aytıs & Polatkan, 2010; Taşdemir, 2011; Wilkinson, 2015; Margolin, 2003; Dempsey, 2019; Erdoğan & Sorguç, 2011; Yeler, 2012; Garlan, 1995; Craven, 2016; Asabere et al., 1989; Curtis & Curtis, 1996; Benovolo, 1977; Sadler, 2005; Söderqvist, 2011; Belluschi, 1955; Karakiewicz, 2006; Murphy, 2016; Wang & Yu, 2012; Bardzinska, 2017; Bridge, 2019; Howard E., 2019; Roth, 2019; Weston, 2015; Taricat, 2016; Erginöz, 2012; Hasol, 2019; Ching et al., 2017; Benyus, 2003; Çakmaklı et al., 2022, Turan et al., 2021, Vitruvius, 2018)

ARCHITECTURAL STYLES						
Style	**Date**	**Origin**	**Motivation**	**Motivation Category**	**Characteristics**	**Characteristics Category**
Ancient Egyptian	BC. 3000-200	Egypt	The form of ancient art evolved with time	Religion	Massive walls, flat roofs, posts and lintels, columns, sunbaked mud bricks and limestone, pyramids, temples, tombs, symbolic ornaments, plant motifs	Monumental, symmetrical, harmonious
Ancient Greek	BC. 590-25	Greece	Development in construction methods and use of permanent materials (stone) instead of ephemeral materials (wood, mudbrick, thatch)	Development	Orders (Doric, Ionic, Corinthian), columns and decorations (entablature, pediment), intricate details	Classical, structuralist, symmetrical, formal, harmonious
Roman	BC. 100-AD. 395	Italy	New construction techniques, large public buildings	Necessity	Arch, dome, and vaults	Classical, structuralist, symmetrical, formal
Byzantine	AD. 527-565	Eastern Roman Empire	Transfer of the capital from Rome to Byzantium and religious reasons	Religion	Realistic nature, use of brick instead of stone, heightened dome, square base, mosaics, ecclesiastical	Classical, structuralist formal rich, stylized
Moorish	AD.8th -16th C.	North Africa and the Iberian Peninsula	Developed as articulated Islamic architecture (mostly mosques and fortifications)	Development	Variety of arches (Horseshoe arches, crenelated arches), domes, intricate calligraphy, vegetative design, courtyards, decorative tilework, muqarnas (honeycomb vaulting)	Cultural

Romanesque	AD.11th C.	West Europe France Germany	Combining features of Byzantine and Roman. Romanesque architecture can be seen as a base for Gothic architecture.	Development	Large spaces, massive quality (solidity and strength), heavy, thick walls, small windows, dimly lighted, round arches, sturdy pillars barrel vaults, decorative (plants and flowers) arcading	Classical, structuralist, symmetrical, formal
Gothic	AD. 1122-1220	France	Religious reasons. In order to increase the influence of Churches	Religion	Large stained glass windows, pointed arches, ribbed vaults, flying buttresses, clustered columns, intricate sculptures, ornate decorations, stone structures, rose windows, pinnacles	Classical, structuralist, symmetrical, formal
Renaissance	AD. 1426-1521	Italy	Reaction against Medieval architecture	Reaction	Revitalization of the classical forms used by ancient Greeks and Romans, the façades of the buildings are symmetrical to the vertical axis, columns, arches, and domes	Classical structuralist, symmetrical, proportional, geometrical, formal.
Tudor	AD 1485-1558	England	Transition from Gothic to Renaissance	Development	Known as Perpendicular Gothic in elements of Renaissance architecture with a Gothic style. Brickworks and Half timbering, steeply pitched gable roofs, masonry chimneys, embellished doors, grouping of windows	Classical, structuralist, symmetrical, formal
Orientalism	AD. 15th C.	West Europe	Increasing interest in Eastern especially Chinese and Indian Architecture	Cultural curiosity	Chinese and Indian cultural architectural details are static, uniform, passive, emotional, chaotic	Cultural, exotic, rational, chaotic
Mannerism	AD. 1520-16th C.	Italy	Emphasis on the development of society. The search for answers to the problems of the period.	Development	Increased ornamentation, individuality, elegance, relief. It is based on the renaissance.	Modern, avant-garde
Palladianism	AD. 1556-1738	Italy	Influenced by Ancient Roman Architecture and Vitruvian ideas.	Revitalization	Strict classical style, proportional and symmetrical buildings, and porticos, Corinthian columns, decorative motives (masked faces or scallop shells), pediments over doors and windows	Classical, structuralist, proportional, symmetrical, formal
Baroque	AD. 1624-1746	Italy	Religious reasons and Reaction against religious reformation (Counter-reformation)	Religion	Exaggerated motion, clear details in order to produce drama and grandeur curving forms, massing of elements, new explorations of form, light and shadow, distortions and illusions, decorative elements	Classical, structuralist, symmetrical irregular, formal, dramatic
Industrial Architecture	AD. 1709-1797	The United Kingdom	Emerged during the Industrial Revolution.	Necessity	Design for industrial buildings, factories, warehouses, train stations, retail stores. New construction materials and metal frames	Transition, symmetry, classical

Rococo	AD. 1730-1764	France	Reaction against Baroque architecture	Reaction	Vertical lines were avoided, curved lines, soft angles, elegant and ornate furniture, ornamental mirrors, elaborate ornamentation (scrolls, vines, shell shapes), asymmetrical, ivory, pastel, and gold-based colours, airy and light	Natural, asymmetrical, classical, simple
Genius Loci	AD. 1731-1764	England	Reaction to Baroque architecture	Reaction	Designing according to the protective spirit of a place considering atmosphere, environment and nature.	Natural, asymmetrical, simple
Neoclassicism	AD. 1748-1817	Italy	Derived from palladian architecture as a reaction against the excesses of Rococo.	Reaction	Ancient Greek and Roman architecture, the grandeur of scale, sober colours, huge structures with symmetry, minimal decorations, columns (particularly doric), blank walls	Nostalgic, classical, simple, pure
Restoration	AD. 1786-1886	The United Kingdom	Emerged from the necessity of renovation for buildings	Necessity	Process of returning a building from the Medieval ages to its former state by using appropriate methods	Historical preservation, rich, natural
Romantic Arch Romanticism	AD 18th C.	England	A reaction against the rational and classical ideals of the style of architecture of the past	Reaction	Strong emotions. Exotic, simple, classic, and interesting shapes. Ancient-looking structures. Emphasis on folk art, nature and traditions	Exotic, classical, mixture
Polite architecture (The Polite)	Late 18th, Early 19th C.	England	Reaction against vernacular architecture	Reaction	Rejects traditional structure styles, national or international architectural fashions, styles and conventions, aesthetics, and decorative (bricks, metals, plastics, glass). Stylistic and romantic features.	Universal, mixture
Eclecticism Eclectic architecture	AD 19th and 20th C.	France, England, Germany	Around the same time period as Neo-Classical architecture. Born from the need for novelty	Necessity	Universal, a mixture of different architectural styles while each style reflects its features (harnessing of styles to create something novel and original), traditional motifs and styles, decorative, ornaments	Mixture, novel
Beaux-Arts	AD. 1803-1903	France	Taught at the Ecole des Beaux-Arts in Paris and emanated from France.	Learning	Classical and Neo-classical details, grandiosity, elaborate ornamentation, hierarchy, symmetry, arched doors and windows, subtle polychromy	Classical, structuralist, symmetrical, formal, order
Neo Gothic	AD. 1833-1889	England	Desire for Gothic style revitalization and reuse of the same features	Revitalization	Gothic architectural style (pointed arch, flying buttresses, tall buildings, etc.)	Nostalgic, classical, structuralist, symmetrical, formal
Art Nouveau New Art Stil 1900	AD. 1833-1907	England	Reaction against chaotic, formal, and imitative historicism	Reaction	Asymmetrical shapes, arches and curved forms, mosaics, stained glass, organic lines, linear rhythm, synthesis of ornament and structure	Natural, asymmetrical, simple, novel

Prefabricated Architecture	AD. 1836-1944	England	Emerged from the necessity of reducing the amount of labour, quick construction, less construction waste, standardization, and consistency,	Necessity	Panelized and skeletal structure, load bearing elements, precast cladding	Avant garde, simple
Victorian	AD 1837-1910	The United Kingdom	Evolved from Gothic style with the addition of French, Italian, Tudor and Egyptian styles	Revitalization	Dollhouse-like (gingerbread houses), bright colours, beautiful rather than functional, two-three storeys, wood/stone exterior, decorative trim, textured walls, one-story porch, steep/multi-faceted/mansard roof, towers	Asymmetrical
Art and craft	AD 1850-1900	England	Reaction against Industrialization. Inherent beauty of the material principle	Reaction	Revival of craftsmanship, inspired by nature, porches and fireplace, low pitched roofs, exposed beams, simplicity, utility and beauty	Cultural, nostalgic, simple, natural
Skyscraper	AD. 1854-1931	The United States	Increase of population density of urban areas led to the necessity of more buildings. Taller buildings brought the solution.	Necessity	Steel frame, structure of columns and girders, curtain walls, modern lines, ornate decorations	Modern, avant garde
Antiscrape	AD. 1877-1955	England	Reaction against exaggerated style of restoration	Reaction	Restoring historical buildings without scraping plaster with 'existing fabric', reverting to some point in its past	Historic preservation
Functionalism	AD 1896	The United States	Designing a building based on the purpose of it, nothing more	Necessity	Minimum or no ornamentation or decoration, display of raw material, design or craftmanship is not important, it is possible to design identical, industrially-produced elements as long as functional aspects are fulfilled	Simple, structuralist
Vienna Secession	AD 1897	Austria	Reaction against Conservative and Classical architecture, closely related to Art Nouveau	Reaction	Rejects historicism, no unifying characters, decorative and functional approaches, geometric forms, abstraction	Modern, avant garde, geometric, abstract
Modern Architecture (Modernist Architecture)	AD 1950s - Present	Europe and the United States	Influenced by the Enlightenment and a desire to break away from historical approaches	Development	Emphasis on volume, simplicity and clarity of forms, industrially-produced materials (steel, concrete, glass), minimal ornamentation	Avant-garde, functional, formal, flexible, simple, asymmetrical
Rationalism	AD. 1900-1928	Italy	It argues that Baroque architecture uses the concept of beauty by deceit and that classical beauty will be with honesty and rationality.	Reaction	It is distinguished by thoroughness and simplicity of form. The main patterns it uses are geometric shapes: straight lines, squares, rectangles.	Avant-garde, symmetrical, geometrical, formal, simple
Mimetic architecture (Novelty)	AD 1900-1950	The United States	When cars became widespread, roadside architecture started to be used for advertising to passing cars	Economy	Mimicking the function of the building or designing buildings in the shape of the product it is sold there	Modern, avant garde

Rustic	AD 1900-1950	The United States	Influenced by the American arts and crafts style, to be able to protect natural areas by building basic facilities	Necessity	Wooden, rough, aged, casual, natural, and organic materials (wood and stone), nature-inspired textures, earthy colours, unpretentious, heavy, dark, and lack of modern materials. Landscape and buildings are in harmony.	Natural, simple
Futurism	AD. 1909-1933	Italy	Motivated by antihistoricism	Reaction	Chromaticism, long dynamic lines, the notion of speed and motion, concrete, glass, and steel material, unique forms, sharp edges	Modern, avant garde, asymmetrical, dynamic, high-tech
Organic Architecture	AD. 1909-1944	The United States	Promoting harmony between man-made structures and the natural surroundings	Preservation	Designs are shaped by the nature of the component material, texture, or color. Harmony with the surrounding landscape not imitation of it, ornamentation as an integral part of the structure, clear forms. Shelter, space, nature, peaceful	Natural, asymmetrical, simple, unique, harmonious
Nationalist Architecture Neoclassical Turkish Style	AD. 1910-1930	Türkiye	Using local and old architectural examples by reviving them	Revitalization	Wide eaves, pointed arch, dome, column, muqarnas, tile covering	Nostalgic, classical, cultural
Cubism	AD 1912	France	Rejection of traditional techniques and preparation of Modernism. Displaying an object from many angles and points of views at the same time	Development	Transparency, asymmetry, sharp and clean lines, often cuboid shapes, subtle colors (brown or gray), modern materials, simple geometric exterior, open space interior	Natural, asymmetrical, geometric, formal, modern, simple
Expressionism	AD. 1913	Germany	Formal innovation inspired by natural biomorphic forms and new technologies	Development	Distorted forms, curved geometrics, vertical or horizontal dramatic effects, innovative building techniques using concrete brick, steel and glass, organic, sculpture-like and symbolic forms	Natural, asymmetrical, geometric, formal, avant-garde, simple, abstract
Constructivism	AD. 1913	Russia	After the Russian Revolution of 1917, new social demands and industrial tasks required of the new regime	Necessity	Incorporation of lines, cylinders, cubes and rectangles, steel structures, advanced technology, mechanistic dynamic, minimal, geometric forms, spatial	Avant garde
De Stijl Neo-plasticism	AD. 1916-1924	The Netherlands	Reaction against decorative excess. Aimed at the development of Modernism	Reaction	Straight lines, squares and rectangles, strong asymmetrical, primary colour with black and white, aesthetic balance	Modern, avant garde, harmony, geometric, asymmetrical, abstract
Purism	AD 1918	France	Born from a criticism of Cubism, Post-cubist style.	Reaction	Objective, universal, reject over embellishment, rational forms, simple and pure, geometric shapes, golden ratio	Mixture, simple, pure
Bauhaus	AD. 1919-1937	Germany	Composition of craftsmanship and technology. Pioneering	Development	Industrialised Arts and Crafts, function and directness over	Cultural, asymmetrical,

			modern design developed from Arts and Crafts		ornamentation, geometric forms, flat roofs, modern materials, simplified colours (white, gray and black), no decorative ornamentation, cubic shapes, some rounded corners and balconies	simple, practical
Organism Architecture	AD 1920-1950	Germany	It was born against eclecticism. It is the advanced stage of organic architecture.	Reaction	It creates architectural forms from the motion scheme. The interior is reflected in the exterior.	Modern, avant garde, asymmetrical, dynamic
International Style Internationalism	AD. 1923-1932	The United States, Europe	Search for an honest, economical, utilitarian architecture without decorations	Reaction	Steel and glass, less visible reinforced concrete, visually weightless, open interior spaces, flexible, regular, volume of space, rectilinear forms, light, no ornamentation or decoration	Modern, avant garde
Surrealism	AD 1924-1959	France	Emerged from the quest of illogical and startling effects	Architectural quest	The juxtaposition of uncommon objects, a combination of elements not normally found together	Modern, avant garde structuralist
Art Deco	AD. 1925-1934	France	Desire for a modern style for details and decorations	Development	Strong vertical emphasis, stucco, concrete, stainless steel, decorations with opaque plate glass, chrome and aluminum, everything points up, zigzag lines, lightning bolts, stylized images from nature (waterfalls, sunrise, palm tree leaves)	Modern, natural, asymmetrical, simple, geometric
Minimalism	AD. 1929-1988	Spain, Germany	Origin is based on Modernism from reduction, simplification and unification and influenced by Japanese architecture	Development	Simple design elements, no ornamentation or decoration, bare essentials, pure geometric forms, clean lines, repetition for a sense of order and unification, plain materials	Modern, avant garde, simple
Dymaxion	AD. 1930-1967	The United States	Invented to address shortcomings in home-building techniques and constructing sustainable autonomous mass-produce single family dwellings	Architectural quest	Geodesic dome, space frame energy-efficient, sustainable	Modern, natural, avant garde
Googie Architecture	AD 1930	The United States	A different interpretation of Futurism	Architectural quest	Tailed, boomerang shaped, angled and cantilevered structures and designs	Modern, avant garde, asymmetrical, dynamic
Streamline Architecture	AD 1930s	The United States	A new aspect of Art-Deco	Architectural quest	Long horizontal lines, curved forms. Especially transportation buildings.	Modern, simple, geometric
Brutalism	AD. 1954	England	Emerged during post-war era as part of reconstruction projects, a form of modernism	Development	Bare building materials (raw concrete and brick), visible structural elements over decorative design, fortress-like, visually heavy, monolithic, blocky, large-scale	Modern, avant garde structuralist

Organic abstraction	AD 1940-1950	France	The idea of rounded lines and shapes are more comfortable and familiar to people. Reaction against figurative art.	Architectural quest	Inspired by nature, abstract rounded lines and shapes, (smooth, free-flowing), diverse, conserving, flexible	Natural, Simple, sustainable
Biomorphism	AD 1950	England	Focus on the naturally occurring patterns or shapes	Learning	Inspired by nature, abstract, organic shapes, vaguely spherical	Natural, simple
Archigram	AD. 1958-1969	England	The aim was exploring extreme alternatives to urban design	Learning	Modular, colourful, high-tech, mobile and miniaturised alternatives, walking cities, living pod, instant city	Modern, avant garde
Metabolism	AD. 1958-1972	Japan	Post-war Japanese movement with the idea of buildings and cities should be designed imitating living beings (metabolisms)	Development	Flexible, modular, natural, practical, futuristic	Modern, natural, avant garde, simple
Land Art	AD. 1960s 1970s	The United States	Reaction to industrial development and technological speed. To make nature visible and to raise awareness about nature.	Reaction	Working in harmony with nature with artistic materials and transferring them from nature to art. digging in nature, burying in the ground, soil, manure, stone or human-made eco-friendly objects in the gallery space	Modern, avant garde, natural
Structuralism	AD. 1960-1972	The Netherlands	Reaction against Rationalism	Reaction	Logical pattern, modern, changeability, user democracy, space-structuring constructions, visible skeleton, flexible, extensible, liveable	Modern, avant garde
Regionalism	AD. 1960-1984	Anonymous	Reaction against internationalism of modern architecture (and lack of identity)	Reaction	Inspired by culture, design by knowledge related to a region, modern buildings materials and technologies. Regional climate and material	Cultural
Neo-Futurism	AD 1960s	The United States	Belief to a better future	Development	Impossible forms created with new materials and high tech	Avant-garde, modern, asymmetrical, dynamic, high-tech
Postmodernism	AD. 1963-1980	The United States	Reaction against austerity and formality of modern architecture (and lack of variety)	Reaction	Curved forms, decorative elements, asymmetry, bright colours, humor, fragmentation, complex	Modern, avant garde, asymmetrical,
Megastructure	AD 1964	Japan	A response to the need of larger spaces and big structures with multiple functions	Necessity	Modular, massive, repeating components, interconnected structures, a huge building or connected buildings	Avant garde
Neo Rationalism	AD. 1966-1993	Italy	Reaction against modernism and postmodernism	Reaction	Both historical and recent forms, shapes and plans	Mixture, universal
Vernacular Architecture	AD 1970	The United States	Emerged as the pure response to individual's or society's needs, architecture without architects	Necessity	Local and cultural structures and materials, often built by the users, trial-and-error testing, less specialization, tailored to wants and needs, low-tech	Cultural, climatic, functional

Neo expressionism	AD 1970	West Europe and The United States	Reaction against Minimalism and based on expressionism	Reaction	Asymmetrical, sculptural, innovative materials and methods, unconventional roofs, vivid colors and contrasts, abstraction, motion and emotion, recurring formal themes, organic and non-geometric forms	Traditional, simple
Earthship	AD 1970s	The United States	Recycling and conservation of energy	Recycling	Recycling materials (old tires, soil, stone, glass bottles etc.) and renewable energy sources (solar panels, wind turbine, water purification etc.)	Natural, simple
Green Architecture (Green Design)	AD. 1970-1993	The United States	Aiming green and sustainable architecture	Preservation	Eco-friendly, natural, local materials, sustainable, efficient use of space, using natural resources, renewable energy...etc	Natural, asymmetrical, simple
Kinetic Architecture	AD. 1971-1985	The United States	The idea that architecture should develop dynamic solutions against the stagnation of architecture.	Reaction	Products that are dynamic, adaptable, can be added, reduced or even eliminated.	Modern, avant garde, dynamic
High-Tech	AD. 1971-1992	The United Kingdom	To enhance Modernist architecture, link between modern and postmodern architecture	Development	High-tech, avant-garde, functional as well as aesthetics, sheer surfaces, lightweight materials, skeletal structures, colourful pipework	Modern, avant garde, asymmetrical, high-tech
Alternative Architecture	AD. 1972-2004	Mexico	Aiming sustainability and environmentalism, balance between nature and design	Preservation	Using recycled material, economical, different from accepted standards, national	Environmentalist approach, natural, simple, sustainable, eco-friendly
Deconstructivism Neo-modernism Post-structuralism	AD. 1977-1989	The United States	Opposed to traditional perception of architecture and ordered rationality geometry	Reaction	Fragmentation, non-rectilinear shapes, distorted and dislocated elements, surface manipulation	Modern, avant garde, asymmetrical, unpredictable
Biomimicry	AD 1990s	The United States	Inspired by nature not only forms but also processes, models and systems	Learning	Nature-inspired, natural, based on systems, sustainable, imitate nature in terms of systems and processes	Environmentalist approach, natural, simple
Parametricism	AD 1990s	The Netherlands The United States	A successor to Modern and Postmodern architecture.	Development	Design by numbers and algorithms	Avant-garde, modern, geometric, high-tech
Blob (blobitecture)	AD 1995	The United States	Computer-aided design tools allowed flexible and wide design exercises	Development	Curved and rounded buildings, organic and aerodynamic forms, soft, free-flowing, freeform surfaces, pre-fab plastic, modern, inflatable buildings	Modern, avant garde, asymmetrical
Parasitic Architecture	AD 2015-Today	The United Kingdom	Developed to offer solutions to urban problems in densely populated areas by attaching buildings to existing larger ones	Development	Low-cost, attached to larger structures, pod-like additions, scrap material, efficient space use, inclusive, feasible, affordable (for disadvantaged), small scale,	Simple

PRINCIPLES OF URBAN PLANNING THAT INFLUENCE ARCHITECTURE						
Principles	**Date**	**Origin**	**Motivation**	**Motivation Category**	**Characteristics**	**Characteristics Category**
The City in the Landscape/ Townscape (The New City)	AD. 1944-1961	England	Emerged as an alternative to Modernist style	Preservation	Aesthetic subjects and systems, organic cities using aesthetic	Natural, asymmetrical, Simple
Segregated Planning	AD 1929	The United States	Necessity to separate pedestrian and vehicle traffic and ensure pedestrian safety	Architectural quest	Causeway/elevated streets, covered pedestrian crossings, pedestrian and functional areas away from vehicle traffic	Avant garde
Garden City	AD. 1875-1919	The United Kingdom	Idea of creating self-sufficient cities with greenbelts, proportionate areas of residences, industry and agriculture	Necessity	Large scale planning, limited size cities, personalization of homes. Open spaces, public parks, radial pattern, central civic institutions, rural belt (agricultural recreational area), peripheral ring for industry	Natural, symmetrical, geometric, simple
City Beautiful	AD. 1893-1909	The United States	Shaping American urban landscape similar to European manner	Necessity	Balanced composition, recreational areas, open spaces, diagonal boulevards, limited building heights	Classical, structuralist, symmetrical, formal
PHILOSOPHICAL APPROACHES IN ARCHITECTURAL THEORIES						
Theories	**Date**	**Origin**	**Motivation**		**Characteristics**	
Contextualism	AD 1960	The United States	Reaction architecture		Structure should be designed (form and features) in response to urban and natural environments, adaptive, genius loci, context-appropriate architecture	
Feng Shui	Since BC. 4000	China	To situate the human-built environment with an invisible form of energy exist in nature or to harmonize living spaces with the environment.		The belief that everything has energy. Inspiration is nature. Design ensures movement and flow of energy. Five elements (fire, water, tree, metal, soil) and colors, environment, directions, history, forms and geographical factors in nature are important in this philosophy.	
SIGNIFICANT ARCHITECTURAL PRACTICES						
Practices	**Date**	**Origin**	**Motivation**	**Motivation Category**	**Characteristics**	
Grand Tour	AD. 1705-1840	Europe, The United States	Privileged Upper-class young Europeans (architects, scholars, writers…) travelled across Europe in search of art and cultural experiences as part of their education.	Learning	Cultural exchange, Impressions and thoughts on Classical art and architecture were recorded through painting and sketching	
The Picturesque	AD. 1774-1812	England	Reaction against palladian architecture and neoclassicism	Reaction	Asymmetrical, natural design approach, combined with landscape, awe-inspiring, irregularity of form, colour and light, cottages	
Taste	Early AD 18th C.	England	Simplicity and purity of classical architecture influenced this style. Revitalization of Palladianism	Revitalization	Successful design is possible with morality and specific artistic features. Parallel to Palladianism. Sense of grandeur	

Heritage	AD. 1894-1984	Greece	Emerged to preserve structures with their original form	Preservation	Made law

3.2. Country-specific Review

All important architectural styles that come into question are classified according to the countries of origin of the styles (Table 2). This shows how many styles can be found in which countries. This is important because it provides information on how countries have contributed to the history of architecture and its development. It also provides an opportunity to examine the correlation between the number of architectural styles and the countries' level and pace of development. At the same time, the architectural styles, their motivations and construction techniques provide information about the needs, expectations, lifestyles and cultures of the countries in which they originated.

When looking at the table, it can be seen that countries with a deep-rooted architectural history follow either a classical or traditional approach. Other countries with more recent architectural traditions, on the other hand, follow a trend towards modern styles. In particular, the United States, which is home to the most styles in this context, is the country where most styles are considered modern. However, countries that are home to only one or a few styles also have a tendency to develop modern features. Table 2 shows that most styles originate from the United States, the United Kingdom and England. France and Italy follow them in terms of numbers. It should be noted that styles that are local and have not spread to other places or countries have not been included in this evaluation. It is worth noting that all of the major and influential architectural styles originated either in the United States or in one of the European countries. The United Kingdom and England have adopted more natural trends.

Table 2. Number of styles by country of origin of architectural styles (Original)

Country	Styles			Dominant Characteristic
Eastern Roman Empire/1 style	Byzantine			Classical
Egypt/1 style	Ancient Egyptian			Monumental
Greece/1 style	Ancient Greek			Classical
France/10 styles	Eclecticism	Surrealism	Beaux-Arts	Classical
	Gothic	Art Deco	Cubism	
	Organic abstraction	Rococo	Purism	
	Romanesque			
Italy/7 styles	Palladianism	Neo Rationalism	Roman	Classical
	Neoclassicism	Mannerism	Rationalism	
The United States/25 styles	Modern Arch.	Green Arch.	Postmodernism	Modern
	Segregated Planning	Biomimicry	Neo expressionism	
	Skyscraper	Blob (blobitecture)	Deconstructivism	
	City Beautiful	Contextualism	Organic Arch.	
	Functionalism	Vernacular Arch.	Dymaxion	

	Mimetic Arch.	International Style	Parametricism	
	Earthship	Neo-Futurism	Streamline Architecture	
	Googie Architecture	Rustic	Kinetic Architecture	
	Land Art			
The United Kingdom/7 styles	Industrial Arch.	High-Tech	Garden City	Preservation, Natural
	Victorian	Restoration	Brutalism	
	Parasitic Architecture			
England/13 styles	Genius Loci	Archigram	Prefabricated	Natural, Classical
	Romanticism	Townscape	Arts and Crafts	
	Polite architecture	Tudor	Anti-scrape	
	Biomorphism	Eclecticism	Neo Gothic	
	Art Nouveau			
Europe/6 styles	Orientalism	Internationalism	Neo expressionism	
	Romanesque	Modern Architecture	Byzantine	
The Netherlands/3 styles	De Stijl	Structuralism	Parametricism	Modern
Germany/6 styles	Bauhaus	Minimalism	Expressionism	Modern
	Eclecticism	Romanesque	Organism Architecture	
Türkiye /1 style	Nationalist Architecture			Classical
Russia/1 style	Constructivism			Modern
Spain/1 style	Minimalism			Modern
Japan/2 styles	Metabolist Arch.	Megastructure		Modern
Mexico/1 style	Alternative Arch.			Natural
Austria/1 style	Vienna Secession			Modern
North Africa/1 style	Moorish			Cultural
Chine/1 style	Feng-Shui			Harmonious
Anonymous/1 style	Regionalism			Cultural

Table 3 shows that almost all styles have emerged in the last 500 years. If we take a closer look at the last 200 years, we see that most of the styles emerged during this period. The most remarkable observation in this evaluation is that the countries that lead the architectural foundations, traditions, and trends for a millennium, both before and after Christ, do not have much influence on the later improvement of architecture.

Table 3. Country-specific architectural styles by time period (Original)

Time period	Number of styles	Country
BC	2	Egypt, Greece
0-500	1	Italy
500-1000	2	Eastern Roman Empire, North Africa
1000-1500	5	France, Italy, England, Germany, Europe
1500-1600	2	Italy
1600-1700	1	Italy
1700-1800	7	Italy, France, UK, England
1800-1900	11	France, US, UK, England, Austria, Germany, Europe
1900-1950	21	Italy, France, US, UK, England, The Netherlands, Türkiye, Russia, Germany, Spain, Europe
1950-2000	23	England, US, UK, Italy, Mexico, Japan, Anonymous, Europe, The Netherlands
2000-2020	1	UK
TOTAL	**76**	

3.3. Historical and Chronological Review

In order to be able to examine the effects on architecture, periods of 50 years are defined, and important historical events of this time are noted. Finally, it is examined whether there is a connection between the architectural styles and the historical events in the same period. Table 4 shows the defined time periods and important historical events and their possible influences on the styles and the relationships between them are examined below.

It is thought-provoking to confront one age with another. Nevertheless, each public sphere has a unique revelation of its national virtues in its art history (Wölfflin, 2018).

Table 4. Influential historical events and architectural styles in the same period (Original)

Population *(million)*	Time Period	Style	Country	Important Historic Events
14-100	BC 3000-200 BC 590-25	Ancient Egyptian Ancient Greek	Egypt Grece	BC 9000: Gobekli Tepe was built BC 3000-AC 476: Ancient Age BC 3500 The first wheeled vehicle BC 3500 The invention of writing BC 3000-2000: Stonehenge was constructed. BC 1250 The Abu Simbel was built. BC 490: Battle of Marathon, Greeks resisted Persian invasion and survived Foundation of Western civilization was laid. BC 327: Alexander the Great launched Indian campaign and his empire extended to the Indus River, Asian culture and European classics were linked. BC 202: Hannibal was defeated by the Romans. The Roman culture and civilization expansion BC 27: The Roman Empire was established. BC 1: Arches, vaults and domes were constructed after the introduction of cement (Rome) BC 1 Vitruvius' book, De architectura
180	0-100	Roman	Italy	1.C: Christianity began 165-180: Antonine Pandemic

190-200	500-600	Byzantine	Eastern Roman Empire	200-700: Migration Period in Europa 200-1519: Classic and Postclassic Era 300-900: Dark Age 476: Beginning of European Middle Ages (Fall of the Western Roman Empire) 541-542: Plague of Justinian 7.C: Islam began
210-220	700-800	Moorish	North Africa and the Iberian Peninsula	735-737: Variola pandemic in Japan 750-1300: Islamic Golden Age
265-320	1000-1100	Romanesque	Europe France Germany	
320-340	1100-1150	Gothic	France	900: Agriculture was introduced into Europe 1000: Growth of European towns 1088: The first modern university was founded in Italy Bologna
350-385	1400-1450	Renaissance	Italy	1337-1453: Hundred year wars 1347-1351: Black plague 1350-1650: The Renaissance in Italy 1440: Printing Press 1453 or 1492: End of the Middle Ages and the Modern era began (1453 Fall of Constantinople/ 1492 Christopher Colombus discovered America)
		Orientalism	Europe	
385-480	1450-1550	Tudor	England	16-18.C: Age of Discovery 16.C: The Protestant Reformation
	1500-1550	Mannerism	Italy	
480-545	1550-1600	Palladianism	Italy	1520: Variola pandemic in the world
545	1600-1650	Baroque	Italy	1618-1648: Thirty Years Wars 1629-1631: Plague in Italy 1642-1648: British Civil War 1640-18.C: Scientific Revolution 1665: Plague in London
610-720	1700-1750	Industrial Arch..	UK	1650-1780: The Enlightenment Age 18-19.C: Industrial Revolution 1700-1950: Age of Imperialism
		Rococo	France	
		Genius Loci	England	
		Neoclassicism	Italy	
720-900	1750-1800	Restoration	UK	1750-1917: Age of Revolution 1765-1783: American Revolution 1776: Declaration of Independence in The United States. 1789: French Revolution 1775-1783: American War of Independence 1789: End of New/Modern era and Beginning of Contemporary age
		Romanticism	England	
		Polite Arc.	England	
900-1.200	1800-1850	Eclecticism	France, England, Germany	1790-1850: Romantic Era 1817-1923: Cholera pandemic
		Beaux-Arts	France	
		Neo Gothic	England	
		Art Nouveau	England	
		Prefabricated	England	
		Victorian	UK	

1.200-1.625	1850-1900	Skyscraper	US	1853: The invention of the elevator 1885: The first car with oil/gasoline was produced by Benz. 1885: 3. Plague pandemic 1861-1865: American Civil War 1880-1945 Machine Age Late 1800's: Yellow fever pandemic 1889-1890: Russian Flu
		Arts and Crafts	England	
		Garden City	UK	
		Antiscrape	England	
		City Beautiful	US	
		Vienna Secession	Austria	
		Functionalism	US	
1.625-2.500	1900-1950	Futurism	Italy	1901- present: Age of Oil 1914-1919: World War I 1918-1919: Spain Flu 1918-1939: Inter-War Era 1919-1929: Roaring Twenties 1929-1939: Great Depression/World Economic Crisis 1939-1945: World War II 1940's: Jet Age 1945- present: Atomic Age 1945: The Atomic Bombing of Hiroshima and Nagasaki 1945-1991: Cold War 1950- present: Nuclear Age 1950- present: Digital Revolution 1957- present: Space Age 1971- present: Information Age 1996- present: Social Age 2001-present: Big Data Age
		Organic Arc.	US	
		Expressionism	Germany	
		De Stijl	The Netherlands	
		Constructivism	Russia	
		Bauhaus	Germany	
		International S.	US	
		Art Deco	France	
		Minimalism	Germany/Spain	
		Dymaxion	US	
		Brutalism	UK	
		Modern Arc.	Europe/ US	
		Rustic	US	
		Townscape	England	
		Purism	France	
		Segregated Planning	US	
		Organic Abstraction	France	
		Mimetic Arc.	US	
		Cubism	France	
		Surrealism	France	
		Nationalist Architecture	Türkiye	
		Organism Architecture	Germany	
		Googie Arc.	US	
		Streamline Arc.	US	
		Rationalism	Italy	

2.500-6.115	1950-2000	Biyomimikri	US	1957-1958: Asian flu 1968-1970: Hong Kong flu 1969: First human landing on the moon 1981-present: HIV 1989: Tearing Down of The Berlin Wall
		Archigram	England	
		Metabolism	Japan	
		Structuralism	The Netherlands	
		Regionalism	Anonymous	
		Neo-Futurism	US	
		Postmodernizm	US	
		Neo rationalism	Italy	
		Green Arc.	US	
		High-Tech	UK	
		Alternative Arc	Mexico	
		Deconstructivism	US	
		Biomorphism	England	
		Contextualism	US	
		Megastructure	Japan	
		Vernacular Arc.	US	
		Earthship	US	
		Neo expressionism	Europe/ US	
		Blob	US	
		Kinetic Architecture	US	
		Land Art	US	
6.115-7.780	2000-2020	Parasitic Architecture	UK	2002-2003: SARS pandemic 2009-2010: Influenza pandemic 2011: World Trade Center Attack 2011: Great East Japan Earthquake 2014-2016: Ebola epidemic 2015- present: MERS epidemic 2020: COVID 19 pandemic 2020: Great fire in Australia

Analyzing the time before the birth of Christ, it could be found that outstanding buildings were erected. It is still a mystery how these structures could have been built with the technology and knowledge of the time. The ancient Greeks, who built fascinating structures, were concerned with safety and struggled to maintain their existence, so they may have ushered in a new era for the fate of architecture. The architectural features of that time are still considered captivating in the conditions we have now, thousands of years later. At the same time, the book ‘de Architectura’ was written by the Roman architect and military engineer Vitruvius and published in ten books on architecture. In these books, he explains architecture and the importance of the factors that influence architecture esthetically and practically, such as science, geometry, mathematics, meteorology, and so on.

As the Roman Empire reached its peak, the magnificent architecture of this period and its influences began to strongly influence the trends and styles that followed for centuries. Similarly, Gothic architecture emerged in the Middle Ages in the wake of increasing urbanization in Europe. It could be interpreted that the Gothic style was adopted as an expression of the rise of European cities. When the Renaissance movement began in Europe, art, and science reconnected and focused on people and their way of life. This cultural and artistic enlightenment inevitably had an impact on architecture and led to the Renaissance style and designs that were oriented toward the human dimension. The realistic and rational perspective led to rationalism in the 17th and 18th centuries. Also, during the Industrial Revolution, especially between 1700 and 1750, there was a strong diversification compared to earlier styles. Industrial architecture also emerged to meet the needs of this period.

In the years between 1750 and 1800, when revolutions took place in Europe and the United States, countries underwent many changes and transformations. During this period of radical change and development, emerging styles rejected the previous ones, and local trends or revitalizations of earlier styles began to emerge under the influence of their time.

Styles based on urban and regional development stand out clearly in the 50 years, especially between 1850 and 1900, which could be explained by the impact of three major epidemics in three different regions of the world and the consequences of the questioning of people's living conditions. In addition, the number of skyscrapers and multi-story buildings increased greatly, especially after the invention of the elevator and its widespread use in the industrial age.

Architecture was very dynamic and progressive, especially in the years 1900-1950, a period of 50 years in which most (twenty-two) architectural styles emerged. Nature and environmental, futuristic approaches became one of the key factors of the styles of this period. The designs were mostly simple, plain, and rather functional. The period between 1950 and 2000 is the second period in which most architectural styles emerged after the first 50-year period. The styles in this period were also related to nature and the environment and were more functional than the previous ones. It should be noted that the number of new architectural trends has decreased in recent times. This could be interpreted to mean that architecture has entered an unproductive resting or digestive phase after the rapid and extremely productive period of the last century.

The growing population also influences the styles and trends in the different eras. The more the population grew, the more styles emerged. As the population grew, functionality began to take precedence over esthetics. The peak in the number of styles that emerged was observed during the rapid population growth in the last century.

3.4. Future Assumptions and Scenarios

Architecture must be able to adapt to modern humans. To this end, all modern forms must meet the new requirements and new materials of our time. However, modern forms must take into account the practical and uninterrupted development of humanity as well as technical and scientific achievements (Wagner, 2019).

Although it is not possible to have exact ideas about the characteristics of future styles and how they will look and function, it might be possible to make some assumptions. Many factors influence the diversification of architecture. Examining these factors from the past to the present, we can make some assumptions, which are shown in Table 5.

Table 5. Potential future architectural style assumptions (Original)

Scenario	Date	Origin	Motivation	*Motivation Category*	Characteristics	*Characteristics Category*
1						*Natural* *Eco-friendly* *High-Tech* *Mix*

2				*Reaction* *Development* *Necessity*		
3	2020-near future		Epidemics, environmental disasters, advances in science and technology			
4						
5					Avant-Garde Modern Natural	
6		US UK France				
7				*Reaction* *Development* *Necessity*	Avant-Garde Modern Natural	*Natural* *Eco-friendly* *High-Tech* *Mix*

Scenario 1: Event-based scenario according to influences;

Looking at recent history, diseases, and catastrophes that lead to changes in architecture stand out. Therefore, it could be assumed that future styles will be influenced by the same reasons and evolve to provide solutions to the problems associated with disasters. The state-of-the-art technology and scientific progress would also affect the understanding of future styles. From this point of view, the following styles could have characteristics: “natural”, “environmentally conscious", “high-tech” or a “mixture” of all of these.

Scenario 2: Motivation-based scenario;

The causes of all architectural styles, and how they emerged and changed over time, provide background information. Analyzing this information would allow us to make assumptions about the styles to come. Earlier styles usually arose out of needs, emerged in response to other styles, or developed versions of them. According to the data collected, the motivations of the styles can be identified in a ratio of 27.85% ‘reaction’, 21.52% ‘development’, and 16.46% ‘necessity’. In this data analysis, the top 76 architectural styles, 4 urban planning principles that influence architecture, 2 philosophical approaches in architectural theory, and 4 significant architectural practices were considered, so it seems possible that future styles will emerge from one of the three styles above and follow the same trajectory.

Scenario 3: Reaction-based scenario;

Throughout history, many styles have emerged in response to other styles or to significant events. Thanks to the contrasts, different perspectives, and different construction techniques have been used. With this in mind, it is not difficult to suspect that a new style will emerge in the near future in response to recent events in the styles in use today. A look at recent events and trends shows that they are quite diverse. It is therefore to be expected that future styles will be just as diverse as the events and styles in question.

Scenario 4: Development-based scenario;

All architectural styles influence each other directly or indirectly. This influence sometimes served as a model, other times a style was modified by improving the features currently in use. The newer styles offer a range of different features, so in the future, it is possible to develop new styles from those already in use by redesigning them.

Scenario 5: Feature-based scenario;

When taking a closer look at the styles, it could be characteristics of them vary to a great extent realized that they differ greatly in their features. Some also have common features that share ideas and views.

Throughout history, the characteristics of the styles can mostly be categorized as 'avant-garde' with 34.17%, 'modern' with 27.85% and 'natural' with 22.78%. Because of these values, it can be assumed that the following styles have one of these most common characteristics.

Scenario 6: Country-based scenario;

Throughout the history of architecture, 19 countries have pioneered and actively contributed to the development of the main influential styles, as they are home to most of these styles. The countries with a share of 30.66% in the US, 26.66% in the UK (16% in England, 10.66% in the UK) and 12% in France most often serve as the origin of these styles. For this reason, it could be said that the following styles may come from the above-mentioned countries in the future.

Scenario 7: Pandemic scenario;

The impact of the virus on public space as well as on architecture at various scales and urban and regional planning could not be ignored. Some metropols have already converted their streets into cycle and pedestrian paths to reduce pollution and encourage more physical activity. Some leading architecture firms are focusing on the solutions for future post-COVID19 designs, with Bahadursingh (2020) and Harrouk (2020) suggesting that post-pandemic cities and buildings will look different from what we are used to. In the future, it is envisaged that antibacterial materials (such as copper) could become mainstream, regardless of cost. While gardens, balconies and terraces would increase to encourage green spaces, interiors would become more minimalist and wholesome. Floor plans would look completely different as adaptable, flexible, and lightweight designs are favored, and some ideas have already emerged. Adjustable walls, screens, and partitions would make it possible to turn a room into emergency accommodation. Sustainability has become one of the key points of all newer architectural styles. Self-sustaining urban agriculture, the planting of edible plants and the use of hydroponics, vertical green gardens (without pesticides) for ventilation and fresh air supply are on the agenda for future developments. Adhering to design principles to promote health and well-being in an ergonomic way is more important than ever in architecture. It is envisaged that automatic doors, voice-controlled elevators, cell phone-controlled hotel rooms, hands-free lights, and temperature control will be increasingly used to avoid further human contact and contribute to adaptive reuse approaches (Bahadursingh, 2020; Harrouk, 2020).

4. Conclusion and Suggestions

After the initial frenzy of art was over, people realized that everything that was created had no justification and was not appropriate at all. All these so-called styles were completely correct for their time. However, it was recognized that it was necessary to look for a new form of expression that was suitable for our modern times. It was recognized that the works of art that were created were the result of archeological studies (Wagner, 2019).

In the first centuries, classical approaches were preferred. Nowadays, it is notable that styles are taking a more eco-friendly approach by using modern, contemporary and natural infrastructures and features. It should also be noted that culture plays an important role, especially in recent decades. Some styles have been revitalized and inspired by the latter. It should be noted that the influences of each style are still present today and examples of each style can be found in different parts of the world. This is the reason why earlier architectural styles can still find their place years later when they are revived in different time periods. This could be taken as a sign that the right decisions were made when the styles, trends and techniques were created at the time the styles were created.

All the major architectural styles mentioned in this article originate from 17 different countries (Figure 1). From a global perspective, it is interesting to note that only a few prominent countries have developed important architectural styles that have been adopted in most countries. In ancient times, the designs of buildings were based entirely on human experience, and the buildings were magnificent and ornate. Even today, some of these buildings are still standing after all these years. Over time, the characteristics of the styles changed from classical styles to more modern, even futuristic and sleek styles. It has evolved from esthetics to functionality with necessities. Nowadays, a more sustainable and flexible approach is being adopted. The growing population is in direct proportion to the increase

in needs and demand. Due to increasing environmental problems, architecture has been forced to take a more sustainable approach to do its part.

There are various motivations for the emergence of styles, which are shown in Table 6. The most common motivation is ‘reaction’ to all major styles. This reaction is sometimes directed against another style or against a historical event that took place during the same period. The second most common motivation is ‘development’. This development can either be the evolution of earlier styles or alternatives in terms of esthetics and functionality or advances in building techniques and materials. Development is followed by ‘necessity' in terms of the frequency of motifs. These necessities usually relate to functional needs.

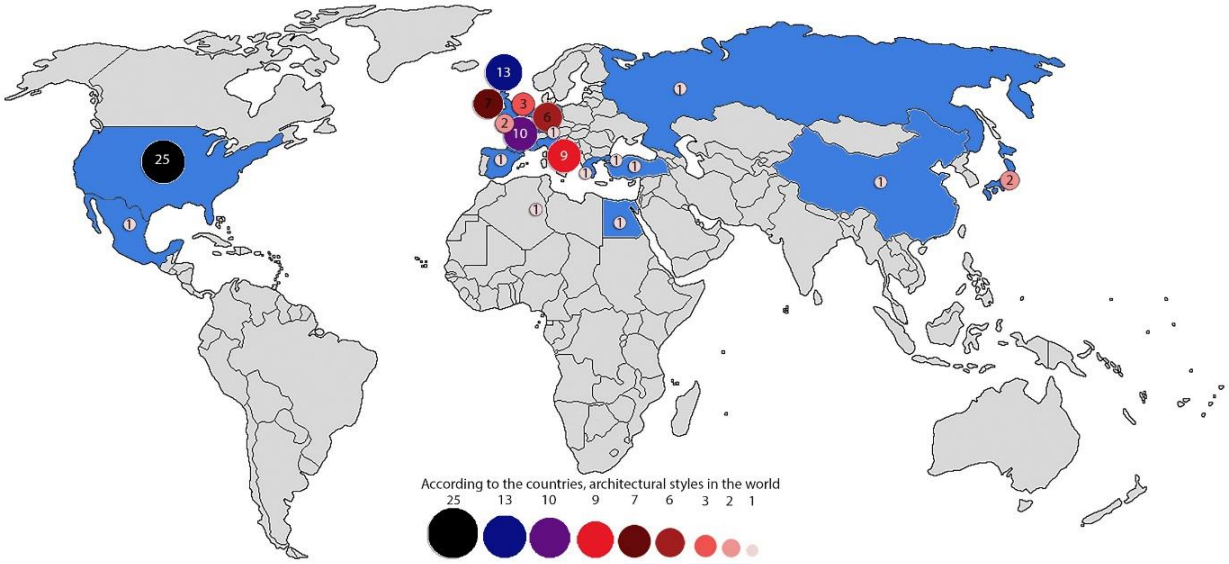

Figure 1. Depending on the country, architectural styles in the world (Original)

Table 6. Motives of architectural styles at all times (Original)

Motivation	Number of styles	Motivation	Number of styles
Development	18	Revitalization	5
Learning	5	Architectural quest	6
Necessity	13	Recycling	1
Reaction	24	Cultural curiosity	1
Religion	4	Economy	1
Preservation	5		

The characteristics of the styles are quite diverse and are shown in Table 7. Most styles are avant-garde, i.e. they brought novelty and originality to structures and adopted design ideas that were ahead of their time. The ‘modern' styles are the second most common, as functionality has been emphasized over esthetics in recent years and sleek designs have become increasingly popular. ‘Natural’ is another important feature. The reason for this popularity could be the sustainable design approach that has been adopted over the last century. It is worth noting that features that are categorized as ‘classic' and are still making an impact in different parts of the world are not as popular as one would have expected.

Table 7. Characteristics of architectural styles throughout the ages (Original)

Style feature	Number of styles	Style feature	Number of styles	Style feature	Number of styles
Monumental	1	Mixture	5	Universal	1
Classical	17	Universal	1	Pure	2
Cultural	7	Modern	27	Unique	1
Exotic	1	High-Tech	4	Novel	2
Avant-Garde	31	Traditional	1	Rich	2
Transition	1	Environmentalist approach	2	Climatic	1
Natural	21	Nostalgic	4	Practical	1
Historical preservation	2	Simple	29	Abstract	3
Asymmetrical	21	Dynamic	5	Flexible	1
Symmetrical	15	Formal	16	Order	1
Harmonious	1	Structuralist	15	Stylized	1
Geometric	10	Exotic	1	Unpredictable	1
Proportional	2	Rational	1	Eco-friendly	1
Chaotic	1	Irregular	1	Functional	2
Dramatic	1	Transition	1	Sustainable	2

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Author Contribution and Conflict of Interest Declaration Information

Author 1 contributed 60% and Author 2 contributed 40%. There is no conflict of interest.

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Unveiling Contemporary and Thrilling Waterfront Design Principles through Theoretical and Case-Based Investigations

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Abstract

This study delves into contemporary waterfront architecture, with a strong emphasis on sustainability, community engagement, and economic revitalization. By seamlessly blending historic preservation with innovative design, it champions cultural authenticity. Environmental stewardship plays a pivotal role in achieving sustainable development. The research meticulously examines award-winning waterfronts in cities spanning continents, considering diverse categories such as historical sites and commercial activities. Six notable waterfronts underwent rigorous analysis: Vancouver Waterfront Park (USA), Albarrada Waterfront (Mompox, Colombia), Belgrade Waterfront (Serbia), Victoria & Alfred Waterfront (South Africa), Udaipur Waterfront (India), Waterfront Tavern (Australia). This comprehensive study contributes significantly to our understanding of urban planning and architecture, providing practical recommendations for ambitious waterfront projects. It also underscores the economic, cultural, and environmental benefits inherent in these transformative endeavors.

Keywords: *Waterfront, waterfront design theories, contemporary waterfronts, thrilling waterfronts.*

Teorik ve Vaka Bazlı Araştırmalar Yoluyla Çağdaş ve Heyecan Verici Sahil Tasarım İlkelerini Ortaya Çıkarmak

Öz

Bu çalışma, sürdürülebilirlik, toplum katılımı ve ekonomik canlandırma konularına güçlü bir vurgu yaparak çağdaş sahil mimarisini detaylıca incelemektedir. Tarihi çevreyi yenilikçi tasarımla harmanlamada kültürel özgünlüğün korunmasının önemi vurgulanmaktadır. Bu çalışma ile ayrıca sürdürülebilir kalkınmanın sağlanmasında çevre yönetiminin önemli rolü belirtilmektedir. Araştırmada, farklı kıtalarda bulunan şehirlerdeki ödüllü kıyıların seçilmesinde tarihi yerler ve ticari faaliyetler gibi farklı kategoriler göz önünde bulundurulmuştur. Altı önemli kıyı bölgesi analize tabi tutulmuştur: Vancouver Waterfront Park (ABD), Albarrada Waterfront (Mompox, Kolombiya), Belgrade Waterfront (Sırbistan), Victoria & Alfred Waterfront (Güney Afrika), Udaipur Waterfront (Hindistan), Waterfront Tavern (Avustralya). Bu kapsamlı çalışma, iddialı kıyı projeleri için pratik öneriler sunmakta olup kentsel planlama ve mimari anlayışımıza katkıda bulunacak öneriler sağlamaktadır. Aynı zamanda bu dönüştürme çabalarının doğasında olan ekonomik, kültürel ve çevresel faydaların da altı çizilmektedir.

Anahtar kelimeler: *Kıyı, kıyı tasarım teorileri, çağdaş kıyılar, heyecan verici kıyılar.*

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1. Introduction

This study delves into the dynamic field of contemporary waterfront design theories. Waterfronts, serving as vital interfaces between land and water (Üzümcüoğlu & Polay, 2022a), hold immense potential for urban development (Jun, 2023), cultural enrichment (Fernandes et al., 2017), and economic growth (Situmorang et al., 2023). As these spaces undergo transformative changes, there is a growing need to comprehensively understand and evaluate the principles guiding their design and development.

A thorough examination of existing literature forms the foundation of this study. Contemporary waterfront design theories (Üzümcüoğlu & Polay, 2022a; Cialdea & Pompei, 2022; Garcia, 2021), encompassing sustainability (Abd El-Tawab et al., 2020; Girard, 2013; Zaki & Hegazy, 2023), community engagement (Dova et al., 2022; Green, 2023; Zakirzianova, 2021), mixed-use development (Latip et al., 2012; Sealey et al., 2021), cultural preservation (Fernandes et al., 2017; Gunay & Dokmeci, 2012; Tian & Yang, 2020), and innovation (Cialdea & Pompei, 2022; Xie, 2023; Üzümcüoğlu & Polay, 2022b), have been explored in academic and professional discourse. This literature review establishes a theoretical framework to guide our investigation.

Despite the wealth of literature, specific gaps persist in our understanding of how these theoretical principles manifest in real-world waterfront projects. Specifically, there is a need for a comprehensive analysis that integrates theoretical foundations with practical applications, considering diverse waterfront types and geographical contexts.

This article is structured first to establish the theoretical foundations, followed by a rigorous analysis of case studies (Table 1). The purpose of this research is to bridge the gap between theory and practice in contemporary waterfront design. The method of case selection involved a systematic approach, focusing on award-winning waterfronts across continents, aiming for diversity in historical, commercial, and recreational contexts. Preliminary results suggest a convergence between theoretical principles and real-world applications, emphasizing sustainability, community-centric approaches, and cultural preservation.

In contributing to the field, this study strives to offer practical insights for architects, urban designers, policymakers, and researchers involved in waterfront development. By addressing existing gaps and synthesizing theoretical and practical perspectives, the authors aim to enrich the discourse on contemporary waterfront design. This research endeavors to inspire transformative approaches and contribute to the sustainable and culturally vibrant development of waterfront spaces.

Table 1. Analytical framework of the study (Authors)

Objective Definition ▪ Clearly defining the study's objective ▪ Exploration and evaluation of contemporary waterfront design theories and their manifestation in real-world projects		
↓		
Literature Review ▪ Reviewing existing literature on contemporary waterfront design theories ▪ Identifying foundational principles and philosophies in the literature ▪ Exploring the theoretical frameworks that guide waterfront design		
↓		
Conceptual Framework ▪ Developing a conceptual framework based on the literature findings ▪ Identifying key concepts and their relationships ▪ Defining the theoretical underpinnings that will guide the analysis		
↓		
Case Selection ▪ Selecting relevant case studies that represent a diverse range of waterfront projects from different geographical locations ▪ Considering factors such as size, cultural context, and success metrics		
↓		
Methodology ▪ Outlining the methodology for analyzing case studies ▪ Specifying the criteria for evaluating the success of each waterfront project		
↓		
Data Collection ▪ Gathering data on each case study, including architectural plans, project timelines, community feedback, economic impact, and any available post-implementation assessments	**Data Analysis** ▪ Applying a systematic approach to analyze the data ▪ Applying the contemporary waterfront design principles identified in the literature review	
↓		
Integration of Literature and Case Findings ▪ Integrating the findings from the literature review with the results obtained from the case studies ▪ Comparing theoretical principles with real-world applications		
↓		
Synthesis ▪ Synthesizing the case study findings and literature review to identify overarching trends, challenges, and critical success factors in contemporary waterfront design	**Discussion** ▪ Discussing the implications of the findings ▪ Addressing how successful waterfront projects align with or diverge from theoretical frameworks	
↓		
Conclusion ▪ Summarizing the essential findings and their significance	**Recommendations** ▪ Providing practical suggestions based on the findings ▪ Offering insights for architects, urban designers, policymakers, and other stakeholders involved in waterfront development	**Limitations and Future Research** ▪ Acknowledging the limitations of the study, such as any constraints in case selection or data availability ▪ Proposing directions for future research to further enhance understanding in this field

1.1. The Foundational Principles and Philosophies of Contemporary Waterfront Design Theories

A set of core ideas and philosophies in contemporary waterfront design theories guides the design and building of waterfront areas. The ideas above are indicative of the changing focal points within the fields of urban planning, architecture, and environmental sustainability. Fundamental principles and ideologies inform contemporary waterfront design theories (Figure 1).

Sustainability is widely recognized as a fundamental component of contemporary waterfront design. The concept encompasses the principles of ecological, social, and economic sustainability (Cialdea & Pompei, 2022; Girard, 2013; Hall & Stern, 2014; Hoyle, 1999; Jun, 2023; Shah & Roy, 2017; Üzümcüoğlu & Polay, 2022a). Waterfront initiatives strive to mitigate environmental consequences, diminish carbon footprints, and integrate sustainable materials and methodologies (Chon et al., 2014). This philosophical perspective greatly emphasizes the long-term preservation of environmental well-being and adaptability (Jun, 2023). Moreover, Resilience has emerged as a prominent focus in contemporary waterfront architecture as a direct response to the multifaceted problems of climate change (Theodora & Spanogianni, 2022; Aerts & Wouter Botzen, 2011; Niedziółka et al., 2021; Garcia, 2021; Zakirzianova, 2021). It encompasses several techniques to mitigate the impacts of escalating sea levels, flooding, and extreme weather events. Resilient waterfronts are purposefully engineered to endure and adjust to fluctuating environmental circumstances. Besides, waterfront areas are perceived as public, with contemporary philosophies prioritizing community interaction (Üzümcüoğlu & Polay, 2022a; Hoyle, 1999; Zaki & Hegazy, 2023; Xie, 2023; Green, 2023; Cihan Yavuzcan & Gür, 2023). Incorporating local citizens and stakeholders in the planning process ensures that waterfronts align with the community's needs and wishes. The objective is establishing inclusive and accessible environments that cultivate a sense of belonging. Also, mixed-use development has become increasingly popular in current waterfront developments, as it integrates many functions such as residential, commercial, cultural, and recreational spaces (Üzümcüoğlu & Polay, 2022a). This technique facilitates the development of active, dynamic communities around the clock, diminishing reliance on automobile-centric lifestyles.

Furthermore, incorporating natural features into the constructed environment is crucial in contemporary waterfront design (Guo, 2023; Jeon & Jo, 2023; Karmanov & Hamel, 2008). It may encompass the rehabilitation of wetlands, the establishment of recreational areas, and the conservation of indigenous ecosystems. The objective is to establish a harmonious integration between the urban environment and the natural world. Besides, Waterfront areas frequently possess historical and cultural importance for cultural preservation (Fernandes et al., 2017; Gunay & Dokmeci, 2012; Osman & Farahat, 2018; Üzümcüoğlu & Polay, 2022a). The primary objective of contemporary design ideas is to safeguard and commemorate cultural history while incorporating contemporary conveniences and practicality. Preserving cultural heritage has a significant role in fostering a sense of place and maintaining authenticity. Also, promoting creative architectural and design concepts is a crucial aspect of contemporary waterfront design (Long & Cui, 2020; Tian & Yang, 2020; Zhao, 2020; White, 2016). It may entail utilizing advanced materials, distinctive aesthetic methodologies, and innovative technology applications. Promoting innovation contributes to the development of aesthetically appealing and utilitarian waterfront areas (Xie, 2023; Üzümcüoğlu & Polay, 2022b). In addition, the economic viability of waterfront developments is anticipated to be both sustainable and financially feasible (Brückner et al., 2022; Hein, 2016; Situmorang et al., 2023). The generation of economic advantages for the community should encompass various aspects, including but not limited to augmented property values, money from tourists, and the provision of employment opportunities. Economic feasibility assessment holds significant importance in the decision-making process of urban planners and developers. Aside from that, environmental stewardship is a core principle underpinning the waterfront design idea, emphasizing the need to conserve the natural environment (Chon et al., 2014; Doka et al., 2022; Bonney et al., 2023). Various strategies, including sustainable stormwater management, erosion control, and responsible land use, are implemented to safeguard and improve the ecological integrity of coastal areas (Liu & Meng, 2023). Likewise, waterfront places' availability can influence physical and mental well-being, thereby contributing to public health (Roe et al., 2019; Yocom et al., 2016; Knöll, 2023). Design theories frequently emphasize elements such as waterfront promenades, green areas, and recreational amenities that promote an active and health-conscious way of life.

A set of fundamental principles and ideologies influence the present-day theories of waterfront design. The approach above to urban planning and development is characterized by its holistic nature, as it places significant emphasis on the harmonious cohabitation of human activities with the natural environment, cultural heritage, and the overall well-being of communities.

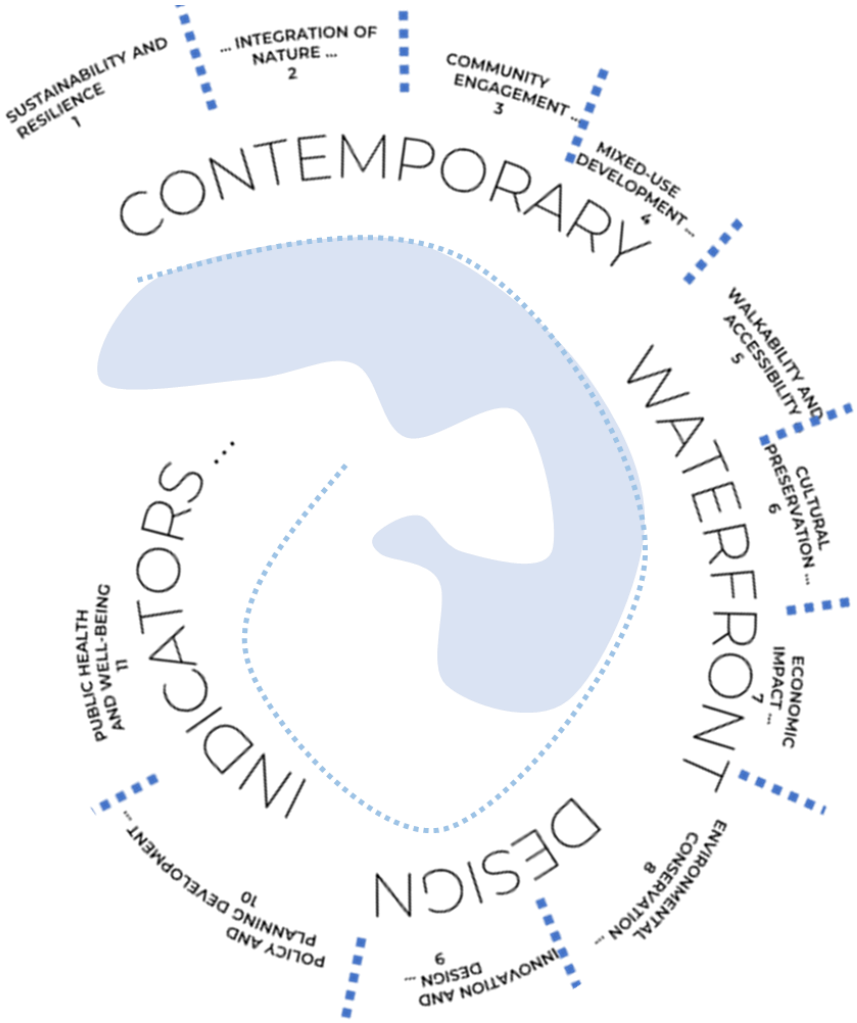


Figure 1. Contemporary waterfront design indicators (Authors)

1.2. The Basic Tenets and Approaches that Form the Basis of Thrilling Waterfront Designs

The foundation of fascinating, lively, and memorable waterfront places lies in the principles and methodologies underpinning thrilling waterfront designs. These principles guide the planning and execution of waterfront projects, enhancing their appeal and impact. The following are the foundational principles and methodologies that form the basis of captivating waterfront designs:

Thrilling waterfronts typically refer to shore with exciting and captivating features, making them appealing to visitors, residents, and tourists alike. These features can vary widely depending on the location and development of the waterfront area. Some standard features of thrilling shores are related to scenic beauty (Yang, 2014; Hu et al., 2023; Sun et al., 2021; Tan & Peng, 2020). Thrilling waterfronts often boast breathtaking natural scenery, including picturesque shorelines, stunning sunsets, and panoramic ocean views. These aesthetic qualities draw visitors seeking a visually pleasing environment. Besides, waterfront areas provide a wide range of recreational activities, such as swimming, surfing, kayaking, paddleboarding, snorkeling, and beach combing. Thrilling shores offer ample opportunities for water sports and outdoor adventures (Kostopoulou, 2013; Üzümcüoğlu & Polay, 2022a). Also, waterfront ecosystems are often rich in biodiversity (Chen & Ma, 2023; Yasin et al., 2023). Thrilling waterfronts may be home to diverse marine life, including dolphins, whales, and colorful coral reefs. Birdwatching and wildlife observation are also popular activities in these areas.

Some thrilling waterfronts have cultural or historical significance, featuring landmarks, museums, or archaeological sites that tell the story of the region's past. These attractions provide educational and cultural enrichment (Üzümcüoğlu & Polay, 2022a; Üzümcüoğlu & Polay, 2022b; Fernandes et al., 2017; Xie, 2023). In addition, waterfront cities and towns along thrilling shores frequently offer a vibrant culinary scene with seafood restaurants, beachside cafes, and bars. Live music, festivals, and cultural

events enhance the entertainment options (Üzümcüoğlu & Polay, 2022c). Apart from this, waterfront areas often have boutique shops, art galleries, and craft markets showcasing local artisans' work. Visitors can find unique souvenirs and artwork that reflect the local culture (Kostopoulou, 2013). Besides, waterfront regions may have hiking trails, nature reserves, or marine sanctuaries that invite exploration. Visitors can embark on hikes, scuba diving expeditions, or guided eco-tours to discover the area's natural wonders (Abd El-Tawab et al., 2020). Aside from this, thrilling waterfronts often feature high-end resorts, beachfront villas, and boutique hotels that provide luxury accommodations and amenities for travelers seeking an indulgent getaway. Also, various waterfront communities host annual festivals and events celebrating local culture, seafood, or maritime traditions (Dova et al., 2022; Pizzichini et al., 2022; Guerreiro et al., 2019; Riyanto & Sari, 2023). These gatherings offer a glimpse into the local way of life. In addition, waterfront areas can be ideal for relaxation and wellness activities, including beachfront yoga sessions, spa treatments, and meditation retreats (Lee & Han, 2020). The soothing sound of ocean waves adds to the overall sense of tranquility. Thrilling waterfronts may also prioritize environmental conservation and sustainable practices to protect the area's natural beauty (Smith, 2023). It can include efforts to reduce pollution, protect wildlife habitats, and promote eco-friendly tourism. Besides, sunbathing, building sandcastles, and simply lounging on the beach are classic activities on thrilling waterfronts. The combination of sun and sea creates a laid-back atmosphere. In addition, some waterfront areas offer thrilling activities like parasailing, jet skiing, and zip-lining, providing an adrenaline rush for adventure enthusiasts (Constantin et al., 2022).

It is important to note that what makes a waterfront area thrilling can vary from person to person. Some may be drawn to the natural beauty and tranquility, while others seek adventure and entertainment. Thrilling waterfronts typically aim to provide diverse experiences to cater to different interests and preferences.

In the course of the theoretical inquiry conducted thus far in this study, it has been explicated that there exist eleven primary principles about contemporary conceptions of waterfront architecture (Figure 1). However, numerous indicators can also be incorporated into these principles to enhance the appeal of shore areas. Figure 2 illustrates the integration of the thirteen highlighted indicators of the thrilling waterfront idea with relevant principles. For instance, the second principle can be combined with features A and C, while the third principle can be mixed with features G and I (Figure 2).

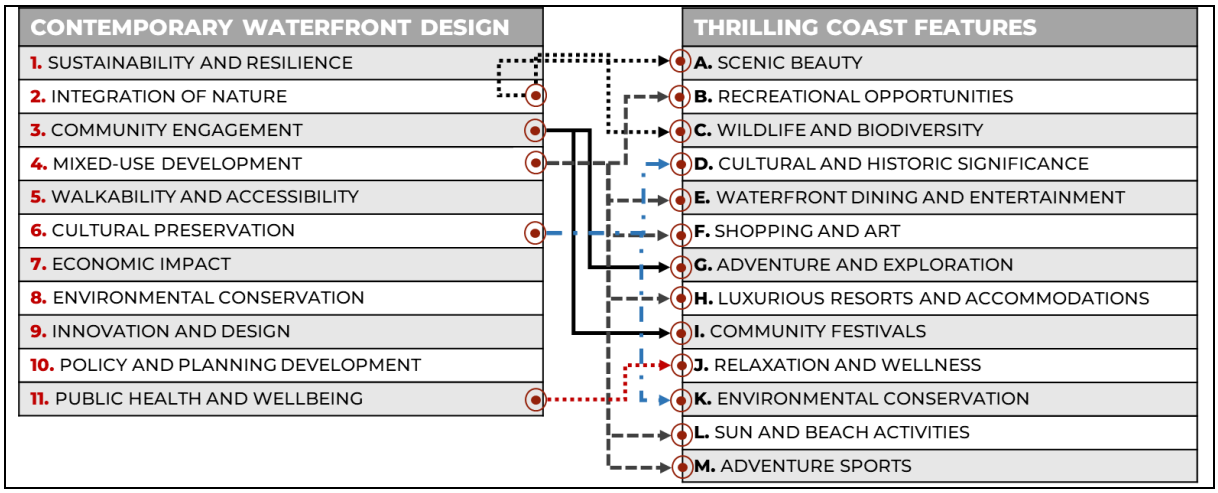


Figure 2. Indicators of the contemporary waterfront design through the prism of thrilling waterfront features (Authors)

- **RESPECT TO AND PROMOTION OF CULTURAL HERITAGE** (ACKNOWLEDGING THE REGIONS HISTORY) – INCREASING AWARENESS BY USING PUBLIC ART
- **CREATIVE / INNOVATIVE APPROACH OF URBAN DESIGN**
- **PROMOTION AND PROTECTION OF SCENIC BEAUTY** – BREATHTAKING VISTAS
- **PUBLIC HEALTH AND WELL-BEING** (SUN AND BEACH ACTIVITIES)
- **ACCESSIBILITY** (SUCH AS APPROPRIATE WALKING PATHS, GREEN SPACES, CYCLING, INCLUSIVE URBAN DESIGNING)
- **ECONOMIC CONTRIBUTION** (LUXURIOUS RESORTS AND ACCOMODATIONS, INVESTMENT, INCREASED TOURIST ATTRACTION)

Figure 2. Indicators of the contemporary waterfront design through the prism of thrilling waterfront features (Authors) (continued)

2. Material and Method

The following methodology was employed to ensure a systematic approach to the study.

1. Selection of Case Studies:
   - Purpose: To represent a diverse range of prominent waterfront projects globally.
   - Criteria: Receipt of prestigious awards for excellence in waterfront design.
   - Limitation: Focused on cities situated on waterfronts across various continents to achieve a controllable sample size and representativeness.
2. Comprehensive Documentary Analysis:
   - Purpose: To gather in-depth information about each selected case study. The cases were evaluated according to the thrilling contemporary waterfront design principles, which were founded through a literature review and combined in Figure 2.
   - Method: Conducted a comprehensive analysis involving the collection of project documentation, architectural plans, historical information, and available reports.
   - Scope: Encompassed the design, development, and post-implementation phases of the waterfront projects.
3. Qualitative Analyses:
   - Purpose: To derive meaningful insights from the collected data for each case study.
   - Method: Applied qualitative analyses to interpret findings and understand the nuances of each project.
4. Synthesis of Qualitative Findings:
   - Purpose: To create a comprehensive narrative for each case study.
   - Method: Synthesized qualitative findings to highlight key success factors, challenges, and policy approaches aligned with contemporary waterfront design theories.
5. Discussion of Synthesized Findings:
   - Purpose: To discuss and contextualize the synthesized findings in relation to contemporary waterfront design theories.
   - Emphasis: Explored how the selected projects embodied and manifested these theories in real-world settings.
6. Acknowledgment of Methodological Limitations:
   - Purpose: To address the limitations inherent in the chosen research methodology.
   - Limitations: The limited sample size was acknowledged due to selection criteria and geographic focus. Recognized potential omissions of significant projects. Highlighted varying data availability among case studies.
7. Evaluation of Methodological Rigor:
   - Purpose: To assess the reliability and validity of the research methodology.
   - Strengths: Emphasized the systematic approach in choosing, collecting data on, and examining a wide range of esteemed waterfront projects. Highlighted the significance of the knowledge gained regarding current theories and practical implementations in waterfront architecture.

This systematic order outlines the steps taken in the study, from the selection of case studies to the acknowledgment of limitations and evaluation of methodological rigor.

3. Findings and Discussion

3.1. Findings

Prestigious waterfront projects exemplify contemporary theories of waterfront design, effectively turning theoretical concepts into captivating and functional real-world environments. A collection of case studies is presented within this area, each carefully chosen based on its typical approaches and global acclaim.

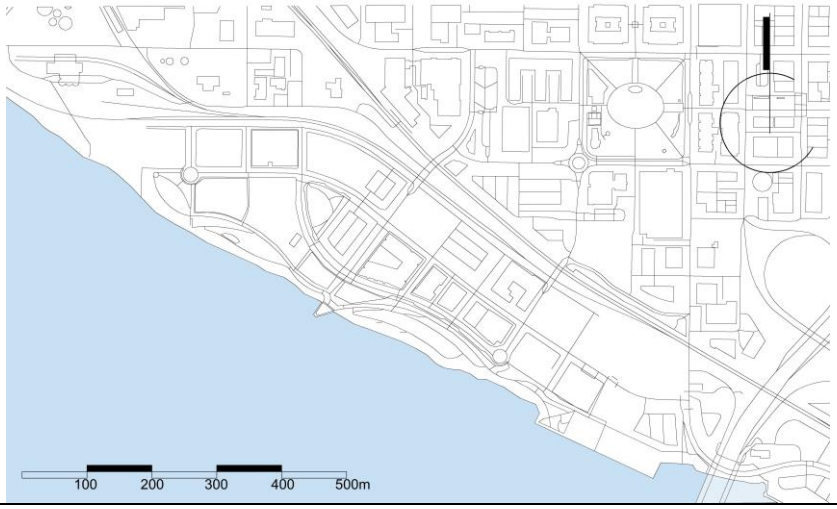
The selection of examples was mainly based on their practice approaches. Initially, the waterfronts that had received pertinent awards were chosen. A limitation has been implemented to ensure a manageable sample size due to abundant waterfront areas. Therefore, as a criterion for selection, the cities should be located on waterfronts across several continents. Furthermore, different categories of waterfront tried to be chosen, including those of historical significance, those for commercial and recreational purposes, and those dedicated to retail and manufacturing activities. Therefore, six waterfront locations from various countries were chosen for investigation based on the imposed limits. The waterfront locations mentioned include Vancouver Waterfront Park in the United States, Albarrada Waterfront in Mompox, Colombia, Belgrade Waterfront in Serbia, Victoria & Alfred Waterfront in South Africa, Udaipur Waterfront in India, and Waterfront Tavern in Australia (Figure 3).

Figure 3. Location of the chosen cases (Authors)

3.1.1. Case 1. Vancouver Waterfront Park in the United States

The evaluation of the Vancouver Waterfront Park in the United States (Table 2) according to the principles of contemporary waterfront design theories and thrilling coast features:

Table 2. Information on Vancouver Waterfront Park in the United States



Name Of the Waterfront	Vancouver Waterfront Park in the United States
Award	Award Of Excellence from the International Lighting Design Awards
Scale	28,328sqm

THRILLING CONTEMPORARY WATERFRONT FEATURES	EVALUATION OF THE CASE AREA
1. USTAINABILITY **2. COMMUNITY ENGAGEMENT** **3. MIXED-USE DEVELOPMENT – DIVERSITY OF ACTIVITIES** **4. RESPECT TO AND PROMOTION OF CULTURAL HERITAGE** **5. CREATIVE / INNOVATIVE APPROACH OF URBAN DESIGN** **6. PROMOTION AND PROTECTION OF SCENIC BEAUTY**	**1.** According to contemporary waterfront design principles, Vancouver Waterfront Park is committed to sustainability through its environmentally friendly design. It incorporates green spaces, sustainable materials, and stormwater management systems that reduce environmental impact. The park's ecological sensitivity aligns with contemporary sustainability principles (City of Vancouver, Parks Department, n.d.). **2.** Besides, the park prioritizes community engagement. It hosts events, provides gathering spaces, and features amenities that cater to residents and visitors alike (The Waterfront Vancouver, USA, 2023). **3.** The waterfront park is designed to meet the community's recreational and cultural needs. Also, Vancouver Waterfront Park embraces mixed-use development by incorporating commercial and recreational spaces. It encourages diverse activities like dining, shopping, and outdoor recreation, creating a dynamic and economically viable waterfront. In addition, the park integrates nature into its design with waterfront trails, green spaces, and public art installations. These elements celebrate the natural beauty of the Columbia River, connecting urban life with the environment (Visit Vancouver WA, 2024). **4.** Apart from this, while contemporary in its design, the park respects cultural heritage by incorporating elements that acknowledge the region's history. It features interpretive signage and public art that educates visitors about the area's indigenous peoples and pioneers (Landezine, 2021). **5.** Also, Vancouver Waterfront Park showcases innovative design through waterfront architecture, and innovative landscaping. The cable-stayed Grant Street Pier, in particular, is a standout example of modern design (The Waterfront Vancouver, USA, n. d.). **6.** According to thrilling coast features, the park capitalizes on the scenic beauty of the Columbia River, offering stunning views of the water and Mount Hood. Its carefully landscaped areas provide vantage points for enjoying these breathtaking vistas (The Waterfront Vancouver, USA, 2023).

Table 2. Information on Vancouver Waterfront Park in the United States (continued)

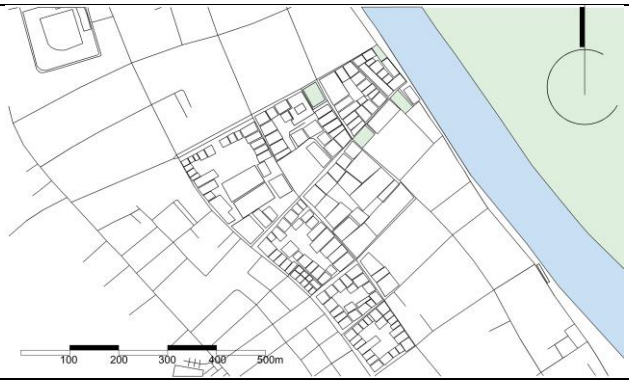
7. PUBLIC HEALTH AND WELL-BEING **8. ACCESSIBILITY** **9. ECONOMIC CONTRIBUTION**	**7.** Apart from this, Vancouver Waterfront Park hosts a variety of entertainment and cultural activities, including summer concerts and festivals. These events add to the park's vibrancy and appeal. Likewise, the park's design incorporates sustainable features like permeable pavements, LED lighting, and native landscaping, contributing to environmental stewardship and resilience. Aside from that, the park's emphasis on walking paths, green spaces, and recreational amenities supports public health and well-being, providing a space for relaxation, exercise, and outdoor enjoyment (The Waterfront Vancouver, USA, 2023). **8.** Also, Vancouver Waterfront Park offers a wide range of recreational activities, from walking and biking along the waterfront trails to kayaking and paddleboarding in the river. These opportunities cater to outdoor enthusiasts, making it a thrilling coastal destination (Visit Vancouver WA, 2024). **9.** Besides, the park actively engages the community through events, concerts, and public art installations. Its amphitheater and open spaces provide venues for cultural and recreational events that draw residents and tourists alike. In addition, with its blend of retail, dining, and entertainment options, the park fosters a lively, mixed-use environment. Visitors can shop, dine, and enjoy cultural experiences while enjoying the waterfront scenery (The Waterfront Vancouver, USA, 2023; Landezine, 2021; Visit Vancouver WA, 2024).

In summary, Vancouver Waterfront Park successfully embodies the principles of contemporary waterfront design theories and features that make it a thrilling coastal destination. It balances sustainability, community engagement, mixed-use development, nature integration, cultural preservation, and innovative design while offering scenic beauty, diverse recreation, community events, and public health and well-being opportunities. This waterfront park serves as a model for creating vibrant and sustainable coastal spaces that enrich the lives of residents and visitors.

3.1.2. Case 2. Albarrada Waterfront in Mompox, Colombia

Evaluating the Albarrada Waterfront in Mompox, Colombia (Table 3) according to contemporary waterfront design principles and thrilling coast features:

Table 3. Information on Albarrada Waterfront in Mompox, Colombia



Name Of the Waterfront	Albarrada Waterfront in Mompox, Colombia
Award	In 2016, the Revitalization of Mompox was awarded the Colombian Biennale's top prize in landscape and urban architecture.
Scale	180,000sqm

Table 3. Information on Albarrada Waterfront in Mompox, Colombia (continued)

THRILLING CONTEMPORARY WATERFRONT FEATURES	EVALUATION OF THE CASE AREA
1. SUSTAINABILITY **2. COMMUNITY ENGAGEMENT** **3. MIXED-USE DEVELOPMENT – DIVERSITY OF ACTIVITIES** **4. RESPECT TO AND PROMOTION OF CULTURAL HERITAGE** **5. CREATIVE / INNOVATIVE APPROACH OF URBAN DESIGN** **6. PROMOTION AND PROTECTION OF SCENIC BEAUTY** **7. PUBLIC HEALTH AND WELL-BEING** **8. ACCESSIBILITY** **9. ECONOMIC CONTRIBUTION**	**1.** According to contemporary waterfront design principles, The Albarrada Waterfront demonstrates sustainability by preserving the historical architecture of Mompox while integrating modern amenities. Sustainable materials and preservation techniques are employed to minimize the environmental impact of development (Landezine Media LLC, n. d.; Opus Studio, n.d.). **2.** Besides, this waterfront project prioritizes community engagement. It offers spaces for social gatherings, events, and cultural activities, fostering a sense of belonging among residents and visitors (Landezine Media LLC, n. d.). **3.** Also, while preserving historical structures, the Albarrada Waterfront encourages mixed-use development by incorporating cafes, galleries, and artisan shops. This blend of commercial and recreational spaces promotes economic viability. In addition, the waterfront embraces its natural surroundings along the Magdalena River. Green spaces, trees, and gardens complement the historical architecture, creating a harmonious connection between the urban and natural environments (Opus Studio, n.d.). **4.** Apart from this, Albarrada Waterfront values cultural preservation, as evident in its commitment to preserving the historical architecture and heritage of Mompox. The waterfront celebrates the town's rich history through design elements and public spaces (Opus Studio, n.d.). **5.** Although the project emphasizes historic preservation, it demonstrates creatively repurposing existing structures and enhancing accessibility for modern needs (Opus Studio, n.d.; Landezine Media LLC, n. d.). **6.** According to thrilling coastal features, the waterfront's location along the Magdalena River offers stunning views and an idyllic atmosphere. The historic buildings and the river create a visually captivating scene (Opus Studio, n.d.; Landezine Media LLC, n. d.). **7.** Apart from this, while focusing on preservation, the project incorporates environmentally friendly features such as green spaces and sustainable construction practices, aligning with environmental stewardship principles. Moreover, Albarrada Waterfront provides a serene environment for leisurely walks, relaxation, and social interaction, promoting public health and well-being (Opus Studio, n.d.; Landezine Media LLC, n. d.). **8.** Also, visitors can engage in recreational activities such as riverside strolls, boat rides along the Magdalena River, and exploring historical landmarks. The waterfront provides a tranquil setting for relaxation and exploration (Landezine Media LLC, n. d.). **9.** Besides, Albarrada Waterfront fosters community engagement through events, festivals, and cultural activities celebrating Mompox's traditions and heritage. These events draw residents and tourists alike. Likewise, including cafes, galleries, and artisan shops adds vibrancy to the waterfront. It creates opportunities for residents and visitors to dine, shop, and experience local culture. In addition, the waterfront hosts cultural events, festivals, and art exhibitions that enrich the cultural fabric of Mompox. These activities contribute to a dynamic and exciting atmosphere (Opus Studio, n.d.).

In summary, the Albarrada Waterfront in Mompox, Colombia, successfully integrates contemporary waterfront design principles while preserving the town's historical and cultural heritage. It offers scenic beauty, diverse recreational opportunities, community engagement, mixed-use development, cultural activities, and environmental sensitivity. It makes it a thrilling coastal destination that respects its past while embracing modernity, enriching the lives of both residents and visitors.

3.1.3. Case 3. Belgrade Waterfront in Serbia

Evaluating the Belgrade Waterfront in Serbia (Table 4) according to contemporary waterfront design principles and thrilling coast features:

Table 4. Information on Belgrade Waterfront in Serbia

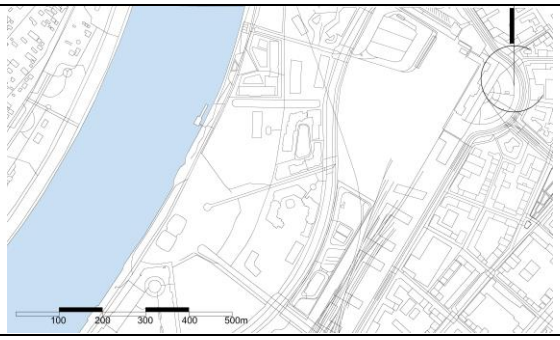
	
Name Of the Waterfront	Belgrade Waterfront in Serbia
Award	The Belgrade Waterfront project was honored with the esteemed European Property Awards in the "Mixed-use Development." Furthermore, in addition to this noteworthy acknowledgment, Belgrade Waterfront was also proclaimed the victor in "Development Marketing."
Scale	27,000sqm
THRILLING CONTEMPORARY WATERFRONT FEATURES	**EVALUATION OF THE CASE AREA**
1. SUSTAINABILITY **2. COMMUNITY ENGAGEMENT** **3. MIXED-USE DEVELOPMENT – DIVERSITY OF ACTIVITIES** **4. RESPECT TO AND PROMOTION OF CULTURAL HERITAGE** **5. CREATIVE / INNOVATIVE APPROACH OF URBAN DESIGN** **6. PROMOTION AND PROTECTION OF SCENIC BEAUTY** **7. PUBLIC HEALTH AND WELL-BEING**	**1.** According to contemporary waterfront design principles, the Belgrade Waterfront project incorporates sustainability through modern architectural designs emphasizing energy efficiency and using sustainable materials. It includes green spaces and promotes walkability, reducing the carbon footprint (Hristić et al., 2021). **2.** Besides, the project prioritizes community engagement by creating public spaces, cultural venues, and recreational areas that cater to residents and visitors. It aims to enhance the quality of life for the local community (Hristić et al., 2021; Cvetinović et al., 2016). **3.** Also, the Belgrade Waterfront embraces mixed-use development, combining residential, commercial, and recreational spaces. This approach fosters a dynamic urban environment with 24/7 activity. The project also integrates natural elements with modern urban design, incorporating parks, green rooftops, and waterfront promenades. It strives to create a harmonious coexistence between urban life and nature (Hristić et al., 2021; Cvetinović et al., 2016). **4.** The project also respects cultural preservation by preserving historic landmarks and heritage sites while introducing modern structures. It honors the city's history and cultural identity (Hristić et al., 2021). **5.** Besides this, Belgrade Waterfront showcases innovative design with contemporary architecture and waterfront promenades that enhance accessibility and aesthetics while incorporating modern amenities (Hristić et al., 2021; Cvetinović et al., 2016). **6.** According to thrilling coastal features, the location along the Sava and Danube Rivers confluence provides stunning panoramic views, especially from high-rise buildings within the project. The scenic beauty of the waterfront is a notable feature (Hristić et al., 2021). **7.** Besides, while focused on urban development, the project incorporates environmental considerations such as green spaces and energy-efficient building designs. Also, Belgrade Waterfront provides ample green spaces, waterfront promenades, and recreational areas that contribute to public health and well-being, encouraging an active lifestyle (Hristić et al., 2021; Cvetinović et al., 2016).

Table 4. Information on Belgrade Waterfront in Serbia (continued)

8. ACCESSIBILITY **9. ECONOMIC CONTRIBUTION**	**8.** jogging and cycling paths, river cruises, and waterfront dining. Residents and visitors can engage in a wide range of outdoor activities (Hristić et al., 2021). **9.** Moreover, Belgrade Waterfront promotes community engagement through cultural events, festivals, and art exhibitions. The inclusion of a cultural district enhances the city's cultural vibrancy. The project also features a mix of residential, commercial, and entertainment spaces, creating a lively urban environment with numerous dining, shopping, and entertainment options. Apart from this, cultural venues, theaters, and concert halls enhance the city's cultural scene. It hosts events and activities that attract a diverse audience (Hristić et al., 2021).

In summary, the Belgrade Waterfront project successfully integrates contemporary waterfront design principles with a focus on sustainability, community engagement, mixed-use development, cultural preservation, innovation in design, and environmental stewardship. It offers scenic beauty, diverse recreational opportunities, community engagement, mixed-use development, cultural activities, and a commitment to environmental sustainability. It makes it a compelling and dynamic waterfront destination that enriches the lives of residents and visitors while honoring the city's cultural heritage.

3.1.4. Case 4. Victoria & Alfred Waterfront in South Africa

Evaluating the Victoria & Alfred (V&A) Waterfront in South Africa (Table 5) according to contemporary waterfront design principles and thrilling coast features:

Table 5. Information on Victoria & Alfred Waterfront in South Africa

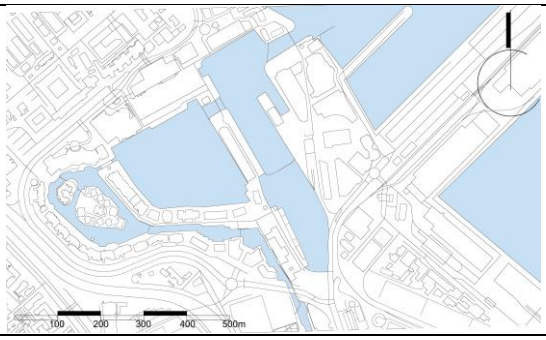
	
Name of the Waterfront	Victoria & Alfred Waterfront in South Africa
Award	The V&A Waterfront demonstrates a solid commitment to the preservation of historical significance, the safeguarding of heritage structures, the promotion of responsible tourism practices, and the implementation of environmentally sustainable initiatives. Over the years, this entity has received numerous accolades, recognizing its notable accomplishments in these respective domains.
Scale	1,230,000sqm
THRILLING CONTEMPORARY WATERFRONT FEATURES	**EVALUATION OF THE CASE AREA**
1. SUSTAINABILITY **2. COMMUNITY ENGAGEMENT**	**1.** According to contemporary design principles, the V&A Waterfront demonstrates sustainability through responsible land use, green building practices, and energy-efficient technologies. It also focuses on water conservation and waste reduction, aligning with contemporary sustainability principles (Ferreira & Visser, 2007). **2.** Besides, the project places a strong emphasis on community engagement. It offers numerous public spaces, cultural attractions, and recreational amenities catering to residents and tourists. This approach fosters a sense of belonging and inclusivity (Ferreira & Visser, 2007).

Table 5. Information on Victoria & Alfred Waterfront in South Africa (continued)

3. SUSTAINABILITY **4. COMMUNITY ENGAGEMENT** **5. MIXED-USE DEVELOPMENT – DIVERSITY OF ACTIVITIES** **6. RESPECT TO AND PROMOTION OF CULTURAL HERITAGE** **7. CREATIVE / INNOVATIVE APPROACH OF URBAN DESIGN** **8. PROMOTION AND PROTECTION OF SCENIC BEAUTY** **9. PUBLIC HEALTH AND WELL-BEING** **10. ACCESSIBILITY** **11. ECONOMIC CONTRIBUTION**	**3.** According to contemporary design principles, the V&A Waterfront demonstrates sustainability through responsible land use, green building practices, and energy-efficient technologies. It also focuses on water conservation and waste reduction, aligning with contemporary sustainability principles (Ferreira & Visser, 2007). **4.** Besides, the project places a strong emphasis on community engagement. It offers numerous public spaces, cultural attractions, and recreational amenities catering to residents and tourists. This approach fosters a sense of belonging and inclusivity (Ferreira & Visser, 2007). **5.** Also, the V&A Waterfront epitomizes mixed-use development by integrating residential, commercial, cultural, and recreational spaces (Ferreira & Visser, 2007). This combination creates a lively, 24/7 community that reduces the need for car-dependent lifestyles. In addition, natural elements are integrated into the project through carefully designed green spaces, landscaped gardens, and waterfront promenades. The project's design respects and preserves the natural beauty of the coastal environment. **6.** Aside from this, while embracing modernity, the V&A Waterfront honors its cultural heritage by preserving historical landmarks and repurposing historic buildings. It seamlessly blends the old and the new, celebrating the city's history (Ferreira & Visser, 2007). **7.** The project also showcases innovative design through its striking modern architecture, waterfront promenades, and creative use of technology. Iconic structures like the Zeitz Museum of Contemporary Art Africa (MOCAA) exemplify design innovation (Nielsen, 2023). **8.** According to thrilling coastal features, located in the heart of Cape Town's working harbor, the V&A Waterfront offers stunning views of Table Mountain, the harbor, and the sea. The scenic beauty of the waterfront is a primary attraction (Ferreira & Visser, 2007; Nielsen, 2023). **9.** In addition, the abundance of open spaces, waterfront promenades, and recreational facilities supports public health and well-being, providing opportunities for relaxation, exercise, and leisure (Ferreira & Visser, 2007). **10.** Besides, visitors can enjoy many recreational activities, including shopping, dining, boat trips, live music performances, and leisurely walks along the quayside. The wide range of offerings caters to diverse interests. Also, the waterfront hosts numerous cultural events, concerts, and art exhibitions, promoting community engagement (Nielsen, 2023). **11.** It provides venues for locals and tourists to immerse themselves in cultural experiences. In addition, with a diverse array of shops, boutiques, restaurants, and entertainment options, the V&A Waterfront offers a vibrant mix of activities, making it a thriving destination for locals and visitors alike (Ferreira & Visser, 2007). Aside from this, cultural institutions like the Zeitz MOCAA, theaters, and live music venues add to the waterfront's cultural vibrancy. It serves as a hub for entertainment and cultural activities. Moreover, the project incorporates environmentally friendly features such as green roofs, sustainable landscaping, and responsible waste management, demonstrating a commitment to environmental stewardship (Nielsen, 2023).

In summary, the Victoria & Alfred Waterfront in South Africa successfully embodies the principles of contemporary waterfront design theories while offering thrilling coastal features. It excels in sustainability, community engagement, mixed-use development, cultural preservation, innovation in design, and environmental stewardship. The waterfront is a captivating destination that combines scenic beauty, diverse recreational opportunities, community engagement, mixed-use development, cultural activities, and a commitment to sustainability. It serves as a dynamic and enriching waterfront destination that celebrates the city's heritage and offers an array of memorable experiences for residents and visitors alike.

3.1.5. Case 5. Udaipur Waterfront in India

Evaluating the Udaipur Waterfront in India (Table 6) according to contemporary waterfront design principles and thrilling coast features:

Table 6. Information on Udaipur Waterfront in India

Name Of the Waterfront	Udaipur Waterfront in India
Award	Udaipur has been awarded the prestigious "India's Best Leisure Destination."
Scale	20,000sqm

THRILLING CONTEMPORARY WATERFRONT FEATURES	EVALUATION OF THE CASE AREA
1. SUSTAINABILITY **2. COMMUNITY ENGAGEMENT** **3. MIXED-USE DEVELOPMENT – DIVERSITY OF ACTIVITIES** **4. RESPECT TO AND PROMOTION OF CULTURAL HERITAGE** **5. CREATIVE / INNOVATIVE APPROACH OF URBAN DESIGN** **6. PROMOTION AND PROTECTION OF SCENIC BEAUTY** **7. PUBLIC HEALTH AND WELL-BEING** **8. ACCESSIBILITY**	**1.** According to contemporary design principles, The Udaipur Waterfront project embraces sustainability by incorporating eco-friendly building practices and materials. Efforts to minimize the environmental impact align with contemporary sustainability principles (Samant, 2010). **2.** Besides, the project demonstrates a community-centered approach by creating public spaces, recreational areas, and cultural venues that cater to the local population. It fosters community engagement and cultural enrichment (Samant, 2010). **3.** Also, while preserving historical architecture, the Udaipur Waterfront encourages mixed-use development by incorporating shops, restaurants, and cultural spaces. This mix enhances the economic viability of the area. In addition, the waterfront integrates nature through well-maintained gardens, promenades, and the presence of Lake Pichola. These elements celebrate the region's natural beauty and create a harmonious urban-nature interface (Samant, 2010). **4.** Aside from this, Udaipur is known for its rich cultural heritage, and the project honors this by preserving historical landmarks and celebrating local traditions. Cultural preservation is a central theme of the waterfront's design (Samant, 2010). **5.** Apart from this, while retaining historical charm, the Udaipur Waterfront showcases innovation through creative landscaping, modern amenities, and the adaptive reuse of heritage structures (Samant, 2010). **6.** According to thrilling coastal features, the Udaipur Waterfront offers breathtaking views of the lake, the Aravalli hills, and the surrounding palaces around Lake Pichola. Its scenic beauty is one of its primary attractions (Samant, 2010; Naik, 1997). **7.** In addition, the serene lakeside environment, walking paths, and recreational facilities promote public health and well-being, offering spaces for relaxation, exercise, and enjoyment of nature (Samant, 2010). **8.** Besides, visitors can enjoy various recreational activities such as boat rides on Lake Pichola, lakeside dining, and leisurely walks along the promenades. The serene environment provides opportunities for relaxation and exploration (Samant, 2010).

Table 6. Information on Udaipur Waterfront in India (continued)

9. ECONOMIC CONTRIBUTION	**9.** Also, the waterfront is a hub for cultural events, festivals, and art exhibitions that engage residents and tourists. It celebrates local culture and fosters community participation. In addition, including restaurants, shops, and cultural spaces encourages a vibrant mix of activities. It creates an inviting atmosphere for people to shop, dine, and experience local culture. The Udaipur Waterfront also hosts cultural events, traditional music performances, and dance shows, enhancing the city's cultural vibrancy. These activities add to the waterfront's allure. Aside from this, the project incorporates environmentally responsible features such as sustainable landscaping and eco-friendly construction materials, contributing to environmental stewardship (Samant, 2010).

In summary, the Udaipur Waterfront in India successfully combines contemporary waterfront design principles with thrilling coastal features. It exemplifies sustainability, community engagement, mixed-use development, cultural preservation, innovation in design, and environmental sensitivity. The waterfront's scenic beauty, diverse recreational opportunities, cultural engagement, mixed-use character, and commitment to preserving local heritage make it a captivating destination for residents and visitors. It is a dynamic and enriching waterfront that celebrates the region's cultural legacy while providing memorable experiences.

3.1.6. Case 6. Waterfront Tavern in Australia

Evaluation of Waterfront Tavern's (Table 7) design, features, and amenities framework based on contemporary waterfront design principles and thrilling coast features:

Table 7. Information on Waterfront Tavern in Australia

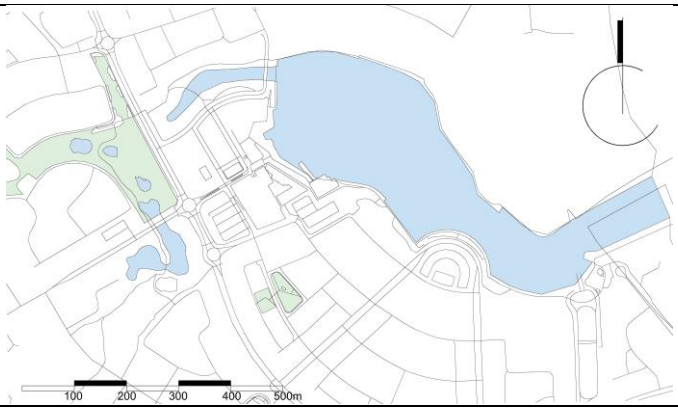
	
Name of the Waterfront	Waterfront Tavern in Australia
Award	The 23rd Australian Timber Design Awards recognizes the architectural excellence of Waterfront Tavern, a project designed by H&E Architects. The Awards acknowledge the utilization of timber and prioritize commendable design and inventive approaches in the implementation of timber and wood products. The utilization of timber and wood products is experiencing a growing range of applications due to the increasing interest of developers and designers in harnessing the advantages of a low-carbon, sustainable, and economically viable construction material.
Scale	4,450sqm
THRILLING CONTEMPORARY WATERFRONT FEATURES	**EVALUATION OF THE CASE AREA**
1. SUSTAINABILITY	**1.** According to contemporary design principles, a waterfront establishment can demonstrate sustainability by adopting environmentally friendly practices

Table 7. Information on Waterfront Tavern in Australia (continued)

2. COMMUNITY ENGAGEMENT **3. MIXED-USE DEVELOPMENT – DIVERSITY OF ACTIVITIES** **4. RESPECT TO AND PROMOTION OF CULTURAL HERITAGE** **5. CREATIVE / INNOVATIVE APPROACH OF URBAN DESIGN** **6. PROMOTION AND PROTECTION OF SCENIC BEAUTY** **7. PUBLIC HEALTH AND WELL-BEING** **8. ACCESSIBILITY** **9. ECONOMIC CONTRIBUTION**	such as energy-efficient lighting, waste reduction, and sustainable materials (Abdel, 2022). **2.** Besides, a successful waterfront tavern prioritizes community engagement by offering spaces for social gatherings, events, and activities catering to residents and tourists (Abdel, 2022). **3.** Also, integrating commercial spaces, restaurants, and recreational areas can contribute to a vibrant and economically viable waterfront. This mix can encourage a diverse range of activities and visitors. In addition, a waterfront location takes advantage of its natural surroundings, whether a coastal view. Incorporating green spaces and outdoor seating helps integrate nature into the design (The Waterfront Tavern, 2023; Abdel, 2022). **4.** Apart from this, while modern in design, waterfront establishments pay tribute to the local culture and heritage through design elements, decor, or even showcasing local art and traditions (Abdel, 2022). **5.** Besides, innovation is demonstrated through unique architectural features, creative use of space, and modern amenities that enhance the overall dining and leisure experience (Abdel, 2022). **6.** According to thrilling coastal features, being located on the waterfront, the Waterfront Tavern ideally offers stunning waterfront views. Outdoor seating areas with water views and coastal landscapes draw significantly (The Waterfront Tavern, 2023). **7.** Also, providing relaxing spaces, outdoor seating, and opportunities for visitors to enjoy the coastal atmosphere contributes to public well-being (The Waterfront Tavern, 2023; Abdel, 2022). **8.** Besides, waterfront establishments often benefit from their proximity to water-based recreational activities. Whether it is offering boat rentals, waterside seating, and access to water sports, these opportunities can enhance the visitor experience (Abdel, 2022). **9.** Also, hosting events, live music, and themed nights can foster community and encourage locals and tourists to frequent the establishment. In addition, combining dining, entertainment, and leisure activities within the tavern can create a lively and dynamic environment that attracts a diverse crowd. Besides, offering live entertainment, cultural events, and showcasing local artists can make the establishment a cultural hub and a source of visitor excitement. Apart from this, promoting environmental responsibility by implementing sustainable practices appeals to eco-conscious patrons (The Waterfront Tavern, 2023; Abdel, 2022).

In summary, integrating contemporary waterfront architectural ideas with captivating coastal characteristics has proven successful for a New South Wales South Coast bar. The attributes above encompass sustainability, active community involvement, integrating many functions within a single development, incorporating innovative design elements, and a heightened awareness of environmental considerations. The mesmerizing allure of the waterfront lies in its picturesque aesthetics and unwavering dedication to preserving local identity. This combination of factors makes it an enticing location for inhabitants and tourists. The waterfront is characterized by its lively and enriching nature, as it serves as a platform for celebrating the region's cultural past while offering remarkable experiences.

3.2. Discussion

Contemporary waterfront design is increasingly synonymous with sustainability, reflecting a global commitment to ecological responsibility. As posited by Pramesti (2017), sustainability is not merely an aspect but a fundamental pillar, evident in the selection of case studies, such as Vancouver Waterfront Park's commitment to green infrastructure and eco-friendly practices. However, a critical lens prompts consideration of the varying degrees to which sustainability is embraced. Are these projects truly regenerative, or do they merely adhere to minimum environmental standards? A nuanced analysis

could draw on the works of Badach & Raszeja (2019) and Sodiq et al. (2019), advocating for a more stringent integration of sustainable practices that extend beyond token gestures.

The emphasis on community engagement is a laudable aspect of contemporary waterfront design, aligning with principles of inclusivity and participatory urbanism (Cihan Yavuzcan & Gür, 2023). However, the extent to which communities are genuinely empowered in decision-making processes requires examination. While the Victoria & Alfred Waterfront project in South Africa showcases community-centric features, the experiences of marginalized groups must be considered. The works of Avni & Fischler (2019) and Wessells (2014) provide a critical framework to evaluate the power dynamics within community engagement initiatives, urging a more profound exploration of equity and social justice.

Striking a Balance between Historic Preservation and Innovation. The integration of historic preservation with modern design is a delicate dance. Albarrada Waterfront's endeavor to balance historical significance with contemporary functionality is commendable. However, challenges arise in delineating the line between preservation and innovation. Scholars like Üzümcüoğlu & Polay (2023) argue that in the pursuit of progress, there is a risk of erasing cultural memory. This discussion urges a critical examination of how waterfront designs negotiate the tension between honoring heritage and embracing innovation.

Waterfront developments often promise economic growth, with an anticipation of increased tourism and commercial activities. Belgrade Waterfront's economic contributions are evident, yet a closer look at gentrification concerns is imperative (Gunay & Dokmeci, 2012). The economic boom can inadvertently displace local communities and alter the socio-economic fabric. Harvey's (2015) concept of the "right to the city" offers a critical lens to assess whether these developments genuinely benefit the existing population or lead to exclusionary urban restructuring.

While environmental stewardship is a core principle, the practical challenges of implementation must be addressed. The complexity of restoring waterfront areas and promoting sustainable development requires a more nuanced understanding. Insights from Giovinazzi & Giovinazzi (2008) prompt a critical inquiry into the feasibility and effectiveness of environmental initiatives within these projects.

Synthesizing Theoretical and Practical Perspectives. The synthesis of theoretical frameworks with practical applications reveals a rich tapestry of successes and challenges. Acknowledging that the presented projects embody contemporary waterfront design theories to varying extents, the critical discussion underscores the need for continual scrutiny. The study encourages an ongoing dialogue that transcends celebratory narratives to confront the complexities and contradictions inherent in the evolution of waterfront spaces, balancing aspirations with realities. This critical perspective invites future research to delve deeper into the unintended consequences and latent challenges that may surface over time, ensuring that the discourse on contemporary waterfront design remains adaptive, reflective, and responsive to the evolving needs of both the environment and the communities it serves.

4. Conclusion and Suggestions

Through the exploration of contemporary waterfront design theories and their manifestation in thrilling coastal spaces through a series of case studies, it is evident that well-planned waterfronts have the potential to become vibrant, sustainable, and culturally enriched environments that benefit both residents and visitors. The case studies of the Victoria & Alfred Waterfront in South Africa, the Udaipur Waterfront in India, the Belgrade Waterfront in Serbia, and the Albarrada Waterfront in Mompox, Colombia, along with the theoretical framework, provide valuable insights into the foundational principles and features that underlie thriving coastal developments.

The synthesis of case studies and literature findings reveals a convergence of contemporary waterfront design principles and thrilling coast features in successful waterfront projects. Sustainability, community engagement, mixed-use development, cultural preservation, innovation in design, and environmental stewardship emerge as common themes in case studies and theoretical frameworks. These principles create vibrant, sustainable, and culturally enriched waterfront spaces. Scenic beauty,

recreational opportunities, community engagement, mixed-use development, entertainment, and cultural activities, environmental stewardship, and public health and well-being are critical components that collectively shape thrilling coastal destinations.

Suggestions and Practical Recommendations based on the case-based and theoretical-based findings:

1. *Sustainability:*

Recommendation: Integrate sustainable practices in the design and construction of waterfronts. Use eco-friendly materials, implement green infrastructure, and incorporate renewable energy sources.

2. *Community Engagement:*

Recommendation: Foster ongoing community involvement in the planning, design, and management of waterfront spaces. Establish forums for public input and participation, ensuring the community's voice is heard.

3. *Mixed-Use Development – Diversity of Activities:*

Recommendation: Encourage a mix of residential, commercial, cultural, and recreational spaces. Create a dynamic environment with diverse activities to attract a broad audience.

4. *Respect for and Promotion of Cultural Heritage:*

Recommendation: Preserve and showcase the cultural heritage of the area through thoughtful design. Incorporate historical landmarks, cultural events, and public art installations that celebrate local traditions.

5. *Creative/Innovative Approach to Urban Design:*

Recommendation: Embrace innovative design concepts that blend modern architecture with the natural environment. Encourage creativity in landscaping, public art installations, and the adaptive reuse of existing structures.

6. *Promotion and Protection of Scenic Beauty:*

Recommendation: Design waterfront spaces to maximize scenic views and preserve natural beauty. Implement landscaping strategies that enhance the visual appeal and protect the surrounding environment.

7. *Public Health and Well-being:*

Recommendation: Prioritize public health by creating spaces for relaxation, exercise, and social interaction. Design walking paths, green spaces, and recreational facilities that promote a healthy lifestyle.

8. *Accessibility:*

Recommendation: Ensure universal accessibility to waterfront spaces. Implement infrastructure that accommodates people of all abilities, including ramps, elevators, and accessible pathways.

9. *Economic Contribution:*

Recommendation: Design waterfront spaces to contribute to the local economy. Encourage the development of shops, restaurants, and entertainment venues that generate economic activity and employment opportunities.

In conclusion, the case study findings corroborate the theoretical foundations of contemporary waterfront design, demonstrating the real-world applicability of these principles. The synthesis underscores the importance of considering these principles. It features holistically in waterfront development, offering a comprehensive approach to creating thriving coastal spaces that enrich the lives of communities and visitors.

These recommendations aim to align waterfront design with the principles of sustainability, community engagement, cultural preservation, innovation, scenic beauty, public health, accessibility,

and economic contribution. Implementing these suggestions can create vibrant, inclusive, and economically sustainable waterfronts that cater to the diverse needs of the community.

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

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Detection of Population Density, LULC Variation and Cross-Regional Similarities Using K-Means Clustering Algorithm in Istanbul Example

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Abstract

In this study, the effect of urban sprawl on land change in Istanbul was examined using Geographic Information System (GIS) technologies and the CORINE Land Cover (CLC) data set produced for the years 1990-2018 and population information. According to this; It has been determined that urban sprawl in the study area has increased due to population growth, especially industrial units, city structures, mines and construction sites have increased by approximately 9%, while maquis areas, arable, mixed agricultural areas and forest areas have decreased by 9%. According to the K-means application, similarities in the districts were revealed between 1990 and 2018. According to the results obtained, it was determined that the districts that were in clusters with similar characteristics in the 1990s changed over time and were located in different clusters. As a result, it is predicted in the study that urban sprawl will increase further due to population growth in Istanbul.

Keywords: *Urbanization, urban development, natural areas, conservation, Istanbul*

İstanbul örneğinde K-Means Kümeleme Algoritması Kullanılarak Nüfus Yoğunluğu, LULC Değişimi ve Bölgeler Arası Benzerliklerin Tespiti

Öz

Bu çalışmada Coğrafi Bilgi Sistemi (CBS) teknolojileri kullanarak, 1990-2018 yılları için üretilen CORINE Arazi Örtüsü (CLC) veri setinden ve nüfus bilgilerinden yararlanarak İstanbul'da kentsel saçaklanmanın arazi değişimi üzerindeki etkisi incelenmiştir. Buna göre; çalışma alanında kentsel saçaklanmanın nüfus artışına bağlı olarak arttığı özellikle endüstri birimleri, şehir yapısı, maden ve inşaat sahalarının yaklaşık % 9 oranında artış gösterdiği buna karşılık makilik alanlar, ekilebilir, karışık tarım alanları ve ormanlık alanların % 9 oranında azaldığı tespit edilmiştir. K-means uygulamasına göre 1990 ve 2018 yıllarında ilçelerdeki benzerlikler ortaya çıkarılmıştır. Elde edilen sonuçlara göre 1990'lı yıllarda benzer özellikler gösteren kümelerde bulunan ilçelerin zamanla değişim gösterdiği ve farklı kümeler içerisinde yer aldığı tespit edilmiştir. Sonuç olarak çalışmada İstanbul'da nüfus artışına bağlı olarak kentsel saçaklanmanın daha fazla artacağı öngörülmüştür.

Anahtar kelimeler: *Kentleşme, kentsel gelişme, doğal alanlar, koruma, İstanbul*

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1. Introduction

Nowadays, more than half of the world's population lives in urban areas (Li et al., 2009; Shen & Zhou, 2014; Çoban & Uzun, 2023). Due to the growing human population, cities are growing rapidly today, and as a result, natural areas are being destroyed drastically. Cities are increasingly exposed to environmental problems such as construction, improper land use, biodiversity losses, climate change, water, air, and noise pollution, which negatively affect the quality of life (Westmacott, 1991; Doygun et al., 2010). Because of this, one of the best planning strategies for minimizing the adverse effects of urbanization on people and the natural environment is the protection of natural places. The beginning of urbanization is generally accepted as the beginning of civilization. Accordingly, urbanization started with the transition of people from a hunter and gatherer life to a settled life in the historical process. Although the history of cities dates back to Ancient Rome, it is seen that modern cities in today's sense developed rapidly in the 20th and 21st centuries (Uzun and Demir, 2016). The urbanization process causes cities to expand rapidly in space and spread to all urban and rural areas around them, and as a result, natural resources in the urban area are rapidly consumed.

This situation manifests itself with unplanned and uncontrolled growth due to rapid population growth, especially in the cities of developing countries (Sezgin and Varol, 2012). Cities are gradually expanding and developing towards the surrounding settlements, and with the new organization formed, some urban functions are out of the settlement area of the city. As a result, intermittent, disconnected settlement patterns formed and this new growth form of the city was called 'urban sprawl' (Clawson, 1962; Karataş, 2007). The effect of urbanization on the periphery of urban areas causes sprawl, which in turn threatens urban sustainable development and the continuity of the ecosystem, and leads to an increase in waste with the misuse and consumption of natural resources. Within the framework of the studies and research, the main causes of urban sprawl or sprawl are grouped under 7 headings (Gillham, 2002; Ludlow, 2006).

Macro-Economic Factors: Economic development, Globalization, Communication Technologies

Housing Preferences: Increase in the amount of space per person, Change in housing preferences

Urban Issues: Air pollution, Noisy, Small living/housing units, Security problem, Social problems, Insufficient open-green areas

Micro-Economic Factors: Rising standard of living, Land prices, Cheaper agricultural lands, Private propriety

Demographic Factors: Population growth, Increase in housing production

Planning: Regulation and standards, The zoning approach, Weak land use plan, Difficulties in the implementation of plans, Problems in horizontal and vertical coordination and cooperation

This issue has attracted the attention of many researchers in the world and in our country, and the effect of urban sprawl on natural areas in different provinces has been tried to be examined. Uzuneminoğlu (1993), from these studies, examined the urban development of Samsun and stated that the urban area of the city, which was 30 ha between 1850 and 1860, reached approximately 3552 ha in 1990. Aydoğdu et al., (2012) stated that between 2000 and 2010, residential areas increased by 38.66% in Ankara's Yenimahalle district, especially pasture areas decreased. Mansuroğlu et al. (2012) in their study on Antalya emphasized that the natural areas of the city have been adversely affected due to the intense population growth and urbanization pressure in the last 20 years and that future urban development decisions should be taken in line with ecological principles.

Öncel and Meşhur (2012) investigated the causes of urban sprawl in the growth of Konya's urban area and stated that public and private capital investments in recent years played an important role in the development of the city. Doygun and Erdem (2013) stated in their study on Bornova that urbanization puts significant pressure on other land use types and this situation is not sustainable, especially in terms of quality areas close to nature. Kanbak (2013), in his study examining urban sprawl in Istanbul, stated that the two most important reasons for urban sprawl in the area are migration and industrialization. Kurt and Duman (2016) stated that between 2000 and 2014, Sakarya's residential

areas grew spatially due to population growth and tourism activities, while forest and bush areas decreased spatially. Ayazlı et al. (2015) used the SELUTH model supported by T-EFA (Total Exploratory Factor Analysis) to reveal the change in land cover caused by urban sprawl in Istanbul. According to the results obtained, they predicted that by 2040, approximately 1000 km2 of agricultural, forest, and wetlands will change with urban areas. In their study in the Arnavutköy district of Istanbul, Topaloğlu et al. (2021) stated that forests, arable lands and pastures in the area have decreased significantly due to urbanization. Bozkurt et al. (2023) found that urban areas increased by 9.69% in Istanbul between 1990 and 2018. CORINE data sets are one of the preferred data in studies aimed at monitoring urban sprawl. Studies conducted with the CORINE data set for all European countries between 1990 and 2006 found that city areas increased by 146% (Triantakonstantis and Stathakis, 2015). Bilozor et al. (2020) analyzed urban sprawl change in Poland using the CORINE dataset and Geographic Information Systems software. In another study using the CORINE data set from 2018, urban landscape density index (ULII) within the borders of 7 metropolises in Poland and 1 in Germany were evaluated. According to the results, it was concluded that transportation and settlement, which cause urban sprawl, directly or indirectly affect this index (Myga-Piątek et al., 2021). In the study covering Ankara, Istanbul and Izmir between 2000 and 2018, the CORINE data set was used to reveal the extent to which land use would change in 2024 with the help of linear and polynomial regression models (Dinç and Gül, 2021). The CORINE data set was analyzed with Gray and Lebart approaches to reveal the city dynamics of the Marmara Region between 2006 and 2018 (Genel and Guan, 2021).

In addition to these investigations, studies for clustering and detecting urban regions usually favor machine-learning methods. Urban sprawl studies also use the K-means approach, one of the machine learning techniques. In their study of urbanism, Liu et al. (2018) used local spatial entropy, gridded population density, and the K-Means approach. The K-Means approach was utilized by Nithya et al. (2017) to manage resources in the city of Salem. On the other side, Salvati and Sabbi (2014) preferred K-means to identify comparative urban sprawl in their study involving Lisbon, Athens, and Rome.

In this study, using the CORINE Land Cover (CLC) data set in Istanbul province, it was tried to determine how much urban settlement areas changed between 1990 and 2018 and how much natural area the urban sprawl covered. In addition, a K-means program was created using the population, land use and land cover data of the area, and similarities between the districts in 1990 and 2018 were determined. In line with these data obtained, suggestions were made for the protection of natural areas in the districts where the change was experienced.

2. Material and Method

2.1. Material

2.1.1. Study area

The main material of the study is the province of Istanbul. The research area covers the entire administrative area of Istanbul (Figure 1). Istanbul is located at the intersection of two peninsulas in a very strategic position, at the junction of the Asian and European continents, and is located between 28° 01' and 29° 55' east longitudes and 41° 33' and 40° 28' north latitudes. If we look at the land structure of Istanbul, it is generally low in height. The highest point of Istanbul is the 537 m Aydos Mountain between Kartal and Pendik districts. There are three notable lakes in Istanbul. The biggest of these is Terkos Lake, which is 50 km away from the city on the Black Sea coast and has an area of 25 km^2. Terkos Lake is followed by Büyükçekmece and Küçükçekmece Lakes.

The biggest stream in the province is Riva Stream. Riva Stream is the biggest stream of the Kocaeli Peninsula; It pours into the sea from the Riva Village of Beykoz (Istanbul Provincial Environmental Status Report, 2022). The climate of Istanbul is mostly a transitional climate and has a temperate climate (İBB, Geographical Location, and Strategic Importance, 2016-2021). The natural vegetation of the province consists of forest, maquis, pseudo-maquis (maquis plant communities adapted to the Black Sea climate, changed, humid character, more woody), and coastal plants. With the effect of the climate, moist plant species have developed in the northern parts of the city and relatively drier plant species have developed in the southern part (Akkemik, 2017).

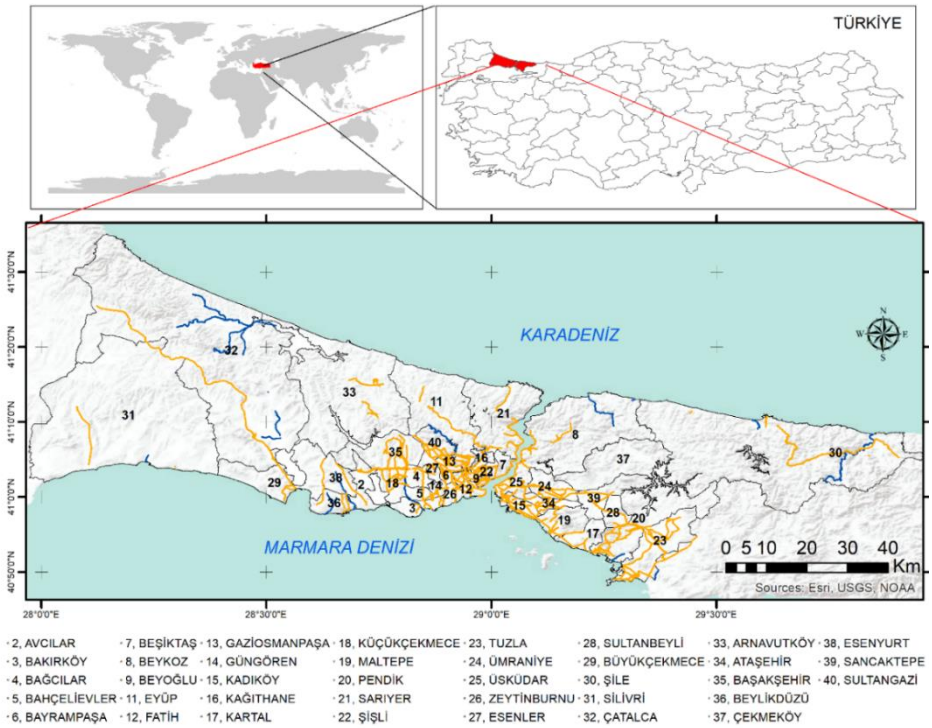


Figure 1. The geographical location of Istanbul province

2.1.2. Data set

The study highlighted two data sets, particularly the CLC (CORINE Land Cover) dataset, and population, to illustrate the impact of population growth and urbanization on other regions between 1990 and 2018.

The most important material in the field is the CORINE dataset. Information about these data is given in Table 1. The CORINE program, which has been a study aiming to collect information on environmental issues since 1985, has been supported by 39 countries as of 2018. Data sets using the EPSG:3035 (ETRS89, LAEA) coordinate system have thematic accuracy of 85% and above.

Table 1. CLC dataset properties

Data set	Satellite Data	Production time	Time Range	Number of Countries
1990	Landsat-5 MSS/TM	10 year	1986-1998	26
2018	Sentinel-2 and Landsat-8	1.5 year	2017-2018	39

Another dataset used in the study is population data. The population data set used in the study was obtained and organized from the web pages of SIS-State Institute of Statistics and TUIK-Turkish Statistical Institute's (TurkStat).

Population data was created also with the help of 1990 (Gökburun, 2017) and 2018 population data. Population densities were calculated by dividing the population data of these years by district area.

2.2. Method

2.2.1.Population density changing

In order to increase urban development, population change rates need to be determined. For this reason this study, firstly, it is aimed to determine how the population density in the area is distributed and how it fragments the urban area in measuring the urban sprawl. For this purpose, provincial and district population data and changes in the area for the years 1990-2018 were determined.

2.2.2. K-Means clustering algorithm

Using the K-means clustering method, the second stage showed the relationships between the districts' land uses and population densities and evaluated how those relationships had changed between 1990 and 2018.

Orange 3.34 with the open source feature was utilized in the study for the K-means algorithm. An open-source toolset for data mining, machine learning, and visualization is called Orange software. It has a visual programming front-end for interactive data visualization and exploratory qualitative data analysis.

Though the concept dates back to Hugo Steinhaus in 1956, James MacQueen employed K-means for the first time in 1967. It is frequently referred to as the Lloyd-Forgy algorithm because Edward W. Forgy presented roughly the same technique in 1965.

With K-Means clustering, n objects are divided into k clusters, and each object is assigned to the cluster that has the closest mean. The maximum number of distinct clusters produced by this method is k. It is necessary to compute the best number of clusters k that will result in the maximum separation (distance) because it is not known a priori. The squared error function, or total intra-cluster variance, is the goal of K-Means clustering.

Where J is the objective function, k is the number of clusters, n is the number of cases, i is the case of xi, and j is the centroid for cluster cj.

$$J = \sum_{j=1}^{k} \sum_{i=1}^{n} \left\| x_i^{(j)} - c_j \right\|^2$$

K-Means is a reasonably successful method. We must predetermine the number of clusters because the final results are sensitive to initialization and often terminate at a local optimum. Unfortunately, there is no complete theoretical method to figure out how many clusters is just right. It is a good idea to compare the outcomes of multiple runs with different k values and choose the best one based on a preset criterion. Determining the number k in clustering analyses is quite uncertain. Analyses such as elbow and silhouette are used to determine the number k. In this study, silhouette analysis is preferred. The distance separating the generated clusters can be examined using silhouette analysis. The silhouette plot offers a visual means of evaluating factors such as the number of clusters by displaying a measure of the proximity between each point in a cluster and points in the nearby clusters. The range of this metric is [-1, 1].

A big k often reduces inaccuracy but raises the chance of overfitting. These data were used to assess manmade regions and woodland, semi-natural regions separately for the European and Anatolian sides in 1990 and 2018. This classification makes use of numerical data and visual maps to assess how much the area's urban sprawl has an impact on the change in land cover. Additionally, it has been made known how Istanbul's forests and natural spaces have changed due to different land uses.

2.2.3.Pixel-Based landuse/land cover change

Lastly, using the CLC dataset for the years 1990 and 2018, the land cover classification of Istanbul was made according to the Level 2 land cover classification since it contains more detailed information than the CLC dataset Level 1 data (Table 2). In the study, pixel information was obtained from the CLC dataset with 100m*100m pixel information using ArcGIS 10.5 software.

Table 2. Corine land cover classes (Corine, 2022).

CORINE LAND COVER CLASSES			
1	Artificial Surfaces	3	Forest and Semi-Natural Areas
11	Urban fabric	31	Forest
12	Industrial, commercial and transport units	32	Shrub and/or herbaceous vegetation associations
13	Mine, dump and construction sites	33	Open spaces with little or no vegetation
14	Artificial, non-agricultural vegetated areas	4	Wetlands
2	Agricultural areas	41	Inland wetlands
21	Arable Land	42	Coastal wetlands
22	Permanent crops	5	Water bodies
23	Pastures	51	Inland waters
24	Heterogeneous agricultural areas	52	Marine waters

3. Findings and Discussion

3.1. The Effect of population growth between 1990-2018 on urban sprawl in Istanbul

When Istanbul is examined in terms of population density, it is one of the most crowded cities in Turkey and even in the world. It is also the most important industrial and commercial center of the country. Due to these features, it constantly receives immigration and its population is increasing rapidly. Over the years that are the subject of our research; While the urban population was approximately 6.900.000 in 1990, this number increased to 15.000.000 in 2018 (Figure 2). During this period, the city has increased almost 2.5 times in terms of population. The correlation value of the population growth rate has a high value of 0.9966. When the correlation result is evaluated, it is possible to say that the population will increase rapidly in a positive direction in the coming years.

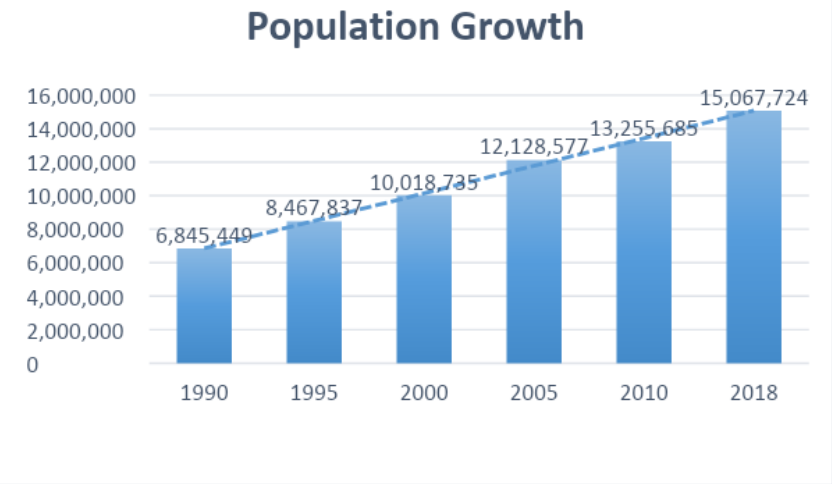


Figure 2. Population growth amount of Istanbul between 1990-2018 (DİE-State Institute of Statistics, 1990-1995-2000) data and TÜİK (2005-2010-2018 data)

The most negative effect of population growth in the city has been on urban sprawl. In order to meet the housing needs of the population coming from the villages, unplanned slums were built on empty lands, and urban sprawl gained momentum with the granting of zoning permits to these structures over time. The population growth and urban sprawl, which developed in parallel with the increase in industrial facilities in the region, caused the construction of new roads and bridges. Thus, the settlement area spread and expanded along the coasts of Tekirdag in the west, Izmit in the east, the Black Sea in the north, and the Marmara Sea in the south. Depending on the population increase, some central districts (such as Bakırköy and Kadıköy) were divided and new districts were formed. These districts are Arnavutköy, Avcılar, Bağcılar, Bahçelievler, Başakşehir, Beylikdüzü, Esenyurt, Esenler, Güngören and Sultangazi on the European side; On the Anatolian side, Ataşehir, Çekmeköy, Maltepe, Sancaktepe, Sultanbeyli and Tuzla districts are. As a result, a dense urban sprawl was detected in Istanbul between 1990 and 2018 due to demographic factors, macro and micro economic factors, changes in housing preferences, urban problems, and problems caused by planning inadequacies.

When examined in terms of population density, Bakırköy is seen as the district with the highest density in the 1990s, as it was before the division, as stated above. It has been determined that the population density is generally concentrated on the coast of the Marmara Sea and in the southern parts of Istanbul. However, as of 2018, it has been determined that the population mobility has increased towards the north and east of the city. This situation has been evaluated as the most important indicator of urban sprawl in Istanbul (Figure 3). Before clustering analyses, the data should be preprocessed according to the method to be used. For this purpose, the data were first categorized, digitized and normalized. The K-means method required categorization of the population density data. As a result, the ranges of population densities are as follows: 10, 11-50, 51-100, 101-150, 151-200, 201-250, 251-300, 301-350, 351-400, and >400 (Figure 3). Numbers such as 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 are used to classify these ranges. K-means were calculated using distribution percentages of categorized population density data within districts.

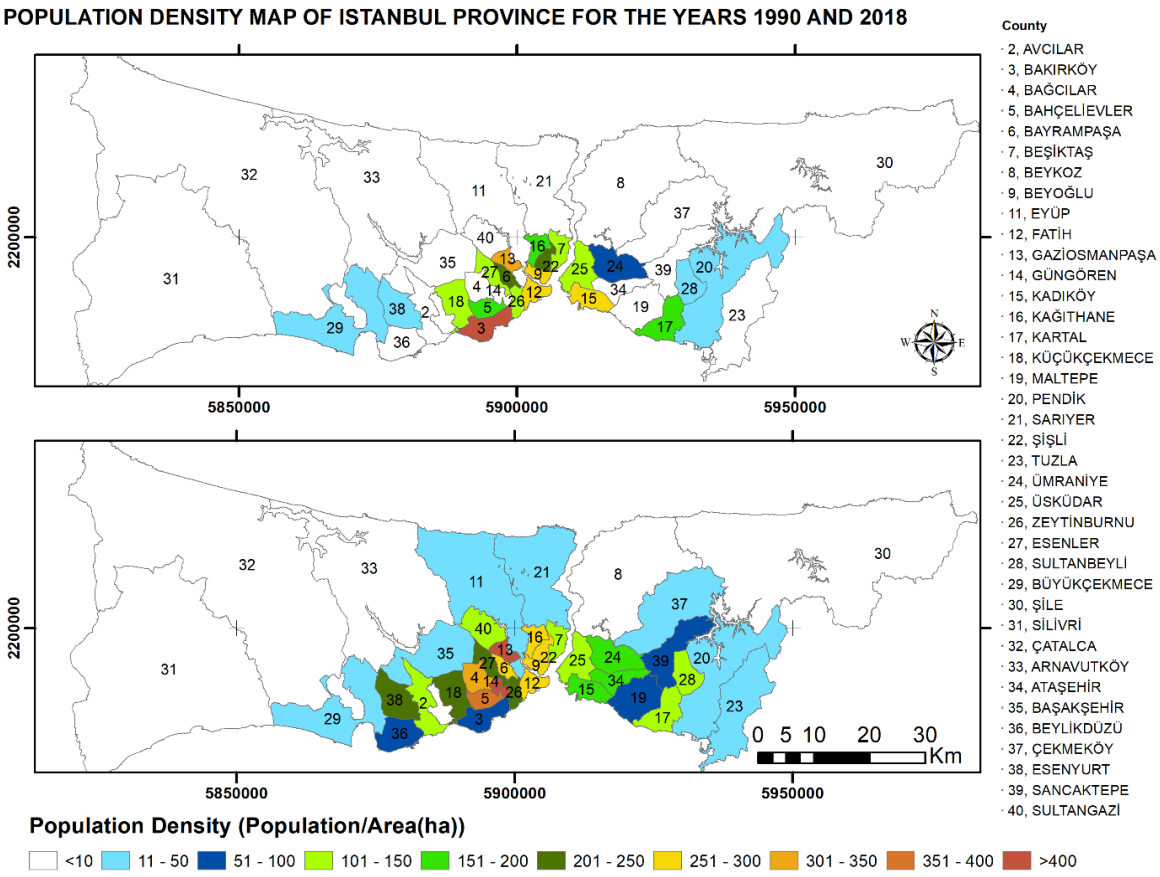
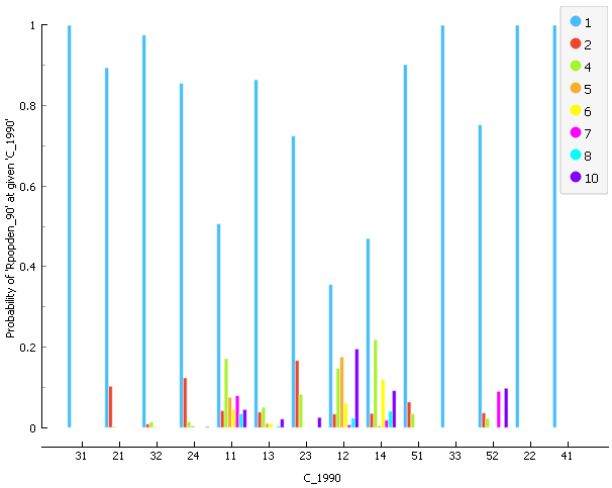


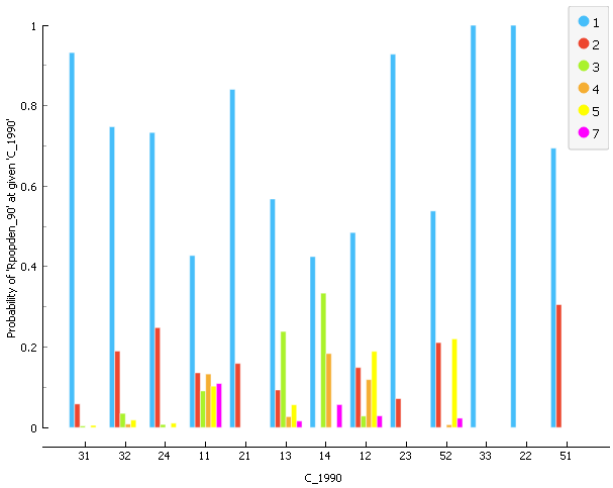
Figure 3. Population density map of Istanbul province for the years 1990 and 2018

3.2. Assessment of Land Use/Land Cover and Population Density

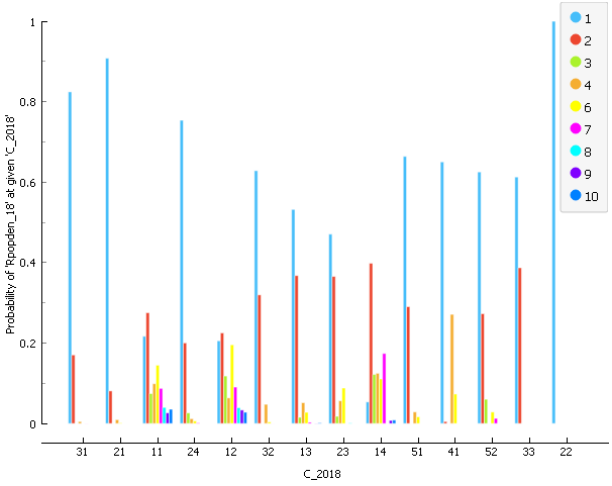
The distribution of the categorized population density with land use was examined separately for both sides of Istanbul and for both years. The codes for land use are given in Table 2. According to this, the high-density population, which was expressed as 10 in 1990, especially on the European side, is encountered in the land use areas expressed as 12 (Industrial, commercial, and transport units), 14 (Artificial, non-agricultural vegetated areas) and 52 (Marine waters) (Figure 4-a). In addition, the Anatolian side had much lower population densities in the 1990s. Only regions 11 and 14 show the population density categorized by the number 7 (Figure 4-b). When it comes to 2018, it is seen that the population densities categorized as 4 and 6 on the European side spread to almost all land uses. It is seen that the population density number 7 is in 11 (Urban fabric), 12 (Industrial, commercial, and transport units), and 14 (Artificial, non-agricultural vegetated areas) ((Figure 4-c). On the Anatolian side, it is seen that the population densities, which fall into the 4 and 5 categories, have begun to disperse towards other land use areas (Figure 4-d).



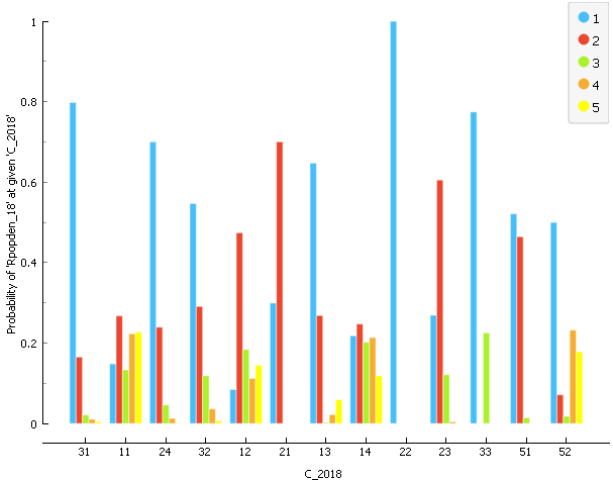
a. 1990 CLC and population density graph of european side



b. 1990 CLC and population density graph of anatolian side



c. 2018 CLC and population density graph of european side



d. 2018 CLC and population density graph of anatolian side

Figure 4. a, b, c, d Population density and CLC graphs

3.3. Analysis of K-Means Clustering Algorithm

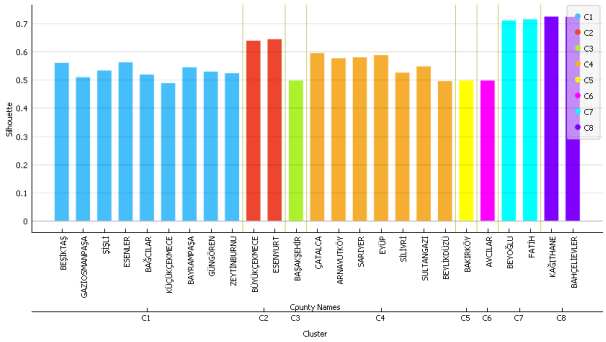
Percentages of land uses and categorical population density data were calculated by districts. These percentages were used in the K-Means clustering method. In this way, similarities between population density and land use were revealed.

In the study, according to the results of the software in silhouette; It has been observed that the number of clusters that emerged for the European and Anatolian Sides in 1990 and for the European and Anatolian Sides in 2018 was 8, 6, 2, and 6 as a result of silhouette analysis for optimal k. Here, especially since the formation of only 2 similar clusters in 2018 provides insufficient information for a dynamic city like Istanbul, the data were reanalyzed to form 8 clusters, which is the highest value of automatic clustering. Here, the criteria of city, population, and land use structure were evaluated in the interpretation and evaluation of both results.

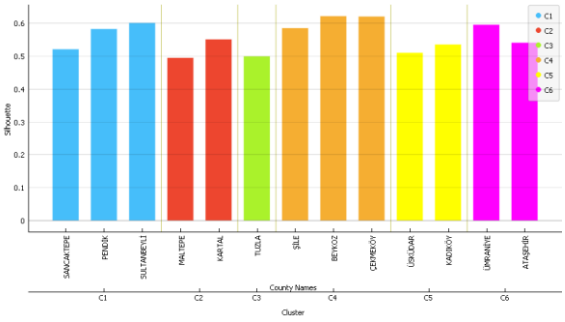
According to this evaluation, there were 8 clusters on the European side in 1990 and a more homogeneous distribution is observed. The first cluster in the distribution; When creating Beşiktaş, Gaziosmanpaşa, Şişli, Esenler, Bağcılar, Küçükçekmece, Bayrampaşa, Güngören, Zeytinburnu; the second cluster is Büyükçekmece and Esenyurt; the third cluster is Çatalca, Arnavutköy, Sarıyer, Eyüp, Silivri, Sultangazi, and Beylikdüzü; the fourth cluster is Beyoğlu and Fatih; The fifth cluster was composed of Kağıthane and Bahçelievler, while Başakşehir, Bakırköy, and Avcılar were not included in any cluster and formed their own clusters (Figure 5-a). In 1990, 6 clusters were formed on the

Anatolian side and Sancaktepe, Pendik, Suntanbeyli formed the first cluster; Maltepe and Kartal the second cluster; Şile, Beykoz, Çekmekoy, the third cluster; Üsküdar and Kadıköy are the fourth cluster; Ümraniye and Ataşehir formed the fifth cluster, while Tuzla formed its own cluster (Figure 5-b).

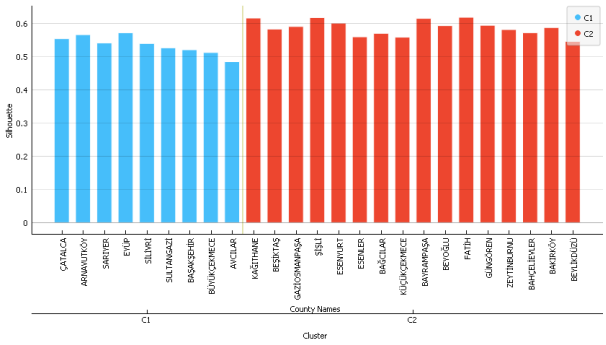
In 2018, the cluster did not show a balanced distribution on the European side, while Çatalca, Arnavutköy, Sarıyer, Eyüp, Silivri, Sultangazi, Başaksehir, Büyükçekmece, Avcılar were in the first cluster, while Kağıthane, Beşiktaş, Gaziosmanpasa, Şişli, Esenyurt, Esenler, Bağcılar, Küçükçekmece, Bayrampaşa, Beyoğlu, Fatih, Güngören, Zeytinburnu, Bahçelievler, Bakırköy and Beylikdüzü formed the second cluster (Figure 5-c). In 2018, a cluster distribution similar to 1990 is observed on the Anatolian side. Although the number of clusters did not change, the distribution changed in some districts depending on the population growth. According to this; Çekmeköy, Pendik the first cluster; Ümraniye, Kadıköy, and Ataşehir the third cluster; Üsküdar, Sultanbeyli, and Kartal the third cluster; Şile and Beykoz formed the fourth cluster, Sancaktepe and Maltepe formed the fifth cluster, while Tuzla formed its own cluster (Figure 5-d).



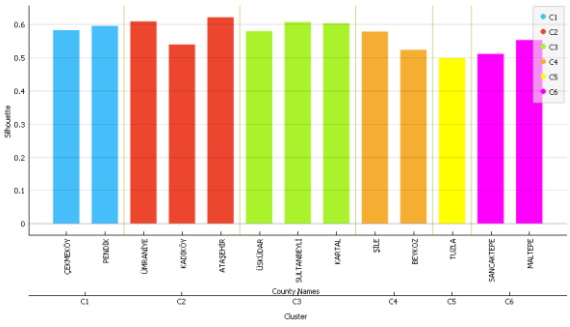
a. European side of K-Means 1990



b. Anatolian side of K-Means 1990



c. European side of K-Means 2018



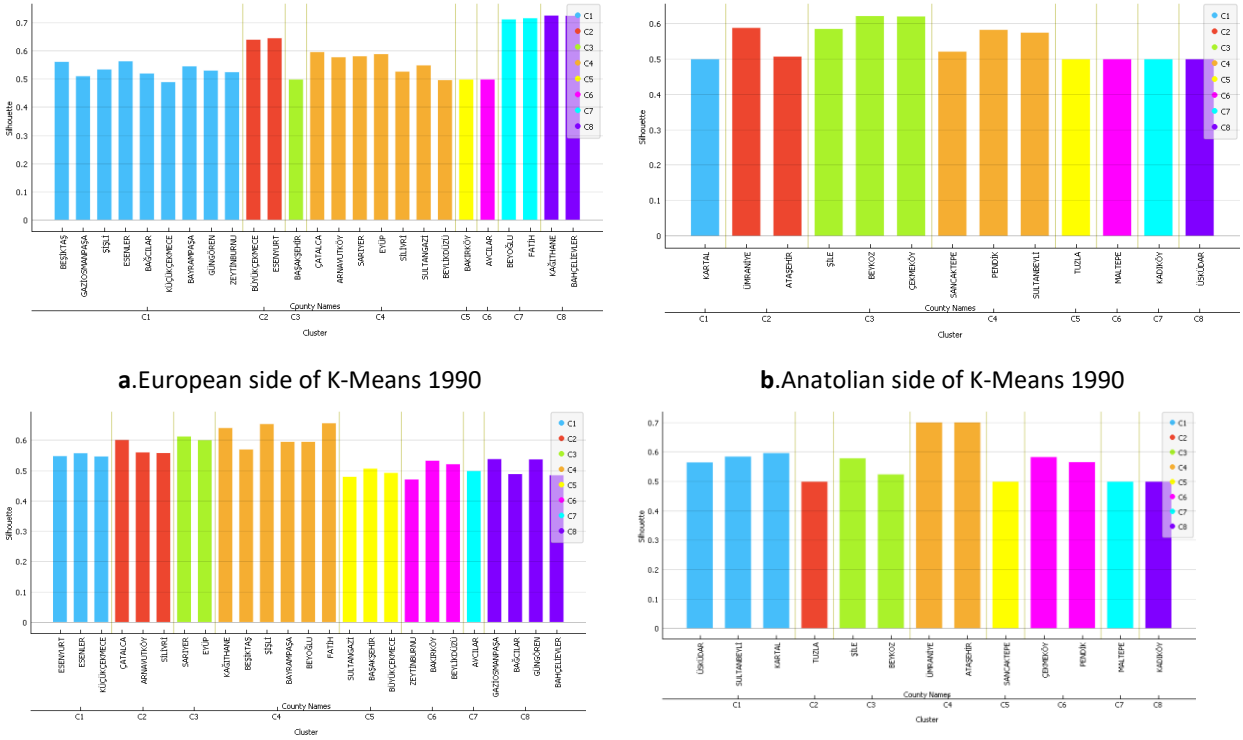
d.Anatolian side of K-Means 2018

Figure 5. K-means with silhouette clustering

In order to be able to compare the K-Means results, the European data of 1990 were forced into 8 clusters in the operations of other times and regions, as they showed a good distribution in 8 clusters. Therefore, cluster distributions of land use and population density in 1990 did not change (Figure 6-a). In 2018, Esenyurt, Esenler and Küçükçekmece; Çatalca, Arnavutköy and Silivri; Kağıthane, Şişli, Beşiktaş, Bayrampaşa, Beyoğlu and Fatih; Sultangazi, Başaksehir and Büyükçekmece; Zeytinburnu, Bakırköy and Beylikdüzü; While Gaziosmanpaşa, Bağcılar, Güngören and Bahçelievler show the same cluster characteristics, Avcılar is again in a separate cluster as in 1990. Looking at 2018, it can be said that districts have a much more heterogeneous distribution and gained new identities compared to 1990 (Figure 6-c).

On the Anatolian side in 1990, Ümraniye and Ataşehir; Şile, Beykoz and Çekmeköy; Sancaktepe, Pendik and Sultanbeyli; Kartal, Tuzla, Kadıköy and Üsküdar were included in clusters with similar characteristics in terms of land use and population density (Figure 6-b). In 2018, Üsküdar, Şile, Beykoz

and Kartal were in the same cluster, while Pendik, Çekmeköy; Ümraniye is in the same cluster as Ataşehir. Tuzla, Maltepe and Kadıköy formed their own clusters. They did not show any similarity with any district (Figure 6-d).



a.European side of K-Means 1990

b.Anatolian side of K-Means 1990

c.European side of K-Means 2018 (c)

d.Anatolian side of K-Means 2018

Figure 6. K-means with 8 clustering

3.4 The Impact of Urban Sprawl on Land Use/Land Cover Change in Istanbul

The most negative effect of urban sprawl in Istanbul has been on the change of area. In order to determine the temporal change in the area, CORINE Level 2 classification data of 1990 and 2018 were obtained and the artificial areas, forest, and semi-natural areas of the city were mapped (Figure 7-8), and the change in urban settlement areas was calculated (Table 3-4).

The distribution map showing the artificial areas of 1990 is shown in Figure 4. It is seen that these areas are generally located in the Historical Peninsula and the shores of the Bosphorus, which are the first settlement areas of Istanbul. Kilyos, on the other hand, is under the influence of open pit mines (Uça et al., 2006) and construction sites. By 2018, artificial zones started to be seen on the coast of the Marmara Sea and in the interior. Kilyos region, where open coal mine works were carried out before, left its place to Istanbul Airport, and Şile and Silivri coasts, which were previously preferred for holiday purposes, have become areas where urban sprawl has increased.

According to the data obtained in terms of urban change, between 1990 and 2018, industry-trade and transportation units, city structure, mine-discharge and construction sites increased by approximately 9%, while maquis and/or herbaceous plants, arable lands, mixed agricultural areas and It was determined that forest areas decreased by about 9% (Table 3). Accordingly, it is possible to say that natural and arable agricultural areas in the city in 1990 were transformed into artificial areas in 2018. When the change in artificial areas in the research area between 1990 and 2018 is examined in particular on the European and Anatolian side, it has been determined that the Anatolian side has increased almost twice. It was determined that the industrial trade and transportation units and the city structure on the Anatolian side showed an increase of 47% from 1990 to 2018. In total, it was determined that the rate of increase in artificial areas in the city was approximately 45% on the Anatolian side and 40% on the European side (Table 4).

Table 3. The rate of increase and decrease of land cover classes in Istanbul province in 1990-2018

Land Cover	1990		2018		Increase/Decrease (-)	
	Area (km^2)	Rate (%)	Area (km^2)	Rate (%)	Area (km^2)	Rate (%)
11 Urban fabric	473.52	8.89	687.43	12.91	213.91	4.01
12 Industrial, com., and trans. units	65.1	1.22	292.79	5.50	227.69	4.27
13 Mine, dump, and cons. sites	126.99	2.38	182.16	3.42	55.17	1.03
14 Artificial Non-Agr. Green Area	52.87	0.99	71.7	0.99	18.83	0.35
21 Arable Lands	1145.49	21.52	999.09	18.77	-146.40	-2.75
22 Permanent crops	5.33	0.10	14.9	0.27	9.570	0.17
23 Pastures	68.4	1.28	91.7	1.72	23.30	0,43
24 Heterogeneous agricultural areas	535.62	10.06	488.48	9.17	-47.14	-0.88
31 Forest	2187.98	41.10	2141.28	40.23	-46.70	-0.87
32 Shrub and/or herb. veg. assos.	621.85	11.68	316.01	5.93	-305.84	-5.74
33 Open spaces with little or no veg.	11.57	0.21	9.73	0.18	-1.84	-0.03
41 Inland wetlands	3.39	0.06	4.51	0.08	1.12	0.02
42 Coastal wetlands	11	0.20	16.81	0.31	5.81	0.10
52 Marine waters	13.34	0.25	5.86	0.11	-7.48	-0.14
Total	5322.45		5322.45			

Table 4. Areas of European and Anatolian side artificial zones (Ha)

	European Side		Anatolian Side	
	1990	2018	1990	2018
11 Urban fabric	27917	39557	19435	29186
12 Industrial, commercial and transport units	4457	17387	2053	11892
13 Mine, dump and construction sites	10197	13581	2502	4635
14 Artificial Non-Agricultural Green Area	2926	4518	2361	2652
Total Area	45497	75043	26351	48365

When we examine the area in terms of forest and semi-natural areas, it was determined that Basaksehir (35) districts on the European side and Maltepe (19) and Sultanbeyli (28) districts on the Anatolian side were exposed to urban sprawl and lost their natural vegetation form (Figure 8).

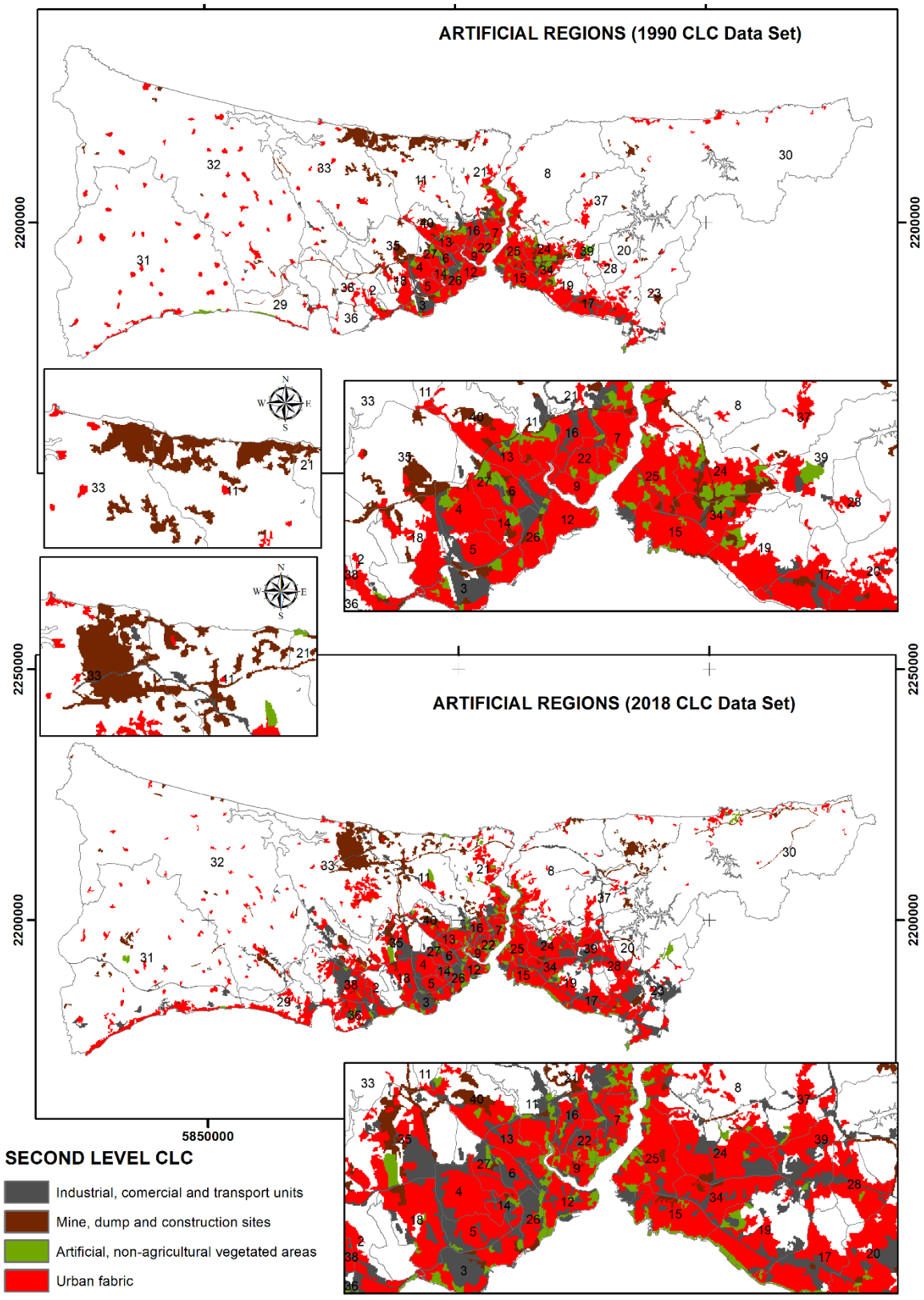


Figure 7. CORINE artificial areas distribution map for 1990 and 2018

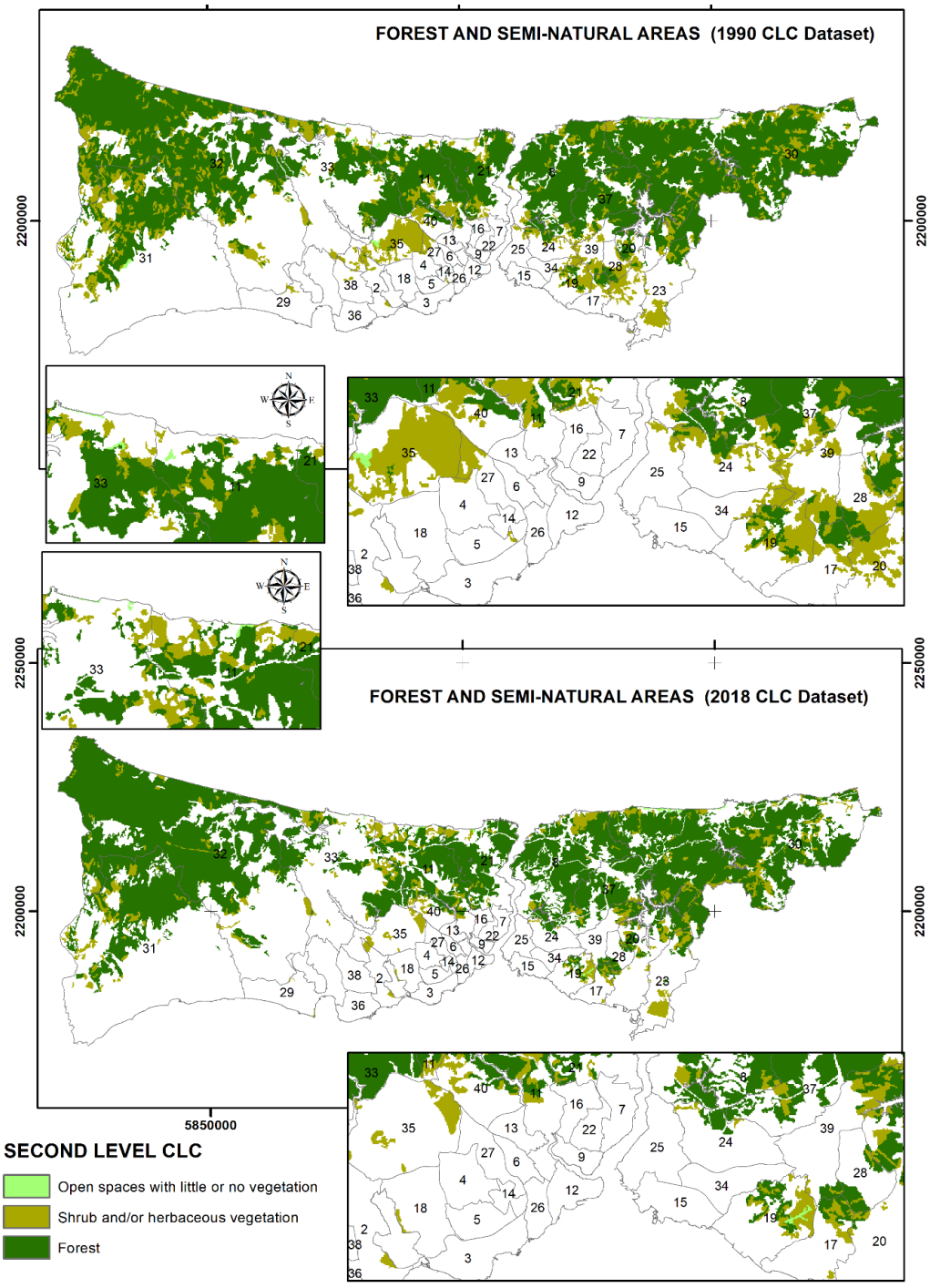


Figure 8. Distribution of forest and semi-natural areas in Istanbul between 1990-2018

When examined specifically on the European and Anatolian sides, it was determined that forest and semi-natural areas decreased by 16% on the Anatolian side and by 9% on the European side (Table 5). The reason for the increase in forest areas on the European side in 2018 was determined as the renewal of forest areas deteriorated as a result of bridge and road works and afforestation works incompatible with natural vegetation.

Table 5. European and Anatolian side agricultural areas and forest and semi-natural areas (Ha)

	European Side		Anatolian Side	
	1990	2018	1990	2018
31 Forest	116970	124276	101828	89852
32 Shrub and/or herbaceous veg. associations	38338	16185	23847	15416
33 Open spaces with little or no vegetation	717	411	440	562
Total	156025	140872	126115	105830

As a result, in this study, it has been determined that natural areas have changed and transformed into urban areas in the city of Istanbul between 1990 and 2018. Figure 9 and Table 6 have been created to examine this transformation in more detail.

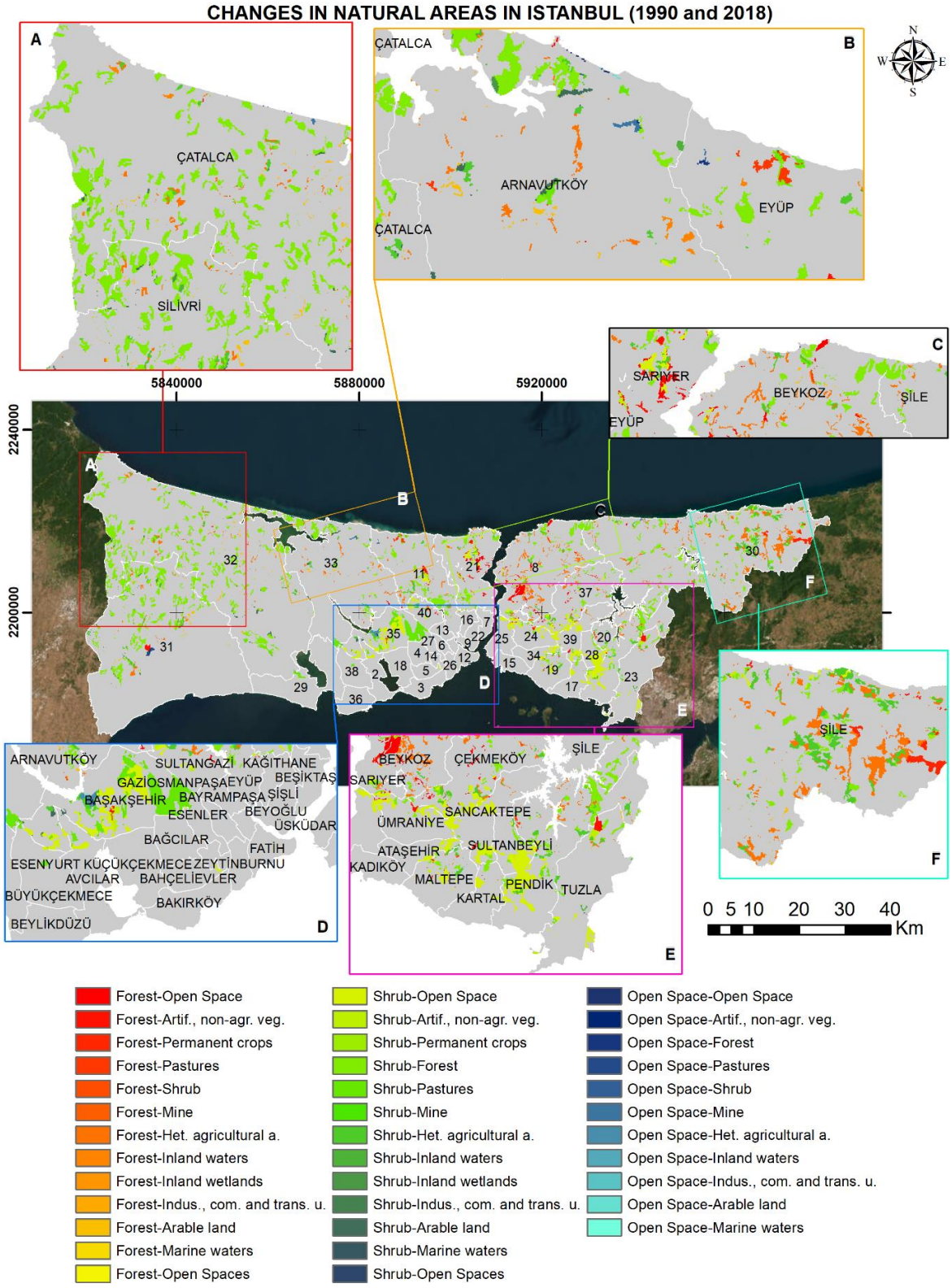


Figure 9. Map of changes in natural areas in Istanbul

Accordingly, from 1990 to 2018, it was determined that 1.34% of maquis or herbaceous plant areas were transformed into urban structures, and 1.54% of forested areas were transformed into mine-discharge and construction sites (Table 6).

Table 6. Artificial area changes in forest and semi-natural areas on the European and Anatolian sides

Land Cover/Land Use Arazi		Change (Ha)		Total	Change (%)		Total
1990	2018	European	Anatolian	(Ha)	European	Anatolian	(%)
31	11	517	971	1488	0.10	0.18	0.28
	12	599	1316	1915	0.11	0.25	0.36
	13	5627	2551	8178	1.06	0.48	1.54
	14	394	341	735	0.07	0.06	0.14
32	11	2436	4702	7138	0.46	0.88	1.34
	12	886	1856	2742	0.17	0.35	0.52
	13	2323	663	2986	0.44	0.12	0.56
	14	419	355	774	0.08	0.07	0.15
33	11	14	9	23	0.00	0.00	0.00
	12	1	4	5	0.00	0.00	0.00
	13	81	0	81	0.02	0.00	0.02
	14	18	0	18	0.00	0.00	0.00
Study Area Total (Ha)		532245					

4. Conclusion and Suggestions

In this study, the effect of urban sprawl on land change in Istanbul was tried to be determined with the CLC dataset, and the structural change of urbanization on natural areas was examined. According to the results of the examination, it was determined that the city was exposed to population growth and urban sprawl as it is the most important industrial and commercial center of the country. This situation has been determined as the most important reason for the land change and destruction of natural areas in the area.

As a result of processing the CLC dataset; The urbanization and urban sprawl that took place in Istanbul from 1990 to 2018 were examined, especially industry, trade and transportation units, city structure, mine discharge, and construction sites increased by about 9%, on the other hand, maquis and/or herbaceous plants, arable lands, mixed agriculture It has been determined that areas and forest areas have decreased by about 9%. When the area was evaluated separately for the European and Anatolian sides, it was seen that the artificial areas in the city increased by approximately 45% on the Anatolian side and 40% on the European side. Accordingly, it has been revealed that maquis or herbaceous plant areas, forest areas, and natural and arable agricultural areas in the city in 1990 turned into artificial areas in 2018. It has been determined that 1.34% of maquis or herbaceous plant areas have been transformed into urban structures in 2018, and 1.54% of forested areas in 1990 have been transformed into mine discharge and construction sites in 2018. It has been observed that these spatial changes are mostly experienced in the Başakşehir, Maltepe, and Sultanbeyli districts of Istanbul. It has been determined that the results obtained for Istanbul regarding land changes caused by urban sprawl due to population growth reveal similar results in Izmir and its districts. For example, land use change analyzes in Bornova district showed a 41% change throughout the district between 1984 and 2009 (Doygun and Erdem, 2013). While this situation was determined as 3% in the city of Aydin and its immediate surroundings between 1986-2002 (Eşbah, 2007), it was reported as 15% for Urla, Çeşme and Karaburun Districts between 1987-2010 (Erdoğan, 2011). There is an increase in urban sprawl and land use changes due to population growth in the districts bordering the Gulf of Izmir; The conversion rate for all districts shows the maximum value of 42% in the same period (Doygun et al., 2012). In addition, the study aimed to reveal the similarities between population density and land use by using K Means cluster analysis. According to the results of the K Means algorithm, the area was forced into 8 clusters in terms of land use and population density on the European and Anatolian sides. While no change was observed in these clusters in 1990, a more heterogeneous distribution was observed in 2018. In this case, it is an indication that urban sprawl has increased in 2018.

The rapid spread of urbanization shows that there is no comprehensive planning for Istanbul, small-scale planning is insufficient and the use of natural areas for urbanization cannot be prevented. The fact that urbanization is especially effective in natural areas shows that the institutions controlling these areas and the laws enacted for this purpose are not sufficient. Based on this, suggestions for future studies can be presented.

1. In order to prevent the impact of urban sprawl on land change and its spread to natural areas, lands should be classified and used according to their ability classes.

2. Arable land in Istanbul decreased from 1145.49 km^2 to 999.09 km^2 between 1990-2018. Conservation of arable agricultural lands in the area should not be used for other purposes.

3. Improvement and recycling studies should be carried out in order to classify the lands within the city limits of Istanbul and use them in accordance with their purpose. In areas where this is not possible, the areas used for purposes other than their intended use should not be exceeded.

4. The urban development plan prepared for the city should be made by considering the land capability classes map and the future development potential of the city.

5. Urban sprawl, land change, and misuse of natural areas should be monitored at required intervals using GIS systems.

6. Sanctions should be applied in terms of the implementation of the necessary laws and regulations regarding land use and the use of natural areas in our country.

Acknowledgment and Information Note

The article complies with national and international research and publication ethics.

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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An Example of Adaptive Reuse in Office Design; Noktalı Fikir Advertising Agency

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Abstract

The purpose of this study is to reuse architectural and industrial components from various disciplines—used for various purposes—in new structures. The study begins by selecting materials from the industrial and interior design sectors that are adaptable and recyclable and then outlines the process of applying these materials in interior spaces. The study presents the authors' analysis of the Noktalı Fikir Advertising Agency office building located in the Meram district of Konya Province. The analysis involved on-site detection stages, relevant person interviews, and interior photography After conducting research, it was concluded that industrial vehicles that were previously used for different purposes could coexist harmoniously with separate pieces of technology utilized in architecture. This study aims to explain how reusable and adaptable materials affect the working comfort of office workers and clients and serve as a valuable resource for interior designers.

Keywords: Office design, adaptive reuse, interior design.

Ofis Tasarımında Uyarlanabilir Yeniden Kullanım Örneği; Noktalı Fikir Reklam Ajansı

Öz

Bu çalışmanın amacı, farklı disiplinlerden gelen ve farklı amaçlar için kullanılan mimari ve endüstriyel bileşenlerin yeni yapılarda yeniden kullanılmasıdır. Çalışma, endüstriyel ve iç tasarım sektörlerinden uyarlanabilir ve geri dönüştürülebilir malzemelerin seçilmesiyle başlıyor ve ardından bu malzemelerin iç mekânlarda uygulanma sürecini özetliyor. Çalışma, yazarların Konya ili Meram ilçesinde bulunan Noktalı Fikir Reklam Ajansı ofis binasının analizini sunmaktadır. Analiz, yerinde tespit aşamalarını, ilgili kişi görüşmelerini ve iç mekân fotoğraflamalarını içermektedir. Araştırma sonucunda, daha önce farklı amaçlar için kullanılan endüstriyel araçların, mimaride kullanılan ayrı teknoloji parçalarıyla uyumlu bir şekilde bir arada var olabileceği sonucuna varılmıştır. Bu çalışma, yeniden kullanılabilir ve uyarlanabilir malzemelerin ofis çalışanlarının ve müşterilerin çalışma konforunu nasıl etkilediğini açıklamayı ve iç mimarlar için değerli bir kaynak oluşturmayı amaçlamaktadır.

Anahtar kelimeler: *Ofis tasarımı, uyarlanabilir yeniden kullanım, iç mekân tasarımı.*

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1. Introduction

The world's lifestyles are quickly moving toward urbanization. There have been numerous changes in society as a result of the transition from rural to urban living. Local populations have changed their lifestyles and customs as a result of the decline in population in rural areas and the effort to adapt to modern life. Used furnishings, spaces, and equipment that make up the space remain idle due to the declining population and the abandonment of living quarters.

The village population made up 75.78% of the total population in the first Turkish census, which was taken in 1927, while the city population made up 24.22% (Sağlam, 2016). As of December 31, 2022, 57 million 934 thousand 583 people lived in settlements designated as dense cities, which only made up 1.6% of the total land area of our nation, according to population data from 2021. In other words, these settlements are home to 67.9% of Turkey's population (Türkiye İstatistik Kurumu (TUIK), 2022). Figure 1 shows the population distribution in Turkey's first and most recent censuses according to the urban-rural classification.

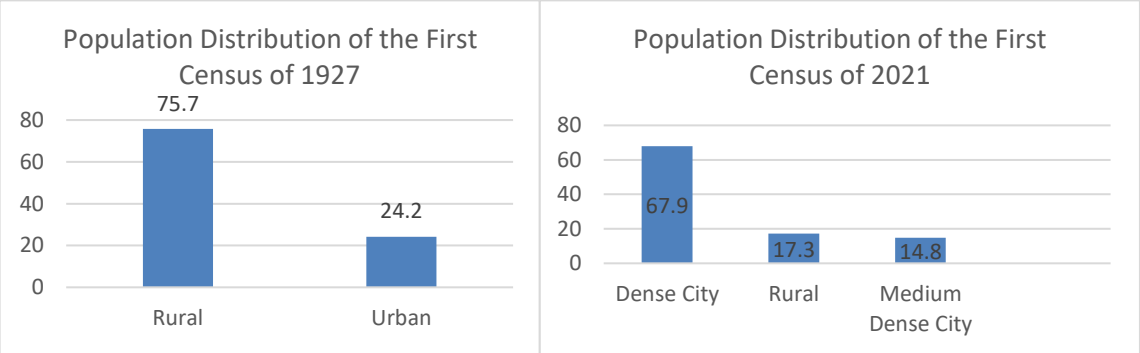


Figure 1. Graph showing urban and rural population between 1927/2022.

Figure 1 shows a significant population shift from rural to urban areas over the past century in Turkey. This migration has resulted in changes to the essential needs of urban life. As a result of this mobility, people's demand for living and working spaces has increased, and there has been a diversification in the housing and employment sectors.

As humans transitioned from a nomadic way of life to a more settled one, they started building their own shelters instead of relying on nature. This shift also meant moving from rural to urban areas (Şiriner Önver, 2016). Houses are not only structures that fulfill our physical needs, but they also represent our lifestyle, cultural values, economic status, and social relationships. The evolution of houses is an important journey that reflects the development and harmony of humanity.

The concept of the office has emerged as a result of the privatization of information-based jobs in the public and private sectors during this phase of changing housing, which has been accompanied by the development of trade and management understanding. Offices have been shaped by factors like the globalization of trade, technological advancements, and changes in business activities over time. Although offices have historically operated in living spaces at first, suitable workspaces have been created over time (Noraslı & Köse Doğan, 2020), and the development process started with the offices being designed in accordance with user needs. . In the current environment, the office is starting to become outdated and is unable to offer users enough physical amenities (Çınar, 2023). The idea of an office, which first emerged in the 19th century, has evolved over time to meet changing needs and technological advancements (Köse Doğan, 2008).

This study's objective is to discuss adaptable and reusable materials within the evolving interior design principles of the office concept that emerged with shifting population mobility. Determining the use of adaptable and reusable materials in the design process of various interior architecture and architectural projects is another goal of the study.

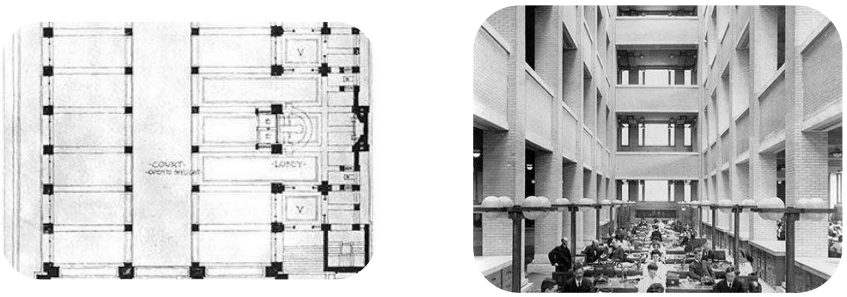
2. Office and Adaptive Reuse Concepts

With the advent of modern life, the demand for a dedicated workspace emerged. Offices were created to cater to this need (Dalga, 2007). As the business world became more complex and specialized, people required specially designed spaces to work in a more efficient and effective manner.

The word office derives from the French meaning workplace, flat, or bureau. In the Turkish language, the words bureau and office are used synonymously (Altınkoç, 2005), however, when the etymology of these words is examined separately, it is understood that they derive from different roots. The bureau is the workplace or building that meets editorial and administrative staff needs. The office, on the other hand, derives from the Latin word "opus", meaning “handiwork, work” (Hasol, 1998).

Design acquisition, according to Yurtgün & Çınar (2023), is a problem-solving activity that involves making decisions to solve the design of an object, space or purpose. The Larkin building's pioneering office layout created by Frank Lloyd Wright has become the standard for how modern workplaces should be configured. The widespread use of open-plan office designs has helped workplaces function more productively and collaboratively (Bailey, 1990).

Even today, the design of office spaces still benefits from this strategy. Wright's Larkin building made the concept of upending conventional office layouts and creating more airy, flexible areas where workers could effectively communicate and collaborate (Soyak, 2009).



A B

Figure 2. a. Larkin office building architectural plan and interior view (Architectural Record, 2023), b. Larkin office building architectural interior view (Architectural Record, 2023)

The functionality and efficiency of offices are now more crucial than ever thanks to technological advancements, the creation of communication tools, and the complexity of business processes. To collaborate, manage data, and share information and resources, people have started to need private offices. As industries have expanded, so too have offices as a result of industry specialization, the emergence of distinct job roles, and office diversification. Office spaces have been developed with various designs and arrangements to meet these requirements because each business branch has unique needs.

At the same time, offices were established to enhance economic growth and manage business activities more systematically. With the advancement of technology, the emergence of remote work opportunities, and the popularity of flexible work arrangements, the concept of the office has evolved significantly. Nowadays, it is no longer the same as it used to be.

In their study on office design, Arslan et al. (2022) claimed that factors like the lighting system, sound and noise control, air conditioning system, equipment compatibility, and color preference in the workplace have a big impact on workers (Arslan et al, 2022).

In Yurtgün's study; In today's office buildings, people; He stated that it consists of crowded, noisy, complex spaces disconnected from natural areas, so employees face some psychological and physical problems, and emphasized that every detail in office designs, from lighting to indoor air quality, will affect the performance of employees (Yurtgün, 2020).

In their 2022 study, Güney Yüksel et al., highlighted the significance of selecting appropriate materials and equipment elements while emphasizing the use of flexible furniture and space solutions to meet user needs. Additionally, they stressed the benefits of incorporating sustainable building materials, ventilation, lighting systems, and technological tools to establish a comfortable work environment for employees (Güney Yüksel et al., 2022).

Office designers must balance incorporating their creative ideas into the space with managing customer satisfaction when deciding on design criteria. Economic conditions are one of the primary determinants of this situation. Handling the design conceptually and transforming it into a prototype in a qualified manner is one of the most important problems encountered in the design process (Noraslı, 2023). In this way, designers can combine the idea of a space that is both creative and sustainable with adaptive and reusable materials.

Design and construction industries are increasingly emphasizing adaptive and reusable materials to promote environmental sustainability and effective resource utilization. The use of such materials allows structures or products to be utilized in various ways during and after use, or to be adapted for different purposes.

The concept, which also refers to the reuse process, is the action or process of allowing a building's harmonious use while preserving its historical, cultural, or architectural values through repairs, changes, and additions (Ijla & Broström, 2015). Concepts like sustainability and adaptive reuse become more meaningful when they are combined. Reuse promotes sociocultural and economic development and has the potential to support sustainability in numerous ways (Orhan & Yalnız, 2022).

The literature on architectural restoration projects often emphasizes the importance of adaptability and reuse. This concept has been extensively studied both in Turkey and around the world.

Marcus Van Der Meulen's research from 2017 covered the adaptive use of architectural elements from several disused churches in the Netherlands in the interior design of a different religious structure (Van Der Meulen, 2017).

In his research from 2015, Fetisov identified three general techniques for the adaptive reuse approach. He highlighted the study's findings regarding the beneficial effects of historical texture, architectural influence, and artistic approach on exterior and interior architectural designs (Fetisov, 2015).

The Ambar Village Church in Mardin serves as an excellent example of adaptive reuse in Kaptan's 2021 study, as per the findings and recommendations (Kaptan, 2021). In another study, Yücel (2023) concluded that the concepts of transience and permanence are present in the studies on adaptive reuse. The study's ideas of transience and permanence suggest that a place containing experiences also preserves memories (Yücel, 2023).

The spatial performance (technical and functional) value of the building, which is a cultural asset and currently used as an architect's chamber- architect's house, and the degree of adaptation of the spaces to the requirements of the function were determined in the study carried out by Aydın & Yıldız in 2010. The benefits and drawbacks of the given function were also discussed. The location and function harmony of the building, the organization and quality of existing spaces, the spatial requirements of the function to be provided, and the assessment of the level of adaptability have been identified as the components and processes that need to be analyzed in the adaptation process in buildings with reuse potential (Aydın & Yıldız, 2010).

3. Materials and Methods

This study focuses on the concept of using adaptive and reusable furnishings and supplies in office interior design. Most projects involving architectural renovation use this technique.

Within the scope of the study, one-on-one meetings, reportages and interviews were conducted as data collection techniques for determining the problem and solving it. The meeting technique is also referred to as interview in some sources. According to this definition, interviews/meetings are conversations held between two or more people for a specific purpose and in a specific order (Coşkun,

Altunışık & Yıldırım, 2007). Qualitative research is conducted with small samples or small study groups (Baltacı, 2018; Marshall, 1996).

Kvale (1994) went into great detail about the stages of interview in qualitative research, covering the entire process from the development of the research to its reporting. Seven stages of the interview technique are listed in Table 1 and are based on Kvale's (1994) classification, used as a basis for this study.

Table 1: Kvale (1994) Interview technique classification.

Kvale (1994) Interview Stages	Thematizing	Designing	Interview	Transcribing	Analysing	Verifying	Reporting
	•Clarification of goal • Drawing the conceptual framework of the subject	• Planning and clarifying the goal • Clarifying the method • Planning the process	• Preparation of interview form •Implementation of the interview	Transcribing the oral conversation into writing	• Choosing an analysis strategy that is appropriate for the research's subject and goals	Comparison of findings and consistency of data	Interpretation of findings

4. Findings and Discussion

Historical buildings can become obsolete and unused due to various reasons such as social, economic, functional, physical, environmental, or legal factors (Pereira et al., 2004). Similarly, materials used for different purposes in various fields also become worn out, outdated and useless over time. Therefore, the interior design and application project of Noktalı Fikir Advertising Agency, which was designed to enhance the daily work-life comfort of office employees and promote awareness among customers, was based on the concept of adaptive reuse, which is extensively discussed in the literature. The project utilized many items, industrial tools, and parts that were used in different areas, for different periods, and for different purposes as interior fittings. Figure 3 illustrates the area and its immediate surroundings where the application was made.

Figure 3. Noktalı Fikir Advertising Agency's place on the map (Akcaova, 2023**).**

The office design and application integration for Noktalı Fikir Advertising Agency began with a survey of the office space at the basement floor level of Mutlu Business Center in the Meram district of Konya province. The architectural layout of the office space, the flooring plan, any existing dividing walls, and carrier systems were all determined in the subsequent stage in order to decide on the spatial setups. The users' requests and recommendations helped to shape the preliminary interior architecture project. Figure 4 shows the office's architectural plan diagram, which was created for quantity surveying and sectioning.

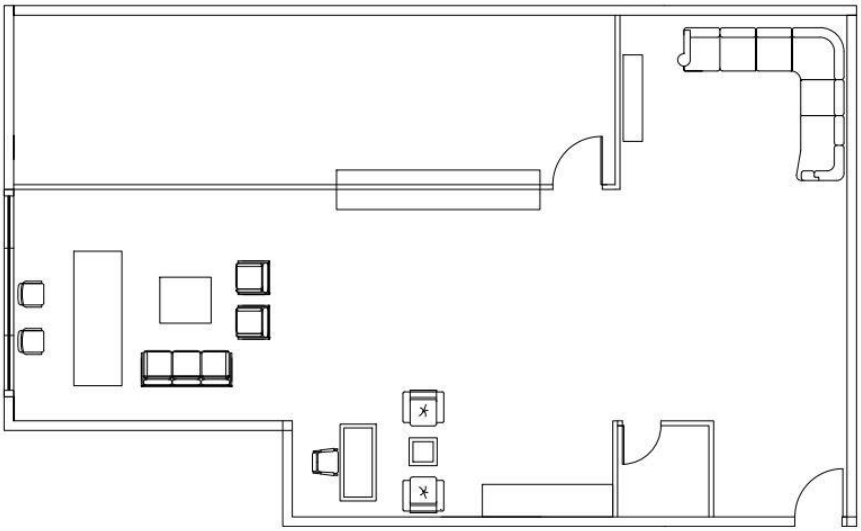


Figure 4. Noktalı fikir advertising agency architectural plan (Akcaova, 2023).

Through interviews with frequent users, the spatial program for the operation of the office was obtained. User requests will provide insight into the choices designers will need to make at the design stage. Table 2 contains the list of requirements created for the office.

Table 2. Noktalı fikir advertising agency requirement list

	ACTIONS	EQUIPMENT	USER REQUESTS
Management Unit	Interview Meeting	Desk Work chair Computer Storage areas	Digital environment for creation of workflow and presentation to customers
Waiting Unit	Welcoming Waiting	Waiting Chair Tv Unit	Creating a friendly environment where guests other than appointment customers can feel comfortable
Photo studio	Preparation	Camera Decor Make up Desk Light Equipment	No natural light Controlled lighting with local lights

The user's office requests and required equipment were processed using the Autodesk-based AutoCAD program. This allowed for the selection of appropriate floor, wall, and ceiling materials, as well as calculations for the building's quantity and density, and defining the various areas within the office.

Tables outlining the design stages, which include adaptable and reusable materials, as well as post-application photographs, are provided below.

Figure 5. a. The vehicle and material (Manitoba, 2023**), b.** Indoor Application View, Reuse of Massey Harris brand tractor front grille part (Akcaova, 2023).

As part of the interior design project, a table was created for office workers to use. The front grille part of a Massey Harris brand tractor from the 1950s-60s was obtained from the Konya Büsan Hurdacılar industrial site and placed in front of the solid table top as an accessory. This part is used in air and water-cooled engines and has gaps in its 3mm thick metal body to enhance airflow. The gaps are covered with a 2mm aluminum perforated wire layer. The piece measures 65cm on its widest axis and stands 105cm tall. It also doubles as a table leg. The piece was used in its original form and color. A 3500K daylight strip LED and LED engine were installed inside the part, making it a viable indoor light source.

Figure 6. (A) The vehicle and material (Sayar, 2023), (B) Indoor application view, Turkish Fiat 480 brand tractor exhaust pipe reuse (Akcaova, 2023).

1984 Turkish Fiat 640 model tractor's silenced exhaust pipe was repurposed to provide local lighting for a conference table during its interior planning stages. The cylindrical object was made of 3mm thick aluminum metal alloy, with a diameter of 6mm and a length of 110cm, and a width of approximately 8cm. To prevent hot air from heating the gas pipe, the component was covered in perforated sheet material. Interior lighting was achieved through the use of a three-chip 3500K LED light and an LED engine on the perforated sheet metal, resulting in circular light points being reflected in the area. The component was used indoors and was fixed to the ceiling with a hook, with no other modifications made to it. The piece's exterior oven paint was also preserved.

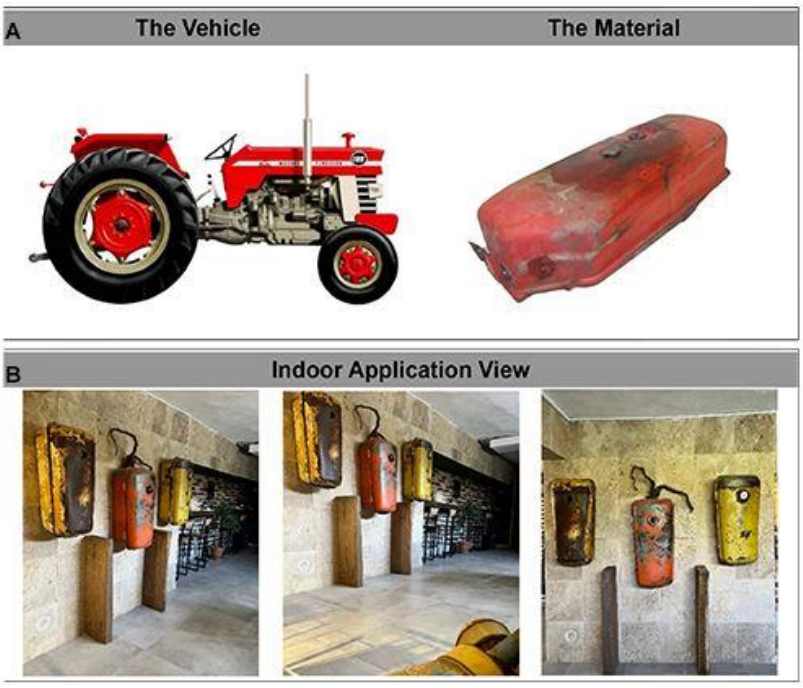


Figure 7. a. The vehicle and material (Ebay, 2023), **b.** Indoor application view, reuse of Massey Ferguson tractor fuel tank (Akcaova, 2023).

The fuel tank of the 188-model tractor, which was previously made by the Massey Ferguson brand between 1972 and 1976, was used as a storage unit while deciding what equipment would go in the office during the interior project phase. The component is made of 3mm thick aluminium metal alloy. The vehicle has a fuel capacity of about 50 liters. The object's dimensions are 40 cm in width, 80 cm in length, and 40 cm in depth. With the aid of flex, the piece was cut transversely so that it could serve as a multifunctional storage unit. The piece that was cut with the aid of the hinge was later repurposed as a cover. The tank's fuel inlet cover served as a cabinet handle. The piece's exterior oven paint was also preserved in the same manner. The three-color fuel tanks in the office now serve as multi-purpose storage spaces.

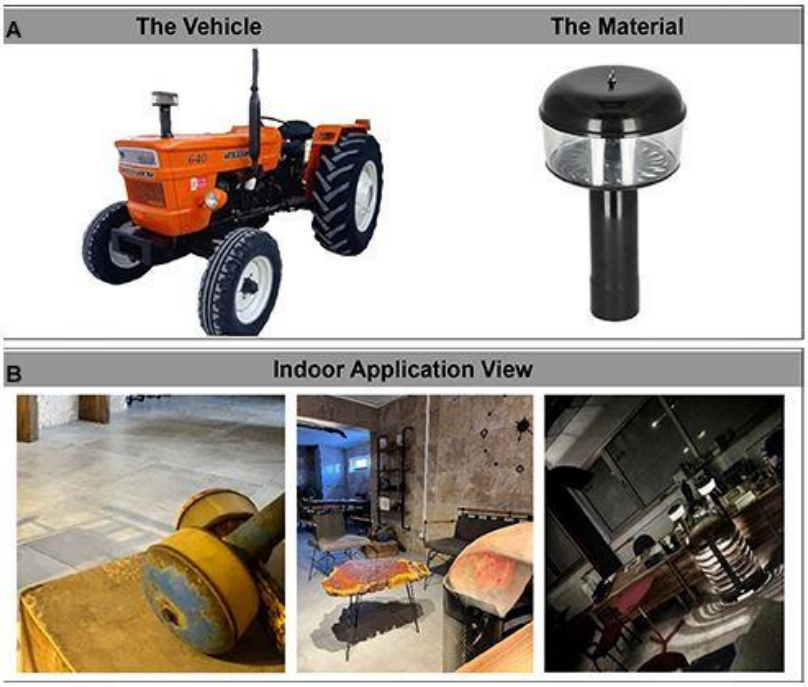


Figure 8. a. The vehicle and material (Sayar, 2023), **b.** Indoor Application View, Reuse of Turkish Fiat tractor air filter (Akcaova, 2023).

On the 1984 Turkish Fiat 640 model tractor's engine hood, there was an air filter component that was used as local lighting for the work desks, which is on the list of office design equipment necessities. There are two main components to the metal alloy part made from aluminium. The air pipe that is attached to the engine under the hood is the main body. The second component is the air pipe connector at the top of the engine, which is made of transparent glass or plexiglass. A three-chip 4000 K indoor LED is positioned in the transparent area in addition to this object, which is made to look like a table lamp in the office design.

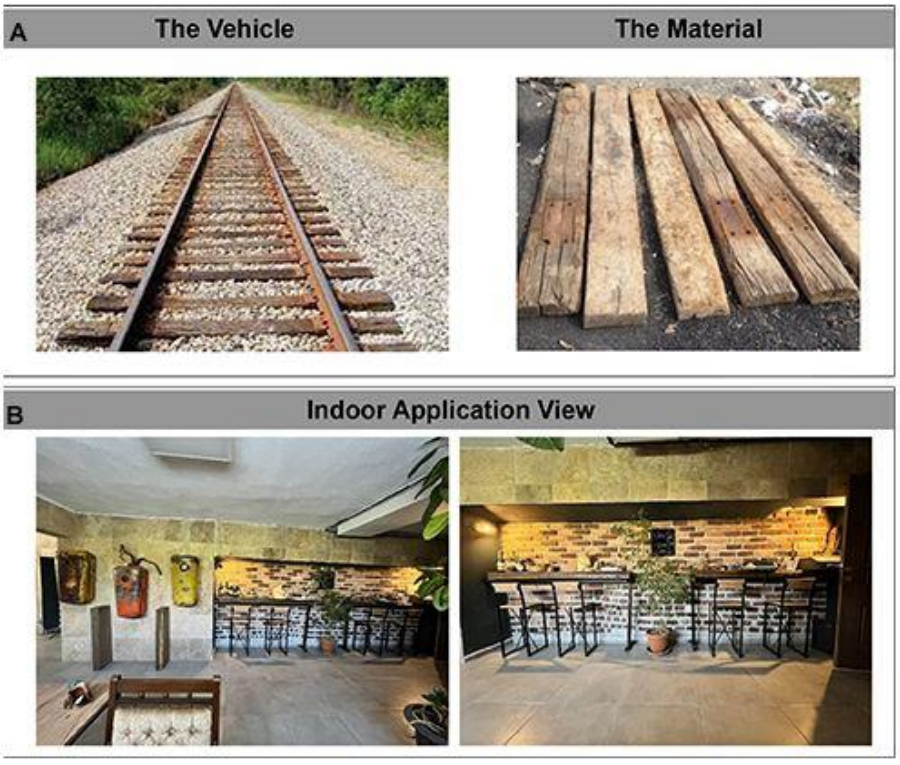


Figure 9. a. The vehicle and material (Silo, 2023), **b.** Indoor application view, reuse of train rail sleeper board (Akcaova, 2023).

The beverage and bar area and the library, which are on the list of office design equipment requirements, were built using train rail sleeper boards that were replaced during the Konya-Ankara high-speed train line phase. Raw solid wood slats were treated with yacht varnish and sandpaper. Despite the natural material's functioning, it dried in the sun for 20 days, stabilizing the moisture content. It was fastened to the wall using dowels and clever screws.

5. Conclusion and Recommendations

The concept of adaptive reuse refers to the ability to employ something in different contexts or situations. This idea is commonly applied in fields such as design and technology, among others. Both designers and users can reap significant advantages from implementing adaptive reuse. This study emphasizes the benefits of adaptive reuse for both designers and users. It has benefits such as saving time, energy and cost by planning the preliminary design, final project, application project and construction phases from the very beginning of the design process and leaving minimum problems to the construction process (Sungur &Bakır, 2023).

As a result of one-on-one meetings with office employees, for users;

- It has been observed that they prefer office spaces specially designed for them.
- The use of adaptable and reusable materials when designing the office structure has been positively received by users.
- During office hours, it has been observed that specially designed office structures made of adaptable and reusable materials foster a more productive work environment and enhance a sense of community.
- It has been found that sharing the experience stories of objects that have served a variety of functions positively affects the users.
- It has been demonstrated that the idea of developing a customized design, designed with adaptable and reusable materials, increases users' sense of belonging to the space.
- Materials that are adaptable and reusable can motivate users to gain experience and pick up new skills in a variety of situations.

For designers;

- It is anticipated that it will benefit the development of new design concepts, the reduction of design expenses, and new application details.
- In terms of efficiency, adaptable products or systems can quickly respond to different needs or changing requirements. This provides greater functionality and efficiency.
- Instead of creating numerous specialized products or designs, it is more cost-effective to use a single design or product for multiple purposes.
- Adaptability can improve the use of resources by maximizing the use of materials.
- Utilizing the same parts or materials in various systems or products reduces waste. Reduced resource use and waste production could have a positive impact on the environment.
- Additionally, it offers flexibility in the design and development processes as well as adaptability for designers. This may inspire original thinking.
- Materials that are flexible and reusable enable the creation of numerous alternatives. Designers now have more design options as a result.

In the field of interior design, the use of adaptable and reusable materials is gaining importance due to the need for environmental sustainability and efficient resource utilization. Such materials can be repurposed or modified for different uses during and after the design and usage of a structure or product. By creating adaptable products or systems, designers can cater to the needs of diverse user groups, making it possible to appeal to a wider audience. This approach has been well-received by both

users and designers and is expected to provide a range of office design solutions, materials, and application skills to designers.

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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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A Responsible Cultural Heritage Consumption for Senior Tourists in Nicosia

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Abstract

Cultural heritage consumption plays a pivotal role in senior tourism, providing unique experiences and fostering a sense of connection with the past. This study focuses on the concept of responsible cultural heritage consumption for senior tourists in the historic Walled City of Nicosia. The primary objective is to examine the preferences and challenges of senior tourists in terms of accessibility and engagement with cultural heritage sites. Qualitative research was conducted through documentation, on-site observations and interviews to gather data about the cultural heritage consumption experiences of senior tourists. The research findings reveal that senior tourists are interested in experiencing authentic cultural heritage and desire opportunities for meaningful interactions with local heritage. However, limited accessibility and lack of age-friendly facilities pose significant barriers to their full participation in cultural heritage sites. The study highlights the need for responsible tourism practices that make cultural heritage inclusive for all age groups.

Keywords: *Responsible tourism, cultural heritage consumption, senior tourists, inclusive access, Nicosia Walled City.*

Lefkoşa'da İleri Yaş Turistler için Sorumlu Kültürel Miras Gereksinimi

Öz

Kültürel miras tüketimi, geçmişle ilgili bağlantı duygusunu geliştirerek, ileri yaş turizminin gelişiminde önemli rol oynamaktadır. Bu araştırma, tarihi Surlarla çevrili Lefkoşa Şehri'ndeki ileri yaş turistlerin kültürel miras gereksinimini incelemektedir. Çalışmanın amacı, ileri yaş turistlerin kültürel miras alanlarına erişimi ve katılımı konusunda karşılaştıkları tercihleri ve zorlukları incelemektir. Kültürel miras tüketimi bağlamında ileri yaş turistlerin deneyimleri hakkında gerekli verilerin elde edilmesi için çalışmada doküman araştırması, yerinde gözlemler ve görüşmeler yoluyla nitel bir araştırma yaklaşımına yer verilmiştir. Araştırma bulguları, ileri yaş turistlerin otantik kültürel miras değerlerine ulaşmak istediklerini ve yerel mirasla anlamlı etkileşimler için fırsatlar aradığını ortaya koymaktadır. Bununla birlikte, sınırlı erişilebilirlik ve yaşa uygun çevresel düzenlemelerin bulunmamasından dolayı oluşan engeller, ileri yaş turistlerin kültürel miras alanlarına tam katılımlarını önlemektedir. Çalışma, kültürel mirası tüm yaş grupları için kapsayıcı hale getiren sorumlu turizm uygulamalarına olan ihtiyacın altını çizmektedir.

Anahtar kelimeler: *Sorumlu turizm, kültürel miras tüketimi, ileri yaş turist, kapsayıcı erişim, Lefkoşa Surlariçi.*

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1. Introduction

The importance of promoting responsible tourism activities among seniors has increased with the rise of cultural heritage tourism and the aging population. Studying seniors' cultural heritage consumption patterns is critical in establishing inclusive and sustainable tourism practices since seniors include a substantial proportion of visitors.

Cultural heritage tourism has gained popularity as a way of engaging visitors with the tangible and intangible aspects of a destination's heritage. Simultaneously, the global population is going through an essential demographic shift, with seniors representing a significant proportion of travellers worldwide. This convergence offers an opportunity to investigate the role of seniors in cultural heritage consumption and to address their inclusive access needs in this context.

Previous studies have mainly focused on cultural heritage tourism, but there has been limited research on the specific behaviours and experiences of seniors in this field. Accordingly; the aim of this research is to investigate responsible cultural heritage consumption and examine how senior tourists access and use the cultural heritages of the Nicosia Walled City in North Cyprus. The research also emphasizes the importance of inclusive access and its impact on the consumption patterns of senior tourists. Understanding these aspects is vital in developing targeted strategies that enhance the experiences of seniors while preserving cultural heritage for future generations.

Cyprus is a Mediterranean Island that attracts visitors with its rich history, diverse cultural heritage, hot climate and stunning coastline. The tourism industry is a significant and profitable sector in Cyprus, which helps to boost the country's economy. Nicosia is the last divided capital of Europe, with Northern and Southern Nicosia currently housing two independent states separated by a buffer zone. In 2008, the Lokmacı Gate, which connects the two sides of Nicosia, was opened. This was a critical step in the growth of the city's tourist potential and the regeneration of its historical district. As a result, the Nicosia Walled City was designated as a "Special Tourism Zone," and a pedestrianization scheme was launched. Today, the historic city has become a centre of attraction and an open-air museum that houses many valuable cultural heritages, with its 6000-year-long history which influences the city's multicultural identity.

The aim of this research is to provide valuable insights that can assist policymakers, cultural heritage site managers and tourism industry stakeholders to create more inclusive and responsible tourism experiences for seniors. In this study; qualitative research methods were employed through documentation analysis, on-site observations and interviews. This combination allowed for a comprehensive understanding of seniors' motivations, preferences and behaviours concerning cultural heritage consumption. Documentation analysis was utilized to understand the development process of a site, while on-site observations and interviews were conducted to gain deeper insights into the how seniors interact with the heritage sites and their impacts on the surrounding environment and local communities.

This study contributes to the growing body of knowledge on responsible tourism and cultural heritage consumption by examining the specific attitudes and behaviours of senior tourists. The findings are expected to inform sustainable tourism strategies and promote responsible cultural heritage consumption among seniors, enriching their travel experiences while preserving cultural and environmental heritage for future generations.

The research is structured as follows: The first section includes a literature review on responsible cultural heritage, senior tourism and inclusive access. The second section outlines the study's material and method. The third section presents the findings and analysis of seniors' cultural heritage consumption patterns in Nicosia. Finally, section four offers concluding remarks and suggestions for the future in this domain.

1.1. Responsible Cultural Heritage Consumption and Senior Tourism

According to the Dictionary of the Turkish Language Association (as cited in Köse & Yamaçlı, 2023, p.201), there are two definitions of tourism. The first definition describes tourism as a journey that

involves relaxation, entertainment and observation. The second definition includes all the facilities that aim to attract travellers to a region or country, including economic, cultural, technological aspects. Cultural heritage tourism, on the other hand, is a form of experiential tourism that focuses on experiencing, participating in and being stimulated by the cultural heritage. This includes performing and visual arts, historic sites and museums, festivities, traditional landscapes, language and traditional ways of life, such as food, beverages, and activities (Cros & McKercher, 2015; Lwoga & Mapunda, 2017). In recent years, cultural heritage tourism has been integrated into current tourism development strategies, such as 'responsible tourism' and 'sustainable tourism destination development' (Csapo, 2015, p.624).

Krippendorf (as cited in Caruana et. al, 2014, p.116) states 'responsible tourism' has been extensively researched over a long period of time. As the tourism industry advances in a more demanding and segmented market, it would need to adopt more "environmentally-oriented and socially responsible" marketing practices to maintain the consumer satisfaction. Various industry guidelines on responsible tourism has been developed to outline its main tenets and practices among practitioners. In particular, the Cape Town Declaration of 2002 describes responsible tourism as reducing negative economic, social and environmental impacts; fostering economic benefits for host communities; involving locals in decision-making; conserving natural and cultural heritage; enabling tourists to have more pleasurable interactions with locals and gain a deeper understanding of their cultural, socio-economic and environmental issues; allowing access for vulnerable segments as disabled people; being attentive to cultural differences; promoting mutual respect between visitors and hosts; and boosting locals' confidence (Cape Town Declaration, 2002).

It is vital to retrieve that the tourism industry is built on the relationships between individuals, locations and goods. The social and physical conditions of a destination, both at a micro and macro level, impact the industry (Hanafiah & Harun, 2010; Hanafiah et al., 2016). There are several sustainability issues associated with tourism such as the exploitation of resources, an unstable economy and changing tourist demand. The advantages of regeneration and resilience must also be promoted and made available to the locals and the region by those responsible for developing tourist policies (Hanafiah et al., 2016). Responsible Tourism Practice (RTP) has similar goals to sustainable tourism such as promoting social justice, environmental integrity and maximizing benefits to communities (Hanafiah et al., 2016).

In tourism research, the age range of senior tourists varies. United Nations (2015) reports seniors as those who are 60 years of age or older. According to the World Health Organization (WHO, 2015), seniors are individuals aged 65 and older. In European Union publications, the term of “senior” is used for people aged 55 and older (European Commission, 2014). However; different researchers preferred to use diverse age ranges to define seniors. Seniors are mentioned in some research as being 50 or older (Shoemaker, 2000), 55 or older (Fleischer & Pizam, 2002), 60 or older (Huber et al., 2018) and 65 or older (Jang et al., 2009; Nikitina & Vorontsova, 2015; Sert, 2019).

As stated by the World Health Organization (WHO, 2015), the global population is aging rapidly. In 2009, over 730 million people over the age of 60 made up almost 10% of the population, which is 20% increase from 2000. By 2050, the number is expected to rise to one-fifth of the world’s population aged 80 and older, with over 20% of the total population being over 60 years old (WHO, 2015). As their population grows, seniors represent a significant market group for the tourist industry due to their growth rates, income, health and beliefs about life (Jang et al., 2009; Sert, 2019). Since they are mainly in retired position, seniors have more time and resources to devote tourism-related activities than other age groups (Kim & Kim, 2018; Sert, 2019).

Senior travellers play a crucial role in the tourism sector as their numbers and affluence continue to increase (Chen & Wu, 2009; Liew et al., 2021). Accordingly; senior individuals can make significant contributions to the tourism industry and they are generally considered to have sufficient time and amount of money to spend. As a result, seniors are able to extend their duration period to stay, spend more money, travel further and more frequently (Fleischer & Pizam, 2002; Sert, 2019).

Borja, Casanovas & Bosh (cited in Alén et al., 2012, p.7) asserts that the senior population will contribute significantly to the growth of the tourism industry. This segment of tourists is greatly experienced and demands a higher level of service from the industry. In addition, they may prefer to avoid from the peak seasons due to their retirement status. Disabled people are also included in this demographic because they have similar accessibility needs as seniors. Enhancing accessibility not only assists seniors and disabled but also pregnant women, children and families, who may have temporary disabilities. In general, increased accessibility is advantageous for all people.

1.2. Inclusive Access and Senior-Friendly Cultural Heritage Sites

According to the United Nations World Tourism Organization (UNWTO, 2013), allowing people with disabilities to travel is essential in establishing responsible tourism. Its General Assembly Resolution A/RES/578 (XVIII) approved the "Declaration on the Facilitation of Tourist Travel" in 2009, which aimed at enabling travel for individuals with disabilities. This declaration is a critical component of any strategy that focuses on promoting responsible tourism. As a result, mainstreaming disability concerns as an intrinsic element of applicable sustainable development strategies will ensure inclusive and accessible tourism for all (UNWTO, 2013). The increasing prevalence of disability among travelling seniors in industrialized nations necessitates the development of accessible environments, transportation and services, to boost the market value of the accessible tourism sector.

Inclusive access is a key aspect that takes into account diverse behavioural patterns. It involves designing, planning, and managing changes to ensure that needs of all individuals, regardless of age, ability, or situation, are considered. The achievement of inclusive access necessitates design solutions that pave the way to restore maximum use (Goodall, 2010; Güvenbaş, 2021). Senior tourism and accessible tourism are closely related concepts that should be consider together since disability is often associated with elderly people. Inclusive access needs of senior tourists could be integrated into responsible tourism practices**.** Attention can be given to requirements of suitable arrangements for elderly individuals as well as other disability groups in this context. Elderly people typically have bone loss, muscle disorders, difficulties with balance, extreme tiredness, vision and hearing impairments. Problems with movement, spatial awareness and mental ability are common among the elderly people when they are using the built environment. Seniors who are asked why they don't prefer to walk, often cite issues such as; the distance between destinations, insufficient sidewalks, a lack of places to relax and fear of crime that makes the use of urban settings difficult (Türel et al., 2007; Güvenbaş, 2021).

The quality of the physical environment influences the mobility of senior tourists in cultural heritage sites. The level of mobility in these sites greatly influence seniors' ability to fully engage in communal activities, encompassing their capacity to move around an area without obstacles (I'DGO, 2007; Türel et al., 2007; Kwok & Ng, 2008; Fadda et al., 2010, Yung et al., 2016).

In cultural heritage sites; the physical inaccessibility could be related to both macro land-use patterns and micro-scaled features of urban planning and design. Senior tourists may face difficulties in access to cultural heritage sites because of the diverse barriers:

- Improperly designed public & private transportation activities
- Problems related to physical infrastructure of pedestrian routes (sidewalks, pedestrian crossings, curb ramps)
- Insufficiently designed street furniture and amenities (benches, lighting elements, ATMs, etc.)
- Inadequate design of building entranceways (e.g. having stairs and hand-opened doors)
- Inadequate public information and signage (Güvenbaş, 2021; Güvenbaş & Polay, 2021).

To create senior-friendly cultural heritage sites, designers and planners must consider significant provisions to upgrade the quality of public and private transportation, pedestrian routes, street furniture, building entranceways and signage.

- ***Public and Private Transportation:*** Accessible transportation is vital for establishing responsible cultural heritage sites. Bus stops should be located within reasonable proximity to

accommodate seniors who may have walking difficulty. Public vehicles must be designed ergonomically, with ramps, safe stair geometry, contrasting stair nosing, handrails and grab bars to ensure the safety and comfort of all passengers (Güvenbaş, 2021). To facilitate entry and exit of people with disabilities, designated loading and unloading zones should be located closer to tourist attractions. Car parking spaces should be wide enough with an access aisle provided senior tourists to travel comfortably between automobiles and wheelchairs (UNWTO, 2013).

- ***Pedestrian Routes:*** Sidewalks, walkways, curb ramps and pedestrian crossings are among the pedestrian routes which need to be designed carefully to ensure effortless access of senior visitors. Accessible facilities should be provided along clear, obstruction-free and continuous pedestrian paths. Sidewalk width, gradient, surface material and grids are among the crucial design components that must be integrated into conservation plans (Güvenbaş, 2021).
- **Street Furniture and Amenities:** Resting areas, telephone booths, water fountains, ATMs, garbage bins, bollards, and public toilets include street furniture and amenities that should be properly dimensioned to prioritize the comfort and safety of senior visitors to cultural heritage sites.
- **Building Entranceways**: Entranceways must be designed with appropriate width, slope and surface covering material to ensure the safety of all users. Adequate material selection should be made to prevent potential dangers and appropriate ramps must be provided to address the level of inequalities.
- **Public Information and Signage**: All signs such as direction signs, information signs and location maps should be designed in a clear, visible and simple form to increase legibility both during the day and night. Signage should carefully be placed to avoid harming or altering the historical character of the heritage sites.

2. Material and Method

2.1 Study Area

The Nicosia Walled City was selected as the study area. Nicosia City, the last divided capital in Europe, is located at the heart of Cyprus Island (Figure 1). It is currently home to two distinct states. After the conflict between Turks and Greeks, the city along with the rest of Cyprus Island were divided into Northern and Southern regions by a buffer zone. The Turks moved to the North while the Greeks inhabited the Southern side of the city (Güvenbaş & Polay, 2023).

Nicosia has a significant historic urban quarter with remnants of numerous ancient cultures that once traversed Cyprus: Ancient times (7500 BC); Persians (525 BC); Romans (58 BC-395 AD); Byzantines (395-1192); Lusignans (1192-1489); Venetians (1489-1571); Ottomans (1571-1878); British (1878-1960); Turks and Greeks- Republic of Cyprus- (1960-1974); After 1974 Turks (North Nicosia) and Greeks (South Nicosia). Today, many historical, architectural and cultural heritages have remained with its 6000-year-long history which influences the city's multicultural identity (Güvenbaş, 2021).

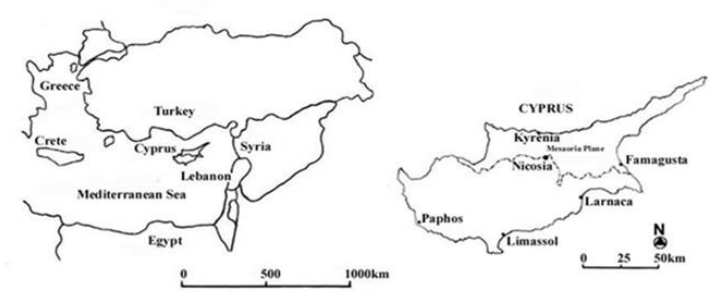

Figure 1. Location of Cyprus and Nicosia (Faslı, 2010)

The buffer zone which is under the control of the United Nations serves as a border between the two states. In 2008, the Lokmacı Gate, located within this zone, was opened. In this research, the main pedestrian axis connecting the Kyrenia and Lokmacı Gates was selected as a case study. Accordingly; three streets –Kyrenia Avenue, Asmaaltı and Arasta Streets– and their close surroundings were evaluated for this study (Figure 2). The study aims to identify positive and negative factors that influence the accessibility and utilization of cultural heritage sites by senior tourists.

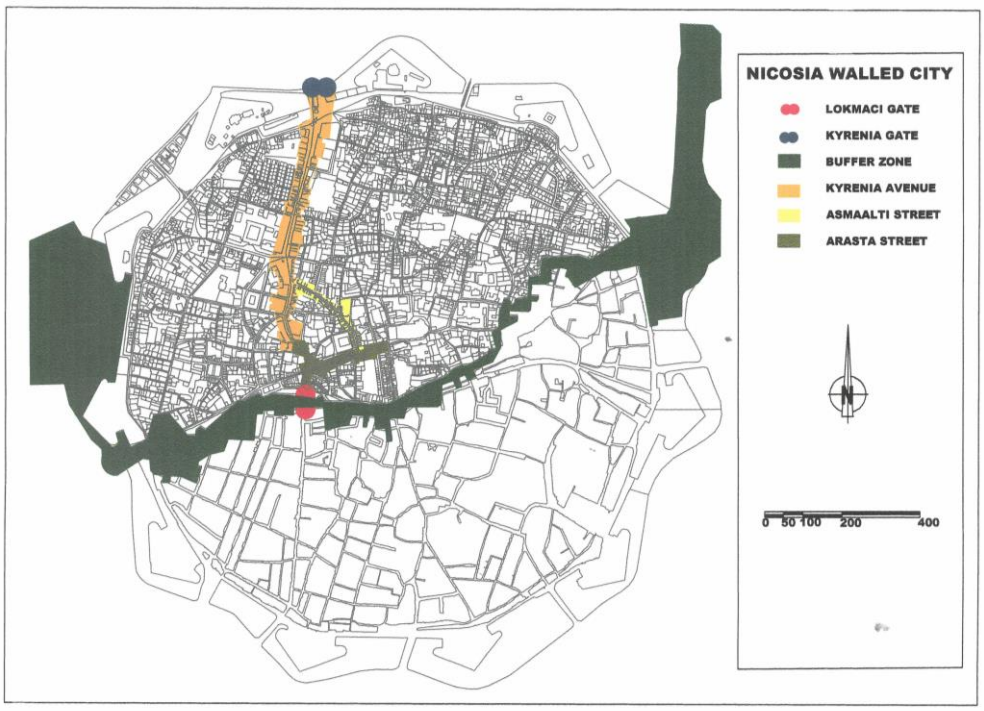

Figure 2. Boundaries of a Case Study Area (Modified from Nicosia Turkish Municipality, 2022)

2.2. Research Method and Procedure

Qualitative research methods - documentation, on-site observation and interviews - were employed in the study. This combination allowed for a comprehensive assessment of the needs, preferences and behaviours of seniors in terms of cultural heritage consumption.

In the preliminary stage of research, documentation analysis was done with written and visual documents in order to identify the historical background and the development process of the site. In particular, governmental reports were obtained to get more detailed data about tourism development strategies and processes in Nicosia. Following the documentation analysis, on-site observations were carried out to determine the existing barriers that hinder senior tourists from accessing and using cultural heritage sites. During on-site observations, problematic features were determined, photographed and recorded in inventory forms. In the final stage; face-to-face interviews were conducted with business owners, staff and senior tourists. The interview forms were systematically prepared and consisted of three sections. In the first section, respondents were asked to provide demographic information such as age, gender, nationality, purpose of visit and mobility situation. The second section of the interview form contained open-ended questions to gather respondents' opinions on the quality of public and private transportation facilities, pedestrian infrastructure, building entrances, street furniture and public information. The third section included two critical open-ended questions:

- Who should take responsibility for ensuring accessible tourism facilities in Nicosia?
- How can accessibility be improved for disabled and elderly users?

3. Findings and Discussion

In the following section, the findings of documentation analysis, on-site observations and interviews are given separately.

3.1. Findings of Documentation Analysis

Before the gate was opened, the Nicosia Walled City had suffered from social, financial and environmental obsolescences. Due to the buffer zone surrounding the south and the development of new areas to the north, access and utilization have decreased. As a result, some changes were necessary to revitalize the historic urban district (Güvenbaş & Polay, 2023).

In 2008, a committee assigned by the Prime Minister developed a plan for the conservation, revitalization and development of the city. The committee believed that Lokmacı Gate presents an opportunity to enhance the city's economic facilities and the overall image of a historic urban site. The report's primary objective was to establish a focal point while considering the area's perspective. According to committee, strategic conservation approaches could not only improve the physical environmental quality of the Nicosia, but also lead to social and economic revitalization by attracting both tourists and residents (Lefkoşa Surlariçi İzleme, Koordinasyon & Yönlendirme Kurulu, 2008).

The report outlined various measures to revitalize the city. These measures included economic; physical, social, cultural, legal, organizational and financial considerations. This study only focuses on the physical and spatial measures of the report that are related to transportation and pedestrian infrastructure as follows:

- Making arrangements for the mobility of the disabled which will prioritize regular public transportation, pedestrians and bicycle access to discourage private vehicle entry into the walled city and improve access to the region;
- Selection of public transportation modes, connections, transit durations and terminating points with regard to the inner and outer walls;
- Establishing pedestrianization schemes including pedestrian-oriented details like benches, streetlights, bike parking, urban furniture and amenities that would attract visitors to experience cultural heritage sites.
- Installation of suitable car parking in the adjacent areas to the pedestrian zones and also the closest points of tourism destinations.
- Creating spaces for vehicles that will shuttle tourists through the area
- Adaptation of more accessible loading and unloading activities for public transportation
- Illumination of the area and the important cultural heritage sites.

Since, the Walled City was declared as a "Special Tourism Zone", a pedestrianization project has been scheduled to upgrade the quality of the historic urban quarter in terms of architectural aesthetics, pedestrian infrasture and landscaping. The Nicosia Turkish Municipality carried out the "Arasta and Asmaaltı Pedestrianization Project" for the primary thoroughfares that connect the Lokmacı to the Asmaaltı and Arasta Regions (Figure 3).

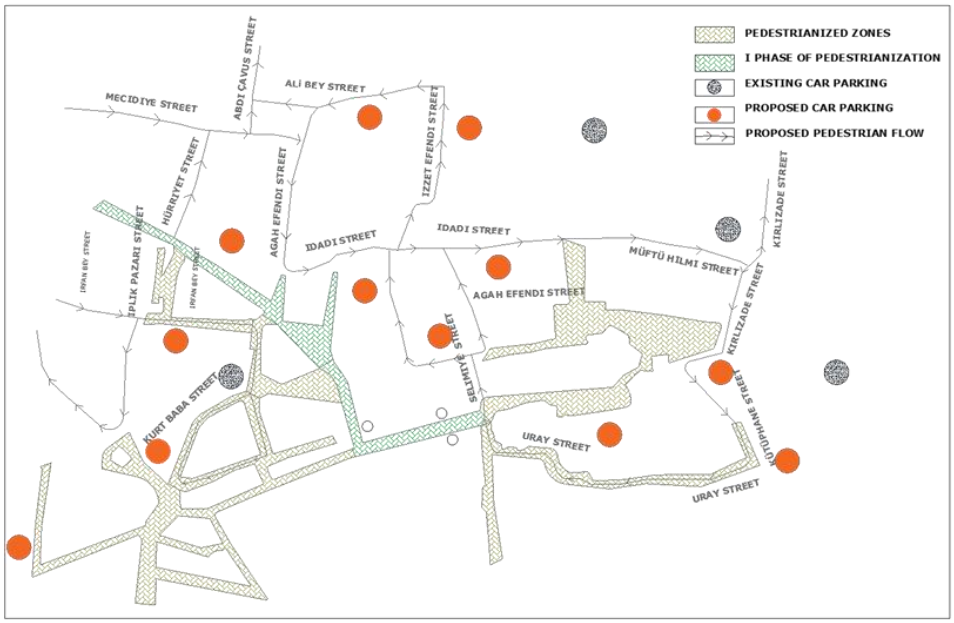

Figure 3. Pedestrianization Project of Arasta and Asmaaltı Streets (Modified from Lefkoşa Surlariçi, İzleme, Koordinasyon & Yönlendirme Kurulu, 2008; Güvenbaş & Polay, 2023, p. 63)

The implementation of pedestrianization project was launched in 2013 and it was concluded in three distinct stages. The majority of the Arasta and Asmaaltı regions that are within the boundaries of the case study were pedestrianized in the first phase. The completed works of the pedestrianization project can be enumarated as following.

- Upgrading signage's quality.
- Installation of street lighting elements.
- Installation of more urban furniture including direction maps, resting elements, flower pots and tensile canopies.
- Preparation of tourist guidebooks.
- Printing of a foot map.
- Painting of pedestrian ways with a blue line for tourist walking tour.
- Printing of the city maps.
- Refurbishment of four existing public toilets.

The project was completed and contributed greatly to the revitalization of the region. Currently, pedestrianization efforts within the walls of North Nicosia are being carried out in some other areas. As a result, the research findings are expected to contribute in fostering the city's prosperous growth, as pedestrianization project is in progress.

3.2. Observation Findings

During the on-site observations, the quality of public and private transportation facilities; pedestrian routes infrastructure; street furniture and amenities; building entrances and public information and signage were examined.

3.2.1. Public & private transportation facilities

Public transportation vehicles can only stop at the bus stops in Kyrenia Gate, which may increase the walking distance to intended destination. Improperly designed public transportation restricted the accessibility of senior tourists. Vehicles without ramps, grab bars, handrails and proper signage are not available for seniors, particularly those with mobility and visual impairments. The number of curbside parking facilities is enough, but they are not appropriate for seniors since they don't have any drop-off zones with curb ramp designs (Figure 4).

Figure 4. Public and Private Transportation Facilities Create an Obstacle for Senior Tourists (Güvenbaş, 2023)

3.2.2. Pedestrian routes infrastructure

Establishing proper pedestrian infrastructure is crucial to make the historic city enticing to senior tourists. Pedestrian seniors require an integrated pedestrian network that seamlessly links each starting to its destination. Observation results revealed that problematic situations of pedestrian roads such as sidewalks, pedestrian crossings and curb ramps prevent cultural heritage sites from being easily accessible by senior tourists. The equipment and shopping vendors placed on sidewalks by business owners hampered senior tourists' access to the cultural site (Figure 5). Curb ramps are not functional and do not satisfy the needs of elderly visitors.

Figure 5. Parked Vehicles, Shoppings Stalls and Equipments were Restricted Usage of Sidewalks by Senior Tourists (Güvenbaş, 2023)

Ensuring the enduring effects on responsible cultural heritage consumption entails improving inclusive access which requires routine maintenance for the heritage sites. Insufficient maintenance facilities create perilous conditions for pedestrians, stemming from uneven pavements on pedestrian roads and the absence of zebra markings at pedestrian crossings (Figure 6).

Figure 6. Poor Maintenace Facilities Pose Danger During the Usage of Pedestrian Routes (Güvenbaş, 2023)

In addition to these; the presence of parked cars on curb ramps and the absence of speed control ramps on the vehicle roads provide considerable hurdles to the access of heritage site.

3.2.3. Street furniture and amenities

Street furnishing elements are problematic for senior tourists, particularly for those with disabilities. Benches without backrest are neither safe nor pleasant. ATMs are commonly positioned on raised platforms, posing challenges for seniors with wheelchairs. Urgent measures are necessary to install more practical and accessible street furnishing in the city to improve the accessibility and enjoyment of its cultural assets (Figure 7).

Figure 7. Street Furniture Elements and Amenities Need to be Refurbished since They are not Usable for Senior Tourists (Güvenbaş, 2023)

The case study area contains four public toilets. Intermittent closures affect some, while others are distant from areas experiencing significant tourist activity. The current number of public toilets is inadequate, necessitating the installation of more facilities. Improper design of public toilets may cause difficulties in use, especially for people with mobility devices. The study's findings reveal a scarcity of appropriate public amenities for senior tourists visiting the historic urban quarter.

3.2.4. Building entrances

The quality of entranceways is among the other determinants that may restrict tourists' consumption at cultural heritage sites. Improper choice of flooring materials and inconsistent levels of the entranceways could be given as problematic issues that impede access of seniors. The observation results indicate that ramps are designed at the entrances of the Great Inn and Gamblers Inn which are

the significant landmarks of the Nicosia. During the renovation of the Great Inn, the intention of a slippery surfaced ramp without handrails generates safety problems for senior tourists. Some shop owners added movable ramps at the entrances as others prefered to keep the existing narrow entrances with high steps (Figure 8).

(a) (b) (c) (d)

Figure 8. a. Undulated Pattern of the Entranceway, **b**. Slippery Surface of Great Inn Building Entrance, **c.** Portable Ramp at Shop Entrance, and **d**. City Museum Entrance with Leveled Surface is not Appropriate for All Seniors (Güvenbaş,2023)

3.2.5. Public information and signage

Insufficient signage poses challenges for senior tourists, making information and ticket sale counters inaccessible. Both audio (preceded by a tone) and visible (characters on electronic boards or large displays) signs are absent at tourist facilities such as bus stops, information desks and ticket sales. In general, the deficiency in signage leads to legibility problem for senior tourists. The inadequate number of direction signs and the neglect of maintenance for existing signage along the blue tourist route contribute to orientation difficulties (Figure 9).

Figure 9. Public Information and Signage are Poor in Quality and Create Orientation Difficulties (Güvenbaş,2023)

Accessible tourism services and amenities should be marked with simple and easily discernible symbols, displayed in a size and colour that contrasts with their surroundings.

3.3. Interview Findings

Since business owners and staff are witnesses to numerous incidents and the most attentive users of the area, they were included in the interview process. A total of 32 interviews were conducted, with 17 involving business owners and staff, and the remaining 15 involving senior visitors of the Nicosia Walled City.

The following section summarizes relevant interview findings under two distinct sub-headings with the opinions of participants represented by different codes. The first section includes the opinions of business owners and staff. Business owners were coded as B1, B2, B3,.....B10. Staff participants

were given with the codes of S1, S2 ,S3.....S7. The second section presents the interview findings with senior tourists which were coded as T1, T2, T3.....T15.

3.3.1. Interviews with business owners and staff

The majority of shop owners claimed that public transportation was insufficient to offer access within the city walls. The main difficulty is the scarcity of bus stops serving in Nicosia. Bus stops are only located at Kyrenia Gate which is deemed too far from the cultural heritage sites primarily clustered around the Arasta and Asmaaltı regions. Some participants underscored the absence of public transportation not only in Nicosia but across all of Northern Cyprus. One of the business owners who has mobility impairment and visual deficiency explains his opinions;

"I am 81 years old. I have never used public transportation since having cataract surgery two years ago. The distance to the bus stop is too far. It is not available for seniors. Public transportation vehicles should have ramps and sufficient signage. Someone's help is required to use public transportation" (B1).

On the other hand, some of the participants emphasized that bus stops are usable and the main problem is their location and vehicle design that restricts accessibility of the heritage sites. Accordingly; they expressed, *"We don't prefer to use public transportation, so we have no idea....Do we have public transport?" (S1, S6, S7).*

The sentiments voiced by participants imply that public transportation is not sufficiently working and available for vulnerable user groups such as senior tourists. The absence of closer bus stops and accessible public vehicles is the most significant obstacle to public transportation facilities. Elderly travellers may experience limited accessibility, possibly due to the risk of developing disabilities related to transportation. Seniors who do not own a private vehicle are less accessible and more likely to have a "transportation-related disability" (Heiser, 1995; Gant, 1997; Bromley et al., 2007; Güvenbaş & Polay, 2021, p.1633).

The majority of business owners and staff asserted that the car parking areas are accessible to all individuals, including those with disabilities and the elderly. However, they noted that these parking areas are situated far from tourist attraction points. Additionally, some business owners emphasized the significance of ensuring seamless travel experiences for all visitors as follows;

"Pedestrian axes in car parking areas must be seamlessly connected to all pedestrian movement paths. Only then the walled city will be open to all users." (B2, B6, B8, B9)

Focusing solely on standards is insufficient for urban design and planning initiatives. Movement patterns between the parking lots and destination should offer different travel options and facilitate simple mobility. The primary objective should be to ensure seamless travel enabling all people to move effortlessly from their origin and destination (Hanson, 2004).

During the interviews, only two business owners/staff mentioned that curb ramps and pedestrian crossings are designed with ideal ergonomics, indicating a lack of hazardous situation (B7, B10). The rest of the business owners/staff interviewees expressed that neither curb ramps nor pedestrian crossings provide safety in usage.

"I've been here for about 20 years and have seen what pedestrians confront when crossing the street. One day, I saw a visually impaired uncle fall into the ground while crossing the street...How many more people have to be exposed to danger?... Why should elderly tourists come here?..." (B3)

The experiences and feelings shared by the interviewees suggest the insufficient and weak maintenance facilities of pathways, preventing easy and safe access to cultural heritage. Continuous maintenance is required to restore the dynamic mobility of senior tourists and ensure unhindered pedestrian circulation that provides a certain level of safety and comfort. In order to achieve inclusive access, regular maintenance is crucial after the completion of projects (Kirschbaum et al., 2001).

The business owners and staff evaluated street furnishing elements and public amenities. Business owners mostly stated that *"street furniture was properly positioned along the pedestrian ways and*

their configuration was not an obstacle any visitors. However; the number of resting facilities is not sufficient when we consider its usage density...Resting elements such as benches were not comfortable...Since they don't have any shading elements, they are not usable during the hot summer days... ATMs have ideal sizes and they can be easily used by everyone." (B3, B10, S2, S5, S6). In addition to these; some of the business owners noted that *"there were four public toilets, almost all of them are not available. Due to the technical problems, they were generally out of use." (B1, B4)*

The research findings present that open space facilities may not adequately cater to the needs of senior tourists who may experience extreme tiredness. There should be a focus on designing street furniture as pleasant sitting elements (Türel et al., 2007). Additionally, senior tourists may suffer from age-related muscle disorders and may require access to toilets more frequently. It is inevitable to mention that the lack of accessible public toilets adversely impacts tourism activities in the walled city.

According to the majority of business owner/staff participants, building entrances should be usable by all people, including seniors. *Two staff interviewees highlighted that "the entrances of shops were not proper for seniors with mobility impairment, since they had high steps and uncomfortable ramps as significant obstacles." (S3, S4)*

Business owners/staff provided feedback regarding the quality of public information and signage. Almost all of them noted that inadequate maintenance of existing signage and public information has a detrimental effect on tourism facilities. The removal of the painted blue tourist route line from the ground and the poor legibility of city maps along the streets were cited as causing orientation difficulties, especially for senior tourists. Some shop owners also claim that the "*tourist leaves before reaching our shops because of the blue line that has been removed from the ground." (B5, B7)*

As a result; the opinions of business owners and staff participants demonstrate that insufficient maintenance facilities of signage impede seniors from finding their routes. Seniors with mental retardation may encounter challenges in wayfinding (Mitchell et al., 2003).

When asked "Who should take responsibility for the accessible tourism facilities in the City of Nicosia?", many business owners and staff emphasized that local and central authorities should take proactive measures to ensure responsible and inclusive tourism practices. In the final question, participants mentioned their recommendations on "how accessibility could improve in the walled city, especially for elderly and disabled tourists?" and several suggestions were provided by business owners and staff participants:

- Upgrading the quality of sidewalks and pedestrian crossings
- Integrating accessibility standards into public transportation
- Increasing the number of tourist guide services
- Adding adequate and appropriate lighting elements for pedestrian crossings
- Ensuring regular maintenance for pedestrian routes
- Adapting systematic public transportation schedules
- Providing alternative transportation modes
- Enforcing new laws regarding accessibility regulations.

Apart from the business owners and staff, interviews were also conducted with the senior tourists. The findings of senior interviews will be given in the following section.

3.3.2. Interviews with senior tourists

Senior tourists were interviewed to gain a better understanding of their experiences. A majority of them agreed that *"public transportation vehicles are not available because of their narrow doors and staircases. We often need to be accompanied by someone when using these vehicles...Lack of signage in vehicles and bus stops making our journeys difficult as well...It's challenging for an older person with a handicap to travel alone. One never knows what kind of difficulties you will face... You don't know*

where to go next when you get off the bus, there aren't any informative signs." (T1, T5-T11). The interview findings show that the attitudes of senior tourists and business owners about public transportation facilities are almost similar. Improving accessibility indeed requires the implementation of alternative transportation modes.

During interviews with seniors, it was found that none of them had prior experience with the car parking areas in the walled city. Some tourists arrived by bus, while others walked from South Cyprus. Senior tourists evaluated the quality of pedestrian routes and almost all of them stated that there is no integrated pedestrian network that connects all tourist attractions without interruptions. Overcrowded sidewalks with shopping stalls and furniture obstruct pedestrian movement, forcing them to walk on the roadway instead of the sidewalks.

As implied by participicant, coded as T2; *"I frequently come here for shopping and I can find traditional Cypriot products at very reasonable costs. Within the boundaries, there are two states, yet as I move from south to north, I face very poor infrastructure. I can't use my wheelchair without my daughter and grandchildren. Unmaintained pedestrian paths, pedestrian crossings and curb ramps scare me...Everything gets much more difficult when business owners occupy the sidewalks with their stalls."* Provision of appropriate sidewalks and facilities encourages people to visit the historic urban corner (Güvenbaş & Polay, 2021).

According to senior travellers; street furniture and public services are generally insufficient. Senior respondents expressed unfamiliarity with the accessibility and usage of ATMs, as they had never used them before. One respondent stated, *"We've arrived for the first time today. We were fatigued after a long journey to the bus stations and couldn't find a suitable bench to relax on. The weather was quite hot and the seats in the sun were as so. We moved a long distance to find a cafe and sat there to rest...Until we reached the cafe, we couldn't see any public restroom to use it...In short, we have learned that you must pay for rest and other public services." (T3,T12-T15)*

Additionally, senior visitors expressed their opinions about the quality of building entrances. The participant with code T4 sadly voiced her opinions; *"The building's entrances are completely inaccessible when steep steps and sliding surfaces are combined with small doorways. They are extremely dangerous. You must wait outside in the scorching sun for the group you are travelling together if you require a scooter or wheelchair as my husband".* The inappropriate design of building entrances and the lack of sufficient and accessible toilets clearly demonstrate that necessary regulations are needed at different scales to ensure inclusive and responsible tourism activities for seniors (Azmin-Fouladi, 2007; Evans, 2009; Güvenbaş, 2021).

When interviewees were asked about who should be responsible for the provision of accessible tourism facilities in Nicosia, most of them suggested that all stakeholders, including the municipality, governmental departments such as tourism, business owners, local people and universities, should take responsibility for promoting accessible and inclusive historical context. More than half of the interviewees underscored the necessity for collaborative efforts among all stakeholders to enhance the quality of the historic environment. However, they also emphasized that local and governmental authorities should take a leading role in providing suitable arrangements and enforcing necessary laws. Finally, senior tourists have provided several recommendations that are essential for improving their experiece in the walled city.

- Upgrading the pedestrian infrastructure's quality
- Integration of more resting areas with shading elements
- Installation of public toilets
- Improvement of the quality of public transportation facilities
- Enactment of new laws and regulations towards the attitudes of the business owners
- Adaptation of regular maintenance facilities

The findings of the study determined that the physical environmental quality is inadequate and does not meet seniors' needs for inclusive access. Consequently, there is an immediate need to develop

strategies for fostering responsible cultural heritage sites tailored to senior tourists in the Walled City of Nicosia.

4. Conclusion and Suggestions

Cultural heritage consumption plays an important role in the travel of senior tourists as it offers unique visitor experiences and fosters a sense of connection with the past. This study explores the concept of responsible cultural heritage consumption among senior tourists visiting the Walled City of Nicosia. The major goal is to investigate senior travellers' preferences and obstacles in accessing and participating in cultural heritage places.

Since current findings show that the population of elderly tourists has a significant proportion, promoting inclusive access can be accepted as a 'win-win' solution for the tourism industry in Nicosia. Accordingly; this research provides a valuable insights to cultivate responsible tourism practices by addressing the inclusive access needs and expectations of senior visitors. This may help to foster a harmonious coexistence between cultural preservation and sustainable tourism growth as well.

The Walled City of Nicosia has been declared a ‘Special Tourism Zone’ and intended for conservation and revitalization strategies after the opening of the Lokmacı Gate. The pedestrianization project has been implemented to upgrade its quality (Lefkoşa Surlariçi İzleme, Koordinasyon & Yönlendirme Kurulu, 2008).

In this study, the senior tourists’ inclusive access needs were measured through comprehensive research on documentation, on-site observations and interview surveys. The research results reveal that despite the presence of the pedestrianization, there are many failures in terms of physical qualities that negatively influence access and usage. In the study, the main problems are listed such as; inadequate public transportation facilities, improperly designed pedestrian routes, inaccessible building entrances, the lack of inclusive signage and public services.

Based on the findings, suggestions are given as follows;

- **Increasing Public Awareness with Community Engagement and Empowerment:** Encouraging the participation of the community to the development of conservation practices and tourism plans is recommended. In turn, this will empower local people to take an active role in preserving their cultural heritages and respectively sharing them with visitors.
- **Education and Awareness**: Education and training opportunities is required for all stakeholders- local communities, business owners, staff, design professionals, cultural heritage site managers, tourism department officers, tour operators. Training programs must be implemented to increase their knowledge about the importance of cultural heritage preservation and senior tourism.
- **Infrastructure and Accessibility**: It is crucial to create an infrastructure enhancing responsible tourism, such as well-maintained and equipped pedestrian networks, properly designed public transportation facilities and influential signage instalments that will make cultural sites accessible to all, including senior tourists. In the context of comprehensive conservation plans, prioritizing pedestrian access needs are essential.
- **Regulation and Enforcement**: Legislations and policies that enforce responsible tourism practices must be enacted. Penalties should be implemented for activities that harm cultural sites or disrespect pedestrian accessibility.
- **Collaborative Partnerships**: Fostering collaborations between government agencies, local communities, NGOs and private sector stakeholders is principal to achieve responsible tourism goals in the light of cultural preservation and sustainable growth.
- **Monitor and Evaluate Environmental Impact**: It is imperative to continuously monitor the impact of environmental design on tourism activities. This will enable stakeholders to understand the factors that negatively impact to the development of responsible cultural heritage sites and conservation actions.

In conclusion, this study illuminates the profound connection between senior tourists and responsible cultural heritage consumption in the Walled City of Nicosia. Understanding the preferences and behaviours of senior tourists contributes to developing a more responsive and inclusive historical context.

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

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Re-Assessing Hagia Sophia and Istanbul Land Walls through the Lens of Cultural Landscape Concept

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Abstract

Istanbul Historic Peninsula hosts diverse cultural heritage values that represent overlapping cultural layers lasting from the Ancient Greek city of Byzantion to the present city. This study examines the contribution of cultural landscape and historic urban landscape approaches to the conservation of heritage values in the Istanbul Historic Peninsula. Two of four UNESCO World Heritage sites, Hagia Sophia and Istanbul Land Walls are selected as case studies that are the architectural and urban scale components of the city's image. This study aims to attribute to the world heritage sites of Hagia Sophia and Land Walls, which face the risk of loss of authenticity, integrity and outstanding universal value, the concept of cultural landscape, which enables the holistic and sustainable protection of the values and components of these sites. This study reveals the changing and continuing values of which are overlapped on a monument and a site.

Keywords: *Cultural landscape, historic urban landscape, risks, integrity, Istanbul World Heritage Sites.*

Ayasofya ve İstanbul Kara Surlarının Kültürel Peyzaj Kavramı Merceğinden Yeniden Değerlendirilmesi

Öz

İstanbul Tarihi Yarımada, Antik Yunan kenti Byzantion'dan günümüze uzanan ve birbiriyle örtüşen kültürel katmanları temsil eden farklı kültürel miras değerlerine ev sahipliği yapmaktadır. Bu çalışmada, kültürel peyzaj ve tarihi kentsel peyzaj yaklaşımları dikkate alınarak, İstanbul Tarihi Yarımada'daki miras değerlerinin korunmasına sağlayacağı katkılar irdelenmektedir. UNESCO Dünya Mirası alanı ve kent imgesinin mimari ve kentsel ölçekteki bileşenleri olan Ayasofya ve İstanbul Kara Surları makalenin örnek çalışması olarak seçilmiştir. Bu çalışmada, özgünlük, bütünlük ve üstün evrensel değer kaybı riski ile karşı karşıya olan Ayasofya ve Karasurları dünya miras alanlarına, bu alanların değerlerini ve bileşenlerini bütüncül ve sürdürülebilir şekilde korumayı sağlayan kültürel peyzaj kavramının atfedilmesi amaçlanmıştır. Bu çalışma, bir anıt ve bir alanın üst üste çakışan değerlerinin değişen ve devam eden yönlerini ortaya koymaktadır.

Anahtar kelimeler: *Kültürel peyzaj, tarihi kentsel peyzaj, riskler, bütünlük, İstanbul Dünya Miras Alanları.*

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1. Introduction

The awareness of 'heritage' emerged in Europe within the avantgarde movements in the 19th century, followed by the theories and practice of conservation as restoration of architectural monuments from 19th century to the mid-20th century. Beginning from the half of the 20th century, after the destructive effects of World War II on cities and growing awareness of losing identity and the memory of places, the context of heritage was first enlarged with the Venice Charter in 1964 by including ordinary buildings and historic areas. The following charters marked the evolution of the concept of heritage from a single 'monument' to a 'site' and 'place' (Alici, 2021). The expansion of the meaning of cultural heritage and greater recognition of the concept of the built environment provides the basis for a new common language which develops and encourages as a collective resource and responsibility (Assi, 2000).

The context of heritage also gets a deeper meaning from the beginning of the 21st century through contemporary approaches such as cultural landscape. In 1925, Carl Sauer emphasized cultural landscape (Figure 1) as a geographical area and human influences in that area and how culture shapes geography (Sauer, 1925 & Leighley, 1963 in Tuna Yüncü, 2015; Fowler, 2003). After the 1970s, the concept of cultural landscape was recognised as a process that takes place over time through of human activities rather than a physical and historical product (Taylor, 2009; Kap Yücel & Salt, 2018). Similarly, the concept of heritage is considered as process that constitutes a process in several topics such as experience, identity, intangibility, memory and remembering, heritage as performance, place and dissonance (Smith, 2006).

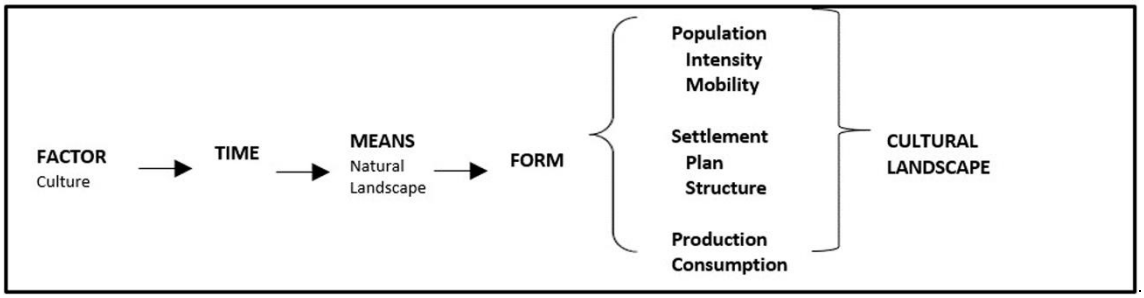


Figure 1. Sauer's chart showing the components of the cultural landscape (Buckle, 2002)

One of the earliest documents using the term 'landscape' is "Recommendation Concerning the Safeguarding of the Beauty and Character of Landscapes and Sites" adopted in the 12th General Assembly of the United Nations Educational, Scientific and Cultural Organization [UNESCO] in 1962. This document intends to take measures for the protection of nature. According to this document, safeguarding mean the preservation and restoration of both natural and man-made natural, rural and urban landscapes (UNESCO, 1962). European Landscape Convention defined a landscape as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" (Council of Europe, 2000).

World Heritage Convention is the first international document that defines cultural landscapes as a cultural property category. The term 'cultural landscape' is defined as "combined works of nature and of man" in Article 1 of World Heritage Convention (UNESCO, 1972). Following the Convention, the definition and three categories of World Heritage cultural landscapes were adopted by the World Heritage Committee in 1992 and included in Operational Guidelines in 2002. According to Operational Guidelines, cultural landscape is defined as the 'interaction between humankind and its natural environment' (UNESCO-WHC, 2002) which remained the same in 2005 and 2008 revisions of Operational Guidelines (Mitchell et al., 2007). Thus, cultural landscapes became one of the cultural property categories in the World Heritage Convention after the 1990s (Aplin, 2007).

The Recommendation on the Integrative Conservation of Cultural Landscape Areas, published by the Council of Europe in 1995, emphasises that the continuity of the cultural landscape areas defined as pieces of land that were formed by artificial and natural factors, that witnessed the evolution of human society and the temporal and spatial character of social settlement, that introduced the past land use

and activities, social skills and traditions, that bore the physical traces witnessing the historical events, and that were identified with different social values in the historical process should be provided with appropriate and effective tools (Plachter et al., 1995).

Cultural landscape is the trace left by human activity in the environment and a direct reflection of the way of life, social and cultural activities of a society. Cultural landscapes also contain memory places that reflect the cultural identity and memory of societies. Places of memory are one of the most important components of the cultural landscape in terms of function and formation process. Cultural landscapes are the reflection of people's social development, creativity and way of life, and thus are a determining factor in urban identity (Günaçan & Erdoğan, 2018).

At this point, the concept of cultural landscapes reminds the world-famous playwright William Shakespeare's words "All the world's a stage, And all the men and women merely players." Assuming a cultural landscape or heritage landscape as a theatrical play, we can say that the stage is the place, the theatre is the whole landscape, the players, audience, and workers backstage are part of the stakeholders, and the play is the cultural process that creates the heritage. A theatre is the mirror of life. From this point of view, cities and all human settlements are magical mirrors of life reflecting past and present at the same time on one screen.

To understand and study a place in terms of the cultural landscape approach, we need to understand what the interaction is and how it happens. Both cultural and natural heritage with intangible associations contribute to the creation of identity and thus to collective memory. Therefore, documenting and managing heritage places requires community participation to recognise the cultural significance of a place. At this point, the cultural landscape approach is a way of understanding a cultural heritage component with its all associations which contribute to the creation of it from past to present, from tangible to intangible, from natural to artificial. In this paper, the concept of cultural landscape is examined with a holistic and inclusive perspective, and it is explained that conservation can be achieved with an understanding as a part of the natural continuity.

While the term "cultural landscape" was first used in heritage studies as a category of heritage sites in the World Heritage Convention, it was consumed as an approach and adopted to urban sites. The other key concept concerning the cultural landscape approach and implements it to historic cities is the 'historic urban landscape (HUL)' which is defined as "the urban area understood as the result of a historic layering of cultural and natural values and attributes, extending beyond the notion of 'historic centre' or 'ensemble' to include the broader urban context and its geographical setting" (UNESCO, 2011). Historic Urban Landscape (HUL) is not a new type of heritage, but an innovative method in urban heritage conservation and it provides an opportunity to rethink the values and characteristics and identify the heritage components of a site in a new perspective for sustainable conservation of them (Yan, 2018). According to Jukka Jokilehto, "HUL means an approach to the identification and recognition of specified qualities, characteristics and significant relationships in the built and natural territory, resulting from processes over time and being associated with multiple layers of significance" (Jokilehto, 2010). Ken Taylor raises a few questions in his article about cities as cultural landscapes. He asks how the cultural landscape concept relates to the historic urban environment, what is the importance of landscape as a repository of social history and human values, and what are the plural identities, beliefs and traditions of a city (Taylor, 2015). The HUL approach emphasises the historical layers of a city. Furthermore, Dennis Rodwell argues that the concept of layering has the same meaning with the separate layers which are overlayed by superimposition, so, layering does not manifest the term harmonious co-existence (Rodwell, 2018).

Istanbul, a world city, has been the subject of many research activities due to its local, regional and international importance in terms of world and national history throughout history. The Historic Areas of Istanbul, representing the cultural layers of its history, are one of the earliest UNESCO World Heritage sites in Türkiye. Since the inscription into the World Heritage List in 1985, the concept and context of heritage have continued to develop from urban sites to cultural landscapes and historic urban landscapes. At present, they face several problems such as loss of authenticity, integrity and outstanding universal value that require to study of historic sites in this new concept.

There are various studies that have previously examined the renovation areas in Istanbul with the HUL approach (Dinçer, 2013). Several studies considered the Land Walls not only as a monument but also the surrounding landscape (Durusoy & Cihanger, 2016; Kıvılcım Çorakbaş, 2021; Kıvılcım Çorakbaş & Kunt, 2023) and intangible cultural qualities (Aksoy & Kıvılcım Çorakbaş, 2021) of the territory. Although there are many studies on World Heritage Sites in Istanbul, this paper is one of the few academic studies that examine and discuss the area with cultural landscape and HUL approaches.

The aim of this paper is to apply these new heritage concepts to the Istanbul Historic Peninsula and the World Heritage Sites. This paper investigates and re-interprets the Istanbul Historic Peninsula by referring to 'cultural landscape' and 'historic urban landscape' approaches to deeply understand the cultural significance of the city. Firstly, the history of the area has been briefly mentioned and the relationship of the city with its immediate surroundings and hinterland that explained from macro scale to urban scale. At the architectural scale, the Sultanahmet Urban Archaeological Component Area focusing on Hagia Sophia is discussed to understand a monument and its immediate surroundings by explaining the conservation theory and practice during periods of the Ottoman Empire and Republic of Türkiye as well as the continuing and changing functions of heritage places by exemplifying the Hagia Sophia. Then, at the urban scale, Istanbul Land Walls is discussed to understand the use of place, intangible values of its territory, integrity of setting and re-interpret the area as a changing and living landscape. Additionally, this study considers the risks faced by heritage values today, when it is desired to produce solutions to these risky situations, answers to the questions of what is conceptually necessary to ensure the protection and sustainability of heritage without losing its authenticity and cultural significance have been sought.

Consuming a city as a living entity, they are like the nucleus and wall of a cell. From this point of view, Hagia Sophia and Land Walls cannot be seen as two separate monuments of the city. The gates and streets constitute a network which reaches Hagia Sophia, the core of the city. From this point of view, Hagia Sophia and Istanbul Land Walls, the two of four World Heritage Sites in Istanbul that represent two symbolic monuments at urban and architectural scales are selected to identify the rich historical layers of Istanbul as a living heritage today. This study discusses how to apply these approaches to two different scales and different typed of heritage sites. It reveals the changing and continuing values of which are overlapped in the two cases.

2. Material and Method

The development of the context and the new concepts of contemporary conservation theory such as cultural landscape and historic urban landscape approaches requires to re-assess the historical environment and world heritage sites. The material of this paper is the two of the four World Heritage Sites in Istanbul Historic Peninsula. These cases are the Sultanahmet Urban Archaeological Component Area, focusing Hagia Sophia and the other one is Istanbul Land Walls. Thus, this paper focuses on the different cases at the urban and architectural scales. These heritage places have been selected for their changing and living cultural landscape characteristics.

2.1. A Brief History of Istanbul and the Two World Heritage Sites

The Istanbul Historic Peninsula, the old city center, is strategically located on the Bosphorus between the Balkans and Anatolia and the Black Sea and the Mediterranean (Figure 2, Figure 3) and has been associated with major events in political history, religious history and art history for more than 2,000 years (UNESCO-WHC, 2020).

Figure 2. Bosphorus and Golden Horn, a view from Beyazıt Tower (The photo is taken by the first author in 2014)

Figure 3. Panaromic view of the Istanbul Historic Peninsula and Bosphorus, a view, from Beyazıt Tower (The photo is taken by the first author in 2014)

Even though several settlements were discovered in Istanbul and its hinterland dated back to the Prehistoric, Neolithic and Chalcolithic eras, there was no settlement on the Istanbul Historic Peninsula because of the insufficient water resources (Özdoğan, 2020). The very first settlement on the Historic Peninsula, named Byzantion, was an Ancient Greek city founded in 7th century BCE by a Megarion colony that migrated from Greece (Kuban, 2002).

Byzantion was a typical colonial trade city with urban components such as temples, amphitheater, agora, stadium, tetras toon, baths and residential area (Kubat & Kürkçüoğlu, 2014). The city came under the domination of Roman Empire in the 2nd century BCE named Byzantium, and then became the capital city of the Eastern Roman Empire in 4th century BCE named Constantinople. The city expanded by constructing or renewing the walls in different periods of the emperors. Besides the Land Walls and Sea Walls, the Forums, Hippodrome, Harbors, Aqueducts, the main street (Mese) which was a part of Via Egniata, as well as basilicas and churches such as Hagia Sophia and Hagia Eirene were the urban elements that represented the development of Roman city image (Kuban, 2002; Müller-Wiener, 2016; Aktüre, 2018).

The advantage of the location of peninsula (Figure 4) was not only the geostrategic one but also the fertile agricultural lands, water resources, forests and marble quarry in the hinterland (Sakarya, Bursa ans Thrakia plains) that contributed to the development of capital city (Aktüre, 2018). The topography was the decisive factor for the development of the city to the west. The hills were especially chosen to construct symbolic buildings such as Hagia Sophia (Kubat & Kürkçüoğlu, 2014).

Figure 4. Istanbul and its hinterland (Reproduced from Google Earth image by Authors)

The urban pattern and the location of the forums and monuments demonstrated the adaptation of urban structure to the topography. Despite the change and loss of many current elements, the beauty of the city is hidden in its relationship with water and the use of topography. These are examples of how to understand the city image from a cultural landscape perspective in a wider context. The location of the first settlement on the peninsula, the urban pattern as a result of its physical and visual interaction with the water sources, and urban heritage as a multicultural composition created in time are the basic aspects of the cultural landscape perspective for Istanbul.

The Ottoman Emperor Sultan Mehmet II took control of the city in 1453 and the city, named *Konstantiniyye* (refers to Constantinople) and later *Dersaadet* (means gate of happiness), became the third and last capital city of the Ottoman Empire. Beginning from the mid-15th century, the city's image started to change and took an Islamic character too. For example, while most of the churches protected their function, some of them were converted to mosques such as Hagia Sophia. The industrialization and modernization movement started in the mid-19th century and the industrial facilities took place around the Land Walls and Golden Horn (Çelik, 2019).

Istanbul was one of the important centers of cultural wealth of the Ottoman Empire from 1453 to 1922 and the city protects its significance at present (Bilsel, 2016). the foundation of the Republic of Turkey in 1923 and the following political periods were the other key events that changed and effected the urban area (Kubat & Kürkçüoğlu, 2014).

The Istanbul Historic Peninsula hosts diverse cultural heritage values that represent overlapping cultural layers throughout history beginning from the Ancient Greek city to the modern era today. The four historical areas in Istanbul (1) were inscribed into the UNESCO World Heritage List in 1985. The outstanding universal value of Istanbul lies in the unique composition of the architectural masterpieces that reflect both the European and Asian cultures that constitute a beautiful skyline in relation with the Bosphorus (Figure 5).

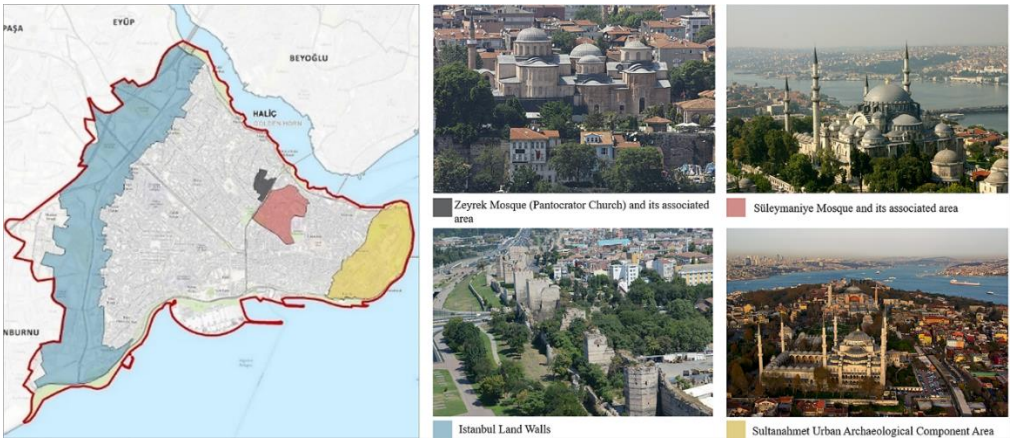


Figure 5. The UNESCO World Heritage Sites in Historic Peninsula, boundary map and photos (Istanbul Site Management Unit, 2020)

At present, the city and the World Heritage Sites are threatened by the population pressure, industrial pollution and uncontrolled urbanization (UNESCO-WHC, 2020).

2.2. Method

UNESCO is an intergovernmental group which also covers the experts on conservation of cultural heritage. Likewise, ICOMOS is member of advisory body. Türkiye is members of both institutions and has a national committee. The experts in these institutions work in cooperation with conservation experts from many different countries that publishes international declarations and guidelines on current issues, problems, and processes of disruption conservation of cultural heritage. One of these international charters is the 'Recommendation on Historic Urban Landscape (HUL)' published by UNESCO in 2011. The universal principles established by this approach compile local values within the framework of a universal concept. The method of the paper is based on the HUL approach (UNESCO, 2011) which is also based on former international charters such as the Washington Charter (ICOMOS, 1987), and Burra Charter process (ICOMOS-Australia, 2013) that are related to the conservation of historic areas. The basis of conservation is to understand the place and assess its cultural significance (ICOMOS-Australia, 2013), so, the HUL approach and its context constitute a basic for this paper's method. The main structure of the research method is designed in four steps as shown in Figure 6.

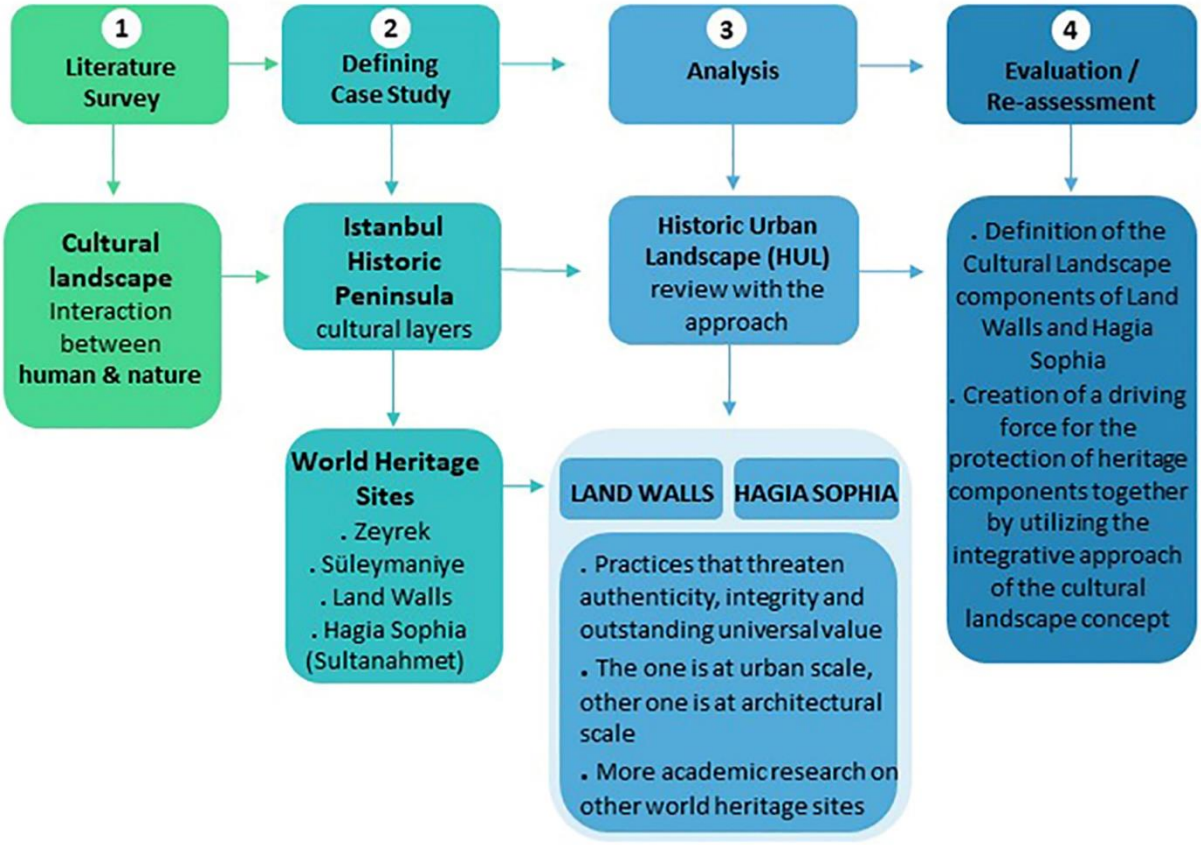


Figure 6. The four-step method scheme (Prepared by the authors)

According to Figure 6, in the first stage of the study, the concept of heritage, its scope, development and cultural heritage conservation approach were searched through the national and international literature. The concepts of cultural landscape and historic urban landscape, their scope, utilisation and what they bring in the context of heritage conservation were questioned. In the second stage, the study area is chosen and defined at three levels: Istanbul Historic Peninsula, World Heritage Sites and two of them as cases. The third stage is based on the cultural landscape concept and historic urban landscape approach which was also developed from the cultural landscape concept. The context and content of the "historic urban landscape (HUL)" approach, in which UNESCO puts the concept of cultural landscape at its centre, is applied to the Istanbul Historic Peninsula. Then, the selected two

UNESCO World Heritage sites, Hagia Sophia and Istanbul Land Walls which are the architectural and urban scale components of the city's image. At the final stage, cultural landscape components and values are defined and the changing and continuing values which are overlapped on a monument and a site are revealed.

Based on the second stage of the method, before explaining the two case studies, the urban character and heritage values of Istanbul Historic Peninsula need to be reconsidered with HUL approach This approach-provide better understanding of the urban are within its natural and historical context, the significance of heritage sites and the relation between them. According to the related Recommendation by UNESCO, the context of HUL approach is defined considering the interaction between human and nature which is also the definition of cultural landscape (UNESCO, 2011; Dinçer, 2013). The Table 1, organised according to the context of the HUL approach, shows the diverse heritage elements in the Istanbul Historic Peninsula.

Table 1. The context of HUL approach (UNESCO, 2011) and its implementation to the Istanbul Historic Peninsula (The table is prepared by the authors)

Definition	Historic Layers	Components of the Istanbul Historic Peninsula
	Natural	Sea, Boshporus, forests, coastline, topograhpy,
	Cultural	Ancient Greek, Roman, Byzantine, Ottoman, Republic of Turkey (urban pattern and architectural heritage)
	Context	
	Topography	City is located on a hill in Historic Peninsula Coastline defines the borders of city (changing during time)
	Hydrology	Marmara Sea Haliç (Golden Horn) Bayrampaşa Stream (Lykos) Büyükçekmece Lake
	Natural features	Bayrampaşa Stream (Lykos) Monumental trees Water resources
	Built environment (historic and contemporary)	The settlements in Prehistoric time Archaeological remains Historic layers of different periods (especially, with the legacy of Architect Sinan) (monuments, civil architecture, Turkish baths, fountains etc.)
	Infrastructure (above and below ground)	Archaeological remains (above and below) The Milion Stone, Via Egnatia Basilica cistern Historic Aquaducts Water Gauge (supplement systems) Taksim tunnel (Funicular railway, 19th century) Modern highways and subways (20th century)
	Open spaces and gardens	Squares (old Roman forums-Ayasofya-Çemberlitaş, Beyazıt) Sultanahmet Square (Hippodrome) Gülhane Park (archaeological site) Haliç-Marmara Sea (as open space)
	Land use patterns and spatial organization	Various building types Mese / Divanyolu (main street) Ottoman kulliyes (social and religious complex) Churches and monastries Fatih Complex, madrasah, the first university Topkapı Palace Industrial heritage (19th and 20th century)

	Perceptions and visual relationships, urban structure	Silhouette of Bosphorus peninsula and Maiden Tower (*Kızkulesi*) Vista points
	Social and cultural practices and values	Ahırkapı Hıdırellez festivals (celebration of coming spring) Yedikule (Seven Towers) Lettuce festivals Yedikule (Seven Towers) Dungeon as concert hall Fener Greek Patriarch, Churches etc.
	Economic processes	Trade city, port city, industrial city, productive city in history Agricultural areas inside and outside the city walls, Vegetable gardens (*Bostan* in Turkish)
	Intangible dimensions of heritage (related to diversity and identity)	Contributions of foreign architects Multi-Cultural society of the city Multi-Religious society of the city İstanbul as an inspiration in literature (Pera Palas, Orient Express, the city itself etc.) Books and memories of travelers (Amicis, Le Corbusier etc.) Spirit of place and memory of citizens Names of Street and roads
	Urbanization and globalization	Opening new streets (Ottoman-Republic) Planning against city fires Demolish of city walls during 1950s Development Plan of Henri Prost (French city planner and architect) Gentrification projects (Sulukule) Skyscapers along the Boshporus, changing silhouette. Yenikapı meeting area (landfill area) Yenikapı *Marmaray* Subway Project process and archaeological excavations
	Development	Tourism (World heritage, cultural, congress, economy etc.)
	Environment	Natural disasters Earthquake (monitoring systems for few monuments) Climate risks on heritage buildings and sites

Historic layers are analysed according to the following headings as stated in HUL Recommendation (UNESCO, 2011): “natural, cultural, context, topography, geomorphology, hydrology, natural features, built environment, infrastructure, open spaces and gardens, land use patterns and spatial organisation, perceptions and visual relationships, urban structure, social and cultural practices and values, economic processes, intangible dimensions of heritage, urbanisation and globalisation, development and environment.”

The heritage elements listed in the Table 1 are compiled from the literature (Kuban, 2002; Kubat & Kürkçüoğlu, 2014; Ahunbay et al., 2015; Bilsel, 2016; Müller-Wiener, 2016). Then they are reinterpreted according to cultural landscape and HUL approaches, then placed under the related heading. In the Table 1 above, which was created specifically for the Istanbul Historical Peninsula, the historic layers are exemplified through the cultural landscape components of the Istanbul Historic Peninsula. According to the interpretation of Istanbul’s urban heritage by HUL approach the natural layers are sea, Bosphorus, forests, coastline, topography; the cultural layers: Ancient Greek, Roman, Byzantine, Ottoman, Republic of Turkey; topography layers: city is located on hill in historic peninsula, coastline defines the borders of city (changing during time); geomorphology layers: stone quarry, marble quarry; hydrology layers: Marmara Sea, Golden Horn, Bayrampaşa Stream (Lykos), Büyükçekmece Lake; natural features layers: Bayrampaşa Stream (Lykos), monumental trees, water resources; etc.

When Table 1, which was created in the context of Istanbul according to the HUL approach, is analysed, it is seen that the concepts of layering and harmonious coexistence, which are the tasks undertaken by the historic urban landscape, as mentioned by Dennis Rodwell (2018), are exemplified in this study

area. Since the foundation of the city, the city has continued its multi-ethnic and multi-religious character by hosting diverse cultures. This cultural diversity and heritage diversity exemplifies the harmonious co-existence and overlapping separate layers.

Based on the third stage of the method, to understand and define cultural landscape components, different models in the literature are examined to propose a new model is for two case studies in this paper. The cultural landscape components are categorized as natural-physical (built environment)-social (Kevseroğlu & Ayataç, 2019; Kevseroğlu, 2022; Acar Bilgin & Kıvılcım Çorakbaş, 2023) or natural-cultural/social-perceptional (Swanwick, 2002; Tudor, 2014) or natural-cultural/social (Tuna Yüncü, 2015) or natural-cultural-intangible (Güler, 2018). The proposed model categorizes the cultural landscape components as natural-physical (built environment)-social (intangible dimensions and values) and also refers to the context of HUL Recommendation on Table 1. The analysis model designed for case studies in the third stage is shown in Figure 7.

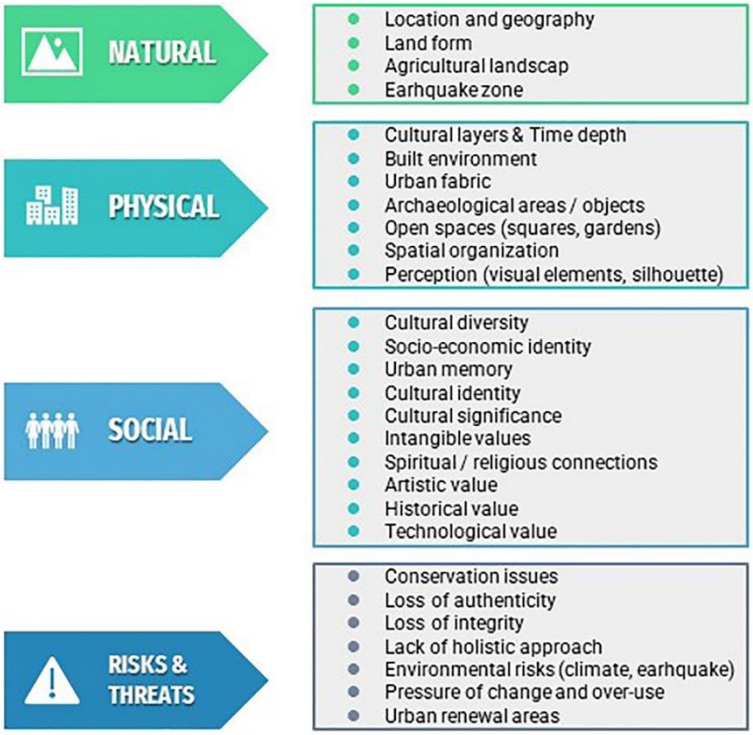


Figure 7. The four-step the model proposal for case studies for defining cultural landscape components of case studies (Prepared by the authors)

According to this model in Figure 7, the model includes not only cultural landscape components but also the risks and threats because cultural landscape and HUL approaches require to consider conservation problems and risks for the sustainable conservation of heritage sites. Two case studies are in detaily explained, and their cultural landscape components and their values are defined and discussed in the following section.

3. Findings

Hagia Sophia and Land Walls in Istanbul Historic Peninsula were inscribed into the UNESCO World Heritage List with the criteria i, ii, iii, iv in 1985 (UNESCO-WHC, 2020). What these criteria have in common is that they exemplify tangible architectural and urban values. However, when these two areas are analyzed with a cultural landscape approach, it is understood that there is a coexistence of tangible values as well as intangible values and cultural and natural values. Therefore, attributing the concept of cultural landscape to these areas will ensure that all of these values are first documented and protected from a holistic perspective. In this point of view, the model shown in Figure 7 is implemented to the two cases in Table 2.

Table 2. The cultural landscape components of Hagia Sophia and Land Walls (The table is prepared by the authors)

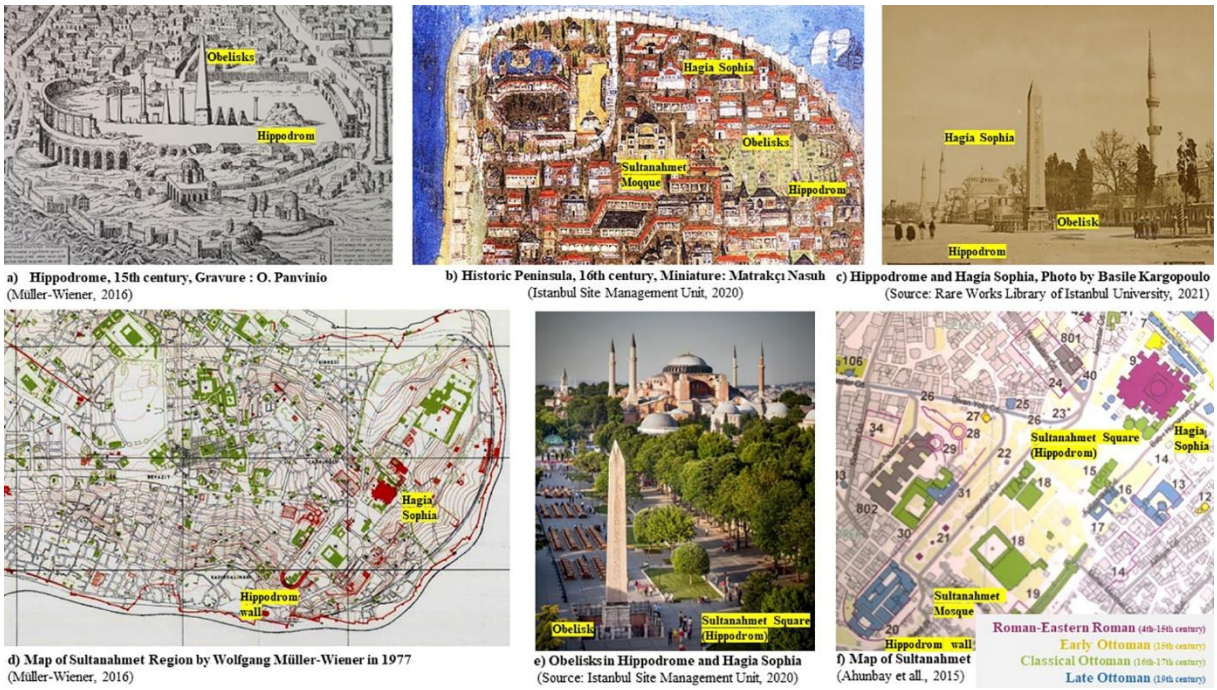
	UNESCO WORLD HERITAGE / Selection Criteria	CULTURAL LANDSCAPE COMPONENTS																				
		NATURAL				PHYSICAL (Built Environment)							SOCIAL (Intangible Dimensions and Values)									
		Location and geography	Land form	Agricultural landscape	Earhquake zone	Cultural layers & Time depth	Built environment	Urban fabric	Archaeological areas / objects	Open spaces (squares, gardens)	Spatial organization	Perception (visual elements,	Cultural diverstiy	Socio-economic identity	Urban memory	Cultural identity	Cultural significance	Intangible values	Spiritual / religious connections	Artistic value	Historical value	Technological value
HAGIA SOPHIA	**i, ii, iii, iv**	✓			✓	✓	✓		✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	
LAND WALLS	**i, ii, iii, iv**	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓

Although these sites are included in the world heritage list by emphasizing their tangible values, they also offer heritage diversity and cultural wealth in terms of intangible values as seen in Table 2.

3.1. Hagia Sophia in Sultanahmet Urban Archaeological Component Area

Sultanahmet Urban Archaeological Component Area of the World Heritage Site consists of two zones. The first part is the Sur-i Sultani (Ottoman imperial walls) Zone in which Topkapı Palace is located as well as the acropolis of Byzantion city. The second one is the Sultanahmet Zone which is a registered archaeological-urban site (Ahunbay, 2011).

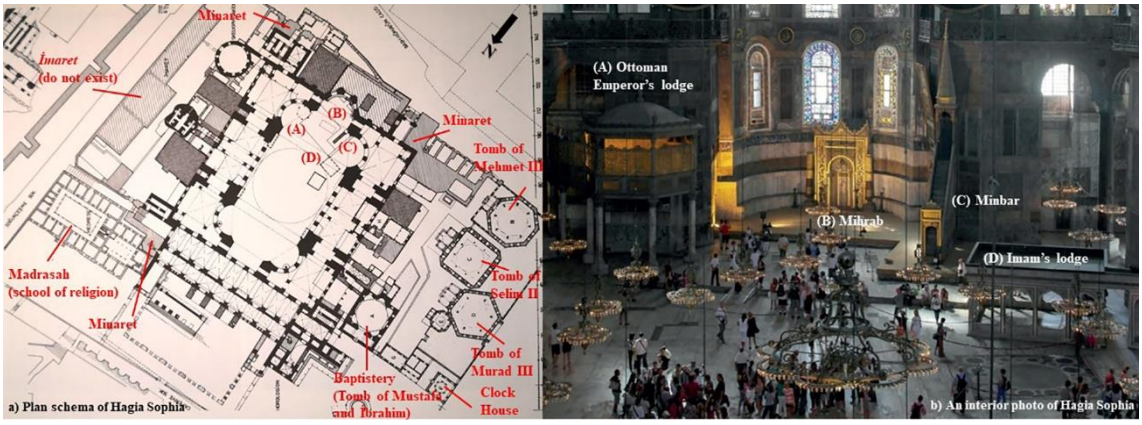
The Augustaion Forum and Hippodrome have managed to protect their character as open spaces throughout the part times; this area is presently called the Sultanahmet Square. Similarly, Mese Street is still the main axis of the city. Hagia Sophia (built in the 6th century) and the Sultanahmet Mosque (built in the 17th century) are the significant monuments of the silhouette (Kubat & Kürkçüoğlu, 2014). The functional continuity of monuments and open spaces inherited from different historical periods is still legible in the Sultanahmet Zone. These heritage places such as monuments and voids can be seen almost on all the old maps and gravures from the 15th century to the 19th century and even present photos (Figure 8).



a) Hippodrome, 15th century, Gravure : O. Panvinio (Müller-Wiener, 2016)
b) Historic Peninsula, 16th century, Miniature: Matrakçı Nasuh (Istanbul Site Management Unit, 2020)
c) Hippodrome and Hagia Sophia, Photo by Basile Kargopoulo (Source: Rare Works Library of Istanbul University, 2021)
d) Map of Sultanahmet Region by Wolfgang Müller-Wiener in 1977 (Müller-Wiener, 2016)
e) Obelisks in Hippodrome and Hagia Sophia (Source: Istanbul Site Management Unit, 2020)
f) Map of Sultanahmet (Ahunbay et all., 2015)

Figure 8. Images of Sultanahmet Area and Hippodrome showing the historical layers through time

The historic layers are also legible on the monuments as well as urban patterns. After Sultan Mehmet II took control of the city, this church was converted to an imperial mosque (2) and became a religious complex between the 15th and 19th centuries (Figure 9). Since the painting of human figures was forbidden in the Islamic culture, the mosaics and figures in the interior of the church were plastered and covered but never destroyed. A waqf (foundation) was established for conserving and repairing the monument. During the Ottoman era, several buildings with new functions and different architectural styles were added to Hagia Sophia in different periods. The interior of Hagia Sophia also underwent some changes by the addition of some elements for Islamic worship such as the mihrab, minbar, emperor's lodge and imam's lodge which were also the examples of different architectural styles. Refunctioning of Hagia Sophia as a mosque was an example of the conservation of monuments for practical need in the Ottoman era. Hagia Sophia was used as a mosque until 1935 (Aykaç, 2019a).



a) Plan schema of Hagia Sophia
b) An interior photo of Hagia Sophia

Figure 9. Plan schema (Müller-Wiener, 2016) and an interior photo of Hagia Sophia (Istanbul Site Management Unit, 2020)

The conservation history of Hagia Sophia reflects the conservation practice of both Ottoman State and Republic of Turkey. For instance, Sinan the Architect added the outer walls to strengthen and support the structure in 16th century. The waqf (foundation) system ensured the maintenance and repair of monuments in the Ottoman era. The first legislations on built environment in the Ottoman era were made in the second half of 19th century, containing some regulations against the city fires, enlarging roads, building restrictions near the monuments, demolishing wooden structures close to monuments

for fire prevention etc. (Madran, 2009). As a consequence of this legislation, all the traditional wooden houses near Hagia Sophia were demolished in mid-19th century (Çelik, 2019).

In the second half of 19th century, there were a great deal of interaction between Europe and Ottoman Empire; foreign experts in many fields were invited to Istanbul. Gaspare Trajano Fossati and his brother Guiseppe Fossati restored between 1847-1858 Hagia Sophia with the request of Sultan Abdulmecid. Akdoğmuş (2020) evaluates those comprehensive and transformative repairment as radical interventions. They restored the mosaics and ornaments. They removed the plaster on the pandantives of dome; then the faces of four angels came to light. They plastered the outer walls and painted them in stone-brick lines imitation. Similarly, Gaspare Fossati designed the Imperial lodge. After the earthquake in 1894, Raimondo D'Aranco, the Italian architect repaired the Hagia Sophia (Akdoğmuş, 2020).

In Republican era, the General Directorate of Foundations (3), the new owner of the building, repaired Hagia Sophia in 1926. The American Byzantine Research Institute made research on the mosaics and art works in 1930s. Cahide Tamer, the first female conservation architect in Türkiye, repaired several parts of interior and exterior in 1950s. After the historical areas of Istanbul was inscribed into the UNESCO World Heritage List, a scientific committee (4) was organised for the maintenance and restoration works of the building.

3.1.1. Changing function of Hagia Sophia

After the foundation Turkish Republic in 1923, the city of Ankara, located in the central Anatolia region, became the capital city of new the Republic of Turkey. Istanbul but lost its importance as a governmental city and Sultanahmet District and its components remained the legacy of Ottoman authority.

Musealization approach of the new secular Republic regime was adopted as "a strategy for neutralizing the imperial and Islamic past and their associations of historic monuments" such as Topkapı Palace and Hagia Eirene. Based on this point of view, the Council of Ministers declared Hagia Sophia as a museum in 1934, then, it was opened to visitors in 1935 after repairs. As mentioned in the act, Hagia Sophia became a new scientific institution for humanity. Consequently, the Hagia Sophia Museum became a symbol of secularism and neutralization of contested religions (Aykaç, 2019b; 2019c). The decision taken in 1934 by Atatürk, the founder of the Republic of Turkey, and his cabinet reflected the worldview of the Republic of Türkiye and its interpretation of common cultural heritage (ICOMOS Turkey, 2020). Refunctioning of Hagia Sophia as a museum is an example of conserving monuments with their cultural values.

Günaçan & Erdoğan (2018) stated that Hagia Sophia is a multi-layered place of memory that keeps the traces of the memories and events of different religions in the same space by being functioned as a church for 916 years and a mosque for 481 years. Additionally, the building served as a museum for 85 years until 2020 and kept its role of being a memory place at international level.

The debate on refunctioning of Hagia Sophia as a mosque and legal process began in 2005. Some part of the museum structure started to be used for worshipping in 2016. There started a fresh debate in mid-2020 once again. The government intended to change its museum function and convert it back to a mosque again. While many experts from diverse fields of science and arts, and most people in the community in the country supported this idea, many conservation experts, and national and international institutions, on the other hand, defended the idea of continuing its museum function, focusing on cultural values and transmitting them to future safely (Ahunbay, 2020; Eldem, 2021; UNESCO, 2020; KORDER, 2020; AISB, 2020). Moreover, representatives of some Christian minority groups said that Hagia Sophia was large enough to be used and shared by the Muslims and Christians together; it can be a place of peace. Eventually, the legal status of Hagia Sophia changed again on the 10th of July, 2020 and was re-opened as a mosque on 24th of July, 2020.

ICOMOS Turkey Board made an announcement on 10th of July 2020 on this debate named "Call for Hagia Sophia" which stated that the museum function should continue because it would strengthen the perception of the multi-layered character of Hagia Sophia in due course. The announcement also

stated that “The Hagia Sophia’s presentation, intact with all its layers, should not be obstructed, so this magnificent monument of world architectural history can keep inspiring us all as a symbol of interfaith brotherhood and world peace” (ICOMOS Turkey, 2020).

The requirements of the new mosque function, on the other hand, are arranged inside and outside the building. The spatial changes according to the mosque function can be followed as:

- While the entrance of the building was on the north side, it was later moved to the east side. The people can reach to the nave passing through the eastern side aisle (Figure 10a, 10b)
- Wooden racks with glass covers are arranged inside the eastern aisle to keep shoes safe and odour-free (Figure 10c). This arrangement is because of wearing shoes is not allowed inside the prayer hall according to the Islamic rules. In connection with this rule, the floor of the nave was covered with carpets to keep the body warm during prayer. Even if these carpets protect the stone surface against deterioration, it conceals to see the artwork on the floor. It must be told that the carpets were used where they were needed, such as the floor of nave and some parts of aisles are covered with carpets. (Figure 10d).
- The dome above the mihrab (the apse) is partly covered by curtains inside to conceal the figure of St. Mary and St. Jesus (Figure 10e). This is also because of the human figures and pictures are also forbidden in Islamic culture, too. Concealing the work of art can result in covering the universal value of the historical construction. The changes should not threat the authenticity of building.
- Another example of adapting new function is arranging moveable wooden panels are used to give women private spaces during prayer (Figure 10f).
- Lastly, movable metal separators to interrupt the access to some spaces by all people. (Figure 10g). Similarly, accessing to the aisles upstairs is also restricted. This kind of arrangements might be necessary to protect building against the negative effects of mass tourism.

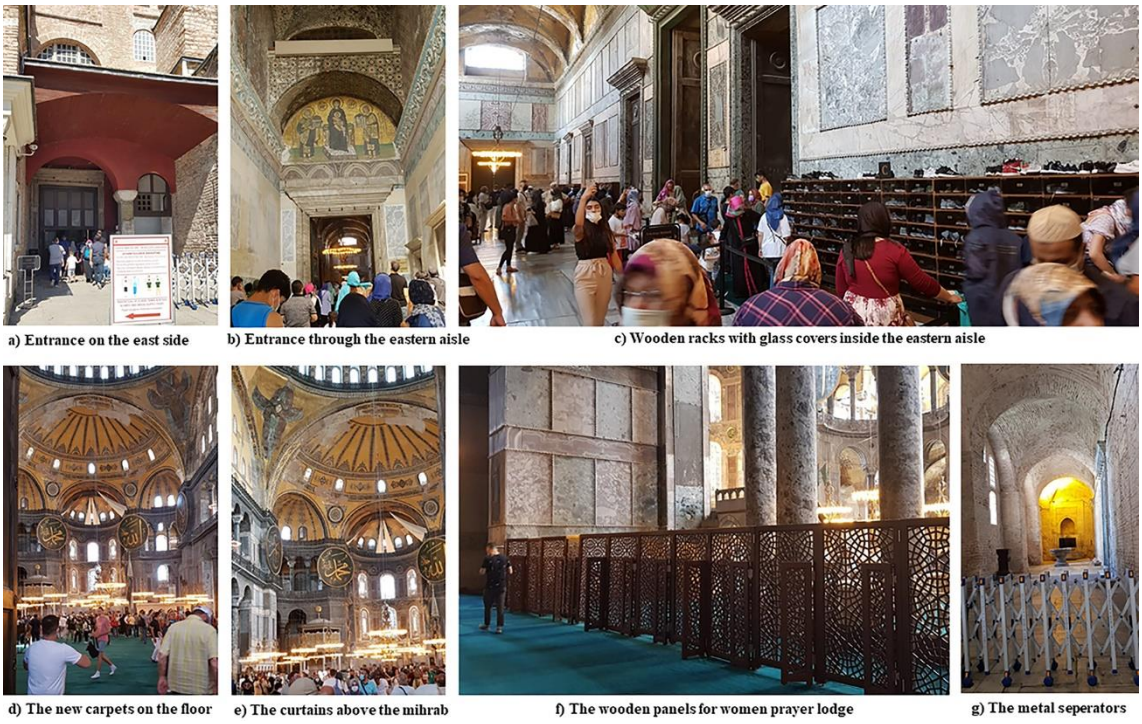


Figure 10. New arrangements inside Hagia Sophia after being a mosque (The authors, 2021).

Hagia Sophia is the urban component that generates the urban identity, collective and individual memories associated with heritage values. Countless people have worked for it over centuries and kept working to protect and transmit it to the future generations. As quoted from Jokilehto (2010) and

Rodwell (2018) before, Hagia Sophia is a result of processes over time, and it has multiple layers of significance which represent a harmonious co-existence.

Hagia Sophia, in addition to being an architectural masterpiece, has a symbolic meaning for different religions and cultural significance for many people from all over the world. Furthermore, it constitutes a lesson and source of historic knowledge for experts from all over the world such as architecture, structure engineering, art history etc. Hagia Sophia is a symbol of cultural diversity and plurality of Istanbul for centuries. The concept of cultural landscape requires to consider all physical, social and cultural layers and to respect to all intangible values of each layer.

3.2. Istanbul Land Walls

Historic Peninsula has been fortified since first settlement in 7th BC to protect the city against attacks from the sea and land (Semiz, 2017). The city expanded from east to west in due course; each time, new walls were built by the names of Byzantium (Wall of Byzantium), Septimus Severus (Septimius Severus Walls), Constantine (Wall of Constantine) and Theodosius (Theodosius II Land Walls) beginning from 7th BC to 5th BCE. At the beginning of the IV century, the Emperor Constantinus (324-337) designated the city of Byzantion as the eastern administrative center of the Roman Empire with the name Constantinople/Nea Rome and the land walls were built. The Komnenos Walls located in the north of Theodosian Walls has been built in medieval period (Kayra, 1990; Semiz, 2014; Ahunbay et al., 2015; Başaran & Kızıltan, 2016) (Figure 11).

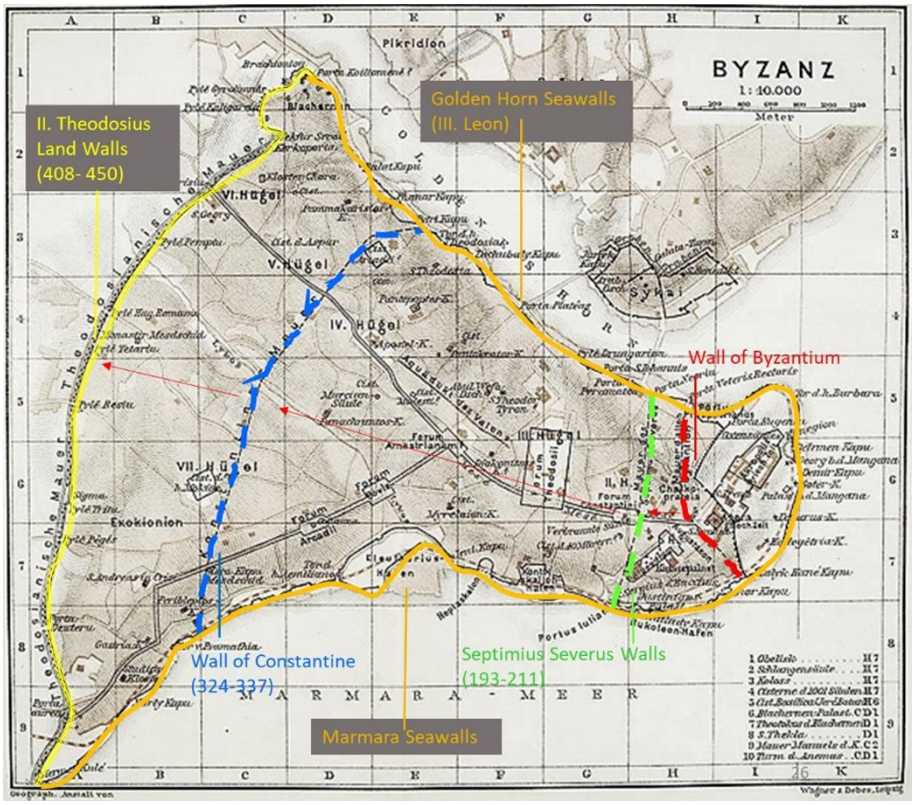


Figure 11. The location of settlements and walls of Istanbul Historic Peninsula that expanded from east to west over time (Reproduced by authors from the old map of ancient Byzantium drawn by Wagner & Debes in 1914 and published in Yetişkin Kubilay, 2010)

There are seven gates and many passageways on the Land Walls. While only the Porta Aurea/Golden Gate is for the imperial gate on the walls, others were used by public (Semiz, 2014; Ahunbay et al., 2015). The valley system, water reserve areas, rugged (mountainous) areas and topography of the city determined the locations of the walls. The land walls consist of a triple defense system consisting of the main wall, the front wall and the ditch, located on natural topographic curves (Figure 12, Figure 13). The arched stone bridges built to cross the large ditch in front of the gates are the oldest bridges in the city. The network of roads connects the historical city center to the Land Walls where the city opens out with magnificent gates.

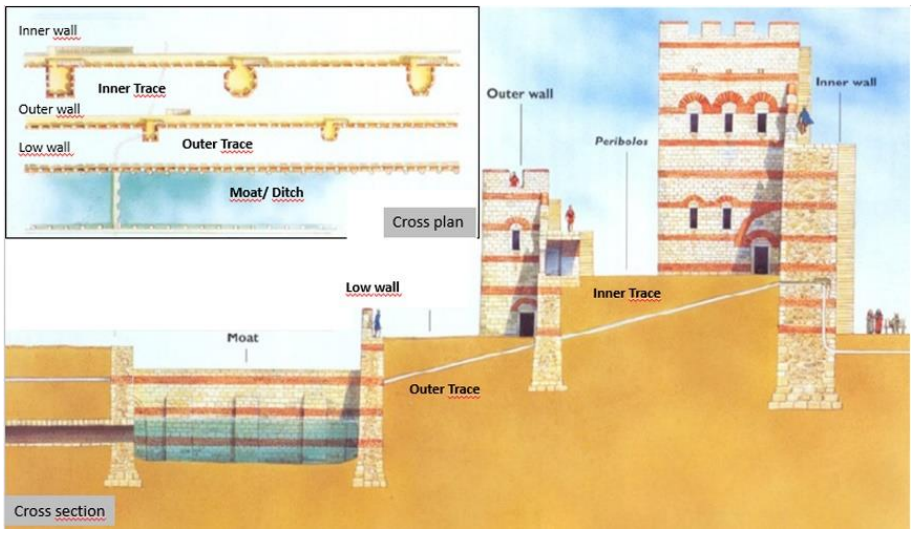


Figure 12. The schema of triple defense system of the Theodosian Walls (Turnbull, 2004)

Figure 13. The photo of triple defense system of the Theodosian Walls (Istanbul Site Management Unit, 2020)

The Land Walls and gates which are the first city images encountered by those who come to the city for the first time have always been perceived as the monuments symbolizing the power of the state. The architectural structure and spatial characteristics of the Land Walls and its relationship with the historical context of the city demonstrates the cultural significance of it.

Istanbul city walls have become the main focus of many scientific studies in the fields of archeology, architecture and urban history, as well as literary depictions. Over the centuries, the land walls in Istanbul have been depicted by many travellers and explorers. As clearly seen in the Historic Peninsula maps and engravings drawn by local and foreign artists since the first depiction drawings made by Buondelmonte (5) (Yetişkin Kubilay, 2010), the city walls are the significant element that defines the boundary of the city. Also, they are the most prominent symbol in the engravings and miniatures of different centuries (Figure 14).

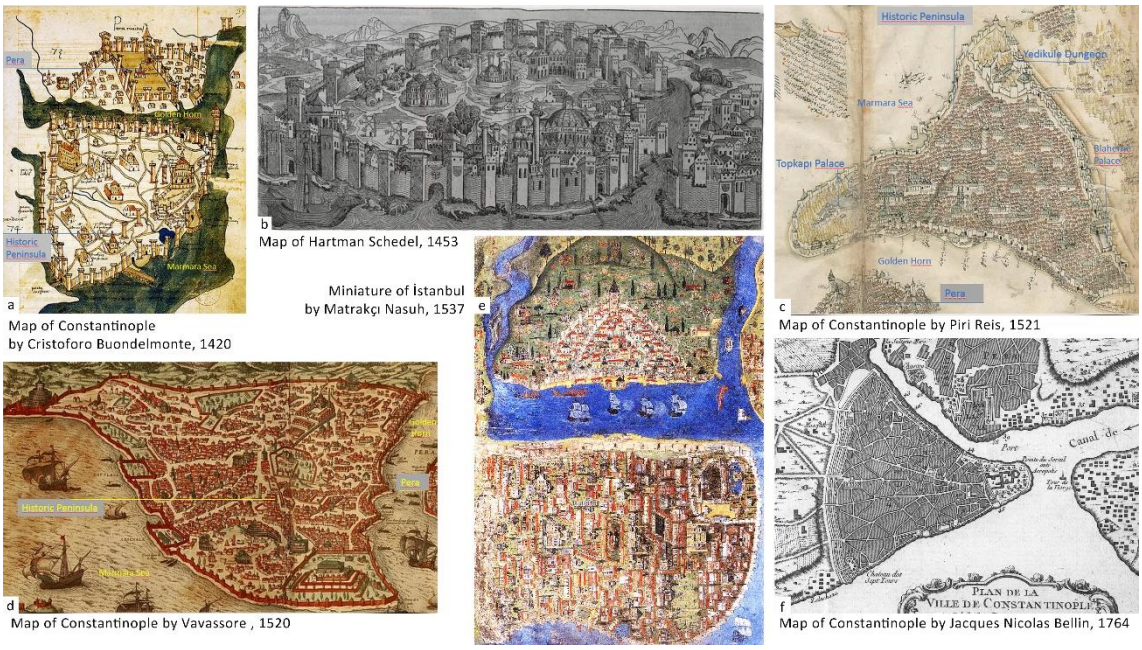


Figure 14. Istanbul Land Walls in maps and gravures (The source of the images a, b, c, e is Kayra 1990; The source of the images d, f is Yetişkin Kubilay, 2010)

Currently, even though the settlement areas of the city have been developing towards the west, it is still the city walls that define the west border of the Historic Peninsula. The location of the city walls, representing the cultural landscape character of the city, contributes to the extraordinary silhouette of the Historic Peninsula.

3.2.1. Conservation history and state of conservation

The city walls, primarily the gates were repaired many times throughout history during the periods of Byzantine, the Ottoman and the Republic of Turkey. On the contrary, city walls were damaged or demolished because of strong earthquakes such as happened in 447, 741, 1766, 1894. After the 1894 earthquake, the 'Ministry of Internal Affairs' underlined the historical importance of the city walls and decided to restore the ruined parts (Ahunbay et al., 2015; Bilsel, 2016; Sarımeşe, 2018). Additionally, the city walls also partly demolished during the urbanisation works and the construction of the railway in the 19th century (Çelik, 2019; Acar Bilgin & Kıvılcım Çorakbaş, 2023). The Yedikule Fortress, which was entrusted to the Directorate of Imperial Museum (Müze-i Hümayun) in 1895.

The scope of the first legislation regarding the protection of ancient monuments called Antiquities Regulation, issued in 1869 (updated in 1874) was only the conservation of the archaeological assets and excavations. While the third Antiquities Regulation, issued in 1884, were declaring 'fortifications" as ancient monuments (Asar-ı Atika in Ottoman) for the first time, the fourth Antiquities Regulation, issued in 1906 clearly defined the city walls as ancient monuments to be protected (Madran, 2002; 2009; Acar Bilgin & Kıvılcım Çorakbaş, 2023).

Land Walls were declared as a "conservation area" in the Old City Master Plan approved by European city planner Henri Prost in 1939. This decision was made sure that the aesthetic value of the walls was revealed as a whole. Within the framework of the first city development plan prepared for Istanbul in 1939, the Land Walls and its surroundings were registered as "archeological site" came under legal protection. This city development (master) plan envisaged the creation of a wide green belt surrounding the Historic Peninsula from the west. The sea walls were destroyed during the period when the coastal roads were enlarged in the 20th century (Aydemir, 2008; Bilsel, 2011; 2016).

Compared to the Land Walls, the Golden Horn and Marmara walls were destructed more considerably high. Even the Land Walls has partly damaged or demolished, it noticeably stands out and protects its integrity and continuity at present. The Figure 15 shows the conservation state of city walls at urban scale.

Figure 15. Istanbul Historic Peninsula, the red lines show the remains of city walls at present (Semiz, 2014, 489-491; Semiz, 2020)

The Municipal Zoning Directorate prepared the 1/5000 scale Historic Peninsula and Eyüp Region conservation plan in 1964 under the management of architect Turgut Cansever. The areas surrounding the Hagia Sophia and the Blue Mosque and the Land Walls and its immediate surroundings were marked as two special conservation areas (Bilsel, 2016).

The Istanbul Land Walls were taken under protection in 1981 as a conservation area within the scope of national legislation. The Land Walls were included in the UNESCO World Cultural Heritage List in 1985 and the Municipality initiated a protection project for this specific area. The restoration of the land walls and gates started in the 1940s. Some of the land walls were restored between 1987 and 1991 (Ahunbay et al., 2015; Bilsel, 2016). The fact that the methodology and technique used during the intervention and the excessive intervention imposed on the walls and the use of inappropriate materials raises the question of integrity.

In 1995, within the scope of the Law on the Protection of Cultural and Natural Assets (Law No. 2863, 1983), the Historic Peninsula was declared as a site, partly “archaeological”, partly “urban archaeological” and partly “historical and urban” and was taken under protection as a whole. The Istanbul Metropolitan Municipality adopted the First Site Management Plan in October 2011 (Bilsel, 2016).

3.2.2. The Land Walls as a cultural landscape and its diverse values

The concepts of cultural landscape, memory, and identity are inextricably linked to and interacted with heritage, and the heritage, which has intangible connections with human values, is now focused on the significance of places (Taylor, 2015; Taylor & Xu, 2019).

Cultural landscape is a complex phenomenon with a tangible and intangible identity. Moreover, the cultural landscape is the diversity shaped by the interactions between the human beings and their natural environment and it is the mirror of the cultures that have created it.

The Istanbul Land Walls is interpreted according to the proposed model in Figure 6 and Figure 7 and the cultural landscape components are defined. From the past to the present, the physical form of the Land Walls, its immediate surroundings, the identity of the people living in the neighbourhoods, the migration movements there, the settlements of local population, the network of relations between the productions here can be considered as the cultural landscape components of the area.

In the course of time, the significance of user experience and heritage interaction has emerged in the discussions on authenticity in the conservation of cultural assets. Furthermore, the collective memory of cultural landscape value is another factor that ensures and sustains the authenticity. In this context, the Historic Peninsula of Istanbul has a multi-layered cultural landscape.

The Theodosian Walls were built by the individual efforts of the local fellow citizens of the city. According to the Codex of Theodosius dated 422, there was no single citizen who did not contribute to the construction of the walls. It was stated in the relevant sources that the expenses related to the construction of walls were met by the citizens (Kuban, 2002).

The physical environment of the people living in the neighbourhoods around the Land Walls had significant impact over their social lives at (Yılmaz et al., 2019). In this context, a research project (6) conducted in cooperation with academics from Turkey and England, oral interviews with the residents of the neighbourhood were recorded, the relationship established with the Land Walls was examined (Aksoy & Kıvılcım Çorakbaş, 2021; Kıvılcım Çorakbaş & Kunt, 2023).

Ever since the city walls were built, the existence of visual and written sources documents the agricultural use of the green areas with the walls, the existence of the market gardening (bostan) culture and the traditions of market gardening, the continuity and integrity of the gardens and walls. In fact, the ditches outside the walls were filled with soil and have been used as a vegetable garden for centuries (Kıran, 2019).

According to the Codex of Theodosius dated 422, the interior parts of the towers of the Land Walls were allocated for the storage of agricultural equipment and vegetables and fruits, and that the farmers would be responsible for the protection of these walls in return for using these areas (Ricci, 2008; Kıvılcım Çorakbaş et al., 2017).

The market gardening techniques, passed down from generation to generation, reveal that the orchards are the cultural assets that should be preserved as tangible and intangible cultural heritage. Today, market gardening is carried on in some orchards inside and outside the city walls using traditional methods.

It was stated in the Land Walls World Heritage Site Monitoring Report by UNESCO that the market gardens around the walls should be evaluated as cultural landscapes with an integrated approach. The market gardens are an authentic example of the landscape character and the use of heritage sites associated with the Land Walls. Nevertheless, as part of the Land Walls, the market gardens are not legally protected. Conversely, tangible and intangible values need an integrated conservation approach in order to protect the spirit of the place.

The transformation projects which are prepared after the declaration of the area as a “renovation area” in 2006, were implemented in 2013. These park and recreation projects eliminate the existence and threaten continuity of the market gardens (Kıran, 2019).

Physical indicators of intangible cultural qualities may be the past land use with different meanings for different cultures, monuments, places or buildings with spiritual or religious connections, depictions in literary or artistic works, the places where historical events took place, and physical remains that reveal a road or a route (Kıvılcım Çorakbaş & Çabuk, 2017).

The previous studies show that intangible values are the main factor in ensuring the sustainability of the tangible values of the Land Walls. These living values of Land Walls have indirectly encouraged the local people to maintenance and preserve the walls for centuries.

For the city dweller, the city walls together with civil and military gates, towers, ditches and bridges, ports, docks and piers, the cultivated areas near the walls, the monasteries and traditional houses within the walls, the memories of enemy attacks or the emperors’ return from victory, or the repairs that the people carried out in a kind of collaboration were an integral part of the Constantinople life (Kuban, 2002).

The multicultural and multi-ethnic society of the territory have lived together for a long time. There are various heritage elements such as mosques, churches, cemeteries of different religious groups, monumental remains, archaeological remains and industrial heritage buildings in and around the Land Walls (Figure 16).

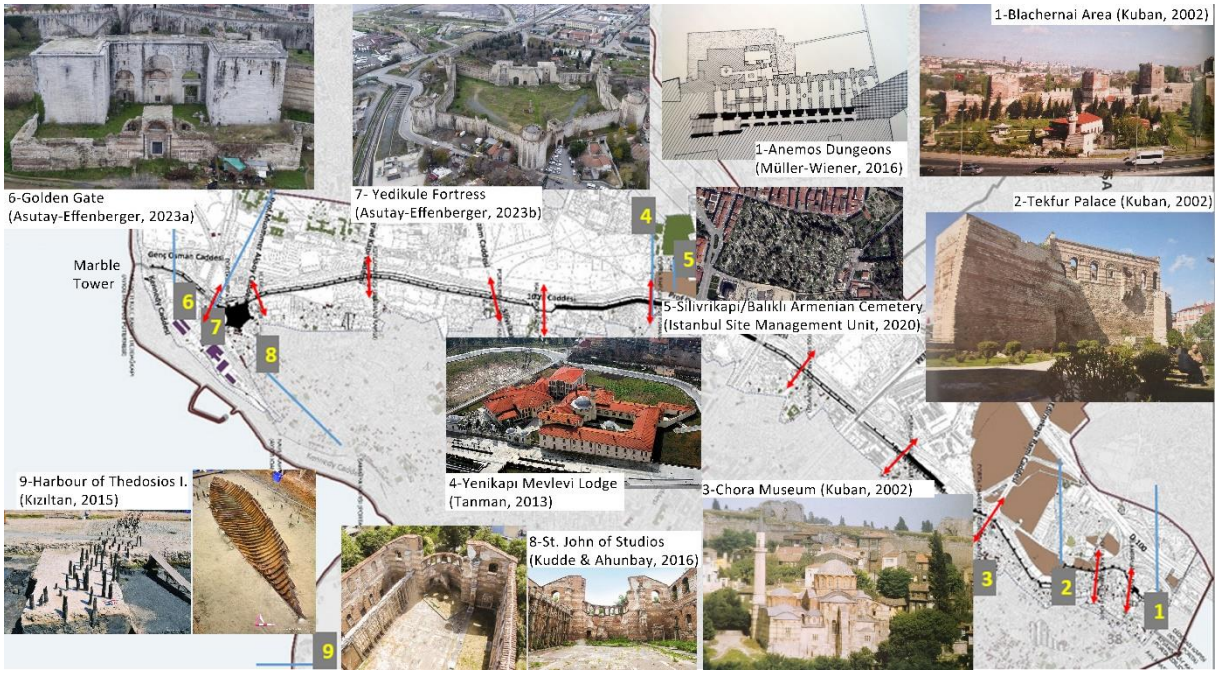


Figure 16. The photos and locations of landmarks in the territory at present (The base map is reproduced by authors that taken from map the Istanbul Site Management Unit, 2020)

3.3. Discussion

The World Heritage justification focuses on the tangible heritage of the city. In addition to tangible values, the city needed to be reinterpreted and evaluated according to cultural landscape approach which includes the intangible values in comparison to tangible ones. Also, it is necessary to define and manage the risks on these values that contribute to the formation of the cultural landscape character of the area.

In the 30th Session of the 2006 Mission Report of the WHC in Istanbul, it was stated that the boundaries of the renovation areas were expected to be changed considering that the intersection of the world heritage sites (Sultanahmet, Süleymaniye, Zeyrek and Theodosius Walls) posed a risk. The World Heritage Sites have faced the risk of breaking the unity of tangible and intangible values and the connection of local people with place because of the renovation areas around, especially for the last two decades (UNESCO-WHC, 2006).

How should these sites be approached in order to take measures against the risky situations on the World Heritage sites in Istanbul and to ensure their sustainability? Firstly, an answer to this question has been sought. In the research on heritage conservation, in the context of current conservation concepts, the vast majority of world heritage sites are evaluated with the concept of cultural landscape.

The historic layers that have developed and accumulated from the hinderland of Istanbul and its immediate surroundings to the present day reveal the strong cultural landscape of the area. The power/impulse that brings forth to the concept of historic urban landscape is that it is unifying and integrative. The landscape serves as an inclusive framework that prioritises the integrity of the tangible and intangible values of the region and the unity of the user and the space and contributes to the solution of cultural and environmental problems.

The cultural tourism based on this kind of heritage buildings economically benefit the society and institutions in the host cities. Visitors coming from all over the world to visit and appreciate the Hagia

Sophia Museum. The mosque function allowed the building to be used not only for cultural and scientific research purposes but also for worship and just for visiting. While this function gives the advantage of use of the building by a wide range visitor, the nonrestricted use increases the number of daily visitors and causes over-use of the building. Also, the new mosque function which provides free of charge entry, may minimise income which comes from cultural tourism. Aykaç (2019a) emphasised that this change might have negative impact and consequences on the museum functions such the other three Hagia Sophias in different cities in Turkey. It is necessary to keep track of and monitor what will change in it after the Hagia Sophia in Istanbul has been converted back to mosque again.

The cultural landscape approach can be considered while studying sites and/or buildings by own. The case of Hagia Sophia exemplifies how a building can be interpreted by analysing with cultural landscape approach. This approach requires the consideration of both physical and social contributions of different periods as well as associated values of them. The location of the monument on a hill, the view around, its contribution to the silhouette of Historic Peninsula, to city's image and to identity and its place in the collective memory, create the cultural significance of it.

Historic Urban Landscape (HUL) approach (UNESCO, 2011) aims to take into account the city's past, safeguard and transfer it to the future. It requires a deep understanding of the history and cultural significance of heritage sites, as well as the identification of threats and risks to these sites. The Land Walls faces several risks such as the changes ignoring the cultural landscape values, development and zoning pressure around them, demolition of heritage buildings associated with the region. The urban renewal projects around Land Walls such as building luxury residences in place of the abandoned industrial areas caused the immigration of local users around the Land Walls to other districts. Also, the market gardens which are in a fragmented state, have different ownerships. These situations cause the loss of urban memory, local identity, discontinuation of the market garden's which are not legally protected and threatened with destruction and conversion. Changing the function of some of the market gardens to hobby gardens, arranging parking spaces in some places of them, ignoring the multi-layered character of the city walls gradually. This kind of changes damage the harmony of space and the spirit of place, loss of collective and individual memory.

Another risk that the heritage areas face is the lack of cultural landscape concept in the conservation legislation in Turkey. The conservation of cultural heritage in Turkey is mainly based on the Law on the Protection of Cultural and Natural Assets (Law No. 2863, 1983), with recent updates. The definition of cultural landscape should be included into the content of related current national legislation on protection of cultural properties. There is a need to re-assess and try to understand the Istanbul Historic Peninsula with cultural landscape approach and develop specific conservation measures.

4. Conclusion and Suggestions

Hagia Sophia and city walls as monuments that constitutes a place of memory. But, re-assessing these heritage sites with cultural landscape approach, it can be revealed that beyond being a single monument, their cultural significance comes from their own social and physical environment which they effected and also were affected by.

Similar to the Sultanahmet Area and Hagia Sophia, the Land Walls and its immediate surroundings have been decisive in the formation of Istanbul's historical center and silhouette. Instead of transforming the market garden areas, which are an integral component of the Land Walls and its surroundings should be evaluated as a whole. In order to protect the tangible and intangible heritage together and prevent the loss of the spirit of the place, primarily it is necessary to examine the existing risks on heritage elements and values in detail.

This paper re-assessed the two World Heritage sites considering not only the cultural layers and intrinsic values of them separately but also integrated parts of the whole historic urban landscape of Istanbul Historic Peninsula. The cultural landscape approach has the most effective set of concepts for the protection of heritage sites with all their components. It includes the concepts of heritage as a human value, common heritage, social contribution, cultural diversity and protection of cultural

pluralism. In this context, the concept of cultural landscape is attributed to the Land Walls and Hagia Sophia World Heritage Sites in this study. Thus, the cultural landscape approach will constitute the most comprehensive conservation framework in generating solutions to the risks that these sites face today.

As far as integrated conversation of our cultural heritage is concerned, recognition of values and public awareness at all levels of the society seems to be a prerequisite. Therefore, at this point, it must be emphasized that the primary responsibility of the conservation professionals is being one of actors in education of cultural heritage. Cultural heritage education should be included in the education of young people as a lesson at all levels of the education system. Active conservation and research, developing sustainable heritage management methods should be made a part of everyday life. In order to achieve an ethical and spiritually internalized heritage experience, the international conservation context should be discussed locally, and a specific way/method of heritage management should be sought in local context.

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(1) The four world heritage sites in Istanbul are Sultanahmet Urban Archaeological Component Area, Süleymaniye Mosque and its associated area, Zeyrek Mosque (Pantocrator Church) and its associated area, the Istanbul Land Walls (UNESCO-WHC 2020).

(2) Mehmet II ordered the protection of the Hagia Sophia and never allowed it to be destroyed. Mehmet II was a well-educated intellectual person. He was aware of the artwork and significance of Hagia Sophia for the society.

(3) A new institution of the state that follows-up the waqf (foundation) system in Ottoman period.

(4) Zeynep Ahunbay, another female conservation architect who made many contributions to the process.

(5) Cristoforo Buondelmonte prepared a guidebook titled “Liber Insularum Archipelagi” for the travels in the Mediterranean Basin.

(6) The web site of the research project, “Plural Heritages of Istanbul”, Accessed: August 25, 2020). The project titled “Plural Heritages of Istanbul: The Case of Land Walls” was prepared under the coordination of Prof. Dr. Asu Aksoy and Assoc. Dr. Figen Kıvılcım Çorakbaş with the support of TÜBİTAK in Türkiye, in cooperation with the University of Newcastle with the support of the Newton Fund in England. “This project develops new valorisations of the Istanbul Land (Theodosian) Walls, working with communities to co-produce both situated and web-based, public-facing digital heritage interpretation resources that reflect non-official, hitherto unauthorised understandings of the Walls and their environs. The project also builts capacity, in line with the aims of the Newton Fund, through modelling heritage management/interpretation practice, digital technologies and community engagement within the heritage sector”. Accessed July 3, 2022. https://pluralheritages.ncl.ac.uk/#/about).

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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Measuring Universities' Sustainability Performance with Using UI GreenMetric World Ranking: A Case Study of Düzce University

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Abstract

The university campus is a dynamic system in which the concept of sustainability can be applied to all the needs of the university. Universities with the "green campus" approach provide effective use of their resources. As part of the study, the data of the main campus of the Düzce University for 2021 was evaluated based on the UI GreenMetric Ranking. Calculations and assessments were made for the campus land cover, structural and vegetative areas. A general assessment of the entire campus was carried out using the sustainability and green campus approach with dataset. As a result, Düzce University is progressing towards the realisation of a sustainable/green campus, facilitated by the discernible impact of the survey components. The creation of a sustainable/green campus will make a difference in the province of Düzce and accelerate local development actions.

Keywords: *Climate change, green campus, nature-based solutions, resource efficiency, Türkiye.*

Üniversitelerin Sürdürülebilirlik Performansının UI GreenMetric Dünya Sıralaması Kullanılarak Ölçülmesi: Düzce Üniversitesi Örneği

Öz

Üniversite kampüsü, sürdürülebilirlik kavramının üniversitenin tüm ihtiyaçlarına uygulanabileceği dinamik bir sistemdir. "Yeşil kampüs" yaklaşımına sahip üniversiteler kaynaklarının etkin kullanımını sağlamaktadır. Çalışma kapsamında Düzce Üniversitesi ana kampüsünün 2021 yılı verileri UI GreenMetric Ranking'e göre değerlendirilmiştir. Kampüs arazi örtüsü, yapısal ve bitkisel alan hesaplamaları ve değerlendirmeleri yapılmıştır. Karbon ayak izi kampüs nüfus verileri kullanılarak hesaplanmıştır. Sürdürülebilirlik ve yeşil kampüs yaklaşımıyla veri setine dayalı tüm kampüsün genel bir değerlendirmesi yapılmıştır. Sonuç olarak, Düzce Üniversitesi, anket bileşenlerinin fark edilebilir etkisiyle kolaylaştırılan sürdürülebilir/yeşil bir kampüsün gerçekleştirilmesine doğru ilerlemektedir. Sürdürülebilir/yeşil bir kampüsün oluşturulması, Düzce ilinde fark yaratarak yerel kalkınma eylemlerini hızlandıracaktır.

Anahtar kelimeler: *İklim değişikliği, yeşil kampüs, doğa tabanlı çözümler, kaynak verimliliği, Türkiye.*

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1. Introduction

The security and sustainability of fundamental resources, including water, food, and energy, represent a global concern (Fader et al., 2018; Hao et al., 2022). Numerous systems, and frameworks (Shah, 2020), models, and methodologies exist that develop nature-based solutions for promoting the integrated management of natural resources, supporting their conservation and sustainable use (Sahani et al., 2019; Kumar et al., 2021; Yuan et al., 2022). Amidst the escalating deterioration of the environment and the escalating ramifications of climate change, diverse strata of society are progressively delineating their roles in assuming responsibility for concurrent social and environmental quandaries (Wang et al., 2020; Li et al., 2022). This circumstance has made it possible to create development strategies for environmental problems at different levels of society, to elaborate nature-based solutions, and to increase green practices (Fu et al., 2022; Abbas & Dogan, 2022; García-Madurga, 2022). The Sustainable Development Goals (SDGs) collectively agreed by 193 countries upon during the Sustainable Development Summit. Primary goals of SDGs are to promote environmentally friendly regulations in different sectors and levels, eliminate inequality, and minimize the effects of climate change (Mushtaha et al., 2022).

Universities are a significant stakeholder in the success of sustainability (Findler et al., 2019). Particularly, they can play a crucial role in capacity building among the youth to support the global agenda for sustainable development, aiming to establish a foundation (Disterheft et al., 2019; Haseeb et al., 2022). The literature refers to various sustainable practices observed on campuses, such as environmental management planning and sustainability reports sharing information with indicators related to water, energy, emissions, waste, and transportation use for the implementation of sustainable buildings (Hooey et al., 2017; Weiss, et al., 2021).

The global imperative of climate change mitigation and the promotion of campus sustainability have prominently emerged as focal areas of concern for university leadership. Prominent academic institutions are actively engaging in efforts to address climate change by methodically diminishing their carbon footprints, thereby demonstrating a commitment to the effective management and augmentation of their sustainability initiatives (Suwartha & Sari, 2013). Assessing environmental factors in heavily pressured urban areas poses challenges. However, initiatives focusing on development-driven ecotourism and similar activities in rural areas offer solutions that support sustainable development environmentally, economically, and socially (Kiper et al., 2022). In urban settings, efforts are underway to enhance environmental sustainability through nature-based solutions aimed at strengthening green infrastructure (Mertens, 2022). As for universities represent spaces at an urban scale but with high social mobility. In these areas, embracing ecological, economic, and social approaches is essential. Universities are small cities characterized by education, research, and community-involved activities, with high daily mobility. It's notable that this mobility contributes to increased greenhouse gas emissions linked to transportation/accessibility. Depending on the university's structure and functioning, there are different energy needs, electricity consumption, waste generation, water and material consumption, public transportation, and educational activities. All of these pose pressures for actions that would contribute to a sustainable world. Hence, recent efforts have focused on evaluating and enhancing these small cities in contemporary studies (Heinz, 1995; Lukman et al., 2010; Grindsted, 2011; Grindsted & Hol, 2012; Suwartha & Berawi, 2019; Boiocchi et al., 2023).

Universities, like other sectors of society, are taking serious steps to achieve the Sustainable Development Goals (SDGs). Universities are educational establishments for future environmental, social, political and economic decision-makers (Marsudi et al., 2021). Considering the university campus as an urban space, or even as a microcosm of society, it is clear that the steps towards sustainability taken by universities are directed by society (Dalbelo, 2021). The community well-being of universities depends on advancing in environmental, social, and economic areas (Romero-Infante et al., 2022). The sustainability paradigm is based on economic growth, social progress, and environmental sustainability. The Talloires Declaration, published by the "Association of University Leaders for a Sustainable Future" in 1990, explained that universities should focus on environment,

population, and development issues (Alshuwaikhat & Abubakar, 2008). In this context, measures have been initiated for effective waste management and implementing environmentally sustainable spatial plans to mitigate carbon emissions (Abtahi, 2021). Nowadays, an increasing number of universities are adopting sustainability strategies. These approaches go by various names, including "environmental university," "eco-campus," "green campus," "sustainable university," "sustainable campus," and "environmental campus." (Ribeiro et al., 2021). These approaches support long-term development activities such as adequate energy and water conservation, rainwater harvesting, green building practices, and renewable energy, increasing the amount of green space per capita, green infrastructure applications, accessibility, reducing carbon footprint, etc. (Setyowati et al., 2013; Lai et al., 2020).

SDGs that include 17 goals are addressed in the UI GreenMetric criteria and indicators. The SDGs are defined within universities under 6 main categories (GreenMetric, 2023) (Figure 1). The universities use their own ranking teams to apply and evaluate the UI GreenMetric criteria provided by the UI GreenMetric database.

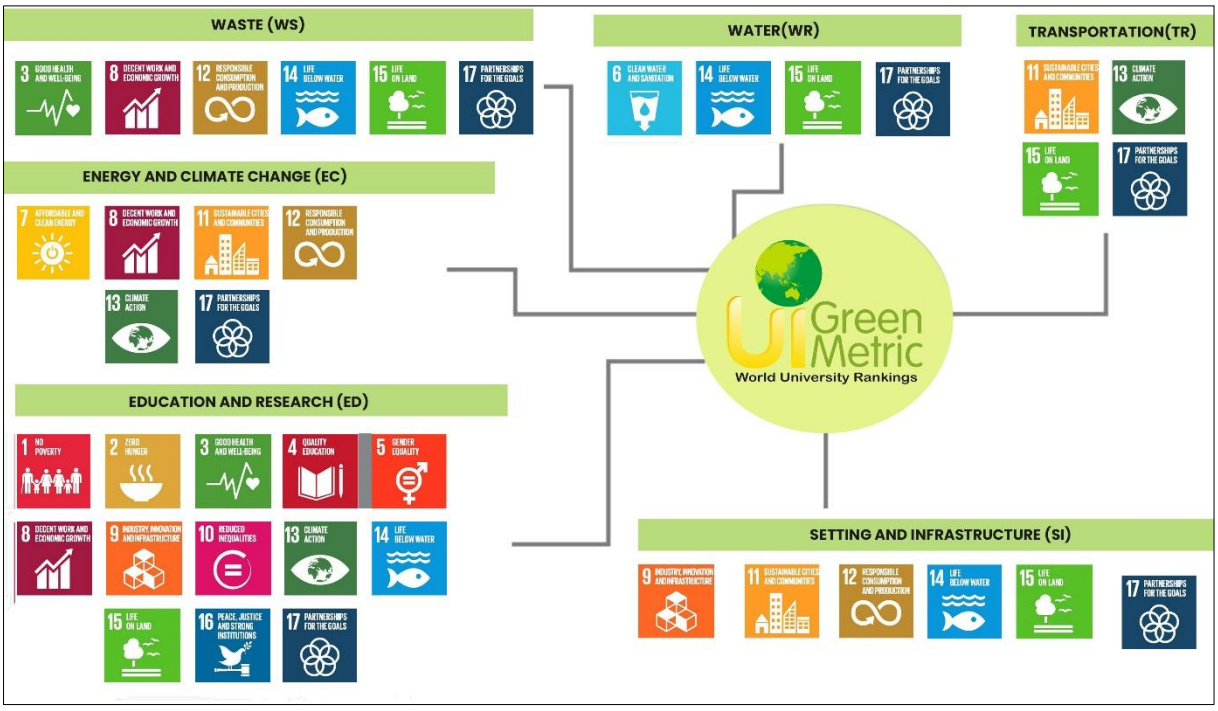


Figure 1. Implementation of SDGs at campus level (GreenMetric, 2023)

The 17 main SDGs, which intend to eliminate poverty, conserve the environment, prevent the climate crisis, ensure equitable distribution of wealth, and promote peace, have been reviewed by universities in the areas of infrastructure, energy and climate, water, transport, waste, and education. Indexes have been created to evaluate the environmental studies of universities in line with SDGs such as "Green League," "Environmental and Social Responsibility Index," "Sustainability Tracking and Assessment System-STARS," and "GreenMetric". GreenMetric is the first global measurement system (Grindsted, 2011; Suwartha & Sari 2013; Kalayci Onac et al., 2021).

The GreenMetric is a ranking system that rates universities on their sustainability efforts and potential (Suwartha & Sari, 2013). This ranking aims to enhance the standing of a university, foster sustainability, and implement a range of measures to attain green campus standards (Abtahi, 2021). Every year, more than 800 applications are made from different countries of the world. 950 universities applied in 2021 (GreenMetric, 2022). Düzce University, examined in this study, has been applying for this ranking system for 4 years, and the campus is evaluated in accordance with the GreenMetric methodology.

Regional development plans comprehend land sustainability, scientific management of soil wealth, space efficiency, environmentally friendly economic and urban development, etc. as main goals. In this context; the university has been declared as a "Specialization University in the Field of Environment

and Health" by the Turkish Higher Education Council. Within this direction; "Recycling of Agricultural Wastes for Industry Application and Research Center" was established. This study aims to determine the practices and deficiencies of Düzce University Main Campus in terms of infrastructure, climate change, energy, and waste management. In this context, the main questions of the research are:

RQ 1: Does Düzce University main campus have adequate practices aligned with the sustainability goals?

RQ 2: Are Düzce University's environmentally friendly approaches sufficient in terms of infrastructure, climate change, energy and waste management?

1.1. Conceptual Framework

The GreenMetric ranking measures the university's efforts under the categories of infrastructure, energy and climate change, transportation, education, energy and waste management, each scored on a scale of 1-5 (Maçin et al., 2020). The ranking then multiplies the score of each category by its respective coefficient score. GreenMetric is a ranking system based on the questionnaire. The questionnaire consists of 51 different questions focused on sustainability concept that has three elements environmental, economic, and social. These aspects provide campus sustainability efforts (Rodríguez-Rodríguez et al., 2022) (Figure 2).

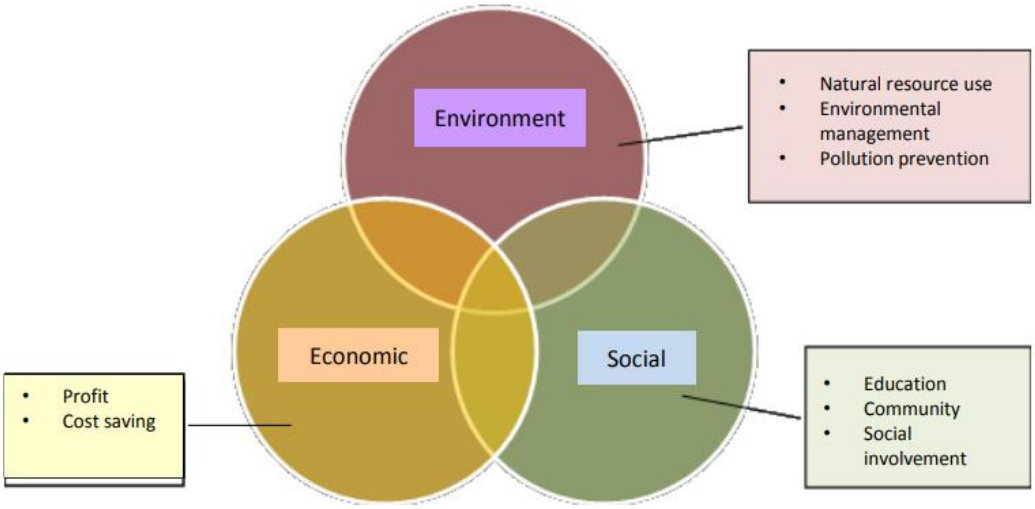


Figure 2. Conceptual framework of GreenMetric (GreenMetric, 2023)

The questionnaire consists of 6 stages: Setting and Infrastructure (SI), Energy and Climate Change (EC), Waste (WS), Water (WR), Transportation (TR), Education and Research (ED). While ED is directly related with social context, EC and SI are directly related with economic context. EC, WS and WR are directly related with environmental context.

2. Material and Method

2.1. Study Area

The field of study was determined as Düzce University main campus, a newly developing university. Düzce University was established in 2006. Düzce University has nearly 30 thousand matriculated students; and comprises 13 Faculties, a Graduate School, 2 Colleges, 10 Vocational Schools, 31 research centers, a Technopark and a University Hospital. Though the main campus was built 10 km away from the city center, the city has been growing towards the university and today the university has remained in the city periphery. The main campus of the university is 1.78 km² (Figure 3, Table 1).

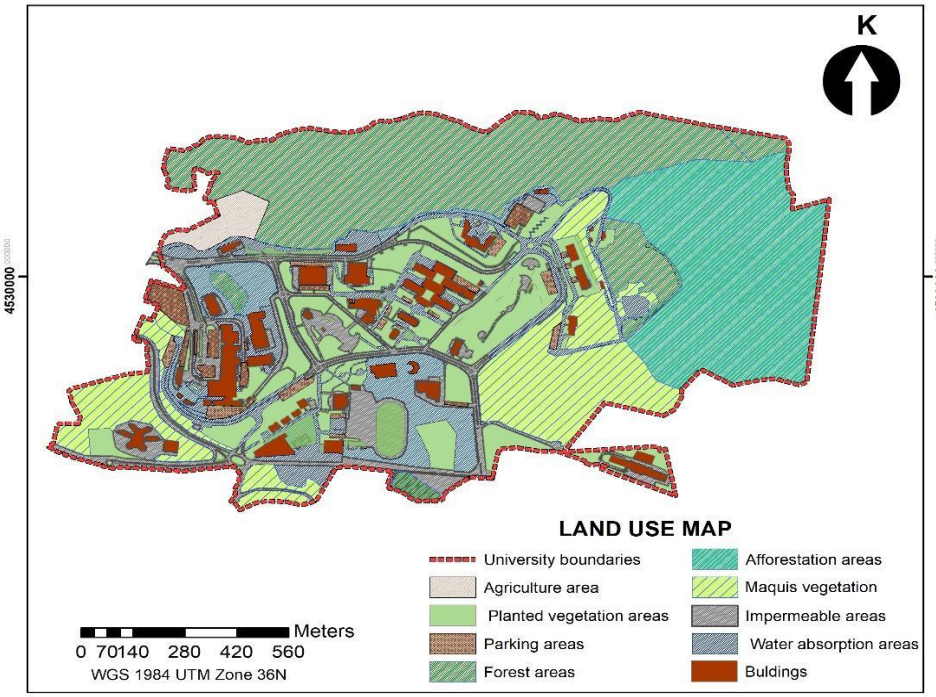
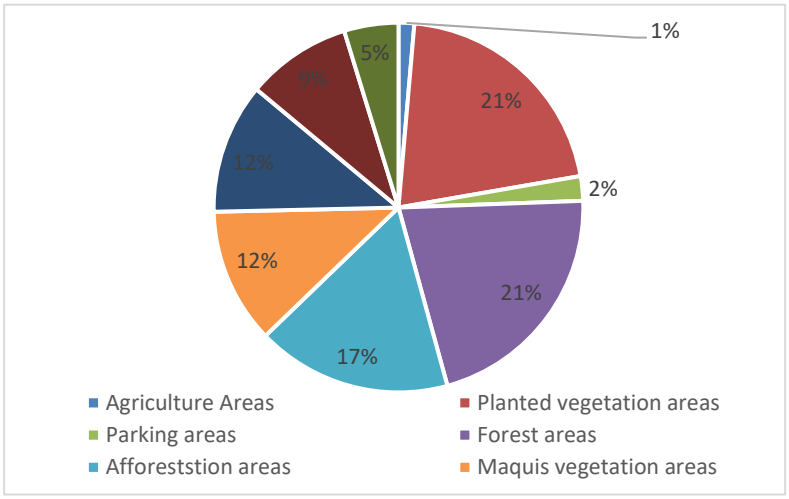


Figure 3. Main campus area of Düzce University (Prepared by authors)

Table 1. Land use distribution of Düzce University main campus (Prepared by authors)

Land use	Area (m^2)	Graphic
Agriculture areas	24.712	
Planted vegetation areas	382.586	
Parking areas	2.625	
Forest areas	400.650	
Afforestation areas	304.644	
Maquis vegetation areas	219.535	
Impermeable areas	209.953	
Water absorption areas	173.481	
Buildings	84.214	



The main campus contains 3 types of natural areas; natural oak forest, black pine afforestation area, and maquis vegetation, specific to the mediterranean climate. The area covered by the natural oak forest is 400.850 m^2, the black pine forestation is 304.744 m^2 and the area covered with maquis is 219.635 m^2 (%51). The ratio of planted vegetation area compared to total area is 382.786 m^2 (% 21).

2.2. Method

The method is based on a questionnaire prepared by GreenMetric (GreenMetric, 2022a). The survey instrument was devised to investigate prospective challenges to civilization, encompassing issues such as population pressure, climate change, energy security, environmental degradation, water and food security, and sustainable development. Within this framework, the survey's objectives incorporate salient concepts aligned with the triple bottom line, namely equity, economy, environment, as well as considerations of green building and education for sustainable development. The survey was applied to 44 departments in 12 faculties located on the main campus of Düzce University. As a result, activities

relating to six of the headings were recorded in all the sections. In this study, the campus was evaluated according to the six main categories and indicators given in this questionnaire. The six principal categories are universally acknowledged as pivotal considerations among universities prioritizing sustainability. These encompass the compilation of fundamental data pertaining to the university's scale and zoning profile, delineating its geographical classification as urban, suburban, or rural.

The data pertains to the university's ecological footprint, as it encompasses factors such as the extent of green spaces, electricity consumption, transportation practices, water utilization, and waste management. The six main categories: Setting and Infrastructure (SI), Energy and Climate Change (EC), Waste (WS), Water (WR), Transportation (TR), and Education and Research (ED). These mechanisms offer insights into the university's responsiveness to, and management of, sustainability issues through the formulation of policies, implementation of actions, and communication strategies. There are categories, indicators and their percentages in the GreenMetric questionnaire (Table 2). Scoring of each indicator is done numerically and these numerical data are evaluated statistically. In addition, evidence information is requested beside categories and indicators. The calculation details are based on the equations shown in the GreenMetric Guide. Each criterion will be systematically classified within a broader category of information, and during the results analysis, the raw scores will undergo a weighting process to derive a final computation. The GreenMetric ranking is being developed and continuously updated in light of the feedback from the participants and the latest developments in the field (Dağlıoğlu et al., 2018; GreenMetric, 2022b).

Table 2. Criteria and indicators of questionnaire (GreenMetric, 2022a)

No	Criteria / Indicators	Point
	Setting and Infrastructure (SI)	**1500**
1	SI1 The ratio of open space area to the total area	
	SI2 Total area on campus covered in forest vegetation	200
	SI3 Total area on campus covered in planted vegetation	200
	SI4 Total area on campus for water absorption besides the forest and planted vegetation	100
	SI5 The total open space area divided by the total campus population	200
	SI6 Percentage of university budget for sustainability efforts	200
	SI7 Percentage of operation and maintenance activities of building in one year period	100
	SI8 Campus facilities for disabled, special needs, and/or maternity care	100
	SI9 Security and safety facilities	100
	SI10 Health infrastructure facilities for students, academics, and administrative staff's wellbeing	100
		100
	SI11 Conservation: plant (flora), animal (fauna), and wildlife, genetic resources for food and agriculture secured in either medium or long-term conservation facilities	100
	Energy and Climate Change (EC)	**2100**
2	EC1 Energy-efficient appliances usage	200
	EC2 Smart building implementation	300
	EC3 Number of renewable energy sources on campus	300
	EC4 Total electricity usage divided by total campus' population (kWh per person)	300
	EC5 The ratio of renewable energy production divided by total energy usage per year	200
	EC6 Elements of green building implementation as reflected in all construction and renovation	200
	EC7 Greenhouse gas emission reduction program	200
	EC8 Total carbon footprint divided by total campus' population (metric tons per person)	200
	EC9 Number of the innovative program(s) in energy and climate change	100
	EC10 Impactful university program(s) on climate change	100
	Waste (WS)	**1800**
3	WS1 Recycling program for university's waste	300
	WS2 Program to reduce the use of paper and plastic on campus	300
	WS3 Organic waste treatment	300
	WS4 Inorganic waste treatment	300
	WS5 Toxic waste treatment	300
	WS6 Sewage disposal	300

	Water (WR)	**1000**
4	WR1 Water conservation program & implementation	200
	WR2 Water recycling program implementation	200
	WR3 Water-efficient appliances usage	200
	WR4 Consumption of treated water	200
	WR5 Water pollution control in the campus area	200
	Transportation (TR)	**1800**
5	TR1 The total number of vehicles (cars and motorcycles) divided by the total campus' population	200
	TR2 Shuttle services	300
	TR3 Zero-Emission Vehicles (ZEV) policy on campus	200
	TR4 The total number of Zero-Emission Vehicles (ZEV) divided by the total campus population	200
	TR5 The ratio of the ground parking area to the total campus' area	200
	TR6 Program to limit or decrease the parking area on campus for the last 3 years (from 2019 to 2021)	200
	TR7 Number of initiatives to decrease private vehicles on campus	300
	TR8 The pedestrian path on campus	200
	Education and Research (ED)	**1800**
6	ED1 The ratio of sustainability courses to total courses/subjects	300
	ED2 The ratio of sustainability research funding to total research funding	200
	ED3 Number of scholarly publications on sustainability	200
	ED4 Number of events related to sustainability	200
	ED5 Number of student organizations related to sustainability	200
	ED6 University-run sustainability website	200
	ED7 Sustainability report	100
	ED8 Number of cultural activities on campus	100
	ED9 Number of university program(s) to improve teaching and learning	100
	ED10 Number of sustainability community services projects organized and/or involving students	100
	ED11 Number of sustainability-related startups	100

According to the category and indicators expected from us in the GreenMetric questionnaire, the data were obtained from the following units of the rectorate:

- Department of Strategy Development
- Department of Construction and Technical Works
- Department for Student Affairs
- Scientific Research Projects
- Department of Landscape Architecture
- Department of Environmental Engineering
- Health Application and Research Centre
- Health, Culture and Sport Center

The data obtained from the units are presented with verbal and numerical values. Some have been mapped and reported with evidence. At this stage; ArcGIS 10.4 and Microsoft Excel programs were used by using aerial photographs.

3. Findings and Discussion

The objective of the GreenMetric classification is to facilitate comparative assessments of environmental concerns, as well as social and economic dimensions, with a concurrent emphasis on advancing the attainment of the 17 SDGs (Lambrechts & Ceulemans, 2013). Evaluating the sustainability of higher education institutions is a multifaceted problem (Shi and Lai, 2013). In this context; The GreenMetric survey directs universities to various actions to improve their own sustainability. Düzce University also had the opportunity to take an x-ray of the campus with the

components of this survey. It has been a mirror for Düzce University, which aims for a sustainable campus, to see the deficiencies.

In 2021, 71 Turkish universities were included in the index, which included 956 universities from different countries of the world. The rankings of Düzce University, which has been on the list since 2018, are given in the Table according to the criteria. In 2021, Düzce University rose to the 507th place among 956 universities, with a total score of 5375 from the indicators. Wageningen University & Research (Netherlands) is at the top of the list with a total score of 9300 (Table 3).

Table 3. Comparison of the scores of Düzce University with the scores of the top 3 universities in 6 categories (GreenMetric, 2022)

Rank 2021	**1**	**2**	**3**	**507**
University	Wageningen University & Research	University of Nottingham	University of Groningen	Düzce University
Country	Netherlands	United Kingdom	Netherlands	Türkiye
Total Score	9300	8850	8800	5375
Setting & Infrastructure	1325	1375	1275	1150
Energy & Climate Change	1825	1525	1550	850
Waste	1800	1800	1800	450
Water	1000	1000	1000	400
Transportation	1550	1500	1650	1175
Education & Research	1800	1650	1525	1350

It is seen that the universities in the top three are particularly successful in water and waste management. Düzce University is successful in the location and transportation of the campus. However; has not yet developed effective solutions in energy, water and waste management. There are processes and initiatives adopted in this regard. When we examine the last 3 years of the ranking, it is seen that the score of Düzce University has increased (Table 4). Rankings vary based on the number of universities participating in the year. According to years; the total score of Düzce University is given in the Figure 4 among the universities with the maximum and minimum scores in list.

Table 4. The total score of Düzce University among the universities with the maximum and minimum scores (GreenMetric, 2022)

Years	**2018**	**2019**	**2020**	**2021**	**2022**
Number of Total University	719	780	912	956	1050
Rank	573	525	645	507	382
Max. Score in List	9125	9075	9150	9300	9300
Total Score	3625	4275	4300	5375	6610

Figure 4. The total score of the university according to the years in the ranking (GreenMetric, 2023a)

In the last 3 years, the rankings according to the indicators were examined (Table 5). The presented evidence after the study with aerial photographs in the Setting & Infrastructure section contributed to the increase of the score. The increase seen in the Energy & Climate Change section has provided experimental areas to be prepared for academic research on campus. Waste section is a critical issue that concerns the municipality as well as the university administration. The score of this section is fixed according to the years. In order to ensure the increase, there is a need for improvement in the policies and practices of the local government. In the Water management section, the score varies periodically based on technical problems and solutions on campus. The policies and investments followed by the rectorate on the campus regarding Transportation increased the score. In the field of Education & Research, the academic studies of the university show international developments and accept students as part of the team. It is predicted that the increase of the score in this area will be seen. In the list, the total scores of Düzce University in maximum indicator scores are given in Figure 5 according to the years.

Table 5. The rankings of Düzce University according to the indicators in the last 5 years (GreenMetric, 2023a)

Years	2018	2019	2020	2021	2022
Setting & Infrastructure	625	850	850	1150	1125
Energy & Climate Change	525	825	875	850	1235
Waste	450	450	450	450	1050
Water	475	250	150	400	350
Transportation	575	1125	1125	1175	1275
Education & Research	975	775	850	1350	1575

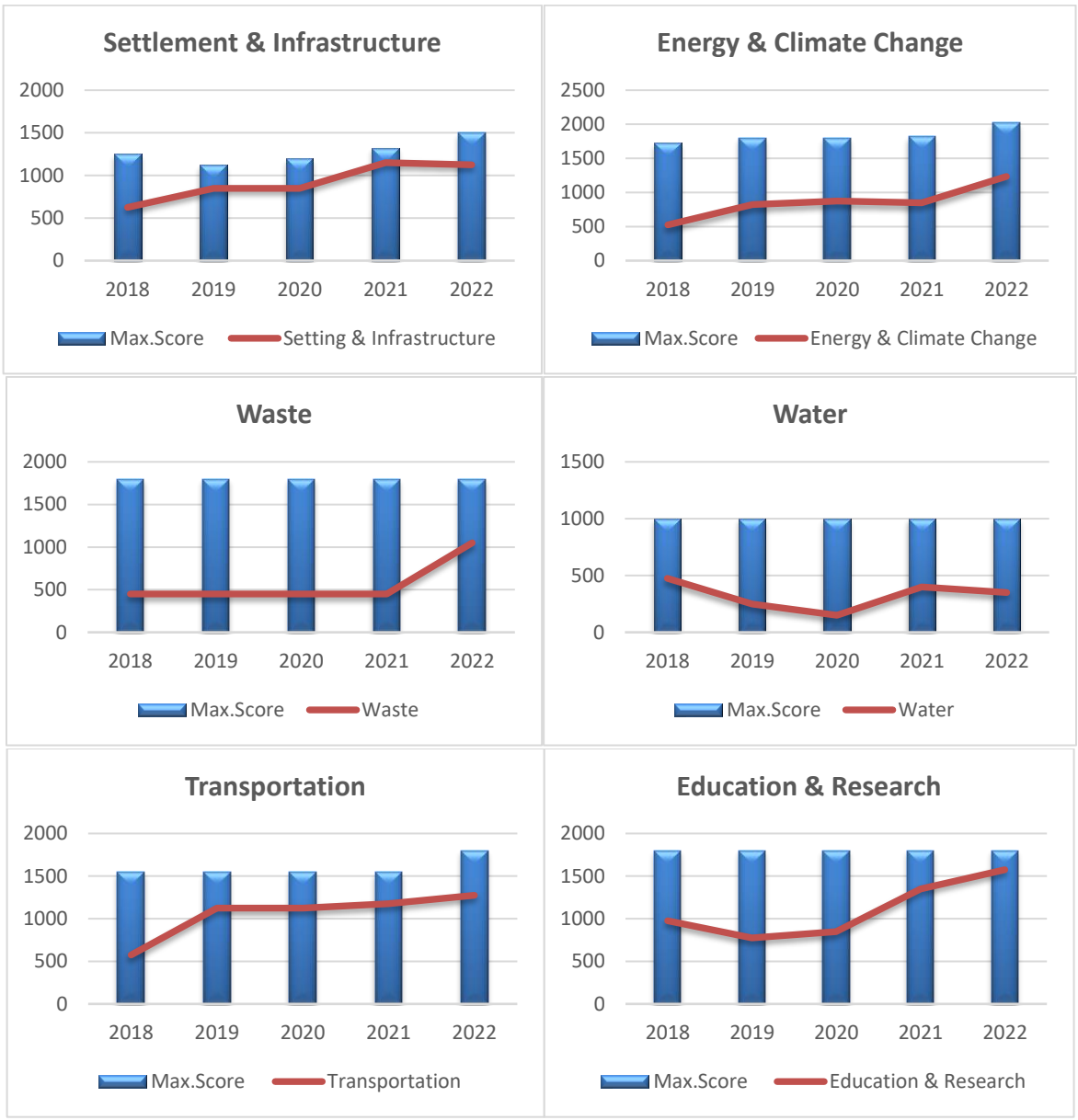


Figure 5. Scores of Duzce University in 6 categories for 5 years (GreenMetric, 2023a)

Scoring in the questionnaire is determined by the evidence presented to the questionnaire. According to the answers to the questionnaire; the evidence of Düzce University campus is explained under the 6 categories.

3.1. Settlement and Infrastructure (SI)

The campus environment and infrastructure will afford a comprehensive assessment of the campus's proclivity towards ecological sustainability. This indicator will also show whether a university is ultimately deemed as a green campus. The aim is to trigger participating universities to green their campuses and provide more green open spaces to preserve the environment. Thus, the increased green spaces on campus grounds can also support initiatives in the city's green infrastructure (such as xeriscaping, sustainable agriculture, rainwater management, and wastewater management, etc.), in line with the understanding of sustainable urban management (Turna & Solmaz, 2023).

Düzce University main campus is 1.78 km². Open spaces area of main campus is 1.661.123,50 m^2 (Figure 6).

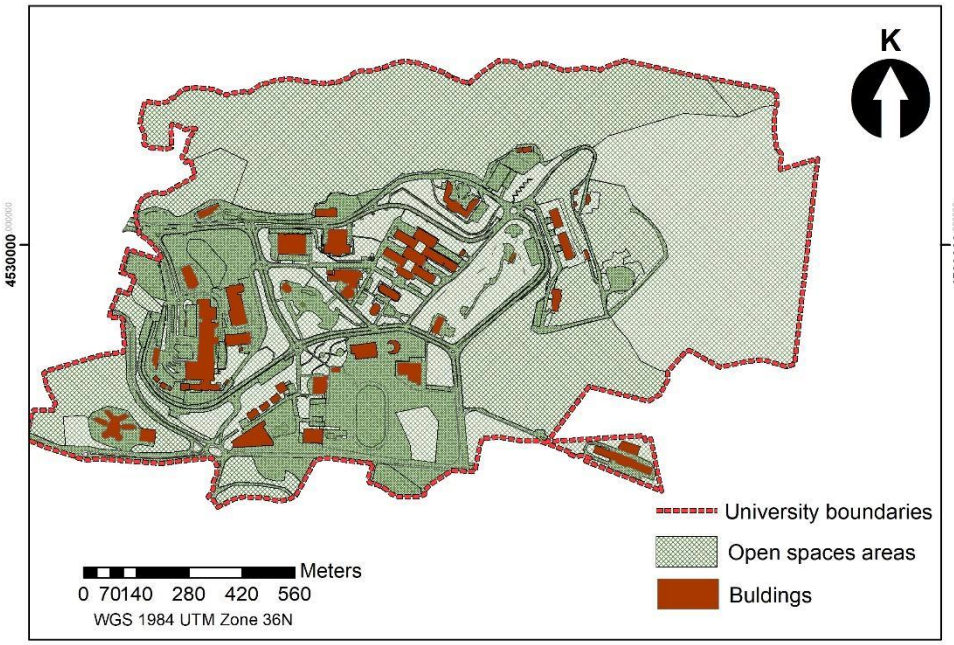


Figure 6. Open spaces areas of the Duzce University's main campus (Prepared by authors)

There is a botanical garden of 46,276 m^2 and a forest of 298,770 m^2 in the open areas. Other open areas consist of planted green areas, permeable and impermeable surfaces (%86). Total campus population (include students and staff) is 22.487 and the total open space area divided by total campus population is 66,7 m^2.

Various facilities are being provided for the disabled in the indoor and outdoor areas of the campus. There are elevators, ramps, toilets for disabled people, and notices written in Braille in all buildings. Pedestrian routes are suitable for the standards stated for disabled people. There is a yellow band application on the pedestrian roads. However, opportunities such as child care room, stations for electrical vehicles are limited.

The university has got healthy infrastructure facilities for students, academics and administrative staffs' wellbeing. Within the scope of medium or long-term conservation; Greenhouse for planting vegetables for campus residents, Experimental Animals Application and Research Center, Herbarium at Düzce University Forest Faculty, Botanical Garden, Clean Energy Resources Application and Research Centre, Application and Research Centre for Recycling of Agricultural Wastes to Industry are available.

3.2. Energy and Climate Change (EC)

Sen et al. (2022) scrutinized the sustainability strategies employed by multiple Australian universities, selecting six institutions as focal case studies for in-depth analysis. The primary challenge for universities is determining how to reduce their own carbon footprints. Wai (2022) reported that more than 80% of universities' CO^2 emissions come from electricity consumption. Therefore, it is crucial to conduct an inventory of the primary electricity usage on campus, considering the amount of electricity consumed, its service life, technology maturity, and financial requirements. Subsequently, setting energy-efficient goals for continuous improvement is essential.

In the questionnaire, various indicators are identified for specific areas of particular importance, such as usage of energy-saving tools, smart building applications, renewable energy usage policy, total energy consumption, energy-saving programs, green building elements, climate change adaptation and mitigation, greenhouse gas policies and carbon quantity. It is expected that these indicators will encourage universities to intensify their efforts towards energy efficiency in buildings and increase concerns about the nature and sources of energy.

In this section, it is evident that Düzce University's performance score is steadily rising. Nevertheless, the pace of advancement is hindered by fiscal constraints and infrastructural deficiencies. Düzce University aims to achieve more energy savings by focusing on energy management. Renewable

energy activities are carried out with solar panels and wind measurements. There are solar panels with a total power of 7.5kW on the roof of the University's Central Laboratories. Here, each type of solar panel is connected to different inverters to produce clean energy for Düzce University Scientific and Technological Research Application and Research Center (DUBIT) by solar panels. 3500 kWh is produced annually from wind energy. In addition, the use of energy-saving light bulbs, LED lighting and Class A devices has become mandatory in the campus. 90% of the bulbs used for lighting on campus are in the category of energy saving bulbs.

At Düzce University, smart stations have been established on campus in order to reduce gas emissions. In order to reduce the use of vehicles, the transportation of the students within the campus has been facilitated by the ring shuttles. Motorcycles are used for transportation of personnel between units. In addition; within the scope of energy conservation and climate change; “Sustainable and Smart Cities, Landscape Architecture, Network Technologies (5G, Internet of Things), Climate Change” doctorate programs were opened.

According to the results of the questionnaire; the campus has many shortcomings in terms of energy. Among the main reasons for this are economic and infrastructural inadequacies. There are academicians who are competent enough in the fields of energy conservation, water management and healthy food. However; no structures were created in the energy-based system during the establishment of the campus. Intelligent building systems are very costly today. Large funds are needed to re-establish these systems in an old structure.

3.3. Waste (WS)

Activities related to waste processing and recycling are significant factors in creating a sustainable environment. The activities of university staff and students on campus are likely to generate a considerable amount of waste. Therefore, waste management and recycling programs such as handling toxic waste, organic waste processing, managing inorganic waste, sewage disposal, and policies aimed at reducing paper and plastic usage should be among the university's areas of interest.

Universities are living laboratories where learning and social interaction thrive (Berchin et al., 2017). Consequently, the adoption of separate waste collection in universities can contribute to the societal embrace, creating a synergistic effect (Adeniran et al., 2017). There are examples globally from various universities (de Vega et al., 2008; Iresha & Prasojo, 2018; Dahlawi & El Sharkawy, 2021): Cornell University (Sun et al.,2022) recycles over 70% of its waste, Florida University (UF Sustainability Task Force, 2002) manages 30% of its waste, and Lagos University (Adeniran et al., 2017) recycles 53% of its waste (Haksevenler, et.al, 2022).

Recycling activities at Düzce University; continues in cooperation with private companies in the recycling of paper waste. For Düzce, which has a high agricultural quality, paper production is carried out with the agricultural wastes (sawdust, hazelnut shell) obtained from these areas within the university. Online systems are used to save paper and speed up transactions during the work and transactions. Paper cups are preferred in campus cafeterias. Used papers are shredded in the shredder machine or collected in paper collection boxes and made ready for recycling. It is forwarded to contracted recycling companies for the processing of solid wastes. Waste batteries are stored and evaluated in the program of the Ministry of National Education. A zero-waste management system has been established at Düzce University Training and Practice Hospital. The zero-waste certificate is given by the Ministry of Agriculture and Forestry. Düzce University’s electronic waste (computers, tablets, printers, etc.) is re-organized and distributed to the primary schools. With the decision taken in May 2021, the installation of a 3.500-liter compost unit machine was started. Work continues with the Zero-Waste Management Project. Since the processes related to sewage waste depend on the local administration, the university administration cannot make any arrangements.

3.4. Water (WR)

The reuse of wastewater has been traditionally allocated for agricultural use (Angelakis et al., 1999; Fatta-Kassinos et al., 2011; Pedrero et al., 2009). Worldwide, the reuse is progressing to encompass urban and industrial applications (Kellis et al., 2013). The recycled wastewater on university campuses

serves a multifaceted purpose, finding application in landscape irrigation, toilet flushing, and various other washing activities.

Water usage on campus is a significant criterion highlighted in the GreenMetric standard. This criterion aims to reduce water consumption on campuses, develop conservation programs and preserve living spaces. Diverse criteria, encompassing initiatives related to water conservation, water recycling, water use efficiency, and the utilization of treated water, are assessed as integral components in the pursuit of attaining these objectives. These indicators measure campus sustainability efforts by focusing on sustainable water resources and efficient water usage.

One of the components negatively affecting Düzce University's ranking is wastewater reuse/recycling. The wastewater line of the campus is connected to the local sewer system. This is a situation that prevents scoring and sustainability evaluation. However, treatment works related to municipal activities continue in the local sewage system. Because Düzce Province basin is a valuable basin that provides drinking water. A different campus wastewater scoring method is needed in the survey, taking into account country-specific regulations for water reuse and recycling (Angelakis et al.; 2003).

Within the framework of the Düzce University Climate Change Action Plan, determinations pertaining to water management have been formulated and are poised for execution. The wastewater treatment facility affiliated with the faculty of medicine is in active use. There are warnings about the effective use of water in toilets for water saving. A botanical garden is being built in the valley structure within the university. The dried-up stream in the valley is being revived. With the recirculation unit installed in the water element, the water becomes reusable.

Progress could not be made as some decisions regarding water management depend on the local government in this category. However; there are nature-based sustainable solutions for water management. In this regard, the initiatives of academicians on open spaces have started.

3.5. Transportation (TR)

Sustainable transportation is considered as a factor of social transformation to achieve social rights such as education (Randal et al., 2020). Thus, spatial mobility is an important factor for participation in education and other activities (Sterzer, 2017).

It's impressive to see universities embracing carbon neutrality and prioritizing the assessment of climate impacts within their products and services. The concurrent shift towards low-carbon technologies across electricity, buildings, and transportation sectors highlights a proactive stance in addressing climate change. This commitment solidifies universities' influence and active contribution to reducing their environmental footprint while combatting climate change (Tian & You, 2019; Zhang et al.,2020; Sun, et al., 2022).

Transportation policies on campuses play a crucial role in reducing environmental impact. Limiting the number of vehicles can reduce carbon emissions and air pollution within and around the campus. Campus buses, bike lanes and pedestrian policies not only encourage students and staff to reduce private vehicle usage but also contribute to a cleaner environment. Additionally, using eco-friendly public transportation can decrease carbon pollution, thereby supporting the sustainability efforts of the campus. Such initiatives are crucial in reducing the environmental footprint of campuses and providing a cleaner living environment.

Transportation is one of the parts of the campus that gets good scores. In order to provide access within the campus, ring services (shuttle/bus campus inside campus, campus motocycle using by personal) are organized at certain times. Cycling is common. That's why there are bike parks. However, bicycles do not belong to the campus. Düzce University Cycling Club organizes various activities in this context. Moreover; the Electric Vehicles and Digital Transformation Application and Research Center at the university conducts academic studies on clean and economic energy consuming electric vehicle technologies and smart factory technologies. There is an average of 100 zero-emission vehicles per day on campus. Parking area is % 8 of the campus area. Roads are reserved for vehicular and pedestrian paths. Access to each building is available. With sufficient lighting, separators are used in places on the

roads. Permeable floors are given priority. There are ramps and direction blocks with a suitable design for pedestrians with physical disabilities. Efforts to increase the accessibility of the disabled need to be continued. And, approximate daily travel distance of a vehicle in campus is 5 km.

3.6. Education and Research (ED)

Education and research play a fundamental role in sustainable development and environmental empowerment. Environmental education enhances students' awareness of the environment and encourages them towards an eco-friendly lifestyle. This positively influences their personalities by enabling the growth of cultured and environmentally conscious individuals. This process can contribute to the future generations being more environmentally sensitive and responsible.

This section is the area with the highest score. Academic studies are generally based on sustainability. There are actively 72 courses related to sustainability at Düzce University. In the last three years, 7 projects and startups related to sustainability have been produced within university. Funds dedicated to sustainability research is %20 of total research funds. The number of scientific publications on sustainability in the 2018-2020 academic year is 311. A large number of events related to sustainability are carried out in cooperation with students, academics and staff. There is university-run sustainability website. Düzce University of sustainability report is published every year.

Muñoz-Suárez et al. (2020) drew attention to the fact that young universities mostly applied to the GreenMetric ranking in their studies. In the study; it is discussed that while the old universities' campuses have more rigid structures that make it difficult to adapt to sustainability, the developing universities are more connected to the natural environment and adapt to the new needs of the society. Düzce University also has a developing campus. However, the fact that on-campus buildings are not built on an energy-efficient basis has a negative impact on the scoring. The revitalization and sustainable reconfiguration of buildings necessitate substantial financial investment. This limits the university as an indicator that is difficult to achieve in the country's conditions. There may be a flexibility in the survey for old or young universities in similar circumstances.

In this ranking, when the geographical and economic conditions of the countries are examined; it is discussed in the literature that some indicators in the survey have conflicting situations in sustainability assessment and ranking (Suwartha & Sari, 2013; Lauder et al., 2015; Boiocchi et al., 2023). When the indicator regarding the number of renewable energy sources (EC) on campus is evaluated; points are taken based on increasing the diversity of renewable energy sources used in the guide. Various renewable energy sources are used and developed in the experimental areas of Düzce University. Considering the geographical conditions of the university; it is possible to benefit from wind and solar energy (Yerli & Özdede, 2017). For universities that do not have these conditions, a disadvantageous scoring system is formed in the evaluation of sustainability (Boiocchi et al., 2023). Under this indicator, parameters related to electricity consumption are questioned. Düzce University has a developing campus. There is an increase in electricity consumption due to population growth on campus and the presence of many laboratories. The decrease in consumption due to the decrease in the campus population during the Covid-19 process is an indicator of this situation. There is a demand situation on campus that cannot be met from renewable energy sources. The fact that universities with small campuses and less population are more advantageous in this indicator affects the ranking.

When waste management is examined globally, it's observed that developed countries are ahead in transforming waste into more efficient and sustainable forms (Moya et al., 2017; Nanda & Berruti, 2020). Nevertheless, developing nations, having recognized the import of waste management belatedly, have consequently experienced a relative lag; Türkiye is emblematic of a similar circumstance (Al-Khatib et al., 2007; Ikhlayel, 2018; Haksevenler et al., 2022). For instance, while municipal waste recycling rates are at 67% in Germany and 57% in Austria (EEB, 2018), they stand at only 13% in Türkiye (Turkish Statistical Institute, 2021). The execution of initiatives such as the Zero Waste Regulation in Türkiye denotes substantial strides towards the advancement of waste reduction and recycling endeavors. Policies of this nature can assume a pivotal role in fostering awareness regarding waste management and cultivating improved recycling practices within academic institutions.

4. Conclusion and Suggestions

GreenMetric primarily serves as a tool for heightening awareness; however, in subsequent iterations, it is envisioned to undergo adaptations aimed at catalyzing tangible transformative changes. Understanding needs to shift to action if we are to address emerging global challenges is crucial. Engaging in the GreenMetric assessment serves to advance the Düzce university's internationalization endeavors and bolster its recognition by positioning its sustainability initiatives on the global stage. This participation may yield heightened web traffic to the Düzce university's website, increased references to the institution in relation to sustainability issues across online platforms, and expanded communication channels with institutions expressing interest in the university's sustainability initiatives. Düzce University is advancing its trajectory toward the realization of a sustainable/green campus, facilitated by the discernible impact of the survey components. The creation of a sustainable/green campus will make a difference in Düzce province and accelerate the actions of local development. Additionally, Düzce University is committed to promoting energy efficiency, increasing the use of clean and renewable energy resources, and actively participating in the fight against climate change. The University's goal is to become a university that offers a high quality of life and welfare to all students and employees with low carbon intensity, in line with Turkey's national vision for climate change. In this context, Düzce University is at the beginning of its journey towards sustainability, and in the coming years, GreenMetric will serve as a guide to help take decisive and concrete action towards achieving tangible change. Although Düzce University makes improvements in UI GreenMetric rankings every year, it should focus on waste management, water management, infrastructure and transport issues that need to be improved.

Finally, on the way to achieving the 2053 Net Zero Emission and green growth target, it is essential to take innovative steps at the university level to the national level. The GreenMetric ranking system is a valuable tool for the improvement of the universities.

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

All authors made equal contributions to the article. There is no conflict of interest.

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A Review of Postgraduate Programmes for Project and Construction Management Education

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Abstract

This paper aims to examine the past and present conditions, update them, and investigate postgraduate programmes in project and construction management in Turkey and the Turkish Republic of Northern Cyprus. It also serves as a reference for researchers on this subject. Although comparable research has been done in Turkey, the Turkish Republic of Northern Cyprus was included in the study because there hasn't been any research done there. In order to accomplish this, the second section provided a historical overview of the history of project and construction management. Project and construction management postgraduate programmes were investigated and researched in the third section. The current state of postgraduate programmes in project and construction management was described in the fourth section. Seventeen common headings were established in order to compare the information in the postgraduate programmes. Information for each postgraduate programme was specified under the common headings, and charts based on this information were created. Postgraduate programmes in project and construction management were assessed in the fifth section, and the results were presented.

Keywords: *Project, construction, management, postgraduate, education.*

Proje ve Yapım Yönetimi Lisansüstü Programlarına İlişkin Bir İnceleme Çalışması

Öz

Bu çalışma, Türkiye'deki ve Kuzey Kıbrıs Türk Cumhuriyeti'ndeki proje ve yapım yönetimi alanındaki lisansüstü programların geçmiş ve mevcut durumlarını incelemeyi, güncellemeyi ve araştırmayı amaçlamaktadır. Ayrıca bu konudaki araştırmacılar için bir referans niteliği taşımaktadır. Türkiye'de benzer araştırmalar yapılmış olmasına rağmen, Kuzey Kıbrıs Türk Cumhuriyeti'nde herhangi bir araştırma yapılmadığı için çalışmaya dahil edilmiştir. Çalışmanın ikinci bölümünde, proje ve yapım yönetiminin tarihçesine ilişkin genel bir bakış sunulmuştur. Üçüncü bölümde, proje ve yapım yönetimi lisansüstü programları incelenmiş ve araştırılmıştır. Dördüncü bölümde, proje ve yapım yönetimi lisansüstü programlarının mevcut durumu açıklanmıştır. Lisansüstü programlarındaki bilgileri karşılaştırabilmek için on yedi ortak başlık belirlenmiştir. Her bir lisansüstü programına ait bilgiler ortak başlıklar altında tanımlanmış ve bu bilgilere dayalı grafikler hazırlanmıştır. Beşinci bölümde ise proje ve yapım yönetimi lisansüstü programları değerlendirilmiş ve sonuçlarına yer verilmiştir.

Anahtar kelimeler: *Proje, yapım, yönetim, lisansüstü, eğitim.*

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1. Introduction

Turkey has become a country that is constantly developing, and its needs are increasing in parallel with its development. One of the most important factors affecting this development is construction. The construction sector is in a position to create demand for goods and services produced by more than 200 sub-sectors. For Turkey, this effect shows that the construction sector is the "Locomotive of the Economy" (INTES, 2022). In the last 30 years, Turkish construction companies have come a long way in overseas contracting services. Thus, Turkish construction companies have become a sought-after brand in the international labor market and have become one of the world's largest construction companies with their entrepreneurial structures and risk-taking abilities by using their trained manpower and technical know-how in the sector.

ENR magazine, one of the most important publications in the field of contracting services, regularly publishes a list of the world's largest construction companies based on the total value of the projects undertaken within a year. According to ENR magazine in December 2022, 38 Turkish construction companies were among the top 100 construction companies. In the general list of the world's 250 largest construction companies, Turkey ranks second with 55 construction companies after the People's Republic of China, which ranks first with 75 construction companies. The United States of America ranked third with 36 construction companies (ENR, 2022). As of July 2022, 44.6 percent of the projects undertaken by Turkish construction companies were in the CIS (Commonwealth of Independent States) region, 26.9 percent in the Middle East region, 18.8 percent in the Africa region, 6.9 percent in the Europe and America region, and 3 percent in the Asia Pacific region. This shows that Turkish construction companies have great prestige in the neighboring and surrounding countries (INTES, 2022).

In order for Turkey to take part in the construction markets of developed countries abroad, Turkish construction companies should be institutionalized, R&D studies should be given more importance, and projects using new technologies should be realized. This growth target can only be achieved through investments in education and technical training in the construction sector. In order for Turkish construction companies to effectively enter the markets of target countries, it is possible to establish a systematic project and construction management support system that responds to every new need of the construction sector, equipped with qualified personnel who are stronger in theory and experience (Aydın, 2022a, 2022b, 2022c, 2024). Examining and researching the programmes providing project and construction management education abroad, comparing them with the programmes in Turkey, examining the successful programmes academically and technically, and incorporating them into the programmes in Turkey will increase the success of our construction sector at the international level. For this purpose, it is necessary to establish an infrastructure for the existing programmes in Turkey that provide project and construction management education. The aim of project and construction management education is:

- To have in-depth knowledge in the subject area of project and construction management,
- To be able to use the techniques and tools in the field of project and construction management,
- To educate professional people and researchers who gain problem-solving, decision-making, and leadership skills in the field of project and construction management.

In this study, it is aimed to investigate the postgraduate programmes operating in the field of project and construction management in Turkey and TRNC until 2022, to update and/or develop the programmes, to evaluate the past and current situation, and to be a guiding study for researchers working in the field. Although similar studies have been carried out in Turkey, since there is no study for the TRNC, it was included in the scope of the study. For this purpose, the historical development of project and construction management is explained in chapter 2. In chapter 3, postgraduate programmes operating in the field of project and construction management are analyzed. In chapter 4, the current status of project and construction management postgraduate programmes is given. In order to compare the information about the postgraduate programmes, 17 common headings were

identified. Under the common headings, information for each postgraduate programme was detailed, and tables were prepared based on this information. In chapter 5, project and production management postgraduate programmes are evaluated, and the results of the study are given.

2. History of Project and Construction Management

The first project and construction management training started in 1905 at the Technical University of Munich in the chair of tunnel construction and construction management. Planning was needed to solve the problems encountered in the construction of tunnels in the Alps, and solutions were offered through this training (Arditi, 1984). In parallel with this, the inability to establish military facilities in a short time due to unfavorable terrain and climatic conditions during World War II and the difficult construction conditions encountered in the Pacific Ocean brought the need for planning for construction to the forefront (Sorguç, 1997).

Before 1950, the concept of planning started to be addressed in developed countries; computer-aided planning was developed in the 1960s; after 1970, issues such as environment and economy gained importance in addition to planning (Arditi & Polat, 2010). In the 1980s, project management started to be considered a management style; after 1990, project and construction management became an indispensable subject of education (Arıoğlu, Günay, Erku, & Uygur, 1991). With the development of technology in the 2000s, project and construction management education has evolved and changed; education programmes that train project and construction managers have started to take place not only at the master's and doctoral level but also in undergraduate programmes (Acıkara, Kazaz, & Ulubeyli, 2017). Today, project and construction management education in education programmes is being updated and developed according to the needs of the construction sector (Birgönül, Dikmen, Özorhon, & Işık, 2007).

2.1. The development of project and construction management in Turkey and the TRNC throughout history

Developments in the field of project and construction management in Turkey have been different and slower than in the rest of the world. In 1967, METU, under the leadership of Prof. Dr. V. Doğan Sorguç, started to provide education in the field of construction strategies; however, this initiative was later ended (Koraltan & Dikbas, 2002). Similarly, in 1976, it was decided to establish a construction engineering department at METU in order to train construction managers different from civil engineers; however, this was not realized (Arditi, 1984; Arditi & Polat, 2010). Attempts were limited, and even today, except for postgraduate programmes, undergraduate programmes providing project and construction management education have not been offered (Sorguç, 1999).

In Turkey, in 1975, the first project and construction management education were included in the undergraduate programme courses of ITU Faculty of Architecture, Department of Architecture; and it continues to this day (Istanbul Technical University, 2022). After 2000, overseas contracting services have gained importance and the need for Turkish construction companies to work with foreign partners has increased (Akgul, Ozorhon, Dikmen, & Birgonul, 2017). In today's conditions, the managerial skills of construction companies have become an important source of competition as well as their technical skills. Project and construction management education has made significant contributions to the provision of the human resources profile required by the construction sector by covering topics such as management, economics, law, sociopolitics and technology (Birgönül et al., 2007). After the year 2000, the discipline of project and construction management in Turkey slowly started to be established; it moved from the planning level to the implementation level (Öz, 2001). In 2000, a research project was carried out under the direction of Assoc. Prof. Dr. Murat Çıracı in order to evaluate and develop the ITU FBE Building Construction Management Postgraduate Programme, now called Project and Construction Management (Aydemir, 2000). This project was aimed at evaluating the current situation and development trends (needs, expectations, and problems) in construction management teaching and developing a new construction management programme. With this study, the number of postgraduate programmes providing education in the field of project and construction management increased from 3 to 10 with the study published in 2012 (Sertyeşilışık,

Dikbaş, & Giritli, 2012). In this study, similar education programmes in project and production management in the world between 2000 and 2012 were examined; the opinions of graduates and students about the existing programmes were determined and evaluated.

As of 2010, the Project and Construction Management Congress (PYYK) is organized every two years in different universities in Turkey and TRNC. In the 1st PYYK, hosted by METU in 2010, all researchers working in the field of project and construction management came together, and a road map was prepared for Turkey in line with the views of the participants (Middle East Technical University, 2010). The 2nd PYYK was organized at Izmir Institute of Technology in 2012. In the 2nd PYYK, research findings and sectoral experiences were shared by researchers and practitioners; the development axis and potential of the studies in the field of project and construction management for Turkey were determined (Izmir Institute of Technology, 2012). The 3rd PYYK was held in Antalya and hosted by Akdeniz University in 2014. The congress aimed to bring together academics working in the field of project and construction management with professionals in public and private sector organizations to share current research findings in this field and exchange information for the future (Akdeniz University, 2014). The 4th PYYK was organized in Eskisehir in 2016 and hosted by Anadolu University. The congress, which brought together all researchers working in the field of project and construction management, aimed to create an academic platform where researchers could discuss their ideas and studies and develop new communication networks (Anadolu University, 2016).

As of 2018, PYYK is organized as an international conference under the name of the International Project and Construction Management Conference (IPCMC). The 5th IPCMC was organized by the Cyprus International University in Kyrenia in 2018. In the congress, researchers in the field of project and construction management and experts in the architecture, engineering, and construction sectors came together to discuss current research findings and results, and sectoral experiences were shared (Cyprus International University, 2018). Although the 6th PYYK was planned to be held face-to-face by Istanbul Technical University in Istanbul in 2020, it was organized as a virtual (virtual attendance) congress due to the COVID-19 pandemic. Well-known people from academia and the construction industry were invited to the congress to share their experiences and knowledge. At the congress, future collaborations were established between invited researchers and construction industry professionals to share existing knowledge and develop new solutions to the challenges of the construction industry (Istanbul Technical University, 2020). Finally, the 7th PYYK was hosted by Yıldız Technical University in Istanbul in 2022. In the congress, interdisciplinary integration and international cooperation between academics in the field of project and construction management and professionals of the construction industry were ensured; research findings, experiences, and expectations were shared (Yıldız Technical University, 2022). These developments in the field of project and construction management have increased Turkey's ability to have more influence in the international construction industry (Bayhan & Karaca, 2020).

3. Material and Method

In this study, postgraduate programmes active in the subject area of project and construction management and similar subject areas in Turkey and TRNC as of 1 December 2022, were investigated. The search for postgraduate programmes at universities in Turkey and TRNC was conducted with the current "Postgraduate Degree Search Engine" approved by the Council of Higher Education (YÖK) (Search Engine, 2022). All postgraduate programmes in the field of project and construction management were examined depending on the university, institute, and department to which they are affiliated. Within the scope of the study, 16 postgraduate programmes operating in the field of project and construction management were accessed. The list of postgraduate programmes in the field of project and construction management is shown in Figure 1 with the short names used in the study. Apart from the 16 listed postgraduate programmes, there are also some postgraduate programmes operating under programme names such as architecture, civil engineering, engineering management, etc. that include courses in the subject area of project and construction management. However, only the postgraduate programmes operating in the field of project and construction management were examined within the scope of the study.

Postgraduate Programme Name		Short Name
1.	Beykent Üniversitesi Tasarım ve Yapım Yönetimi Yüksek Lisans Programı *Beykent University Design and Construction Management Postgraduate Programme*	BÜ-TYY-T
2.	Doğu Akdeniz Üniversitesi İnşaat Teknolojisi ve Yönetimi (Tezsiz) Yüksek Lisans Programı *Eastern Mediterranean University Construction Technology and Management (Non-Thesis) Postgraduate Programme*	DAÜ-İTY-T"
3.	Girne Amerikan Üniversitesi Yapı Yönetimi Yüksek Lisans Program *Girne American University Building Management Postgraduate Programme*	GAÜ-YY-T
4.	İstanbul Bilgi Üniversitesi Yapım Yönetimi (Tezsiz) Yüksek Lisans Programı *Istanbul Bilgi University Construction Management (Non-Thesis) Postgraduate Programme*	İBÜ-YY-T"
5.	İstanbul Kültür Üniversitesi Proje Yönetimi (Tezsiz) Yüksek Lisans Programı *Istanbul Kultur University Project Management (Non-Thesis) Postgraduate Programme*	İKÜ-PY-T"
6.	İstanbul Kültür Üniversitesi Proje Yönetimi Yüksek Lisans Programı *Istanbul Kultur University Project Management Postgraduate Programme*	İKÜ-PY-T
7.	İstanbul Kültür Üniversitesi Yapım Yönetimi ve Teknolojisi Yüksek Lisans Programı *Istanbul Kultur University Construction Management and Technology Postgraduate Programme*	İKÜ-YYT-T
8.	İstanbul Teknik Üniversitesi İnşaat Projeleri Yönetimi (Tezsiz) Yüksek Lisans Programı *Istanbul Technical University Construction Project Management (Non-Thesis) Postgraduate Programme*	İTÜ-İPY-T"
9.	İstanbul Teknik Üniversitesi İnşaat Yönetiminde Bilişim (Tezsiz) Yüksek Lisans Programı *Istanbul Technical University IT in Construction Management (Non-Thesis) Postgraduate Programme*	İTÜ-İYB-T"
10.	İstanbul Teknik Üniversitesi Proje ve Yapım Yönetimi Yüksek Lisans Programı *Istanbul Technical University Project and Construction Management Postgraduate Programme*	İTÜ-PYY-T
11.	İstanbul Teknik Üniversitesi Yapı İşletmesi Yüksek Lisans Programı *Istanbul Technical University Construction Management Postgraduate Programme*	İTÜ-Yİ-T
12.	Lefke Avrupa Üniversitesi Şantiye Yönetimi (Tezsiz) Yüksek Lisans Programı *European University of Lefke Site Management (Non-Thesis) Postgraduate Programme*	LAÜ-ŞY-T"
13.	Lefke Avrupa Üniversitesi Şantiye Yönetimi Yüksek Lisans Programı *European University of Lefke Site Management Postgraduate Programme*	LAÜ-ŞY-T
14.	Mimar Sinan Güzel Sanatlar Üniversitesi Yapım Proje Yönetimi Yüksek Lisans Programı *Mimar Sinan Fine Arts University Construction Project Management Postgraduate Programme*	MSGÜ-YPY-T
15.	Yıldız Teknik Üniversitesi Konut Üretimi ve Yapım Yönetimi Yüksek Lisans Programı *Yildiz Technical University Housing Production and Construction Management Postgraduate Programme*	YTÜ-KÜYY-T
16.	Yıldız Teknik Üniversitesi Yapı İşletmesi (İnşaat Proje Yönetimi) (Tezsiz) Yüksek Lisans Programı *Yildiz Technical University Construction Management (Non-Thesis) Postgraduate Programme*	YTÜ-Yİ-T"
T: Postgraduate programme with thesis T": Postgraduate programme without thesis		

Figure 1. The list of postgraduate programmes

4. Research Findings

In order to compare the information from 16 postgraduate programmes, 17 common headings were determined. Information for each postgraduate programme was analyzed in detail under the common headings. Figure 2, Figure 3, Figure 4, Figure 5, Figure 6, Figure 7, Figure 8, Figure 9, Figure 10, Figure 11, Figure 12, Figure 13, Figure 14, Figure 15, Figure 16, Figure 17, and Figure 18 were prepared based on this information. The information obtained from the websites of the postgraduate programmes and the contacts in the contact information were used in the examination. Apart from the websites of the programmes, the institute, department, graduate education, and education regulations were included; information other than these was not taken into consideration. The common headings are listed below in the following order:

- The distribution of the postgraduate programmes according to programme names (Figure 2),
- The distribution of the postgraduate programmes according to thesis and/or non-thesis (Figure 3),
- The distribution of the postgraduate programmes according to country names and city names (Figure 4),
- The distribution of postgraduate programme names according to words contained in the programme names (Figure 5),

- The distribution of the postgraduate programmes according to programme durations (Figure 6),
- The distribution of the postgraduate programmes according to total credits required for graduation (Figure 7),
- The distribution of the postgraduate programmes according to enrollment and acceptance requirements (Figure 8),
- The distribution of the postgraduate programmes according to profession areas and profession names (Figure 9),
- The distribution of the postgraduate programmes according to education languages (Figure 10),
- The distribution of the postgraduate programmes according to minimum graduation average requirements (Figure 11),
- The distribution of the postgraduate programmes according to institute names and department names (Figure 12),
- The distribution of the postgraduate programmes according to university types (Figure 13),
- The distribution of the postgraduate programmes according to course numbers and course credits (Figure 14),
- The distribution of the postgraduate programmes according to course types (Figure 15),
- The distribution of the postgraduate programmes according to education times (Figure 16),
- The distribution of the postgraduate programmes according to quota numbers (Figure 17),
- The distribution of the postgraduate programmes according to academic staff numbers (Figure 18).

Name of the University	Postgraduate Programme Name	Thesis / Non-Thesis	Number of the Programme
Beykent University	Design and Construction Management	Thesis	1
Eastern Mediterranean University	Construction Technology and Management	Non-Thesis	1
Girne American University	Building Management	Thesis	1
Istanbul Bilgi University	Construction Management	Non-Thesis	1
Istanbul Kultur University	Project Management	Non-Thesis	2
Istanbul Kultur University	Project Management	Thesis	
Istanbul Kultur University	Construction Management and Technology	Thesis	1
Istanbul Technical University	Construction Project Management	Non-Thesis	1
Istanbul Technical University	Informatics in Construction Management	Non-Thesis	1
Istanbul Technical University	Project and Construction Management	Thesis	1
European University of Lefke	Site Management	Non-Thesis	2
European University of Lefke	Site Management	Thesis	
Mimar Sinan Fine Arts University	Construction Project Management	Thesis	1
Yildiz Technical University	Housing Production and Construction Management	Thesis	1
Istanbul Technical University	Construction Management	Thesis	2
Yildiz Technical University	Construction Management	Non-Thesis	
		Total	**16**

Figure 2. The distribution of the postgraduate programmes according to programme names

Thesis, Non-Thesis and Thesis/Non-Thesis Postgraduate Programme	Number of the Programme
Thesis Postgraduate Programme	9
Non-Thesis Postgraduate Programme	7
Total	**16**
Thesis/Non-Thesis Postgraduate Programme	2

Figure 3. The distribution of the postgraduate programmes according to thesis and/or non-thesis

City Name	Number of the Programme	Country Name	Number of the Programme
Istanbul	12	Turkey	12
Famagusta	1	Turkish Republic of Northern Cyprus	4
Kyrenia	1		
Lefke	2		
Total	**16**	**Total**	**16**

Figure 4. The distribution of the postgraduate programmes according to country names and city names

Word Contained in the Programme / Name of the Programme	Design	Construction	Management	Construction	Technology	Building	Project	Informatics	Business	Construction Site	Housing	Production
Design and Construction Management	X	X	X									
Construction Technology and Management			X	X	X							
Building Management			X			X						
Construction Management		X	X									
Project Management			X				X					
Project Management			X				X					
Construction Management and Technology		X	X		X							
Construction Project Management			X	X			X					
Informatics in Construction Management			X	X				X				
Project and Construction Management		X	X				X					
Construction Management						X			X			
Site Management			X							X		
Site Management			X							X		
Construction Project Management		X	X				X					
Housing Production and Construction Management		X	X								X	X
Construction Management						X			X			
Total	**1**	**6**	**14**	**3**	**2**	**3**	**5**	**1**	**2**	**2**	**1**	**1**

Figure 5. The distribution of postgraduate programme names according to words contained in the programme names

Programme Duration (Term)	/	Programme Duration (Year)	Number of the Programme
2 Periods - 4 Periods	/	1 Year - 2 Years	1
3 Period	/	1.5 years	2
3 Periods - 6 Periods	/	1.5 Years - 3 Years	3
4 Period	/	2 Years	10
		Total	**16**
Average 4 Semesters / 2 Years			

Figure 6. The distribution of the postgraduate programmes according to programme durations

Thesis Postgraduate Programme	Number of the Programme	Non-Thesis Postgraduate Programme	Number of the Programme
21 Credits / 7 Courses + Seminar + Thesis	4	30 Credits / 10 Courses + Term Project	4
24 Credits / 8 Courses + Seminar + Thesis	3	36 Credits / 12 Courses + Term Project	1
30 Credits / 10 Courses + Seminar + Thesis	1	42 Credits / 14 Courses	1
30 Credits / 11 Courses + Seminar + Thesis	1	42 Credits / 14 Courses + Term Project + Seminar	1
Total	**9**	**Total**	**7**
Average: 21 Credits / 7 Courses + Seminar + Thesis		***Average: 30 Credits / 10 Courses + Term Project***	

Figure 7. The distribution of the postgraduate programmes according to the total credits required for graduation

Name of the Postgraduate Programme	ALES Min. Grade (Numerical)	YDS	YÖKDİL	IELTS	TOEFL IBT	4.00	100	Undergraduate Diploma	Portfolio	CV (Personal Information)	Number of Reference Letters	Letter of Intent	Work Experience (Years)	Interview
		Foreign Language Minimum Grade (English)				Undergraduate Min. Grade Transcript								
BÜ-TYY-T	55	X				*		+	-	-	-	-	-	+
DAÜ-İTY-T"	X	65	65	6,5	80	2,50	65	+	+	+	3	+	-	+
GAÜ-YY-T	55	65	65	6,0	80	2,25	60	+	-	+	3	-	-	+
İBÜ-YY-T"	X	60	60	-	72	*		+	-	+	-	+	-	+
İKÜ-PY-T"	55	55	55	-	65	*		+	-	-	-	-	-	+
İKÜ-PY-T	55	55	55	-	65	*		+	-	-	-	-	-	+
İKÜ-YYT-T	55	55	55	-	65	*		+	-	-	-	-	-	+
İTÜ-İPY-T"	60	65	65	6,0	65	2,50	65	+	-	-	-	+	-	+
İTÜ-İYB-T"	55	65	65	6,0	70	*		+	-	-	2	+	-	+
İTÜ-PYY-T	65	65	65	6,0	70	2.70	70	+	+	+	2	+	-	+
İTÜ-Yİ-T	70	65	65	6,0	70	2,50	65	+	-	-	2	+	-	+
LAÜ-ŞY-T"	55	65	65	-	-	2,00	55	+	+	+	+	+	-	+
LAÜ-ŞY-T	55	65	65	-	-	2,00	55	+	+	+	+	+	-	+
MSGÜ-YPY-T	55	60	60	6,00	72	*		+	+	+	1	+	-	+
YTÜ-KÜYY-T	55	50	50	5,5	60	3,00	75	+	+	+	2	+	-	+
YTÜ-Yİ-T"	55	50	50	5,5	60	2,30	60	+	-	+	-	-	-	+
Average	**57**	**60**	**60**	**5,94**	**69**	**2,42**	**63**	**+**	**-**	**+**	**1**	**+**	**-**	**+**

Symbols Used in the Table:
The minimum and higher exam grade and score required for postgraduate programmes are stated above.
(X): *Not required by the relevant graduate programmes.*
(-): *Not specified by the respective Postgraduate programmes.*
(*): *Required by the relevant graduate programmes. However, the undergraduate grade is not specified.*
(+): *Required by the relevant graduate programmes. However, no details are specified.*

Figure 8. The distribution of the postgraduate programmes according to enrollment and acceptance requirements

Profession Area	Number	Profession Name	Number
Engineering Area	6	Civil Engineering	14
Architecture Area	8	Mechanical Engineering	8
		Industrial Engineering	7
		Electrical Engineering	7
		Architecture	15
		City, Region and Planning	9
		Interior Architecture	8
		Landscape Architecture	8
		Economy	1
		Business	3
		Management Engineering	2
Total	**14**	**Total**	**82**

Figure 9. The distribution of the postgraduate programmes according to profession areas and profession names

Education Language	Number of the Programme
Turkish	4
English	7
Turkish-English	5
Total	**16**

Figure 10. The distribution of the postgraduate programmes according to education languages

Minimum Graduation GPA (in 4.00 system)	Number of the Programme
Minimum 3.00	10
Minimum 2.80	1
Minimum 2.70	3
Minimum 2.50	2
Total	**16**
Mean: 2,90 (=2,86)	

Figure 11. The distribution of the postgraduate programmes according to minimum graduation average requirements

Institute Name	Number	Department Name	Number
Science	11	Structural Engineering	1
Science and Technology	1	Construction Project Management	1
Informatics	1	Architecture	3
Postgraduate Education	3	Civil Engineering	4
		Construction Management	1
Total	**16**	**Total**	**10**

Figure 12. The distribution of the postgraduate programmes according to institute names and department names

University Name	Number of the Programme	Type of the University	Number of the University
Beykent	1	Private	6
Eastern Mediterranean	1		
Girne American	1		
Istanbul Bilgi	1		
Istanbul Culture	3		
Lefke Europe	2		
Total	**9**		
University Name	**Number of the Programme**	Public	3
Istanbul Technical	4		
Mimar Sinan Fine Arts	1		
Yildiz Technical	2		
Total	**7**	**Total**	**9**

Figure 13. The distribution of the postgraduate programmes according to university types

Name of the Postgraduate Programme	Number of English Courses	Number of Turkish Courses	Number of Elective Courses	Number of Compulsory Courses	Total Number of Courses	Total Course Credit
BÜ-TYY-T		18	11	7	18	48
DAÜ-İTY-T"	17		10	7	17	48
GAÜ-YY-T	17		11	6	17	45
İBÜ-YY-T"	16		15	1	16	45
İKÜ-PY-T		17	15	1	17	45
İKÜ-PY-T"		16	15	2	16	45
İKÜ-YYT-T		30	26	4	30	84
İTÜ-İPY-T"	5	18	16	7	23	66
İTÜ-İYB-T"	25		15	10	25	75
İTÜ-PYY-T	5	14	12	7	19	51
İTÜ-Yİ-T	7	10	9	8	17	45
LAÜ-ŞY-T	37		28	8	37	105
LAÜ-ŞY-T"	36		29	8	36	105
MSGÜ-YPY-T	9		6	3	9	21
YTÜ-KÜYY-T		21	13	8	21	54
YTÜ-Yİ-T"		30	18	12	30	76
General Total	**174**	**174**	**249**	**99**	**348**	**958**
Average	***17***	***19***	***16***	***6***	***22***	***60***

Figure 14. The distribution of the postgraduate programmes according to course numbers and course credits

Type of the Course	Number
Number of Compulsory Courses	74
Thesis Study	9
Term Project	6
Seminar	10
Total Number of Compulsory Courses	99
Minimum Number of Elective Courses	79
Total Number of Elective Courses	249
Total Minimum Number of Courses	178
Total Number of General Courses (Number of Compulsory Courses + Total Number of Elective Courses)	**348 (99 + 249)**

Name of the Postgraduate Programme	Compulsory					Elective		Total Minimum Number of Courses
	Number of Compulsory Courses	Thesis Study	Term Project	Seminar	Total Number of Compulsory Courses	Minimum Number of Elective Courses	Total Number of Elective Courses	
BÜ-TYY-T	5	+		+	**7**	**3**	**11**	**10**
GAÜ-YY-T	4	+		+	**6**	**3**	**11**	**9**
İKÜ-PY-T		+		+	**2**	**7**	**15**	**9**
İKÜ-YYT-T	2	+		+	**4**	**5**	**26**	**9**
İTÜ-PYY-T	5	+		+	**7**	**5**	**12**	**12**
İTÜ-Yİ-T	6	+		+	**8**	**2**	**9**	**10**
LAÜ-ŞY-T	6	+		+	**8**	**2**	**29**	**10**
MSGÜ-YPY-T	1	+		+	**3**	**6**	**6**	**9**
YTÜ-KÜYY-T	6	+		+	**8**	**5**	**13**	**13**
Total	**35**	**9**	**0**	**9**	**53**	**38**	**132**	**91**
Average (Thesis)	***4***	***1***	***0***	***1***	***6***	***4***	***15***	***10***
DAÜ-İTY-T"	6		+		**7**	**4**	**10**	**11**
İBÜ-YY-T"			+		**1**	**10**	**15**	**11**
İKÜ-PY-T"			+		**1**	**10**	**15**	**11**
İTÜ-İPY-T"	6		+		**7**	**6**	**16**	**13**
İTÜ-İYB-T"	10				**10**	**4**	**15**	**14**
LAÜ-ŞY-T"	7		+		**8**	**3**	**28**	**11**
YTÜ-Yİ-T"	10		+	+	**12**	**4**	**18**	**16**
Total	**39**	**0**	**6**	**1**	**46**	**41**	**117**	**87**
Average (Non-Thesis)	***8***		***1***	***1***	***7***	***6***	***17***	***12***
General Total	**74**	**9**	**6**	**10**	**99**	**79**	**249**	**178**
Overall Average	***5***	***1***	***0***	***1***	***6***	***5***	***16***	***11***

Symbols Used in the Table:

Total Number of Compulsory Courses: *Number of Compulsory Courses + Thesis + Term Project + Seminar*

Total Number of Courses: *Total Number of Compulsory Courses + Minimum Number of Elective Courses (The number of courses required for graduation.)*

Total Number of Elective Courses: *It shows the total number of elective courses of the postgraduate programme.*

Minimum Number of Elective Courses: *It shows the number of compulsory elective courses from the total number of elective courses.*

(+): *Accepted by the relevant graduate programmes. Numerical value is 1.*

Figure 15. The distribution of the postgraduate programmes according to course types

Education Time for the Postgraduate Programme	Number of the Programme
Day	4
Night (2nd Education)	3
Day / Night	9
Total	**16**

Figure 16. The distribution of the postgraduate programmes according to education times

Name of the Postgraduate Programme	Number of Quota
BÜ-TYY-T	-
DAÜ-İTY-T"	-
GAÜ-YY-T	-
İBÜ-YY-T"	50
İKÜ-PY-T"	-
İKÜ-PY-T	-
İKÜ-YYT-T	-
İTÜ-İPY-T"	30
İTÜ-İYB-T"	30
İTÜ-PYY-T	16
İTÜ-Yİ-T	15
LAÜ-ŞY-T"	-
LAÜ-ŞY-T	-
MSGÜ-YPY-T	5
YTÜ-KÜYY-T	10
YTÜ-Yİ-T"	50 (minimum)
Average: 26	

Figure 17. The distribution of the postgraduate programmes according to quota numbers

Number of Academic Staff of the Programme	Number of the Programme
Academic Staff Number 13	1
Academic Staff Number 12	2
Academic Staff Number 11	1
Academic Staff Number 10	3
Academic Staff Number 9	2
Academic Staff Number 7	2
Academic Staff Number 5	2
Academic Staff Number 3	3
Total	**16**

Figure 18. The distribution of the postgraduate programmes according to academic staff numbers

5. Conclusion and Suggestions

The results of the study were evaluated according to the common headings, and the current status of project and construction management postgraduate programmes in Turkey and TRNC was presented. Postgraduate programmes are named with 13 different programme names. It is observed that Project Management, Construction Site Management, and Construction Management are the most frequently used postgraduate programme names. The Management word is used 14 times in all programme names. Of the 16 postgraduate programmes, 9 are with thesis and 7 are non-thesis master's programmes. Among the programmes, two postgraduate programmes offer both thesis and non-thesis options. In Turkey, 12 postgraduate programmes are conducted only in Istanbul. In the TRNC, there are 1 postgraduate programme in Famagusta and Kyrenia and 2 postgraduate programmes in Lefke.

The duration of postgraduate programmes varies between 2–6 semesters and 1–3 years. 10 postgraduate programmes were completed in 4 semesters and 2 years. There is a "Seminar + Thesis" course in all thesis postgraduate programmes. Minimum 4 courses and maximum 7 courses, minimum 21 credits and maximum 30 credits are required. In most of the non-thesis postgraduate programmes, there is a "Course + Term Project" course. A minimum of 10 courses and a maximum of 14 courses, a minimum of 30 credits and a maximum of 42 credits should be taken.

Considering the enrollment and acceptance requirements of postgraduate programmes, it is seen that the average ALES numerical exam grade is 55 and above, the average English language exam grade is 65 and above, and the average undergraduate graduation grade (in a 4-scale system) is 2.50 and above. Postgraduate programmes are provided in English and Turkish. 7 postgraduate programmes are taught in English, 5 postgraduate programmes are taught in Turkish-English (70%-30%), and 4 postgraduate programmes are offered in Turkish.

Day, night, and day/night options are available for postgraduate programmes. There is a second education programme in night options. 5 postgraduate programmes give education during the day, 3 postgraduate programmes offer education during the night, and 8 postgraduate programmes teach during the day or night. It is seen that the undergraduate graduates who can apply to postgraduate programmes are mostly in architecture, civil engineering, urban, regional and planning. 8 postgraduate programmes can be applied by architecture undergraduates, and 6 postgraduate programmes can be applied by engineering undergraduates.

Postgraduate programmes are affiliated with the Institute of Science, the Institute of Science and Technology, the Institute of Informatics, and the Institute of Postgraduate Education. The related departments of the programmes are Construction Engineering, Construction Project Management, Architecture, Civil Engineering and Construction Management. Most of the programmes are affiliated with the Institute of Natural and Applied Sciences and the Department of Civil Engineering. In 7 postgraduate programmes, the maximum quota is 50, the minimum quota is 5, and the average quota is 26. The average graduation grade for postgraduate programmes is a maximum of 3,00, a minimum of 2,50, and an average of 2,90. The postgraduate programmes at Yildiz Technical University have the lowest average graduation grade.

Postgraduate programmes are given by 9 universities. Of the 7 postgraduate programmes in public universities, 4 are offered by Istanbul Technical University, and of the 9 postgraduate programmes in private universities, 3 are offered by Istanbul Kultur University. The total number of academicians in the 16 postgraduate programmes is 129. According to the academic staff of the postgraduate programmes, the highest number of academicians is in the Istanbul Bilgi University with 13 academicians; the lowest number of academicians is in the European University of Lefke with 3 academicians.

The maximum number of courses in postgraduate programmes is 37, the minimum is 9, and the average is 22. Course credits are a maximum of 105, a minimum of 21, and an average of 60. The number of courses in English is a maximum of 37, a minimum of 5, and an average of 17. The number of courses in Turkish is a maximum of 30, a minimum of 10, and an average of 19. The number of courses in thesis postgraduate programmes is a maximum of 37, a minimum of 9, and an average of 21. The number of courses in non-thesis postgraduate programmes is a maximum of 36, a minimum of 16, and an average of 23. The number of elective courses is a maximum of 29, a minimum of 6, and an average of 16. The number of compulsory courses is a maximum of 12, a minimum of 1, and an average of 6. The master's programmes with the highest number of courses are European University of Lefke, Istanbul Kultur University, and Yildiz Technical University. Istanbul Kultur University offers the lowest number of postgraduate courses among its programmes. Istanbul Technical University provides the most course options and course credit for its postgraduate programmes.

The comparison graph in Figure 19 was prepared with the results of the evaluation. The thesis and non-thesis postgraduate programmes in Turkey and the TRNC were compared in Figure 19. The average values in the comparison graph were designed according to the country (TRNC, Turkey) and thesis/non-thesis for the new postgraduate programme planned to be opened in the subject area of project and construction management. According to Figure 19, the postgraduate programmes with above-average values are listed below. These are:

- Istanbul Technical University Construction Project Management (Non-Thesis) Postgraduate Programme,
- Istanbul Technical University IT in Construction Management (Non-Thesis) Postgraduate Programme,
- Istanbul Technical University Project and Construction Management Postgraduate Programme,
- Yildiz Technical University Construction Management (Non-Thesis) Master's Postgraduate Programme.

Total		Turkey			TRNC			Postgraduate Programme with and without Thesis by Country	
	Non-Thesis	Thesis	Non-Thesis	Thesis		Non-Thesis	Thesis		
1					**1**	1		Famagusta	Name of the City
1					**1**		1	Kyrenia	
12	5	7	**12**					Istanbul	
2					**2**	1	1	Lefke	
7	3	4	**7**					Public	Type of the University
9	2	3	**5**	2	**4**	2	2	Private	
7	2	1	**3**	2	**4**	2	2	English	Education Language
4	1	3	**4**					Turkish	
5	2	3	**5**					Turkish-English	
3	3		**3**					Night (2nd Education)	Education Time
4		4	**4**					Day	
9	2	3	**5**	2	**4**	2	2	Day / Night	
8	10	8	**9**	8	**6**	5	3,00	Average Number of Academic Staff	
2,87	2,80	2,84	**2,83**	3,00	**3,00**	3,00	4	Average Number of Graduation (in 4.00 system)	
4	4	4	**4**	4	**4**	4	2	Average Number of Semester	
2	2	2	**2**	2	**2**	2		Average Number of Year	
26	40	12	**26**					Average Number of Quota	
1	1		**1**					Informatics	Name of the Institute
11	4	7	**11**					Science	
1					**1**	1		Science and Technology	
3				2	**3**	1		Postgraduate Education	
4	1	3	**4**					Civil Engineering	Name of the Department
1	1		**1**					Construction Project Management	
3		3	**3**					Architecture	
1	1		**1**					Construction Management	
57	56	59	**58**	55	**55**	55	66	Average ALES Exam Grade (Numerical)	
60	59	58	**59**	66	**66**	66	2,13	Average YÖKDİL Foreign Language Score (English)	
2,42	2,4	2,73	**2,6**	2,25	**2,19**	2,13	2	Average 4.00 Undergraduate Grade (Transcript)	
16	5	7	**12**	2	**4**	2	2	Undergraduate Diploma	
6		3	**3**	2	**3**	1	2	Portfolio	
9	2	3	**5**	2	**4**	2	2	CV (Personal Information)	
9	1	4	**5**	2	**4**	2	2	Number of Reference Letters	
10	3	4	**7**	2	**3**	1	2	Letter of Intent	
16	5	7	**12**	2	**4**	2	2	Interview	

Figure 19. The comparison graph (the distribution of postgraduate programmes in Turkey and TRNC according to 17 common headings)

Total		Turkey		TRNC		Postgraduate Programme with and without Thesis by Country	
Non-Thesis	Thesis	Non-Thesis	Thesis	Non-Thesis	Thesis		
5	5	2	**10**	2	**4**	Civil Engineering	Engineering Profession Area
4	1	1	**5**	1	**2**	Electrical Engineering	
5	1	1	**6**	1	**2**	Mechanical Engineering	
4	1	1	**5**	1	**2**	Industrial Engineering	
3	1	1	**4**	1	**2**	Engineering	
5	6	2	**11**	2	**4**	Architecture	Architecture Profession Area
4	3	1	**7**	1	**2**	City, Region and Planning	
4	2	1	**6**	1	**2**	Interior Architecture	
4	2	1	**6**	1	**2**	Landscape Architecture	
4	2	1	**6**	1	**2**	Architecture	
1			**1**			Economy	Other Profession Area
3			**3**			Business	
1	1		**2**			Management Engineering	
						Other	
65	72	22	**137**	19	**41**	Total	Number of Courses for Graduation
13	10	11	**11**	10	**10**	Average (Compulsory)	
180	171	60	**351**	45	**105**	Total	Course Credit for Graduation
36	24	30	**29**	23	**26**	Average (Compulsory)	
110	131	53	**241**	54	**107**	Total	Number of Courses
22	19	27	**20**	27	**27**	Average	
307	348	153	**655**	150	**303**	Total	Course Credit
61	50	77	**55**	75	**76**	Average	
79	92	38	**171**	40	**78**	Total	Number of Elective Courses
16	13	19	**14**	20	**20**	Average	
31	39	15	**70**	14	**29**	Total	Number of Compulsory Courses
6	6	8	**6**	7	**7**	Average	
46	21	53	**67**	54	**107**	Total	Number of English Courses
15	7	27	**11**	27	**27**	Average	
64	110		**174**			Total	Number of Turkish Courses
21	18		**19**			Average	

Figure 19 (continued). The comparison graph (the distribution of postgraduate programmes in Turkey and TRNC according to 17 common headings)

It is seen that the postgraduate programmes of Istanbul Technical University are in the majority, and their contents are sufficient. These programmes are ideally qualified to serve as a reference for the structure and content of new postgraduate programmes that are expected to be opened in the field

of project and construction management. According to Figure 19, the postgraduate programmes with below-average values are listed below. These are:

- Beykent University Design and Construction Management Postgraduate Programme,
- Istanbul Kultur University Project Management (Non-Thesis) Postgraduate Programme,
- Istanbul Kultur University Project Management Postgraduate Programme,
- Mimar Sinan Fine Arts University Construction Project Management Postgraduate Programme.

The total credits, enrollment and acceptance requirements, quota numbers, graduation average requirements, course numbers, and academic staff numbers required for the completion of these programmes are low and need to be improved compared to other programmes. In general, the contents of postgraduate programmes have average values. It is seen that the highest values are found in postgraduate programmes in Turkey, while postgraduate programmes in the TRNC have average values. While 4 postgraduate programmes in TRNC are offered in 3 different cities, 12 postgraduate programmes in Turkey are given only in Istanbul. It is essential to offer new postgraduate programmes in the field of project and construction management in metropolitan cities in Turkey, such as Ankara and Izmir.

Within the scope of the study, the postgraduate programmes operating in the field of project and production management in the world were not examined, and the main characteristics of the postgraduate programmes with different aims and content could not be determined. Therefore, the related programmes were not compared with the postgraduate programmes in Turkey and TRNC. The evaluation of postgraduate programmes in Turkey and TRNC was based solely on information accessible on their respective websites. Field research could not be performed to determine the opinions, expectations, recommendations, and suggestions of the graduates and students about the postgraduate programmes. It is expected that the evaluations will be a guide and a reference for the assessment of the project and construction management postgraduate programmes in Turkey and TRNC according to the past periods, their improvement for the future periods, and the postgraduate programmes that are planned to be opened.

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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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Will Artificial Intelligence Replace Knowledge Centers? Assessment of the Situation

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Abstract

The study examines the historical journey of information, which started with stone and clay tablets and continued with papyrus, parchment, and paper forms, and ultimately its transformation into digital form with industry 4.0 & 5.0 information technologies (IT), the information age. The developments in IT, that is, computer, network/internet/www, have opened the doors of a new world. Based on these developments, the transformation of information and information resources into digital form, their inclusion in computers and networks, their movement at the global level (www), and their visibility and accessibility have revolutionized the world of information. It has opened the doors of a new world where the information transformed into digital form is used with open source software and internet (w2-w3) supported open data and accredited scientific research data supported by big data, and artificial intelligence software enables the information to think autonomously, produce content, speak and show actionable behaviors. The study tries to find an answer to the question that artificial intelligence (AI) could replace information centers that archive, process, manage, and provide access to accredited information and evaluate the situation.

Keywords: *Information, forms of information resources, digitalization, artificial intelligence.*

Yapay Zekâ Bilgi Merkezlerinin Yerini mi Alacak? Durum Değerlendirmesi

Öz

Çalışma, bilginin taş ve kil tabletler ile başlayan tarihsel yolculuğunu; papirüs, parşömen, kâğıt formlar ve nihayetinde bilgi çağı olan endüstri 4.0 & 5.0 bilgi teknolojileri (BT) ile dijital forma dönüşen değişim izlemiştir. BT'deki gelişmeler olan; bilgisayar, ağ/internet/www yenidünyanın kapılarını aralamıştır. Bu gelişmelere dayalı olarak bilgi ve bilgi kaynaklarının sayısal forma dönüşmesi ile birlikte bilgisayar ve ağ (network) de yer alması, küresel düzeyde (www) hareket etmesi, görünür ve erişilebilir kılınması bilgi dünyasında devrim yaratmıştır. Dijital forma dönüşen bilginin, açık kaynaklı yazılımlar ve internet (w2-w3) destekli açık veriler ve akredite olmuş bilimsel araştırma verilerinin büyük veri destekli olarak kullanıldığı ve yapay zekâ yazılımları ile bilginin otonom düşünebilmesi, içerik üretebilmesi, konuşabilmesi ve eylemsel davranışlar göstermesi yenidünyanın kapılarını açmıştır. Çalışma ile, yapay zekanın (AI) akredite bilgiyi arşivleyen, işleyen, yöneten ve erişime sunan bilgi merkezlerinin yerini alabileceği sorusuna yanıt aranmaya ve durum değerlendirilmesi yapılmaya çalışılmıştır.

***Anahtar kelimeler**: Bilgi, bilgi kaynakları formları, dijitalleşme, dijital kütüphane, yapay zekâ.*

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1. Introduction

In today's global world, we are living in a digital era of "industry 4.0 & 5.0" that started with the Internet of Things and where objects communicate with each other. Advances in information technologies (IT) have radically changed and transformed individuals, societies, governments, education/scientific studies, businesses/economy, industry, and production processes. In today's industry 4.0 & 5.0 digital era, where information has become a valuable commodity, the information object continues to develop as an IT-supported "network/internet/w3". In this process, open data, metadata, and research data, which are the components of information objects, have been transformed into digital form and are located in the network/www environment through server and identified TCP/IP terminal computers, and they talk and exchange information among themselves based on multiple components they interact with (Alav, 2023a, p.156). This process has affected and transformed almost the entire social structure. Today, there are more digital natives than digital immigrants. These developments in IT have given rise to digital information objects - electronic information resources, proprietary and open-access software, networked and self-talking information, and artificial intelligence (AI). Can artificial intelligence replace knowledge centers in the near future? This question constitutes the core of this study. The answers to the questions “How much will AI's ability to think, synthesize, speak, make decisions, and act autonomously affect information centers how will it transform these organizations, and where will human/librarians position themselves in the face of AI?” were sought in the study.

Purpose of the Study

These organizations are transforming into new-generation knowledge centers with digitized information/knowledge sources and network/internet structures, and the transformation is still ongoing. In the digital age of IT and Industry 4.0 & 5.0, the current situation of information center libraries in the near future with "AI" and the prediction of how it will undergo a change and transformation in the near future has been discussed with the support of literature, and the study aims to provide current situation and mental thinking support to future scientific studies.50 years after Cahit Arf asked the question in 1959 just as "Can the machine think and how can it think?" (Arf, 1959, p. 91-103), a big dream has become a reality by evolving/transforming into "Machines that Talk to Each Other" (Alav, 2023a, p.156) and artificial intelligence AI (Korteling et al., 2021, p.1-13) that can be articulated to the big data pattern, process digital information, generate new information, think and decide autonomously. The study seeks the answers to the questions such as "the effects of artificial intelligence on information centers", what research data and information centers may become in the future, how they will serve, and where librarians will be in this development, based on the future prediction on the axis of the structure of IT / Network / Internet / W3 / AI.

2. Material and Method

The research utilized the "description method" was used in the research (Ekiz, 2009, p.22). With this method, a cause-effect relationship was established between events. In addition, a theoretical evaluation supported by the literature was put forward in the research, using qualitative and quantitative data (Tutar & Erdem, 2020, p.245-295). As a quantitative data set, e-user data set statistics of academic electronic libraries were used.

Literature Review of the Research

National and international scientific studies related to the research topic were examined. In the national literature search; TÜBİTAK/TR Index and DergiPark, TR-National TEZ, EKUAL, SOBIAD Index databases, Turkish Academic Archive - HARMAN, E-Hiperkitap, E-Akademi Kitap, Google Scholar and e-databases of university libraries and the Bibliography of Turkish Articles were examined. In the international literature review; Library, Information Science & Technology Abstracts (LISA), Web of Science (WOS): SSCI / ESCI Index, Elsevier /Emerald E-Database, Wiley Online Library, ERIC, GALE, DOAJ, Taylor & Francis, Summon, Springer, ScienceDirect, Scopus, Sage e-Journals, Proquest databases were utilized. Since the literature search is very extensive, in this section, the prominent scientific studies on the subject of the study are examined as domestic/national and foreign/international literature.

National Literature

Among the prominent publications; Arf (1959)'s "Can machines think and how can they think?", Tonta & Madran (2023)'s "Artificial Intelligence and the Future of Information Access" (Tonta & Madran, 2023a-b-c; Youtube), The Impact of Artificial Intelligence on Scientific Communication, The Role of Information Professionals in the Age of Artificial Intelligence, Coşkun (2007)'s Artificial Intelligence Optimization Techniques: Literature Review (Coşkun, 2007, p.142-146),

Alpaydın (2011)'s "Artificial Learning (Alpaydın, 2011, p.1-486), Pirim (2006). Artificial Intelligence (Prim, 2006, p.81-93), Kaya (2022)'s The Rise of Robots: Artificial Intelligence and the Danger of a Jobless Future (Kaya, 2022, p.115-119), Esen (2019)'s Artificial Intelligence: Past and Future (Esen, 2019, p.308-311), Tellan (2020)'s The Responsive Machine: The Maturity Age of Artificial Intelligence (Tellan, 2020, p.142-146), Alav (2023a)'s Machines Talking to Each Other: The Evolution of Knowledge Towards Open Access Supported by Open Data. Erkutlu et al. (2023)'s Artificial Intelligence and Organizational Behavior, Gürsakal (2018)'s "Machine Learning", and Karaboğa (2017)'s "Artificial Intelligence Optimization Algorithms" are included. (Karaboğa, 2017, p.1-246).

International / Foreign Literature

It is seen that the first studies on artificial intelligence started with research on the thinking capacity of machines under the leadership of Allen Turing's Can Machines Think? (Turing, 1950, p.433-460), John McCarthy 's The term "Artificial Intelligence" and ALGOL language structure studies-Dartmounth Conference 1956, The Birth of Artificial Intelligence inside Rebecca E. Skinner's "the Originsof Artificial Intelligence Computing" (Skinner, 2012, p. 1-213). Dennis Shasha and Cathy Lazere's "John Mccarthy: the uncommon logician of common sense" (Shasha & Lazere, 2004, p.1-10), Vasil Teigenes's "Intelligence Artificial -AI" 4th Industrial Revolution (Teigenes, 2020, p.1-132), Arthur Samuel,'s "Some Studies in Machine Learning Using the Game of Checkers" (Samuel, 1959, p.210-229), N. Nilsson's "Learning Machines" (Nilsson, 1965, p.1-137), Mitchell (1997)'s Machine Learning (Mitchell, 1997, p.1-414), Kohavi & Provost's "Glossary of terms & Machine Learning (Kohavi & Provost, 1998, p.271-274),The changing science of machine learning (Langley, 2011, p.275-275), Progress of artificial intelligence, Alpaydın (2016)*'s Machine Learning (Alpaydın, 2016, p.1-230),* Sutton & Barto (2018)'s Reinforcement Learning (Sutton & Barto, 2018, p.1-526), Alpaydin (2021)'s Introduction to Machine Learning (Alpaydın, 2021*, p.1-280),* Korteling's (2021) Human-versus Artificial Intelligence (Korteling, et al., 2021, p.1-13), Lin & Yu (2023)'s A bibliometric analysis of artificial intelligence chatbots in educational contexts and Performance Management and Artificial Intelligence: A Futuristic Conceptual Framework (Bankar & Kasturi, 2023, p. 341-361).

3. Findings and Discussion

Information Technologies (IT)

Information technologies are defined as the products of scientific technology that became evident with the Industrial Revolution and emerged in post-industrial societies (Bensghir, 1996, p.7-8). The computer and internet (informatics) technology, which started to develop in the 1990s, brought about a radical change and transformation in the individual and social structure in the 2000s and beyond. Information technology is an ecosystem that develops as the science of communication (informatics) in which technology and multiple components that support it interact, and hardware and software interact together in a network-supported computer environment depending on the developments of positive science. In this process, there have been many revolutionary changes and transformations such as states, commercial organizations, educational institutions, security / personal data security, country defenses and war technologies, and e-commerce structures. In this process in which IT plays a role, the management of these technologies has become essential. In this governance process, data and information security of the individual/society and the state and other institutions has come to the forefront. In this process, which developed depending on needs and requirements, digital information, e-government, e-commerce and other e-organizations, e-schools, e-libraries, e-NGOs, and an electronic/digital world based on open source and crypto-secure software were created. This digital world, which affects every moment of human life, and the structures and systems with which it

interacts have entered into a pocket tablet, and the development processes have evolved towards big data-supported augmented reality/metaverse and artificial intelligence platforms. In this process, the use and management of IT and artificial intelligence has become important.

Digital Information Centers

Digital information centers are "an old friend in new clothes" (Medeiros, 2014, p. 218-219). A digital information center is a digital/organizational structure in which a large percentage or all of the library operations are carried out with the support of an IT-supported network/internet/www and artificial intelligence. The historical journey of information, which started with stone and clay tablets, was followed by papyrus, parchment, and paper forms, and finally the transformation into digital form with industry 4.0 & 5.0 information technologies (IT), the information age. The developments in IT have opened the doors of the new world of computer and network/internet/www.

Based on these developments, the transformation of information and information resources into digital form, their inclusion in computers and networks, their movement at the global level (www), and making them visible and accessible have revolutionized the world of information. These developments in IT are transforming or have transformed traditional information centers and information resources into digital/wall-less information centers. Digital information and transformation (Saarikko et al., 2020, p.825-839) centers are not only places to digitize their materials, but also to build collections and support the promotion of these efforts across the country. Strategy, not technology, drives digital transformation (Kane et al., 2015, p.12). This indicates that libraries also need to develop competencies in leveraging digital technology for business purposes (Figure 1).

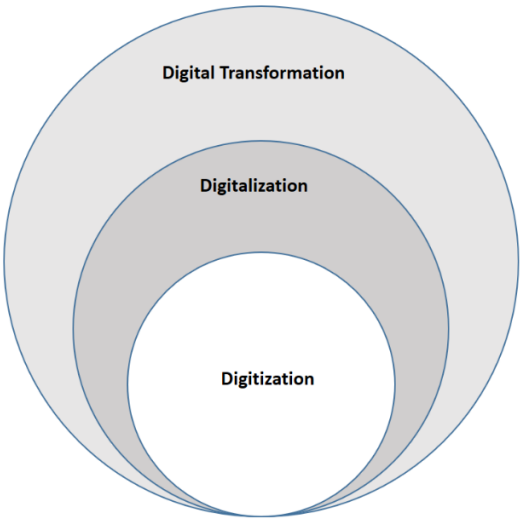

Figure 1. Digitization, digitalization, and digital transformation (Saarikko et al., 2020)

Digital Information Resources

Digital information resources are information resources transformed into digital/digital forms. Digital resources include e-books, electronic journals / e-databases, DVDs, video, audio, pictures, web platforms, server/cloud, magnetic archive storage, etc. Today, there are a large number of electronic (e-formatted) documents/information within digital information resources. Digital information resources (e-data) are data in electronic form that are made available on the network/internet/www with licensed or open source software. The role of libraries However, another explanation for the use of information resources may be the link once more to the university library, which is seen by scholars as a vital digital resource in its right (Warwick et al., 2008, p.23).

Artificial Intelligence

In the literature, artificial intelligence (AI) is the ability of a digital computer or a computer-controlled robot to perform tasks usually associated with intelligent beings "Artificial intelligence-AI" (Brittanica Encylopedia, 2024) and (Alav, 2023b, p.211-213). Artificial intelligence is a (digital) field focused on

programming machines that can analyze and make decisions by defining the human brain and decision-making behaviors (Erbaş, 2023, p.187). In other words, artificial intelligence is the copying of the human brain in inorganic form with a complex structure. Rather than a direct brain perception, artificial intelligence provides access to information by directly interacting with big data (Gartner Online Dictionary, 2024, p.1) and other information platform components, and can infer and act on the information obtained. Artificial intelligence is genetic algorithms that analyze data based on neural networks and learning-based machine computing capabilities and open research data (Dhamija & Bag, 2020, p.870) (Figure 2).

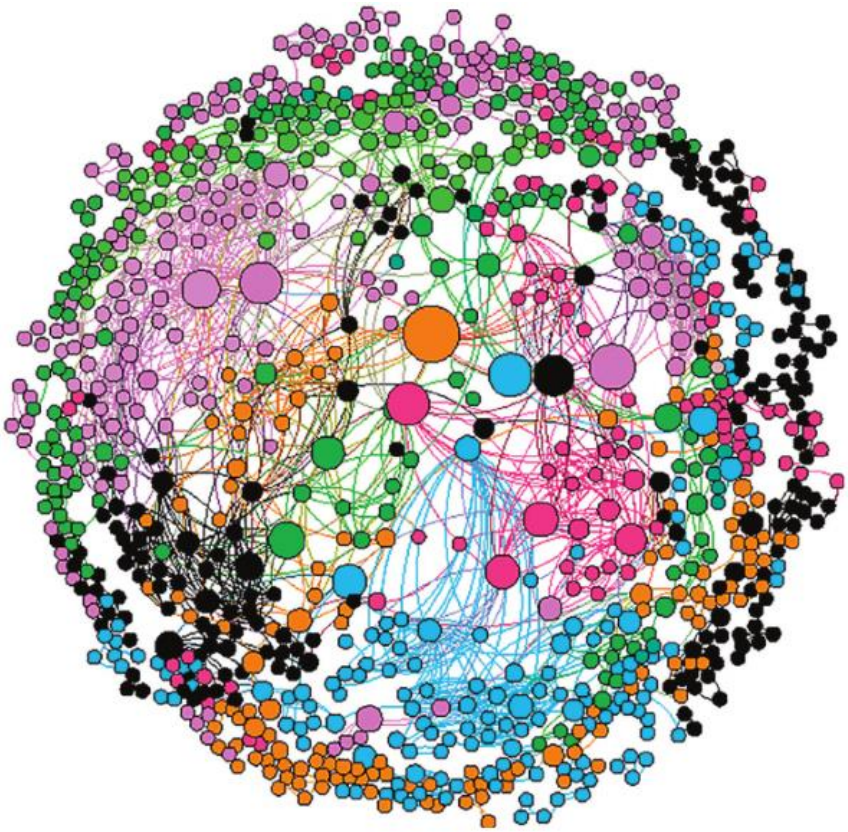

Figure 2. Artificial intelligence (Dhamija & Bag, 2020, p.884)

John McCarthy, one of the first/pioneering scientists to put forward the concept of artificial intelligence, likens the concept of artificial intelligence to a computer that "simulates human beings" (Skinner, 2012, p.125-126). According to McCarthy "A proposal for the Dartmouth summer conference on artificial intelligence refers to it as "machines that can think like humans and make decisions on their own, as well as having the ability to do the tasks that humans focus on and to solve the problems they try to solve". The term "Artificial Intelligence" and ALGOL language structure studies (McCarthy, J., et al., 1995, p.1-13). Transmitter ed. by Enes Sivri (Sivri, 2023, p.177). Today, AI is often the key to achieving convincing operational transformations (Dhamija & Bag, 2020, p.869-870). Managing AI in organizations is the processual act of managing IT, people, knowledge, competitiveness/advantage, and value-generation components together. Since libraries are non-profit organizations, they can manage AI in a more comfortable environment than other organizations."The use of artificial intelligence in libraries can facilitate the work of both library staff and users and further improve library services " (Sivri, 2023, p.176). The use and management of AI in library organizations can be managed according to strategic and multi-component planning (Alav, 2023b, p.203). In this context, AI governance components can be expressed as follows: Strategic planning (goals and objectives, visions and missions of the organization), data management and privacy/data security, information resources and budget/financial support, training of personnel for the use of AI, support and funding of AI product projects, business and external partner collaborations (human/artificial intelligence-inter-organizational collaborations), process management monitoring and metrics, ethics/legal compliance, improvement and environmental sustainability, value generation. In this context, AI governance in

library organizations includes the above-mentioned components as well as the process of managing accredited information and artificially generated information according to ethically and legally determined copyright, licensing, and other criteria. The management of artificial intelligence in libraries will provide great contribution and saving support in terms of time and labor in the execution of technical operations of libraries. To illustrate, strategic planning, resource management; purchasing, provisioning, cataloging/classification, data entry, preventing multiple copy access, language processing, and meaning generation, chat bots and virtual assistant support, managing web interfaces online and offline, metrics and model development for recycling, access and governance of digital collections, data mining/data processing and value creation, data security, support to user services, staff training, operational management of libraries, user services, interlibrary networked (open access) collaborations and AI-enabled joint project governance will be provided. Managing AI in library organizations needs to be based on rational and robust planning and dynamic strategies based on interactive components and the interaction of dynamic strategies on applications, IT, target audience, environment, and other multiple components. Trust, accredited accurate information, human substitutability concerns, and autonomous/independent decision-making are still question marks in the management of AI. We believe that the aforementioned questions and problem areas of artificial intelligence will find answers in the near future. Artificial intelligence interacts with multiple components based on data in the evolving IT/network/internet/w3/IA ecosystem (Figure 3).

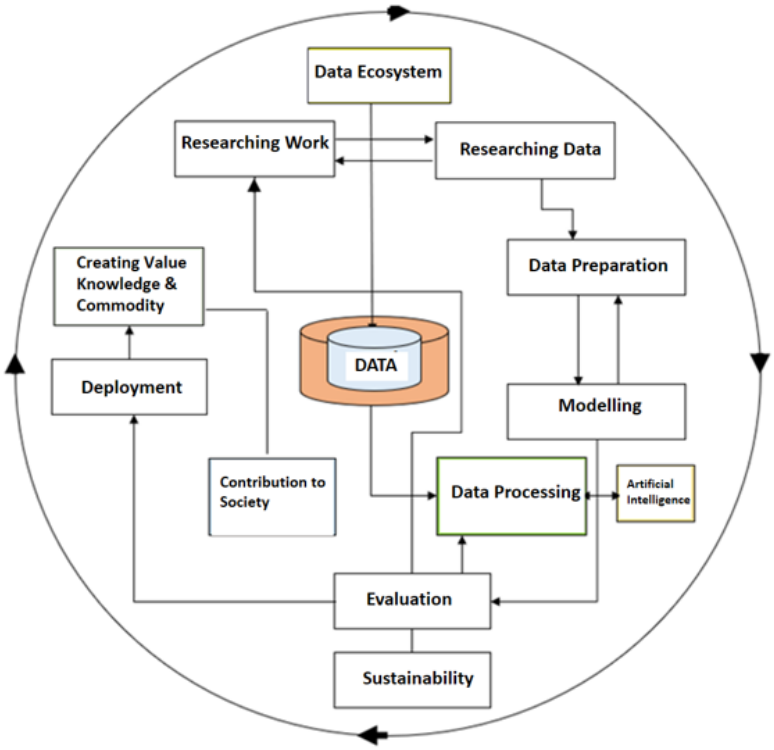

Figure 3. The data ecosystem cycle (This figure, which is Inspired by Kelleher & Brendan (2019), was developed by Orhan Alav).

Within this structure, there are multiple components such as IT/network/internet/w3/IA, data, research data, big data, data preparation, evaluation, data processing, data modeling, artificial intelligence, IT/network/internet/w3/IA, value creation and sustainability, and their interactions. However, Cahit Arf was able to evaluate the idea and applicability of artificial intelligence on the axis of mathematics-oriented algorithms and probability/logic in his article "Can the machine think and how will it think?" in 1958 (Arf, 1959, p.91-103). However, in today's Industry 4.0 & 5.0 digital age, the dream of Arf and the few scientists who think like him has been realized today.

Artificial Intelligence Powered Information Centers

Today, information centers run their content and information resources in a hybrid structure with human and machine support. However, based on a futuristic prediction, in the near future, knowledge centers may transform into centers that are almost entirely digital in terms of information sources and function, and that are run with the support of artificial intelligence.

Even today, artificial intelligence can think autonomously, access big data, synthesize information, and develop actionable behaviors that produce value and results. These capabilities of artificial intelligence will transform knowledge centers into digital forms over time. Thus, people and machines, which are information users, will be able to provide uninterrupted information access 24/7. This will eliminate access restrictions/barriers to information resources. In this process, strong IT infrastructures and digital resources, big data access, and artificial intelligence will constitute important components (Figure 4).

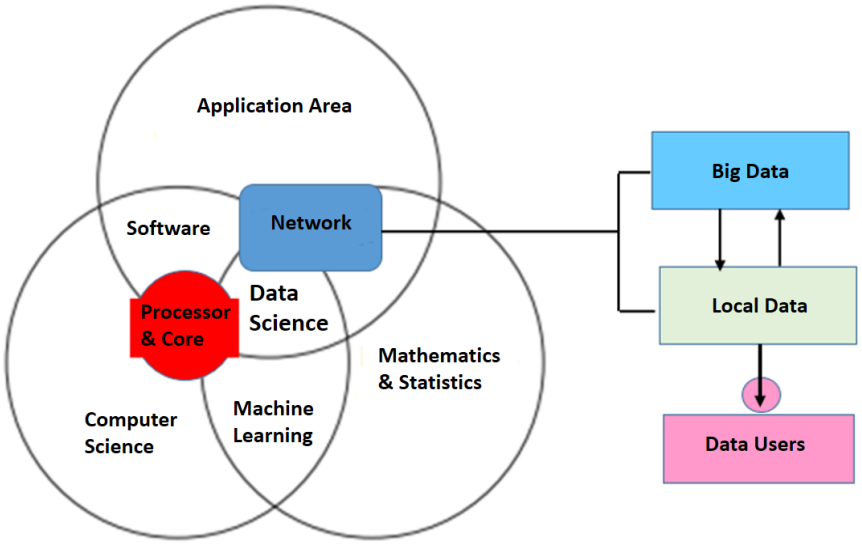

Figure 4. Data components supporting artificial intelligence & data governance (This figure, which is Inspired by Mike & Hazzan, 2023). What Is Data Science? was developed by Orhan Alav).

Today, science can transform imaginable abstract virtual realities into reality. This is not magic. In this context, in the near future, digital libraries without walls (information databanks) will take their place in the social structure, and new generation machines will be able to exchange information by talking among themselves according to certain languages and protocols. This process will redefine people, information resources, information centers, artificial intelligence, and information users. Today, information centers are hybrid, consisting of human and machine components. In libraries, which are the new generation of academic research information centers, IT/Network/Internet/W3/AI are used interactively together. Digitized libraries can articulate accredited information resources and research data into big data with Python, Java C+, C/MPI integrated software, and open-source software support in the High-Performance Computing (HPC) application process (Nowicki et al., 2021, p.2). And so, libraries evolve into inorganic information centers that can access data, read data, process data, and present data/develop solutions by going beyond the data in their archives through "Network / W3 / AI" components by transforming into digital form and joining the big data pattern. Informatics is an interdisciplinary science. IT/Network/Internet/W3/AI, which has developed based on informatics, has developed artificial intelligence technologies. All organizations and social structures have been radically affected by this development and change process. In this interaction, the transformation of traditional libraries into digital content and the generation of technical support and innovative values for deep learning and natural language processing, automated text comprehension research developed in partnership with human, network/internet/artificial intelligence/AI (Zhongyi et al., 2023, p.306-307) have further increased the importance of library organizations.

Librarians Adapted to Artificial Intelligence

The question of the limits of libraries and librarians in the face of artificial intelligence and digital information is the focus of this study. Artificial intelligence is a challenging and cutting-edge direction for changing/digital libraries in governance planning (Bauer et al., 1998, p. 484-488), research policy development, strategic management practices, service delivery methods, scholarly communication and innovation measurement (Zhongyi et al., 2023, p.307). So, where will "librarians", the organic living beings called humans, fit into this? The question remains for now, but will there be "human librarians" in digital libraries in the near future? We are not sure of the answer to this question for now. Nowadays, machine learning, and learning/teaching processes that understand and automate autonomous decision-making about what to do based on reinforcement learning (Sutton et al., 2018, p.13) are improving the capacity of next-generation digital/networked libraries to do almost all their work unmanned. This capacity pits human organism librarians against artificial "robot librarians" in the functioning of library organizations. It is necessary to develop a rational way and method for solving this problem and in the functioning systems of libraries. At the moment, the most appropriate solution seems to be a partnership in which "human" and "artificial" intelligence can be harmonized together.

Developments in IT/Networking/Internet/W3/AI/BD (Big Data) have pushed libraries as information centers towards unmanned libraries that can autonomously think and act. If artificial intelligence goes beyond both its limits and human limits, the big question and the problem start there and then (Figure 5).

Figure 5. Artificial intelligence formed librarians (Onedio Artificial Intelligence-AI, 2023)

Frontiers in Artificial Intelligence

Recent advances in information technology and artificial intelligence may enable greater coordination and integration between people and technology. Therefore, a lot of attention has been paid to the development of human AI, aiming at AI that adapts to the cognitive possibilities and limitations of human team members as a "team member". Moreover, metaphors such as "friend", "partner", "other self", "Intelligent Collaborator", "buddy" and "mutual understanding" emphasize the high degree of collaboration, similarity, and equality in "hybrid teams". When human-conscious AI partners operate like "human collaborators", they must be able to sense, understand, and react to a wide range of complex human behavioral attributes such as attention, motivation, emotion, creativity, planning, or argumentation (Korteling et al., 2021, p.1-13). Therefore, these "AI partners" or "teammates" should be equipped with human-like (or humanoid) cognitive abilities (i.e. "human awareness") that enable mutual understanding and cooperation. However, no matter how intelligent and autonomous AI agents become in certain respects, at least for the foreseeable future, they are likely to remain unconscious machines or special-purpose devices that support humans in specific, complex tasks. As digital machines, they are equipped with a completely different operating system (digital vs biological) and correspondingly different cognitive qualities and abilities than biological creatures such as humans and other animals (Moravec, 2024, p.1) and (Korteling et al., 2021, p.1-13). In general, digital reasoning and problem-solving agents are only very superficially comparable to their biological counterparts with

this in mind, it becomes increasingly important for professionals working with advanced AI systems to develop an appropriate mental model of the different cognitive capacities of AI systems in relation to human cognition (Korteling & Alexander, 2020, p.1-9). This issue will be increasingly important as AI systems become more advanced and deployed with higher levels of autonomy. Therefore, this paper attempts to provide some more clarity and understanding of the main characteristics, differences, and idiosyncrasies of these types. And in the near future, the number of digital data will increase geometrically exponentially (Figure 6).

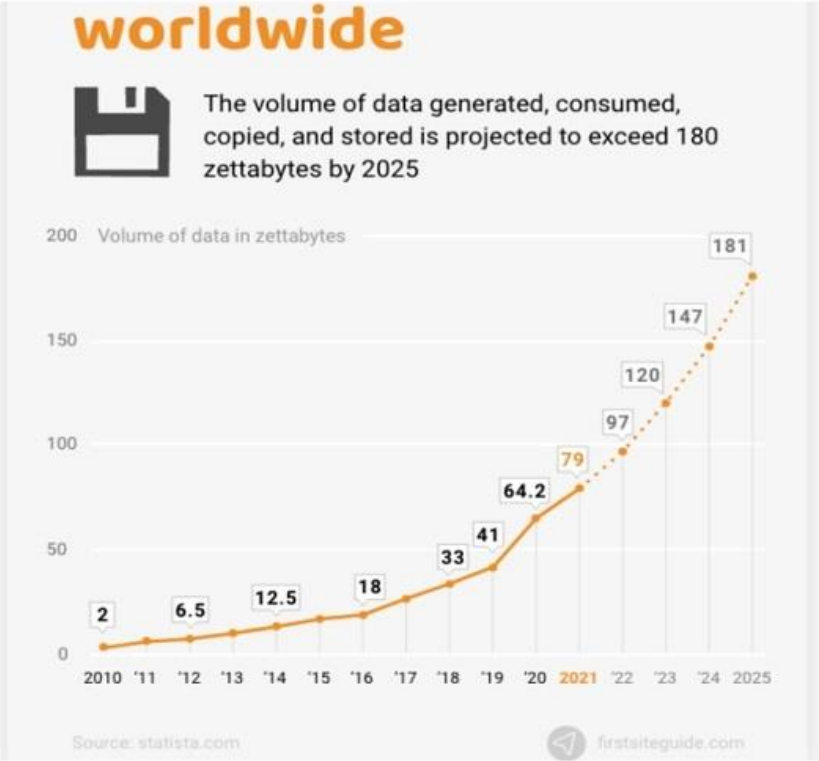

Figure 6. The volume of data/information created, captured, copied, and consumed worldwide from 2010 to 2025, with a forecast from 2021 to 2025 (Statistia, 2024)

4. Conclusion, Evaluation, and Recommendations

Among the most important discoveries of human civilization, "writing" and the "alphabet" have been the most powerful means of discovery and communication that have transformed the planet Earth we live on in terms of scientific and cultural structure. The adventure of writing, which started with stone and clay tablets, has evolved from the invention of papyrus, parchment, paper and printing press, and mass book printing to digital writing forms and digital tablets. In today's industry 4.0 & 5.0 digital communication era, civilization has evolved into a time of digital information resources, software, the internet of things, and artificial intelligence that can think and produce value within the IT/network/internet/w3/AI ecosystem. In this process, libraries as knowledge centers are moving beyond their traditional structures and transforming into action governance models with IT infrastructure, strong communication, and artificial intelligence based on the Internet of things. Today, where information has become a valuable commodity, Post 2 has evolved into a "digital" global world (Alav, 2023b, p.19).

In this process, digital information and autonomous thinking artificial intelligence's ability to produce content, speak, and show actionable behaviors have opened the doors of the new world. In this way, science and imaginable abstract virtual realities have been transformed into reality. New generation information centers will act in the future based on the combination of human profiles and artificial intelligence and will become centers where the use of data content and accredited data information for products is simulated rather than the visibility and access of information in digital form (Alav,

2023b, p.19). It is predicted that the volume of data produced, consumed, copied, and stored today will exceed 180 zettabytes by 2025 (Statistia, 2024) (Figure 6).

Based on our foresight, we can state the following conclusions:

- We believe that in the near future, the new generation of information centers will evolve into a different dimension that protects, processes, transforms, and simulates scientific knowledge based on hologram images, with autonomous function and control, and with networked, self-communicating, and plasma artificial intelligence.
- Today, although information exchange is carried out through artificial intelligence machines, the human factor is still the main determinant and influencing subject.
- It can be predicted that in the near future, the future form of information will be almost entirely in digital/digital form. In the future, librarians may be replaced by robot "artificial intelligence librarians" in digital information centers based on artificial intelligence.
- Artificial intelligence, and non-biological inorganic beings/human beings are now among us.
- "Artificial intelligence can be defined as machines that model human learning as a result of imitating human intelligence. Considering that learning processes in humans take place in the brain, it seems possible to create machines by examining the structure of the brain. Based on the fact that learning in humans takes place through the interaction in brain cells called neurons, artificial neural networks were created in computers, and learning was simulated." (Coşkun & Gülleroğlu, 2021, p.965) This is a magnificent technological revolution on the one hand, and a serious threat and danger to humanity on the other.
- Artificial intelligence's autonomous decision-making and integration with big data provide great advantages for libraries with digital forms and content in terms of time and access to information.
- The IT/network/internet/w3/AI ecosystem has created open science/open access and artificial intelligence. These developments have triggered the birth of unmanned digital libraries by affecting the change/transformation of libraries and the process of change in this direction has begun.
- In the future, machines may take humanity under their control, so humanity must always be careful. Human beings should always be the subject, they should not become objects.
- With the study, digital libraries, digital information resources, digital artificial intelligence robot/processor librarians, and digital transformation in the near future are evaluated with the support of literature.
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The article complies with national and international research and publication ethics.

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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Monitoring of Land Use/Land Cover Change and Statistical Analysis of Change within the Scope of Urban Sprawl; North Cyprus Case

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Abstract

Monitoring land use and land cover (LULC) change is one of the main methods used in assessing landscape dynamics and defining environmental health at different spatio-temporal scales. In this study, the LULC changes between 2013 and 2021 in some centers (Lefkoşa, Girne, Gazimağusa, and Lapta) located in the Northern Cyprus Island were monitored through UA and GIS technologies, and a projection for the year 2050 was created within the scope of the settlements. The results showed that, specifically for settlements, there was an increase of 65.59% in the Girne region, 33.60% in the Lapta region, 66.87% in the Lefkoşa region, and 83.50% in the Gazimağusa region, and this increase was mostly in the north and west directions. As a result of statistical analysis, the 2050 projection reveals that settlement centers will spread significantly. It is anticipated that the results of this study will be a reference for decision-makers within the scope of land management and urban settlement planning in Northern Cyprus.

Keywords: *Land use and land cover, change detection, urban sprawl, Landsat 8 OLI, supervised classification.*

Arazi Kullanımı/Arazi Örtüsü Değişiminin İzlenmesi ve Kentsel Yayılma Kapsamında Değişimin İstatistiksel Analizi; Kuzey Kıbrıs Örneği

Öz

Arazi kullanımı ve arazi örtüsü (AKAÖ) değişiminin izlenmesi, peyzaj dinamiklerinin değerlendirilmesinde ve farklı mekânsal-zamansal ölçeklerde çevre sağlığının tanımlanmasında kullanılan temel yöntemlerden biridir. Bu çalışmada da uzaktan algılama (UA) ve coğrafi bilgi sistemleri (CBS) teknolojileri vasıtasıyla Kıbrıs Adası'nın kuzeyinde yer alan bazı merkezlerdeki (Lefkoşa, Girne, Gazimağusa ve Lapta) 2013-2021 yılları arasındaki AKAÖ değişimi izlenmiş ve yerleşimler kapsamında 2050 yılına yönelik projeksiyon oluşturulmuştur Sonuçlar, yerleşim yerleri özelinde Girne bölgesinde %65,59, Lapta bölgesinde %33,60, Lefkoşa bölgesinde %66,87 ve Gazimağusa bölgesinde %83,50 artış olduğunu ve bu artışın çoğunlukla kuzey ve batı yönlü olduğunu göstermiştir. İstatistiksel analizler sonucu 2050 yılı projeksiyonu, yerleşim merkezlerinin önemli oranda yayılım göstereceğini ortaya koymaktadır. Bu çalışma sonuçlarının, Kuzey Kıbrıs özelinde arazi yönetimi ve kentsel yerleşim planlaması kapsamında karar vericilere referans olacağı öngörülmektedir.

Anahtar kelimeler: *Arazi kullanımı ve arazi örtüsü, değişim tespiti, kentsel yayılma, Landsat 8 OLI, kontrollü sınıflandırma.*

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1. Introduction

Global social and economic developments increase urbanization within the world ecosystem, and urbanization creates pressure on natural areas, causing significant changes in ecosystems, environment, landscape, and biodiversity (Rahman et al., 2019; Kafy et al., 2020; Türker & Akten , 2023). Although urbanization is an indicator of economic development and prosperity, it also creates negative consequences, especially on natural ecosystems, in the short and long term (Maimaitiyiming et al., 2014; Nathaniel et al., 2021). Land use/land cover (LULC) change within the scope of urban expansion brings with it many ecological problems such as climate change, air pollution, biodiversity loss, etc. in the long term (Selim & Demir, 2018; Wang et al., 2020; Zhang et al., 2022). Land use and land cover pattern is a distinctive element of the landscape that has direct and indirect connections with various socio-economic and socio-cultural processes (Foley et al., 2005). This pattern represents the rate of human activities on the land surface, mostly in the form of LULC change, and this change affects land use systems (Wang et al., 2021). The speed and order in the change of LULC depends mainly on the economic, social, and political characteristics of people and the regional policies of central and local governments (Sleeter et al., 2018; Gomes et al., 2020). Therefore, detecting the LULC change temporally and spatially has become one of the priority issues in order to take the necessary precautions by determining the control, limits, speed and possible effects of this change (Li et al., 2023; Alawamy et al., 2020; Lunetta et al., 2022).). The assessment of LULC change has become central to various aspects of the human and natural environment and the interaction between them (Hu et al., 2019; Baig et al., 2022). Assessment of LULC is essential to solve a number of environmental problems at the regional level, such as unregulated urbanization, loss of productive agricultural lands, destruction of wetlands, degradation of wildlife habitat and pressures on ecosystem services (Hussain et al., 2020a; Aghsaei et al., 2020; Aneseyee et al., 2020; Taiwo et al., 2023). In addition, LULC change has become more important in land use planning and land management due to its negative effects on the state and integrity of ecosystem functioning (Duan et al., 2023; Li et al., 2023).

Determining LULC change is a spatial phenomenon and requires a spatial strategic approach (Kafy et al., 2020). Remote sensing (RS) and geographic information systems (GIS) technologies are mostly used in the literature to simulate the current and future forms of land use change (Hussain et al., 2020b; MohanRajan et al., 2020; Bagwan et al., 2023). Nowadays, we can detect spatio-temporal LULC changes using satellite data. These data appear as one of the most reliable tools in monitoring the wide spatial range of the earth (Chamling & Bera, 2020). Remotely sensed wide spectrum range satellite data have been proven in the literature to be highly reliable and cost-effective for measuring various dimensions of LULC variation, saving time and providing accurate results (Abdullah et al., 2019; Shah 2012; Zhai et al., 2021). A comprehensive scientific perspective is offered to get historical, present, and future LULC characteristics by combining several descriptive remote sensing models with variable, multi-temporal, high-resolution satellite images (Li et al., 2014; Chamling and Bera, 2020; Selim et al., 2023). Monitoring LULC change is also very feasible and easy using satellite data, and therefore it is widely preferred among researchers from an operational perspective (Attri et al., 2015; Vivekananda et al., 2021; Ghute et al., 2023).

Determining the LULC change and incorporating the results obtained in this context into spatial planning in the relevant area has become even more important, especially in terms of socio-economic and geo-political regions where urban development is accelerated. In this context, the Island of Cyprus is an important region in terms of monitoring the LULC change and creating future projections due to its location, economic, cultural and social structure. Although the economy of Northern Cyprus is mostly dependent on the service sector, it shows significant growth due to its climate characteristics and tourism activities. Although the economic structure is less diverse like other small island economies, the construction sector has become one of the locomotive sectors of the Northern Cyprus economy due to the increase in foreign demand (Şafakli, 2011). Settlements, especially tourism facilities, are spreading rapidly on the island and especially in the coastal areas. Therefore, land uses differ and land cover changes. Within the scope of sustainability, detecting this LULC change, obtaining information about its momentum from past to present and its potential status in the future is of great importance for spatial planning decisions of the region. The fact that no comprehensive LULC change

study has been found in the literature for Northern Cyprus throughout the region increases the importance of this study.

In this study, it was aimed to determine the LULC change of Lefkoşa (Nicosia), Girne (Kyrenia), Gazimağusa (Famagusta), from now on it will be called Mağusa, and Lapta, which are the 4 major cities of Northern Cyprus that are important in terms of tourism, between 2013 and 2021, and to estimate the potential settlement spread for the future. The main data set consists of Landsat 7 ETM+ and Landsat 8 OLI/TIRS satellite images. Satellite images of each region in the relevant years were provided with open access, image pre-processing and classification were carried out, and accuracy analyzes were applied. The numerical data obtained was used to create future projections with the help of statistical analysis. It is envisaged that the results of the study can benefit the central and local governments of the region and affect spatial planning decisions.

2. Material and Method

2.1.Material

The main material of the study consists of the city centers and their immediate surroundings of Lefkoşa, Girne, Mağusa and Lapta, which are the four largest settlements of Northern Cyprus (Figure 1).

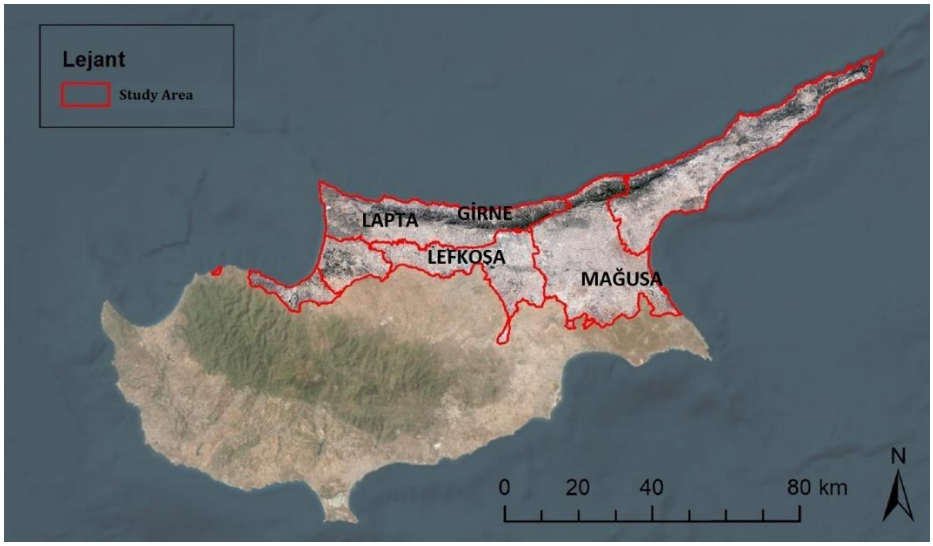


Figure 1. Study area

Cyprus, the third-largest island in the Mediterranean, behind Sardinia and Sicily in Italy, is 71 km away from Turkey and is located at 34°33' and 35°42' north latitudes and 32°16' east longitudes. While the Turkish Republic of Northern Cyprus (KKTC) is located in the northern part of the island, which has a surface area of 9,251 km^2, there is the Greek Administration of Southern Cyprus (GASC) in the southern part. The KKTC surface area is 3241 km^2, accounting for 35.04% of the island, the Greek Cypriot Administration's surface area is 5509 km^2 (59.56%), and the British military zone is 256.01 km^2. The buffer zone covers an area of 244.04 km^2 (TCDB, 2024). The region is defined as "semi-arid" according to the macro climate classification. In winter, the average temperature ranges from 5 to 15 °C, while in summer, it can reach 40 °C. The average precipitation is approximately 500 mm per year, the lowest precipitation is 182 mm and the highest precipitation is 759 mm (Payab &Türker, 2019).

The data set of the study consists of Landsat 7 ETM+ and Landsat 8 OLI/TIRS satellite images. These images were provided open access through the EarthExplorer (EE) user interface developed by the United States Geological Survey (USGS) (Table 1).

Table 1. Satellite images features preferred in the study

Landsat 7	Wavelength (Mikrometer)	Landsat 8	Wavelength (Mikrometer)	Resolution (meter)
Blue	0.45-0.52	Blue	0.45-0.51	30
Green	0.52-0.60	Green	0.53-0.59	30
Red	0.63-0.69	Red	0.64-0.67	30
Near Infrared (NIR)	0.77-0.90	Near Infrared (NIR)	0.85-0.88	30

In the study, open source QGIS 3.6.3 software was used to perform pre-processing (band merge, subset, mosaic, image enhancement) of satellite data. ArcGIS 10.4.1 software, which is in our faculty's inventory, was used for image classification processes.

2.2.Method

The study method was carried out in 6 stages: data acquisition, pre-processing of satellite images, classification processes, statistical projection analyses, assessment and results/suggestions (Figure 2).

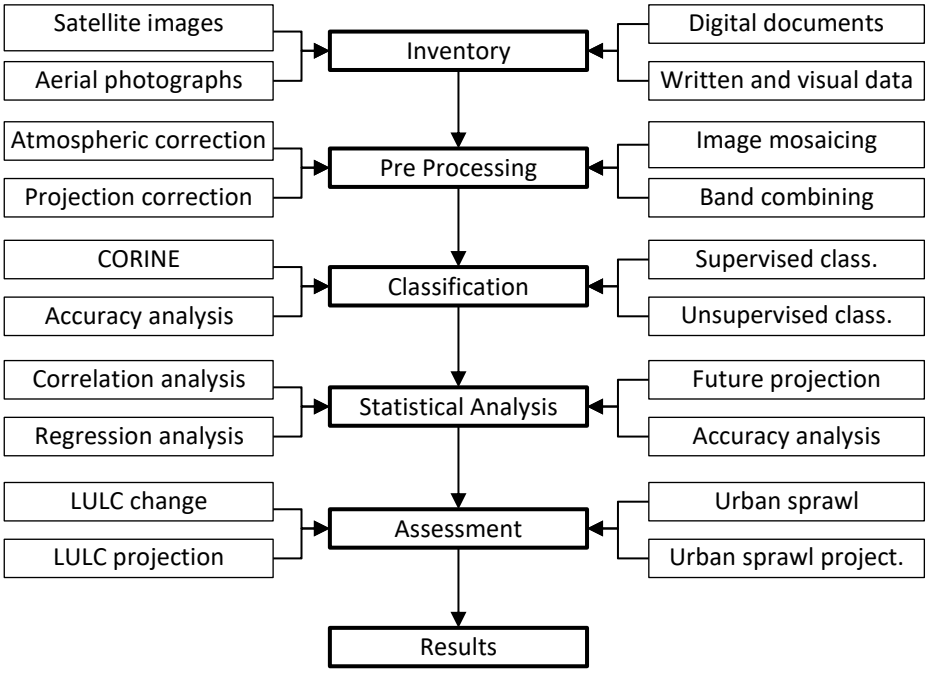


Figure 2. Method flowchart

During the inventory phase, satellite images for June of each year between 2013 and 2021 were obtained. Aerial photographs of the region from past years and today were provided for use in the evaluation phase. A database was created in GIS software by providing written, visual and numerical data to be used in the classification and evaluation phase. In the created database, in the 9-year period, including 2013 and 2021, data for this year were ignored due to the high cloudiness level in the satellite images of June 2015. Then, atmospheric and projection correction operations were carried out with QGIS software over the relevant database, and mosaicing and band combining process steps were applied.

During the classification phase, CORINE (Coordination of Information on the Environment) 1st level settlement, agriculture, forest, water surface and other class values were assigned for supervised and unsupervised classification processes. A minimum of 500 sample points were selected for each class. 500 sample points taken from open access Google Earth Pro on the same date and from the same regions were transferred to ArcGIS and compared with the classifications produced. The image processing phase continued with supervised classification, which produced higher accuracy.

Correlation and regression analyzes were applied in the statistical analysis part of the study, and it was seen that the best statistical analysis technique representing the data obtained specifically for settlements was the linear regression model (formula 1). Therefore, linear regression analysis was applied to the change in the residential areas of each region over the years.

$y = \beta_0 + \beta_1 x + \varepsilon$ (James et al., 2023) formula 1

- y is the dependent variable
- x is the independent variable
- β_0 is the costant or intercept
- β_1 is x's slope or coefficient
- ε is the error term

In the evaluation, conclusion and recommendations stages, the trends in the spread of settlements and potential development projections for 2050 were interpreted within the scope of LULC and specifically for each region. In this context, suggestions that can guide spatial planning are presented.

3. Findings and Discussion

3.1. Findings

In this study, carried out in 4 district centers in the Northern Cyprus, which has strategic and geopolitical importance, supervised classification was carried out to determine LULC classes and reveal their changes according to years, and the average classification accuracies for all years are presented in Table 2.

Table 2. Classification accuracies of regions

Regions	Accuracy (%)	Error ratio (%)
Girne	87,57	12,43
Lefkoşa	87,10	12,90
Mağusa	85,50	14,50
Lapta	88,01	11,99

Supervised classification results reached over 85% user accuracy in all regions. Error rates are generally due to the fact that roofless buildings and vacant lands give similar reflectance values, and the mixing of agricultural lands and forest areas that border each other. Reaching a similar accuracy value in images of a region from all years allows accurate evaluation of LULC change and especially the spread of urbanization. In this context, each region has been examined separately and is presented below as Girne Region, Lefkoşa Region, Mağusa Region and Lapta Region.

3.1.1. Girne region

The urban settlement of Girne District, which has a coast to the Mediterranean, generally spreads in an east-west direction along the coastline. Agricultural areas have a fragmented and scattered appearance within the urban settlement. Urban settlement and agricultural areas are surrounded by forest class, and it is understood that urbanization has spread to the inner regions up to the slopes of the mountains. It is seen that urbanization is in an increasing trend every year from 2013 to 2021 (Figure 3).

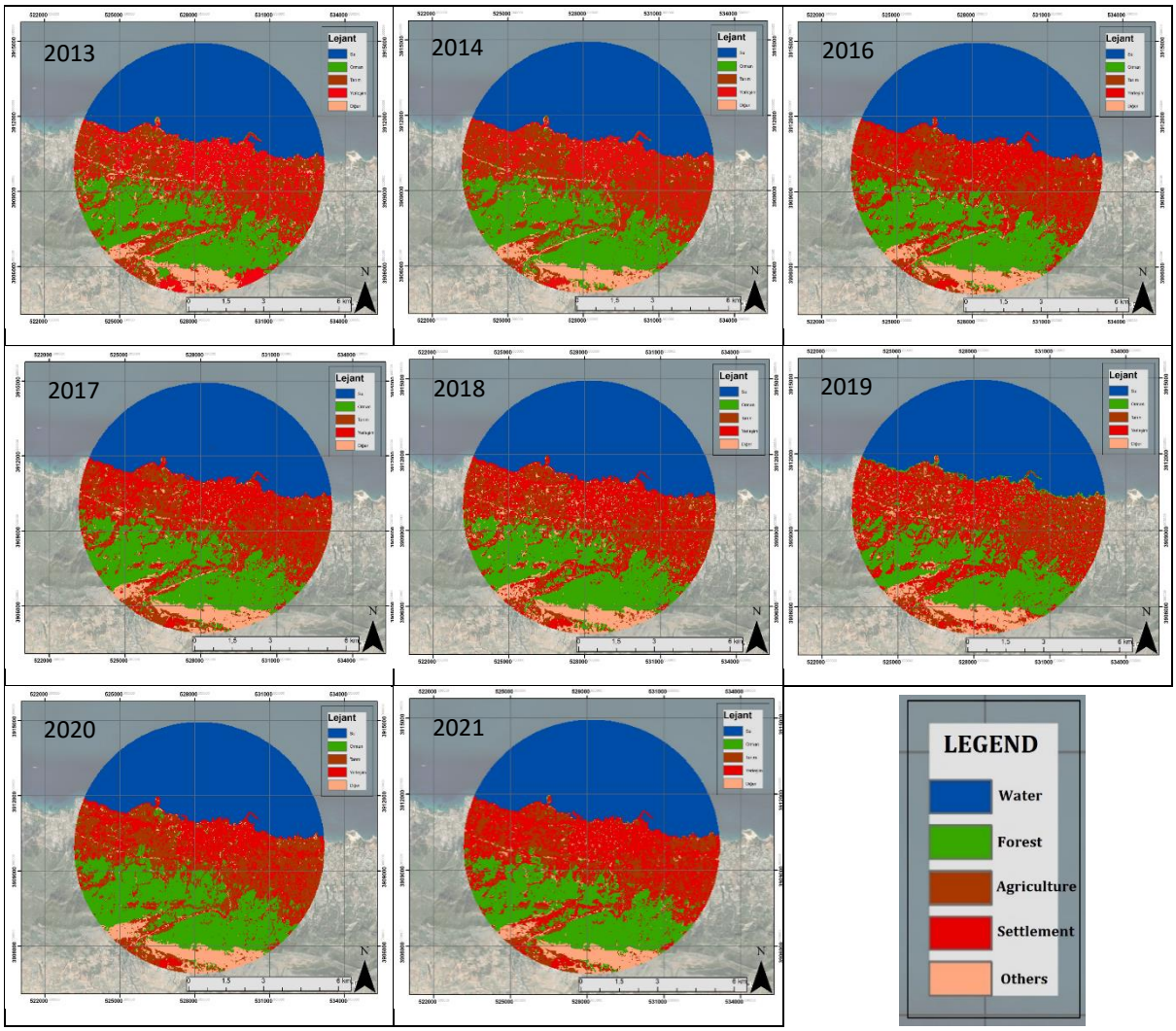


Figure 3. Classified images of Girne urban settlement by years

Girne urban settlement, 7800 ha of which was selected as the study area, showed a steady increase in the classified residential areas from 1186 ha in 2013 to 1964 ha in 2021. Although there is no significant increase or decrease in forest areas, it is seen that settlements increase mostly on agricultural areas and vacant lands (Table 3).

Table 3. Area distribution of LULC classes in Girne region by years (ha)

Girne	Water	Forest	Agriculture	Settlement	Others	Total
2013	2780	1661	1385	1186	788	7800
2014	2775	1799	1440	1402	385	7800
2016	2791	1729	1173	1568	538	7800
2017	2786	1750	1333	1584	347	7800
2018	2799	1706	1168	1676	451	7800
2019	2794	1632	1063	1754	557	7800
2020	2816	1659	1090	1885	350	7800
2021	2812	1653	1029	1964	342	7800

It is understood that some of the urban agricultural areas have been converted into settlements and that settlements are increasing, especially in coastal areas. Girne population increased by 10.7% between 2006-2011 and this rate will be 38.8% between 2011-2020 has been reported (DPÖ, 2020). This confirms that the increase in urbanization is due to the population growth and the need for housing.

3.1.2. Lefkoşa region

Lefkoşa, located in the central part of the island and the capital of the Turkish Republic of Northern Cyprus, is the most populous city in the region in terms of population. There are wetlands and fragmented forest areas in the city. The settlements are densely spread within the study borders (Figure 4).

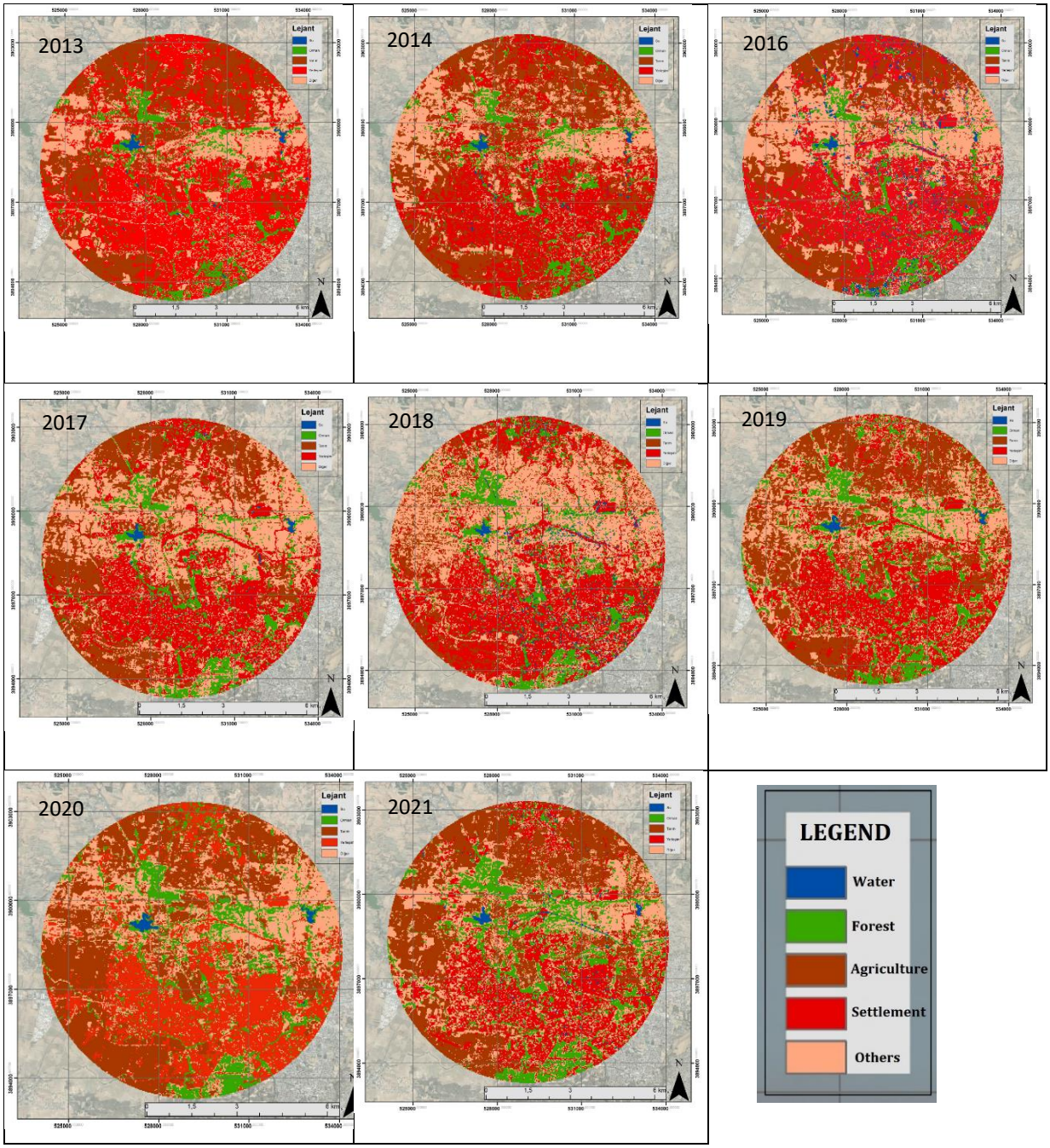


Figure 4. Classified images of Lefkoşa urban settlement by years

In the capital Lefkoşa, the settlement areas classified within the boundaries of the 7800 ha study area in 2013 were 2095 ha, reaching 3496 ha in 2021, an increase of approximately 67%. Likewise, an increase was observed in forest area and water surfaces within the city (Table 4). It is understood that the "KKTC Water Supply Project", which became operational in 2015, positively affected the green areas and water availability in the cities of the region.

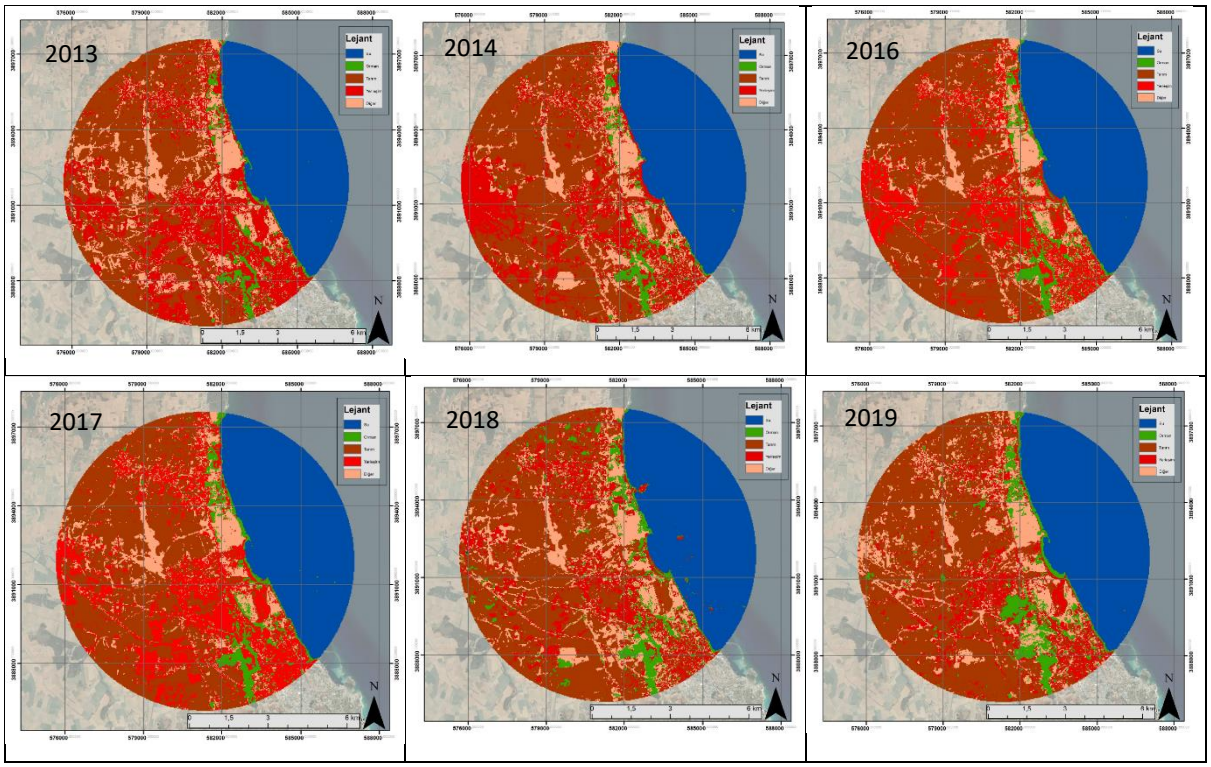
Table 4. Area distribution of LULC classes in Lefkoşa region by years (ha)

Lefkoşa	Water	Forest	Agriculture	Settlement	Others	Total
2013	45	618	2585	2095	2456	7800
2014	61	710	2467	2253	2309	7800
2016	55	603	2500	2295	2346	7800
2017	50	784	2325	2433	2208	7800
2018	43	974	2245	2692	1846	7800
2019	36	1082	2278	2725	1678	7800
2020	38	1019	2255	2832	1656	7800
2021	81	1249	1564	3496	1410	7800

According to DPÖ (2020), it was reported that there was a 32.1% increase in the projection population of Lefkoşa in 2020, which was based on the population censuses of 2006 and 2011. Lefkoşa's capital status, the increase in population over the years and the development of tourism activities have increased the need for housing, and the construction in the city center has developed on urban agricultural lands. The results obtained show that vacant lands in the city are being replaced by residences.

3.1.3. Mağusa region

In Mağusa, which is one of the most important port cities of the KKTC and the Mediterranean and also an important tourism and education center, settlements lie along the coast and spread towards the inner regions due to the suitable land structure. In the 2011 image, it is understood that the building density is distributed in the north-south direction of the city, and in 2023, this density has spread and developed significantly towards the western part (Figure 5).



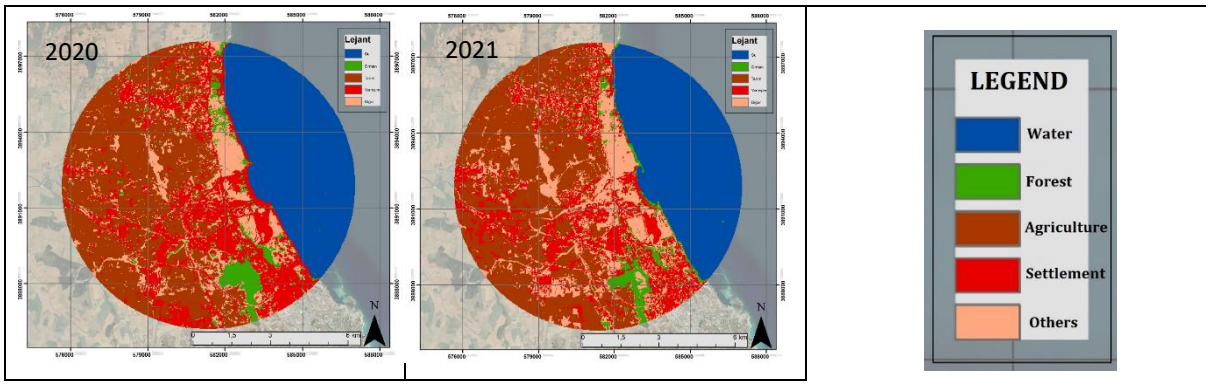


Figure 5. Classified images of Mağusa urban settlement by years

In Mağusa, which is a tourism and port city, the residential areas classified within the boundaries of the study area in 2013 were 1194 ha, reaching 2191 ha in 2021, an increase of approximately 83%. Vacant lands within the city have shrunk under the pressure of urbanization, and the unsloping land structure has been effective in the speed of urbanization. It is understood that tourism construction has increased along the coastal area and the structures have spread throughout the city center (Table 5).

Table 5. Area distribution of LULC classes in Mağusa region by years (ha)

Mağusa	Water	Forest	Agriculture	Settlement	Others	Total
2013	2837	318	3912	1194	1740	10000
2014	2841	366	3893	1274	1626	10000
2016	2837	447	3850	1747	1119	10000
2017	2835	467	3841	1767	1090	10000
2018	2818	571	3752	1878	981	10000
2019	2812	648	3625	1983	933	10000
2020	2835	408	3783	2117	857	10000
2021	2822	369	3648	2191	970	10000

According to DPÖ (2020), it was reported that there was a 36.5% increase in the projection population of Mağusa between 2011-2020. The partial decrease in urban agricultural areas, the stability of the forest class within the city and the approximately 79% decrease in vacant lands in an 8-year period show that the urbanization pressure is developing in this direction.

3.1.4. Lapta region

Located in the Girne region of KKTC and on the seashore, Lapta is a tourism region that serves the tourism sector 12 months a year. Many tourism facilities are located in this region. In addition to the local population, a significant proportion of British and German populations reside in this region. It is mostly covered with tourism facilities in the coastal region, urban settlements with secondary residences in the inner parts, and forest areas towards the slopes of the mountains (Figure 6). The fact that the Girne-Güzelyurt highway passes through this region has caused the settlement density to concentrate around this highway next to the coastline.

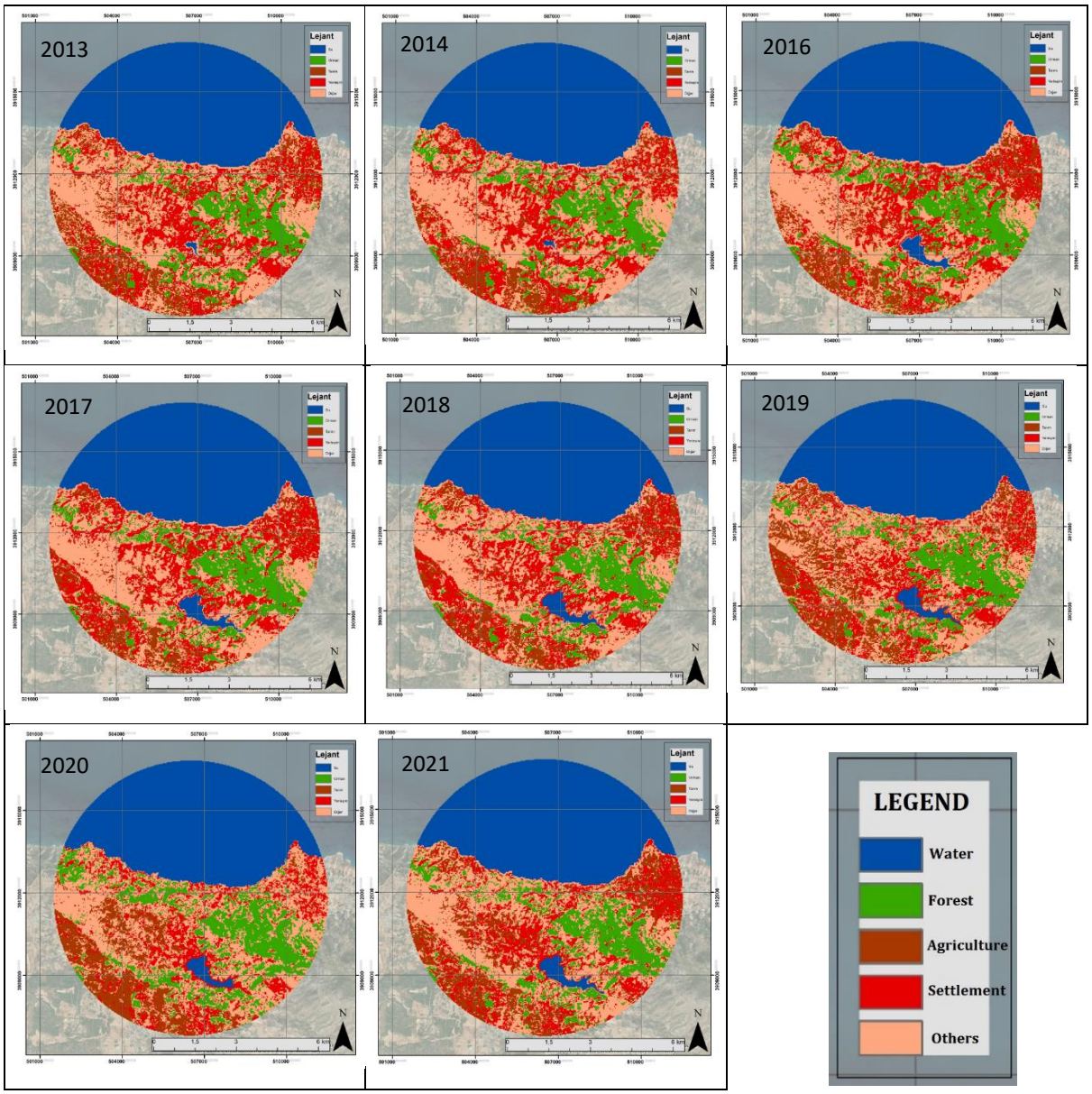


Figure 6. Classified images of Lapta urban settlement by years

Lapta, a tourist town, is more advantageous than other regions in the study in terms of urban forest areas. While the residential areas classified in 2013 were 1110 ha, they reached 1483 ha in 2021, an increase of approximately 34% (Table 6). Geçitköy Dam is located in this region and this supports agricultural activities and irrigation systems in the region. The increase in water surfaces is due to the increase in the amount of water in the Geçitköy Dam with the KKTC Water Supply Project, which came into operation in 2015.

Table 6. Area distribution of LULC classes in Lapta region by years (ha)

Lapta	Water	Forest	Agriculture	Settlement	Others	Total
2013	2830	777	672	1110	2411	7800
2014	2844	872	650	1146	2888	7800
2016	2886	971	620	1183	2140	7800
2017	2914	857	608	1767	1346	7800
2018	2906	817	613	1358	2016	7800
2019	2906	894	638	1394	1967	7800
2020	2919	880	624	1426	1951	7800
2021	2898	866	612	1483	1941	7800

According to DPÖ (2020), it was reported that there was a 23.7% increase in the projection population of Lapta between 2011-2020. This increase is parallel to the 34% increase in urban areas within the scope of the study. Especially with the introduction of the water supply project, an increase in forest areas has been observed since 2016, and settlements have generally spread over vacant lands and agricultural areas.

3.1.5. Statistical analysis of urban change and future projection

In this study conducted specifically for 4 important regions of Northern Cyprus, the LULC change between 2013 and 2021 was determined and this change was calculated in area and percentage. From these change data, regression analysis was applied for the settlement class and correlation curves were created. The mathematical relationship between two variables was produced by "Regression Analysis", and the direction and degree of the relationship was produced by "Correlation Analysis" (Figure 7). Linear regression analysis was used because there is a linear relationship between two sets of numbers (location and time) that may be related to each other. Linear regression, which was applied to create a future projection about the relationship between time, an independent variable, and location, a dependent variable, was preferred because it is the model that best represents the data produced.

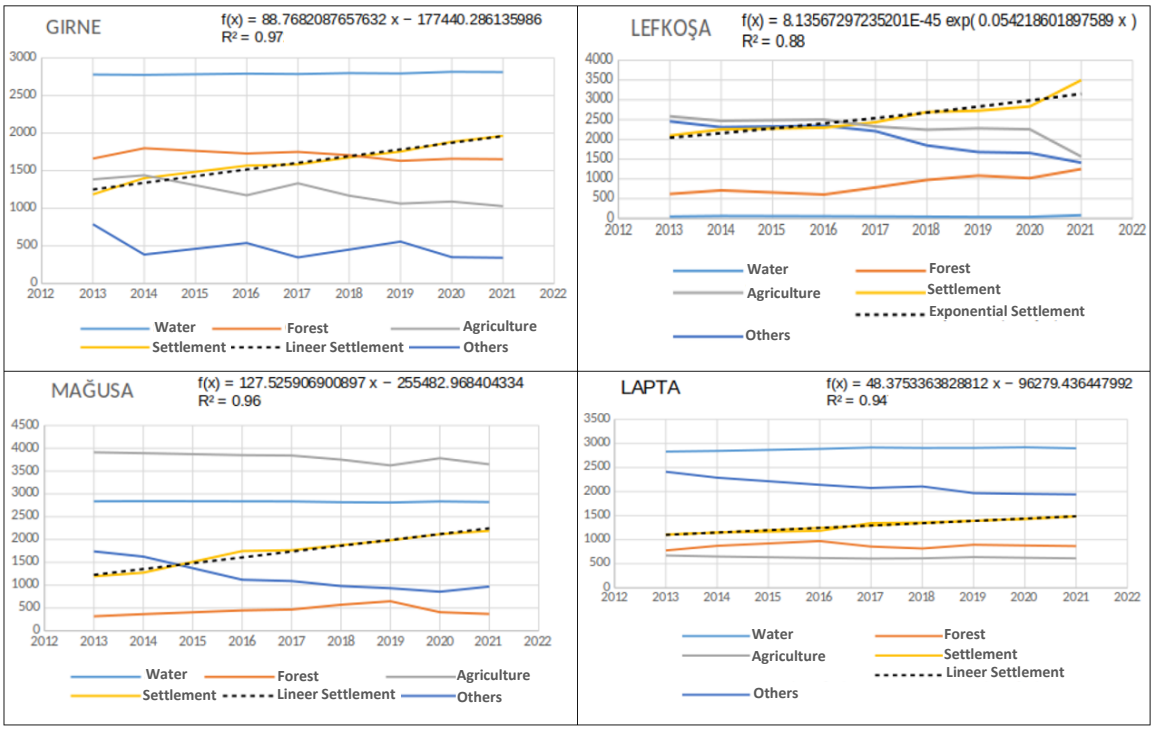


Figure 7. Correlation curves for regions

The r^2 values obtained from the regression analysis are close to 1, as seen in the figure above. The positive linear relationship between settlement and time confirms that settlements are increasing year by year. Within the scope of statistical analysis, a forecast table for 2030-2040 and 2050 was created for the areal values of the increases in the settlements of 4 regions (Table 7).

Table 7. Future projection of areal changes of settlements (ha)

Years	Girne	Lefkoşa	Mağusa	Lapta
2013	1249.98	1934.57	1215.41	1099.88
2021	1960.13	2984.65	233597	1486.88
2030	2759.04	4861.19	3484.10	1922.25
2040	3646.72	8358.53	4759.80	2406.00
2050	4534.40	14372.01	6035.50	2889.75

According to Table 7, when looking at the spread of settlement areas of the regions in 2050, it is understood that the urban settlement spread of the capital Lefkoşa is quite large. It is seen that there may be a large increase if there is no intervention within the current plans and developments. Nicosia is followed by Mağusa, Girne and Lapta, respectively. It is understood that the current acceleration of settlement expansion is quite rapid for Northern Cyprus, an island country.

3.2.Discussions

This study, which covers the important settlement centers in terms of tourism and trade in the northern part of Cyprus, the 3rd largest island of the Mediterranean, aims to determine the change of LULC in central settlements from 2013 to 2021 and to estimate the possible projection for the future based on this change. In this context, meaningful results were obtained in line with the data produced. According to these results, it is estimated that the central settlements of Girne will cover an area of approximately 4534 ha in 2050, the central settlements of Lefkoşa will cover 14372 ha, Mağusa 6035 ha and Lapta 2890 ha. In the case of Girne, while urban expansion was at a minimum level before 2002, it was reported that a serious urban expansion started with the UN Peace Plan of 2002 and there were significant increases in the construction sector (Oktay & Bala, 2015). The projection produced shows that urban sprawl will increase with population growth. It was predicted that the expansion in Girne would increase along the coast, creating pressure on the natural structure (Warner, 1999). Lefkoşa, which is the trade and economic center of the region, has increased greatly both in terms of population and urban expansion, and it has been reported that the old buildings in the city were demolished and replaced with more modern and tall buildings (Oktay, 2005). According to the results of the LULC between 2013 and 2021, it was observed that construction increased. Nikoofam & Mobaraki (2020) emphasized that Mağusa is facing rapid and unplanned urbanization and stated that the quality of life in the region will be affected by this inappropriate settlement spread. Kara & Dolatlı (2021), with their sustainable urban development scenarios studies covering the years 2002–2011, revealed that the Mağusa region will move away from sustainability if no precautions are taken. As a matter of fact, the LULC change covering the years 2013-2021 confirms that this region is under urban expansion pressure. The Lapta region, on the other hand, stands out as a tourism resort where urban expansion is increasing, especially under the pressure of secondary residences (Wagner, 1999b).

In all four regions discussed in the study, urban expansion develops on green areas, productive agricultural areas and vacant lands. In particular, the potential to transform urban open green space into residential areas puts urban sustainability under pressure. In order to benefit from the various ecological and functional features of urban green spaces such as carbon storage, CO_2 emission reduction, sustainable biodiversity etc., the growth of urbanization on these areas should be limited and directed (Selim et al., 2015; Tuğluer & Çakır, 2019; Gül et al., 2021). The resilience of cities can be strengthened if there are sufficient open and green spaces and these areas are integrated into the daily life of the society (Şahin et al., 2024). In order to ensure urban sustainability, spatial-functional

developments and future conservation-development potentials need to be taken into account. In addition, it is necessary to protect the original local values and to consider holistic approaches with the historical information of the cities and their surroundings (Ardahanlıoğlu et al., 2020; Erdoğan and Öztürk, 2019). In order to direct and classify the spread of cities in urban planning, urban green spaces should be included in the green infrastructure system and a holistic planning approach should be applied (Gül et al., 2020; Selim, 2021). The increase in urbanization spread, especially in coastal areas, is a result of transportation routes built with hotels and secondary residences in these regions (Oni, 2013; Fuladlu et al., 2021). These activities lead to the transformation of coastal landforms, flora and fauna (Oni, 2013), and cause the deterioration of micro ecosystems in the coastal area due to economic concerns. The absence of a regional master plan and weak zoning regulations (Fuladlu et al., 2021) have led to an increase in unplanned urban sprawl. Past and current studies on the region support the LULC change produced at the end of this study and confirm that urban sprawl has increased significantly (Oktay, 2005; Oktay & Conteh, 2007; Fuladlu et al., 2018; Kara & Dolatlı, 2021; Geddes et al. , 2023).

4. Conclusion and Suggestions

The increase in population causes an increase in the demand for settlements. Therefore, the urban pattern spreads horizontally and vertically to respond to this population. Urban sprawl is a complex phenomenon that varies from place to place and has a detrimental impact on the sustainability of urban growth. Researchers also explore in detail the monitoring of LULC change in urban sprawl, developing and implementing a number of studies and methodologies. These methods are mostly based on measurements and analysis with tools such as RS and GIS. This study focuses on monitoring the LULC change in 4 important settlement centers in Northern Cyprus, detecting urban sprawl and estimating the future projection by using RS and GIS technologies. According to the research results, settlements have increased significantly in the relevant field of study between the last years 2013-2021. An increase of 65.59% in the Girne region, 33.60% in the Lapta region, 66.87% in the Lefkoşa region and 83.50% in the Mağusa region was detected. This increase is mostly concentrated on agricultural areas, green areas and vacant lands within the city. It is understood from the future projections that if there is no urban development action plan or zoning plan intervention that will allow controlled development, this urban expansion will increase much faster in 2050 and may reach irreparable levels. Since the obtained LULC change covers only the selected study area, this change should be developed to cover all Northern Cyprus settlements, especially in order to monitor urban development more accurately and take the necessary precautions. Additionally, in order to evaluate the different dimensions of LULC change, precise determinations must be made using satellite images at resolutions that will allow monitoring and evaluation analyzes from the regional scale to the neighborhood scale. It is necessary to monitor the development and change of the entire region, especially since the 2000s, and to determine this change with RS and GIS techniques. In this context, sustainable spatial plans must be urgently produced, implemented, and supervised. Only in this way can unplanned development that is likely to be encountered in the future be prevented. In addition, according to the results obtained within the scope of the study, the LULC change in the relevant years mostly showed a tendency towards construction, and this construction created pressure on the natural structure of the island.

The GIS-based methodology preferred in the study can also be applied to other settlements in the region to determine the potential urban sprawl trend. The results of the study can be used by researchers, policy makers, and decision makers to guide the creation of spatial planning strategies. In addition, with the projection created for the future, the effects of potential environmental problems can be reduced and opportunities for sustainable development can be created. This research is one of the most comprehensive studies to date, estimating the future projection of urban sprawl by monitoring the LULC change of 4 large urban settlements in Northern Cyprus.

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Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to the article. Material preparation, data collection and analysis were performed by [Çiğdem Esendağlı] and [Serdar Selim]. The first draft of the manuscript was written by [Serdar Selim] and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript. There is no conflict of interest.

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The Effect of Suggested Ventilation Approaches After Covid-19 on The Probability of Infection, Number of Cases and Ventilation Rates in University Classrooms

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Abstract

After COVID-19, two ventilation approaches have been adopted for infection control. The first is the EN 16798-1 ventilation standard recommended by international organizations. The second is ventilation design, determined according to the risk of infection. This study investigated the effects of various post-COVID-19 ventilation scenarios on the probability of COVID-19 infection, the number of cases, and ventilation rates in four separate university classrooms. Ventilation rates based on infection risk and infection risk were determined by the Wells-Riley mathematical model calibrated to the SARS-CoV-2 virus. The findings showed that the EN 16798-1 ventilation standard may be inadequate in terms of infection risk in classrooms. It showed that ventilation rates determined based on infection risk may not be met by existing HVAC system capacities, even in LEED-certified schools. In possible future pandemics, current ventilation standards and air conditioning system designs in schools should be reviewed in order to control the outbreak.

Keywords: *Ventilation, COVID-19 infection risk, Wells-Riley Model, classrooms.*

Covid-19 Sonrası Önerilen Havalandırma Yaklaşımlarının Üniversite Dersliklerinde Enfeksiyon Olasılığı, Vaka Sayısı ve Havalandırma Oranlarına Etkisi

Öz

COVID-19 salgını sonrasında enfeksiyon kontrolü için iki havalandırma yaklaşımı benimsenmiştir. Birincisi, uluslararası kuruluşlar tarafından önerilen EN 16798-1 havalandırma standardıdır. İkincisi, enfeksiyon riskine göre belirlenen havalandırma tasarımıdır. Bu çalışmada, dört ayrı üniversite sınıfındaki çeşitli COVID-19 sonrası havalandırma senaryolarının, COVID-19 enfeksiyon olasılığı, vaka sayısı ve havalandırma oranları üzerindeki etkilerini araştırıldı. Enfeksiyon riskine dayalı havalandırma oranları ve enfeksiyon riski, SARS-CoV-2 virüsüne göre kalibre edilen Wells-Riley matematiksel modeliyle belirlenmiştir. Bulgular, EN 16798-1 havalandırma standardının dersliklerde enfeksiyon riski açısından yetersiz olabileceğini gösterdi. Enfeksiyon riskine dayalı belirlenen havalandırma oranlarının, LEED sertifikalı okullarda bile mevcut HVAC sistem kapasiteleri tarafından karşılanamayabileceğini gösterdi. Gelecekteki olası pandemilerde, salgının kontrol altına alınabilmesi için mevcut havalandırma standartlarının ve okullardaki iklimlendirme sistem tasarımlarının yeniden gözden geçirilmesi gerekmektedir.

Anahtar kelimeler: Havalandırma, COVID-19 enfeksiyon riski, Wells-Riley Model, derslikler.

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1. Introduction

Various studies have hypothesized that the SARS-COV-2 virus can also be spread through the air and persist in the air for up to 3 hours (Lipinski et al., 2020). Thus, during the COVID-19 pandemic, the risk of airborne infection should also be considered in closed places with many users and common areas such as classrooms. In enclosed indoor situations, one of the best ways to reduce the risk of airborne viral transmission, in addition to taking personal precautions, is to provide ventilation conditions that can lower the virus concentration. Hence, the parameters that determine the indoor environment's air quality and ventilation strategy and the particular actions to be performed as part of the COVID-19 pandemic measures occupy a crucial position.

With the global COVID-19 outbreak, the World Health Organization (WHO) deems inadequately ventilated rooms to be at high risk. For education to continue safely after the reopening of schools during the COVID-19 pandemic, existing facilities should be ventilated as effectively as possible (Bhagat et al., 2020). These developments have proven the need for fresh ventilation design in buildings during the COVID-19 pandemic.

Before the COVID-19 pandemic, two key parameters determined the amount of fresh air that should be provided to the indoor environment in international ventilation standards. The first is the recommended amount of fresh air per person to eliminate the effect of pollutants released by individuals on the ambient air. The second is the amount of fresh air that must be provided per unit area to eliminate the effect of the pollutants generated from the building materials on the surrounding air. Before the COVID-19 pandemic, the fresh ventilation rate required for most indoor spaces was determined per ASHRAE 62.1, ISO 17772, EN 16798, and EN 15251 standards, and sizing an air conditioning system was straightforward.

Although the effect of SARS-CoV-2 viral load on the risk of infection with infection in closed indoor environments is unclear following the COVID-19 pandemic, a clear standard for calculating minimum ventilation rates has not yet been produced. The potential danger of airborne infection indoors has, however, been acknowledged by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), the European Federation of Heating, Ventilation and Air Conditioning Societies (REHVA), the WHO, and a number of researchers. Hence, he proposed various ventilation techniques during the COVID-19 pandemic.

In its assessment of schools and universities after COVID-19, ASHRAE did not give a specific figure for ventilation rates but said that more ventilation is required than the minimum ventilation rates for schools determined by the ASHRAE 62.1 Standard (American Society of Heating, Refrigerating and Air-Conditioning Engineers, 2020). REHVA states that a category I ventilation standard (10 L/h per person) with a higher rate among the three recommended categories in the "EN 16798-1: 2019" ventilation standards in non-hospital buildings may be a solid start for minimizing the risk of infection (REHVA, 2021). The World Health Organization, on the other hand, recommends a minimum ventilation rate of 10 L/s per person, citing the EN 16798-1: 2019 standard for naturally ventilated structures outside the dwelling after COVID-19 (World Health Organization, 2021). Another study discussing the steps to reopen schools suggests that 3 ACH (air exchange rate) ventilation rates in classrooms should be low, that ventilation rates should be between 4 and 6 ACHs, and that 6 ACH is the best-case scenario (Jones et al., 2020).

Kurnitski et al. (2021), stated that constant ventilation rates in classrooms are insufficient under all circumstances and that a general ventilation criterion based on infection risk should be devised using the Wells-Riley model calibrated according to SARS-CoV-2. According to the Wells-Riley model, Dai & Zhao (2020), in their study, the ventilation rate required to keep the probability of infection below 1% according to the Wells-Riley model when staying in a school classroom for 2 hours was found to be between 2-7 ACH. Park et al. (2021), on the other hand, showed that with the Wells-Riley model, with a fresh ventilation rate of 6.51 ACH, the probability of individual infection in classrooms can be kept below 1% if the masked exposure time is 3 hours. In a study in which the risk of infection was estimated according to the CO_2 level, it was stated that the external ventilation threshold to prevent

the spread of COVID-19 aerosol differs according to the space volume and the number of users, and varied between 3-8 ACHs for 3 different classes (Hou, Katal & Wang, 2021).

Two distinct ventilation approaches emerge when the studies on ventilation are analyzed after COVID-19. The first approach is to increase the fixed ventilation rates to the recommended standards of international organizations such as ASHRAE, REHVA, and WHO before COVID-19. The second approach is to give recommended ventilation rates based on the risk of infection.

When the studies on both ventilation approaches mentioned above in the COVID-19 pandemic conditions are examined, it has been determined that the ventilation rates have increased compared to the pre-COVID-19 pandemic conditions. However, there are significant uncertainties between the proposed ventilation rates due to spatial differences. These uncertainties result in a poor understanding of the sizing of air conditioning systems in university buildings and the possible risk of infection in classrooms. In higher education institutions, students are subject to education in diverse classrooms regarding the volume and number of users. This allows for different pedagogical approaches from the undergraduate to the doctoral education process. Hence, fixed ventilation rates defined in international guidelines or randomly determined ventilation rates may be sufficient in some classrooms regarding airborne infection management but may constitute a risk regarding infection control in some classrooms.

In prior studies, the Wells-Riley model was used to evaluate the risk of infection in university classrooms. However, no study has been identified examining the relationship between the fixed ventilation rates determined after COVID-19 and the ventilation approaches determined based on the acceptable risk of infection and the ventilation rates determined according to classrooms and infection risks.

This research examined the impacts of recommended ventilation approaches following COVID-19 on the probability of infection, the number of COVID-19 cases, and the ventilation rates in various types of classrooms at higher education institutions. The study's findings may contribute to the planning of the use of prepared classrooms and the reevaluation of the air conditioning system's capacity in university buildings, so improving future preparedness for other potential airborne pandemics such as COVID-19.

2. Material and Method

The study methodology comprises two parts. In the initial phase, design guides for higher education learning spaces were researched, and four classrooms representing university learning spaces were determined. In the second stage, the ventilation rate in classrooms, the probability of infection, and the number of COVID-19 cases of the ventilation approach based on the acceptable risk approach with the EN 16798-1 ventilation standard recommended by WHO and REHVA following COVID-19 were computed. It was then compared to the period prior to COVID-19.

The proposed Wells-Riley mathematical model determined the probability of COVID-19 infection in classrooms and the number of cases. The Wells-Riley model is typically employed in studies examining the quantitative risk of infection of infectious respiratory illnesses in indoor environments (Foster & Kinzel, 2021; Nazaroff, 2022; Yan et al., 2017; Zhang & Lin, 2021).

According to the ASHRAE 62.1 standard, the minimum ventilation rates recommended for pre-COVID-19 have been determined. Following COVID-19, the ventilation rate in the WHO and REHVA ventilation approach was determined based on category I of the "EN 16798-1: 2019" standard. With the approach of infection risk based on infection risk, the ventilation rates were determined based on the acceptable infection risk level.

2.1. Determination of Classrooms

According to pedagogical requirements, higher education learning spaces are typically split into seminar classrooms, traditional classrooms where didactic education takes place, active learning classrooms, lecture halls, and auditoriums (Arizona State University, 2019; University of Michigan, 2012; University of Toronto, 2012). As learning spaces, two various sizes (small and large classrooms)

and lecture halls classrooms that can be utilized for seminars, traditional classrooms, or contract learning classrooms were determined in this study.

The recommended classroom capacity has been determined based on design recommendations provided by higher education institutions (Mcgill University, 2020; The University of British Columbia, 2014; University of California, 2015). Unit space required for classrooms based on recommended capacities, ASHRAE 62.1 determined based on the density of people seated in the ventilation standard. According to ASHRAE 62.1, the minimum ventilation rate in classrooms is recommended to be 0.66 m^2 per person for lecture halls and 1.53 m^2 per person for other classrooms. The permissible ceiling height for classrooms is 3.5 m^2. Table 1 lists the users and locations of the classrooms.

Table 1. User and location information of the classrooms

Classroom type	**Floor space (m^2)**	**Space Ceiling height (m)**	**Before COVID-19 conditions**		**After COVID-19 conditions**	
			Total number of people	Number of people per area (m^2)	Total number of people	Number of people per area (m^2)
Seminar	30.60	3.50	20	1.53 m^2	10	3.06
Small Classroom	91.80	3.50	60	1.53 m^2	30	3.06
Large Classroom	153.01	3.50	100	1.53 m^2	50	3.06
Lecture Hall (fixed seat)	66.66	3.50	100	0.66 m^2	50	1.32

After COVID-19, in the process of returning to face-to-face education in schools, many precautions have been taken to avoid being infected with the SARS-COV-2 virus indoors. Some of these measures are maintaining physical distance, called social distancing of 1.5−2.0 meters (Welsch et al., 2020), and halving the user density indoors (Li et al., 2021). That's why it has been diluted by 50% for capacities to implement social distance in classrooms after COVID-19.

2.2.Determination of Estimated Infection Risk and Ventilation Rate in Classrooms

2.2.1.Basic Wells-Riley model

The Wells-Riley model is a mathematical model based on the concept of infection quantum that is used to model the probability of transmission of airborne infectious particles to an individual in a well-mixed indoor environment at a steady state. The quantum in this risk model is an estimated unit of infectious dose derived from observational epidemiological studies (Azimi & Stephens, 2013).

The Wells Riley mathematical model for calculating the probability of infection after COVID-19 is shown in equation (1).

$$P_I = \frac{C}{S} = 1 - \exp\left(-\frac{Iqpt}{Q}\right) \quad (1)$$

where P_I is the probability of infection risk (In certain studies, it is referred to as R-value); C is the number of cases that develop infection (It is referred to as the basic reproduction number Ro in certain studies); S is the number of susceptible people; I is the number of infected persons; q is the quanta emission rate depending on the activity; p is the pulmonary ventilation rate of exposed susceptible persons; t is the duration of stay and Q is the volume flow of pathogenic free air. In the original Wells-Riley model, the factors affecting the risk of infection are limited to the parameters specified in the equation.

2.2.2.Calibrating the Wells-Riley model according to SARS-COV-2

The COVID-19 Task Force of REHVA's Technology and Research Committee (REHVA, 2021), has calibrated the airborne infection risk model according to SARS-COV-2 in line with data obtained from COVID-19 studies to calculate the risk of SARS-CoV-2 infection based on the Wells-Riley equation developed by Gammaitoni & Nucci (1997) Subsequently, Kurntiski et al. (2021), derived Equation (2) to calculate ventilation rates for acceptable infection risk levels from the event reproduction number to develop a ventilation design method based on respiratory infection risk. In this equation (2), in addition to the original Wells-Riley equation, the surface deposition loss and virus decay parameters of the virus are considered when calculating the infection probabilities and aeration rates.

$$Q = \frac{qQ_bD}{ln\left(\frac{1}{1-p}\right)} - \left(\lambda_{dep} + k\right)V \quad (2)$$

Where q is the quanta emission rate per infected person (quanta/(h pers); Q_b is the volumetric breathing rate of an occupant (m^3/h); D is the duration of the occupancy (h); I is the number of infectious persons; n is the quanta inhaled; p is the probability of infection for susceptible persons; λ_{dep} is depostion onto surfaces (1/h); k is virus decay (1/h); V is volume of the room (m^3).

As shown in Equation (3), the amount of inhaled quantum (n) depends on the average of the quantum concentration (C_{avg}), a person's volumetric respiratory rate (Q_b, m^3/h), and the length of time people stay in the area (D, h).

$$n = C_{avg}Q_bD \quad (3)$$

Assuming that the quanta concentration is 0 at the beginning for the occupancy of the space, the average concentration is determined as shown in Equation (4) and Equation (5):

$$C(t) = \frac{E}{\lambda V}(1 - e^{-\lambda t}) \quad (4)$$

$$C_{avg} = \frac{1}{D}\int_0^D C(t)dt = \frac{E}{\lambda V}\left[1 - \frac{1}{\lambda D}(1 - e^{-\lambda D})\right] \quad (5)$$

where t is time (h); Λv is the outdoor air change rate (1/h); E is quanta emission rate (quanta/h). E değeri denklem 6'daki gibi hesaplanıır. The first order loss amount coefficient (λ, 1/h) for quanta/h is determined according to Equation (7) (Yang & Marr, 2011) below:

$$\mathrm{E} = \mathrm{Iq} \quad (6)$$

$$\lambda = \lambda v + \lambda_{dep} + k \quad (7)$$

The infection probability and aeration rates calculated with the improved Wells-Riley model (Kurnitski et al., 2021; REHVA, 2021) may differ from the original Wells-Riley model, as the surface depositional loss and virus decay parameters of the virus may affect the average concentration of quanta in the indoor environment.

2.2.3.Calibrating the Wells-Riley model according to SARS-COV-2

Uncertainties about the features and transmission mechanism of the SARS-CoV-2 virus induce various variations in the Wells-Riley model (Guo et al., 2021). To effectively forecast infection risk and ventilation rates, the values of all parameters in the modified Wells-Riley mathematical model must be determined. In this section of the study, the pertinent literature on the SARS-CoV-2 virus was thoroughly read, and the parameters in the Wells-Riley model were calibrated according to SARS-COV-2.

The measurement of the virus emission rate (q), which determines the virus's contagiousness, is one of the most critical difficulties in using the Wells-Riley mathematical model. The quantum emission rate (q) is estimated epidemiologically during an epidemic (Sze To & Chao, 2010). The quanta emission rates of SARS-Cov-2, which change depending on specific activities, have been researched by several researchers. According to the research of Buonanno et al. (2020) the average value of the

quantum emission rate lecture rates (6.85 q/h) was accepted in this study. Subsequently, using a conversion factor coefficient of 3.30 for the SARS-CoV-2 Omicron BA.2 variety, the determined quantum emission rate by Lyngse et al. (Lyngse et al., 2022) has been adjusted to 22.60 q/h. The number of people vulnerable to the virus was determined for classrooms before and after COVID-19, and the capacities of the demonstrations were accepted in Table 1, Table 2 summarizes recent studies and accepted values for the parameters of the Wells-Riley equation.

Table 2. Determination of Wells-Riley model parameters

Parameters	Unit	Value	Related Studies
Virus Inactivation Rate (k)	1/h	0.63	(van Doremalen et al., 2020; Fears et al., 2020)
Accumulation Loss Rate of Virus on Surfaces (Λ_{dep})	1/h	0.24	(Buonanno, Morawska & Stabile 2020; Buonanno, Stabile, et al., 2020; Chatoutsidou & Lazaridis 2019; Diapouli, Chaloulakou &Koutrakis 2013; Miller et al., 2021; Thatcher et al., 2002)
Quantum Emission Rate (Q)	quantum/h	22.6	(Buonanno, Stabile, et al., 2020; Dai & Zhao 2020; Park et al., 2021)
Volumetric breathing rate of an occupant (Q_b)	m^3/h	0.60	(Adams, 1993; Binazzi et al., 2006; Chen, Chang & Liao 2006; Gao et al., 2021; Stephens, 2012; Yılmazoğlu, 2020)
Number of Infected Persons (I)	person	1	(Guo et al., 2021; Park et al., 2021; Stabile et al., 2021)
Exposure time to the virus	hour	4	

The exposure time to the virus in the classrooms was determined by considering the daily usage times of the school. Lessons usually occur between 08:00-12:00 and 13:00-17:00. Therefore, the exposure time to the virus has been determined as 4 hours.

2.2.4.Calibrating the Wells-Riley model according to SARS-COV-2

According to ASHRAE 62.1, the recommended ventilation rates for classrooms before COVID-19 were 3.8 l/s per person and 0.30 L/m^2 space. Considering the classroom capacities, the minimum ventilation rates required are 2.78 L/(s m^2) in the seminar, small and large classrooms, and 6.05 L/(s m^2) in the lecture hall.

REHVA indicates that a category I ventilation standard (10 L/h per person) with a higher rate of infection among the three recommended categories in the "EN 16798-1:2019" ventilation requirements in non-hospital buildings may be a good start for minimizing the risk of infection (REHVA, 2021).

The World Health Organization, on the other hand, recommends a minimum ventilation rate of 10 L/s per person, citing the EN 16798-1:2019 standard for naturally ventilated structures outside the dwelling after COVID-19 (World Health Organization, 2021). In light of the classroom capacity, the required ventilation rates are 3.26 L/(s m^2) in the seminar, small and large classrooms, and 7.57 L/(s m^2) in the lecture hall.

Kurnitski et al. (2021) assessed the probability of infection by updating and calibrating the equation in which ventilation rates were determined during the COVID-19 procedure. The probability of infection and the number of new cases are calculated in equation (8) based on the ventilation infection rates determined before COVID-19.

$$Pı = 1 - \frac{1}{e^{\frac{qQ_bD}{Q+(\lambda_{dep}+k)V}}} \quad (8)$$

2.2.5. Estimated ventilation rates based on the acceptable risk of infection

The probability of infection is usually expressed in terms of the baseline reproduction number (R_0) (Vignolo et al., 2022). In the COVID-19 pandemic, the basic reproductive number $R_0 < 1$ is recommended for the reduction of the disease in the susceptible population (Achaiah, Subbarajasetty & Shetty, 2020; Schibuola & Tambani, 2021). The basic reproduction number is determined by Equation (9) below.

$$R0 = S \times R \quad (9)$$

In the equation, R_0 represents the number of reproductions, S represents the number of susceptible individuals, and R represents the individual risk of infection. In order to estimate the minimum ventilation rate based on the acceptable risk of infection following COVID-19, the fundamental reproduction number was accepted as R_0=0.99. The infection probability determined by equation 1 was determined based on the 0.99 basic reproduction number accepted in the classrooms. Then the required ventilation rates were calculated according to equation (2).

3. Conclusion and Suggestions

Allen & Ibrahim (2021) say that ventilation rates of 4-6 ACH (air change rate per hour) should be targeted in classrooms during the COVID-19 period. The study looking at the measures to reopen schools at Harvard states that 3 ACH is too low for ventilation rates in classrooms, they should be between 4-6 ACH and 6 ACH is the most ideal scenario (Jones et al., 2020). Dai & Zhao (2020) stated that the ventilation rates required to keep the probability of COVID-19 infection below 1% when exposed to the virus for 2 hours in classrooms vary between 2-7 ACH. Hou et al. (2021) reported in their study, which was conducted in three different classrooms from three different schools, that ventilation rates varied between 3 and 8 ACH depending on the classroom in order to prevent the spread of SARS-CoV-2. In the ventilation scenarios investigated within the scope of the study, according to the ventilation rates specified in Table 5 and Table 4, the ventilation rates required in classrooms before COVID-19 varied between 2.85-6.22 ACH. In the ventilation scenario recommended by WHO and REHVA after COVID-19, the required ventilation rates in classrooms were between 3.35-7.78 ACH. In the ventilation design determined based on the risk of infection after COVID-19, the ventilation rates in the classrooms were between 3.70 and 10.62 ACH. The findings obtained within the scope of the study show that they are consistent with the results of studies on COVID-19 and ventilation rates, but ventilation rates may vary depending on the physical conditions in the classrooms.

3.1. WHO and REHVA ventilation design

Table 3 displays the ventilation rate in classrooms of the EN 16798-1 ventilation standard recommended by WHO and REHVA and the pre-COVID-19 ventilation standards, the probability of COVID-19 infection, and the number of COVID-19 cases, assuming 4-hour use of the classrooms.

Table 3. WHO and REHVA ventilation approach infection risk and ventilation rates

Classroom Type	Ventilation before COVID-19				WHO and REHVA ventilation			
	Number of People	Ventilation rate (L/s m^2)	Probability of infection (P_I)	Number of COVID-19 Cases (person)	Number of People	Ventilation rate (L/s m^2)	Probability of infection (P_I)	Number of COVID-19 Cases (person)
Seminar Classroom	20	2,78	%11,9	2,38	10	3,26	%10,7	1,07
Small Classroom	60	2,78	%4,1	2,48	30	3,26	%3,7	1,11
Large Classroom	100	2,78	%2,5	2,50	50	3,26	%2,2	1,12
Lecture	231,83	6,05	%1,4	3,17	115,91	7,57	%1,1	1,31

Hall								
Total	411,83	3,59	%2,68	10,53	205,91	4,33	2,15	4,61

Per Table 3, in the post-COVID-19 WHO and REHVA ventilation scenario, the ventilation rates increased by 17.26% in the seminar, small and large classrooms, 25.12% in the lecture hall, and on average 20.61%, compared to the pre-COVID-19 timeframe. Due to the more significant number of pupils per square meter in the lecture hall, the ventilation rate has increased. In classrooms reduced to 50% capacity after COVID-19, the probability of individual infection dropped by 10.8% in the seminar classroom, 9.75% in the small classroom, 12% in the large classroom, 21.42% in the lecture room, and 19.77% in average when all classrooms are included. Under the post-COVID-19 WHO and Rehva ventilation scenario, the number of COVID-19 cases surpasses the R01 limit, which is crucial for infection management in all classrooms. In this ventilation scenario, if the classrooms are utilized for 4 hours, the number of COVID-19 cases drops by 55.04% in the seminar classroom, 55.24% in the small classroom, 55.2% in the large classroom, and 58.67% in the lecture hall compared to pre-COVID-19. COVID-19 cases in all classrooms were reduced by 56.2%.

The decline in COVID-19 cases was more significant than the probability of individual infection. The results reveal that when the number of persons vulnerable to the virus in classrooms grows, the probability of infection reduces, but the number of new cases increases.

Figure 1 depicts the time-dependent fluctuation of individual COVID-19 infection probability in classrooms, WHO, and REHVA ventilation scenarios.

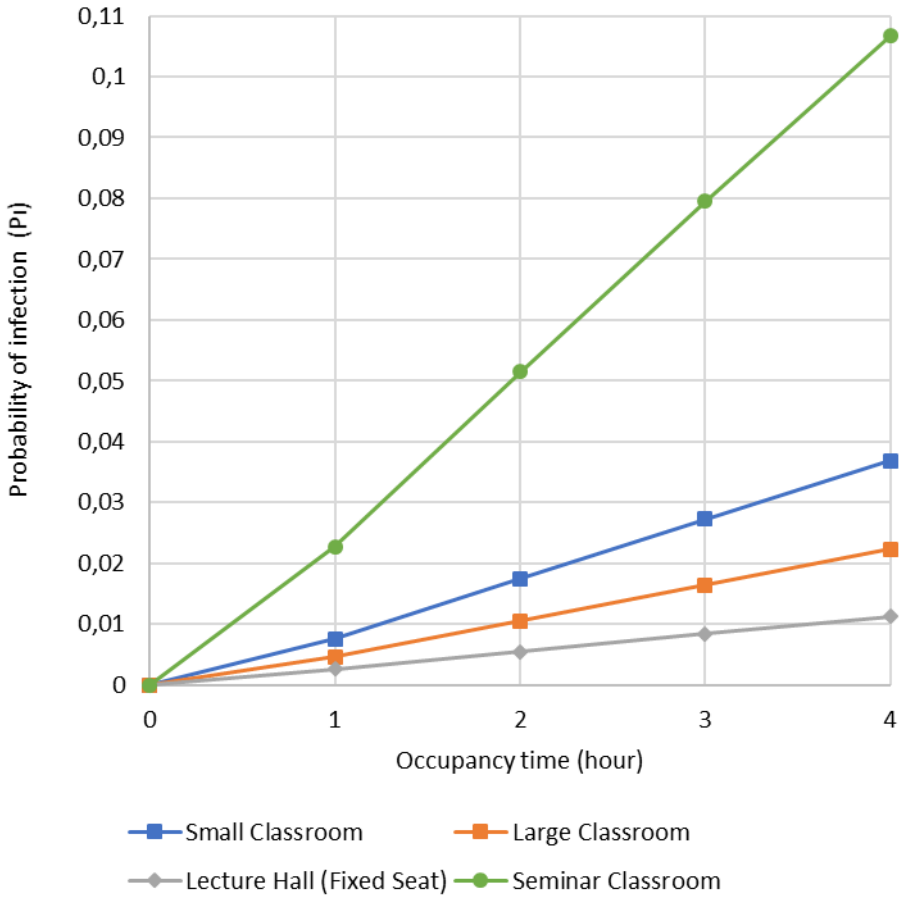

Figure 1. EN 16798-1 ventilation standard time-dependent infection probability

The probability of infection in the seminar classroom surpasses 2% when the SARS-COV-2 virus is exposed for 1 hour, whereas it remains below 1% in other classrooms, as shown in Figure 1. The probability of COVID-19 infection exceeded 1% in all classrooms but the lecture hall by the end of the second hour. The probability of COVID-19 infection cases reached 1.1% in the lecture hall, 2.2% in the large classroom, 3.7% in the small classroom, and 10.7% in the seminar classroom in cases when the

virus exposure period was 4 hours. By the end of the fourth hour, the number of COVID-19 cases surpasses the tolerable ro>1 value regarding infection risk in all classrooms. In the first 3 hours, the number of new teachers in all classrooms was below one value.

3.2. Ventilation Design Based on Infection Risk

Table 4 displays the ventilation rates based on the tolerable infection risk and the ventilation rate of the pre-COVID-19 ventilation standards in classrooms, the number of COVID-19 cases, and the probability of COVID-19 cases in the 4-hour use case of the classrooms.

Table 4. Ventilation and acceptable risk of infection before COVID-19

Classroom Type	Ventilation before COVID-19				WHO and REHVA ventilation			
	Number of People	Ventilation rate (L/s m^2)	Probability of infection (P_I)	Number of COVID-19 Cases (person)	Number of People	Ventilation rate (L/s m^2)	Probability of infection (P_I)	Number of COVID-19 Cases (person)
Seminar Classroom	20	2,78	%11,9	2,38	10	3,6	%9,9	0,99
Small Classroom	60	2,78	%4,1	2,48	30	3,77	%3,3	0,99
Large Classroom	100	2,78	%2,5	2,50	50	3,8	%2	0,99
Lecture Hall	231,83	6,05	%1,4	3,17	115,91	10,33	%0,9	0,99
Total	411,83	3,59	%2,68	10,53	205,91	5,37	1,92	3,96

According to Table 4, in the ventilation scenario determined based on the acceptable risk of infection after COVID-19, the ventilation rates increased by 29.49% in the seminar classroom and 35.61% in the small classroom, by 36.89% in the big classroom, 70.74% in the lecture room, and 49.58% on average in all classrooms compared to the pre-COVID-19 period. In ventilation based on virus risk, the required ventilation rates rise as the number of people susceptible to virus infection in classrooms rises. When all classrooms were considered, the probability of individual infection in classrooms diluted by 50% decreased by 16.8% in the large classroom, 19.51 in the small classroom, 20% in the lecture classroom, 35.71% in the lecture hall, and 28.35% in the classroom. In the ventilation scenario based on acceptable infection risk, the number of COVID-19 cases decreased by 58.40% in the seminar classroom, 60.08% in the small classroom, 60.4% in the large classroom, 68.76% in the lecture hall, and 62.39 percent across all classrooms (6.57) compared to pre-COVID-19. The decrease in COVID-19 cases in all classrooms exceeded the probability of individual infection. The results indicate that as the number of susceptible individuals in classrooms increases, the probability of infection decreases, but the number of new cases rises.

Figure 2 depicts the time-dependent variation of the probability of individual COVID-19 infection in classrooms under the WHO and REHVA ventilation scenarios.

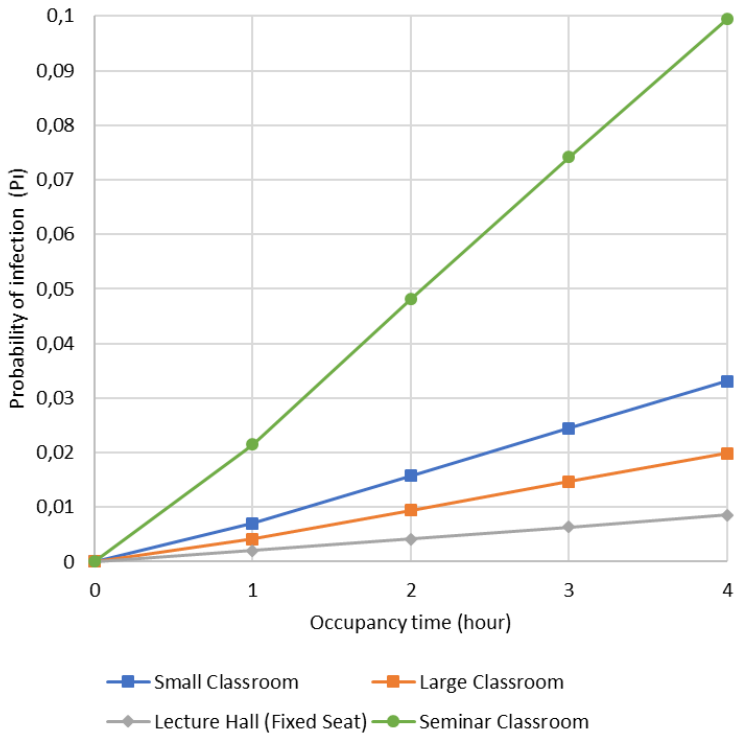

Figure 2. Time-dependent infection probability of ventilation scenario based on acceptable infection risk

The probability of infection in the seminar classroom exceeded 2% after one hour of exposure to the SARS-COV-2 virus, while it remained below 1% in other classrooms, as shown in Figure 2. At the end of the second hour in the classrooms, the probability of COVID-19 infection was 4.7% in the seminar classroom, exceeding 1% in the small classroom but still below 1% in the other classrooms. At the end of the third hour, the probability of COVID-19 infection exceeded 1% in the large classroom and reached 1.5%, while 7.4% in the seminar classroom. The probability of COVID-19 infection reached 0.9% in the lecture hall, 2% in the large classroom, 3.3% in the small classroom, and 9.1% in the seminar classroom in cases where the virus exposure time was 4 hours. At the end of the fourth hour in the lecture hall, the probability of infection remained below 1%. Findings showed better results in infection probability and new cases in ventilation design based on infection risk than in REHVA and WHO ventilation design.

3.3.Comparison of Ventilation Designs After COVID-19

The probability of COVID-19 infection and the number of COVID-19 cases in the classrooms for 4 hours of usage is shown in Table 5, along with the ventilation rates based on the tolerable infection risk and the EN 16798-1 ventilation standard.

Table 5. Acceptable infection risk and EN 16798-1 ventilation standard

Classroom Type	Ventilation before COVID-19				WHO and REHVA ventilation			
	Number of People	Ventilation rate (L/s m^2)	Probability of infection (P_I)	Number of COVID-19 Cases (person)	Number of People	Ventilation rate (L/s m^2)	Probability of infection (P_I)	Number of COVID-19 Cases (person)
Seminar Classroom	10	3,26	10,7	1,07	10	3,6	9,9	0,99
Small Classroom	30	3,26	3,7	1,11	30	3,77	3,3	0,99
Large Classroom	50	3,26	2,2	1,12	50	3,8	2	0,99
Lecture Hall	115,91	7,57	1,1	1,31	115,91	10,33	0,9	0,99
Total	205,91	4,33	2,15	4,61	205,91	5,37	1,92	3,96

According to Table 5., ventilation rates increased by 10.42% in the seminar classroom, 15.64% in the small classroom, 16.56% in the large classroom, by 36.45% in the lecture hall. When the whole classroom was evaluated, the average increased by 24.01% according to the WHO and REHVA ventilation design in ventilation design based on the acceptable risk of infection after COVID-19. The findings indicate that as the number of people vulnerable to the virus in classrooms increases, so do the ventilation rates required for infection control. In the ventilation design developed based on the risk of individual infection after COVID-19, the probability of individual infection decreased by 7.47% in seminar classrooms, 10.81% in small classrooms, 9.0% in large classrooms, 18.18% in the lecture hall, and by an average of 10.69% when all classrooms are taken into account. The probability of COVID-19 infection has further decreased as a result of the increase in ventilation rate in the lecture hall compared to other classrooms. Under the ventilation method based on an acceptable infection risk scenario, the number of COVID-19 cases drops by 7.47% in the seminar classroom, 10.8% in the small classroom, 11.60% in the large classroom, 24.42% in the lecture hall, and by 14.09% (0.65) in all classrooms. In ventilation design based on virus risk, it is seen that the number of new cases of infection decreases as the number of persons vulnerable to the virus in classrooms increases. Results indicated superior results in infection probability and new cases in ventilation design based on infection risk than in REHVA and WHO ventilation design.

4. Conclusion

In the post-COVID-19 ventilation scenarios, when classrooms are utilized for 4 hours, the probability of infection and the average number of cases dropped by 19.77% and 56.22 %, respectively, compared to the pre-COVID-19 ventilation scenario. In the same condition, it decreased by an average of 28.35% to 62.39% in the ventilation scenario based on the tolerable risk of infection. Under the WHO and REHVA Ventilation scenario, the ventilation rates of classrooms rose by an average of 20.61 percent compared to pre-COVID-19. In ventilation design based on the tolerable risk of infection, ventilation rates rose by an average of 49.58 percent compared to before COVID-19. In the ventilation design based on the risk of infection, it was noted that the increase in ventilation rates was more significant as the number of classroom users grew so much that the ventilation rate necessary for infection control in the lecture hall was 70.74 percent greater than before COVID-19.

With the current air conditioning system capacity in schools, supplying the necessary ventilation rates following COVID-19 under actual settings is challenging. The COVID-19 pandemic's suspension of face-to-face schooling has highlighted the significance of air conditioning system design. Hence, educational buildings that will be constructed or renovated in the future should be equipped with air

conditioning systems that allow ventilation rates to increase as necessary, notwithstanding future pandemics.

Ventilation rates in LEED-certified buildings are supposed to be 30% greater than the minimum fresh ventilation rates necessary to guarantee interior air quality. In this way, in LEED-certified schools, the requisite ventilation rates can be delivered in select classrooms under the REHVA and WHO ventilation scenario. Nevertheless, in this ventilation scenario, the number of COVID-19 cases in all classrooms surpasses the baseline production scenario (R0) value of 1 assessed for infection management. Managing the number of COVID-19 cases and the fundamental reproduction number in crowded indoor contexts such as schools is crucial for epidemic control. The category I ventilation rate in the EN 16798 standard suggested by REHVA and WHO should thus be evaluated in light of pandemic dynamics. In this instance, extra filtration and air purification methods should be considered in some classrooms, particularly packed classrooms like lecture halls.

Assessing the risk of airborne infection is a detailed step in the COVID-19 process. In some research, the infection risk is assessed based on the likelihood of individual infection, but in others, it is assessed based on the reproductive number. The probability of individual infection is higher in classrooms with fewer users than in other classrooms, although the basic reproduction rate is lower. While COVID-19 infection is low in packed classrooms, the basic reproduction number is larger. Thus, the infection risk assessment should be considered independently based on regional disparities.

Defining ventilation requirements based on infection risk is complex throughout the pandemic phase. Since this problem involves several scientific fields, including virology, fluid mechanics, immunology, building design, building ventilation systems, and building ventilation methods. There is a need for extensive multidisciplinary research in order to be better prepared for future probable airborne epidemics like COVID-19.

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

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Evaluating the Urban Expansion of Silifke (Mersin) District with a Focus on Green Spaces: The 2050 Projection

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Abstract

The aim of this study is to provide a framework for spatial planning aimed at creating resilient cities through land change trends from the past to the future (1990-2020-2050). Additionally, it aims to guide planning strategies by highlighting the current and future status of urban green areas. In this context, the trends for 2050 were evaluated in terms of green area requirements, using the Silifke example. Most of the development areas in Adana-Mersin RegionalPlan are expected to be built. All of these areas consist of agricultural (202 ha) and bare lands (46 ha). It is estimated that by 2050, the populations of Silifke-Taşucu-Kum Neighborhood will be 102,923 and 24,815, respectively. According to spatial planning regulations, the minimum green area within the 2050 urban plan boundaries should be 1,029,230 m² and 248,150 m², respectively. Consequently, decision-makers are expected to determine green area strategies guided by these findings in spatial planning studies.

Keywords: *Land change trend, urbanisation, urban ecosystem services, urban green space.*

Silifke (Mersin) İlçesi Kentsel Yayılımının Yeşil Alanlar Odağında Değerlendirilmesi: 2050 Yılı Projeksiyonu

Öz

Bu çalışmanın amacı, geçmişten geleceğe (1990-2020-2050) uzanan arazi değişimi eğilimleri ile dirençli kentler yaratmayı amaçlayan mekânsal planlama çalışmalarına bir çerçeve sunmaktır. Ayrıca kentsel ekosistem hizmetleri sağlayan kentsel yeşil alanların mevcut ve gelecekteki durumu ortaya konarak sonuçların mekânsal planlama stratejilerine rehberlik etmesi amaçlanmaktadır. Bu kapsamda, Silifke ilçesi örneğinde, 2050 yılı arazi değişimi eğilimleri ortaya konarak sonuçlar kentsel yeşil alan ihtiyaçları açısından değerlendirilmiştir. Adana-Mersin Çevre Düzeni Planında belirtilen gelişim alanlarının çoğunda yapılaşma beklendiği görülmüştür. Bu alanların tamamı sırasıyla tarımsal alanlardan (202 ha) ve çıplak alanlardan (46 ha) oluşmaktadır. 2050 yılı nüfusuna göre Silifke ve Taşucu-Kum Mahallesi imar sınırlarındaki yerleşimlerde sırasıyla yaklaşık 102.923 ve 24.815 kişinin bulunacağı tahmin edilmektedir. Mekânsal plan mevzuatına göre 2050 yılı imar planı sınırlarındaki kentsel yeşil alan miktarının sırasıyla en az 1.029.230m² ve 248.150 m² olması gerekmektedir. Sonuç olarak, mekânsal planlama çalışmalarını yapacak karar vericilerin, kentsel yeşil alan stratejilerini bu bulgular rehberliğinde belirlemeleri beklenmektedir.

Anahtar kelimeler: *Arazi değişim eğilimi, kentleşme, kentsel ekosistem servisleri, kentsel yeşil alan.*

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1. Introduction

The current era, known as the "Anthropocene," is also recognized as the "Urban Age," in which humans are considered a dominant geological force. With more than half of humanity now residing in towns and cities, this proportion is expected to exceed 60% by 2030 (Elmqvist et al., 2013). The quality of urban environments, comprising both natural and cultural components, is estimated to determine the quality of life for approximately five billion people by 2030 (Firehock & Walker, 2015). Urban areas are among the most affected by environmental issues stemming from extreme weather events, prominent indicators of global climate change. Challenges such as urban heat islands, unsustainable resource use, inadequate planning, and food and water scarcity are increasingly emerging due to urbanization. Additionally, factors such as population growth, vertical and horizontal urbanization, the inadequacy of open and green spaces in terms of both quality and quantity, environmental pollution, noise pollution, incorrect land use planning, and management policies have contributed to unhealthy and unfavourable urban development trends (Akın & Gül, 2020). Therefore, a key challenge for contemporary societies will be the creation of healthy and livable urban spaces.

Land change analysis is crucial for understanding how human activities and natural processes alter landscapes over time. These changes enable researchers to assess environmental impacts, biodiversity loss, and habitat fragmentation. Such analysis informs decisions regarding land management, urban planning, and conservation efforts, helping to mitigate negative effects on ecosystems and maintain ecological balance. It also aids in monitoring climate change impacts and supports sustainable development initiatives (Lambin et al., 2003; Alphan & Derse, 2013; Alphan et al., 2022).

Understanding land change trends along with urban development trends is crucial for effective land management, sustainable urban planning, and environmental conservation. These trends offer valuable insights into how human activities shape landscapes, influence biodiversity, and impact ecosystems. Studying these trends enables policymakers, urban planners, and environmentalists to make informed decisions to address challenges such as habitat loss, urban sprawl, and environmental degradation. Analyzing land change trends allows us to assess the spatial patterns of urbanization, agricultural expansion, and deforestation. This information helps identify areas at risk of habitat fragmentation, loss of biodiversity, and ecosystem degradation (Lambin et al., 2003).

Land change trends and urban development models offer insights into the drivers of environmental change. Various urban models, including compact and sprawled cities, have varying impacts on transportation systems, energy consumption, air quality, and public health. Studying these models enables policymakers to design urban areas fostering social equity, economic prosperity, and environmental sustainability. Furthermore, land change trends and urban development models offer insights into the drivers of environmental change. This knowledge enables stakeholders to develop strategies for mitigating negative impacts and enhancing ecosystem services (Seto et al., 2012).

In conclusion, the study of land change trends and urban development models is essential for promoting sustainable land management, resilient urban planning, and environmental conservation. The quality of life in urban areas correlates with how urban landscapes, which serve as the primary determinants of essential elements such as clean air, water, and food, are managed (Firehock & Walker, 2015). However, societies often overlook the significance of natural resources such as clean air, water, and agricultural lands in sustaining life. Urbanization also exerts pressure on ecosystems, leading to increased sensitivity to invasive species, loss and fragmentation of local habitats, and changes in the quantity, timing, and quality of precipitation (Mell, 2010).

The main focus of ecosystem service studies is the benefits people derive from nature. Thus, in these studies, the sustainability of natural areas is ensured by considering human activities in conjunction with maintaining them. The benefits that humans derive from ecosystems' functioning are collectively referred to as "Ecosystem Services" (MEA, 2005). These services include provisioning services such as food and water supply, regulating services that affect climate, diseases, and water quality, cultural services providing spiritual and cultural benefits, and supporting services maintaining conditions for life such as soil formation, photosynthesis, and nutrient cycling (MEA, 2003). Progress towards human well-being and sustainable development depends critically on improving the management of these

services to conserve and sustainably utilize ecosystems (MEA, 2003). Terms like "urban ecosystems" are often used in studies such as Action 5 and MAES (2015) to represent areas where the majority of the human population resides. These ecosystems, which host important areas for synanthropic species associated with urban living areas, significantly influence other ecosystem types and include urban and industrial areas, commercial and transportation areas, urban green spaces, mines, landfills, and construction areas (MAES, 2016). Various titles, such as Urban Green Infrastructure, Urban Green, Green Urban Spaces, or Urban Green Spaces, are used to specify "Urban Ecosystems," although these terms sometimes refer to the same concept but target different audiences (MAES, 2015).

For instance, under the heading of Urban Green Spaces, numerous ecosystem services are provided for urban ecosystems, including reducing the heat island effect, storing carbon dioxide, enriching soil, providing food and habitat for wildlife, preventing stormwater runoff, and offering recreational and educational opportunities to users (Hepcan & Hepcan, 2017). While it may not always be possible to make clear distinctions among these concepts, it is essential to remember that urban ecosystems, green urban areas, or urban green spaces constitute a structural component, whereas green infrastructure implies a functional implication (MAES, 2015). Green Infrastructure is defined as a network of high-quality green spaces and other environmental features strategically planned to support human well-being and quality of life (EEA, 2014; LI, 2009; Benedict & McMahon, 2002; Ahern, 2007; EC, 2013). When developed and maintained systematically as part of rational development and conservation planning, Green Infrastructure has the potential to serve as a good model for a city's land use and spatial development (Chang et al., 2012).

Due to its coastal location on the Mediterranean, Silifke is under pressure from various sectors such as tourism and construction, transportation with ports, and agriculture, particularly the fertile agricultural lands in the Göksu Delta. Especially along the coast, it hosts numerous species and is home to internationally protected wetlands such as the Göksu Special Protection Area. Given the presence of many natural features, continuous monitoring of these areas' changes and tracking of their potential implications are necessary. This is essential for understanding the consequences of these changes and ensuring the preservation of the region's ecological balance and biodiversity.

The aim of this study is to delineate land change trends toward urban areas, specifically in Silifke (Mersin), from the past to the present (between 1990-2020) and from the present to the future (to 2050), in order to create more resilient cities against the impacts of global climate change. Thus, it will provide a framework for future research. Furthermore, the aim is to guide future studies by delineating the current and future status of urban green areas, the fundamental component of urban green infrastructure providing urban ecosystem services, along with the current and future state of the population.

In this context, the study area boundaries were defined to encompass the central settlements of Silifke through a micro-watershed study. The areas to be developed by the year 2050 were determined through a land change trend analysis, considering the existing urban development zones in the 1/100,000 scale Adana-Mersin Regional Plan. Subsequently, the population projection for the year 2050 was determined for settlements within the zoning planning boundaries of Silifke Center and Taşucu - Kum neighborhood. The urban green space, which constitutes a fundamental component of urban green infrastructure providing urban ecosystem services, requirements of the developing areas, were evaluated in the context of the population status projected for the year 2050. Furthermore, the findings of a study conducted by Derse (2023) concerning the study area (urban green areas and population status in 2020), were re-evaluated in conjunction with the results of this study for the year 2050.

2. Material and Method

2.1. Material

2.1.1. Study area

A micro-watershed study was conducted to define the research area boundary using the boundaries of the Silifke district located within the Eastern Mediterranean Basin Kayraktepe Sub-Basin. For this

study, ALOS World 3D data with a spatial resolution of 30 m was utilized. As a result of the micro-watershed study, the boundaries of the research area were determined. The study area is located within the borders of Silifke (Mersin) district on the Mediterranean coast of Türkiye (Figure 1).

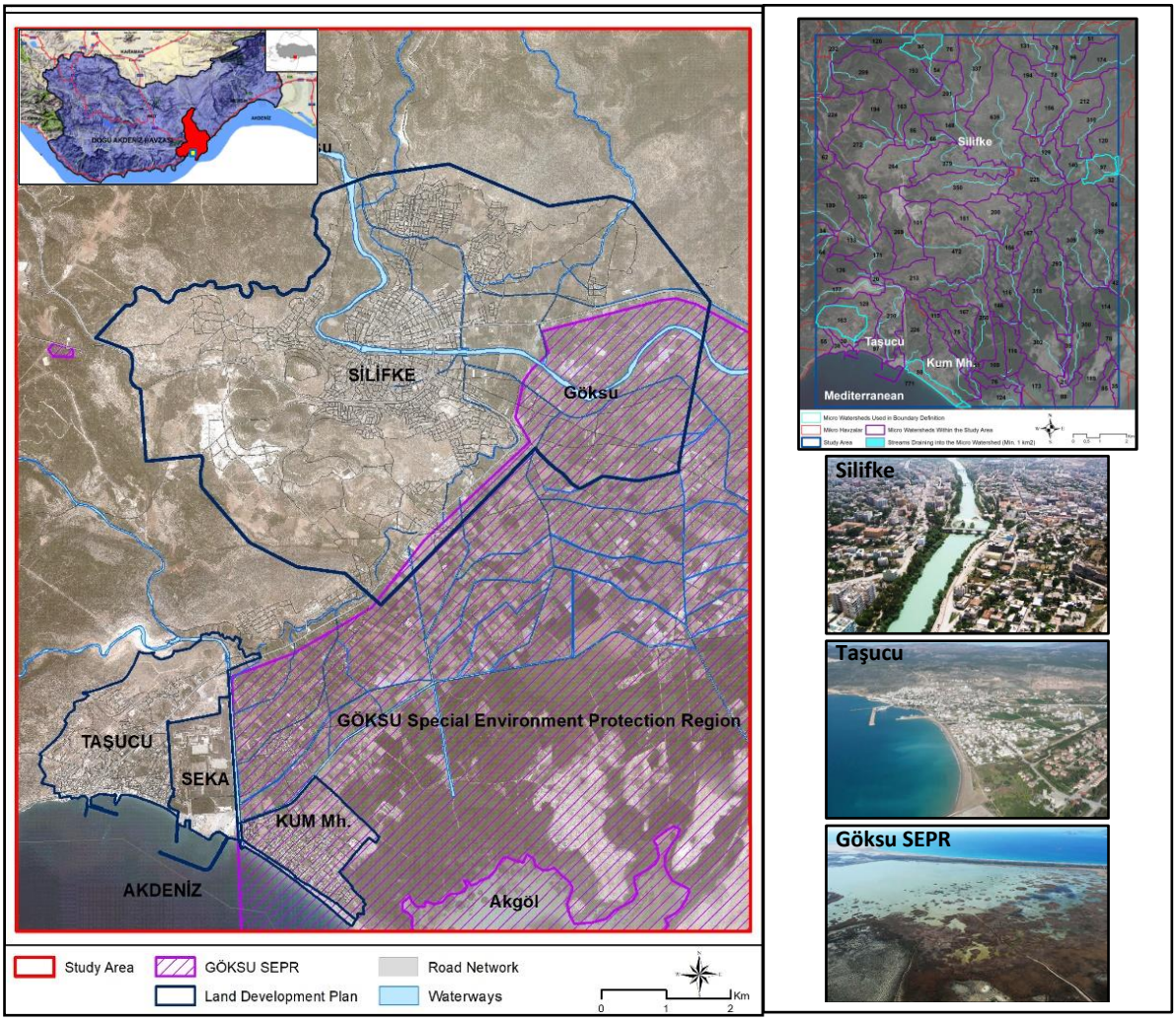


Figure 1. Location of the study area in Turkiye (Photos SB, 2019)

The study area has a total size of 15.845 ha. The Mediterranean Sea is located on the southern border of the study area. The study area is separated from the Central Anatolia by the Taurus Mountains in the north. While the average annual temperature of the area is 19,2 °C, the average temperature in the winter varies between 14,9-23,4°C and the total annual rainfall of the area is approximately 56 mm (MGM, 2022). The study area has a typical Mediterranean climate and the rainiest month is December and the driest month is August. One of the important geomorphological units in the study area is valleys. Mediterranean climate characteristics extend from these valleys extending from south to north to the interior of the Taurus Mountains. Rivers are buried in these deep valleys. Göksu River is one of these rivers Göksu Delta (Silifke Plain), which has fertile agricultural lands, is located on the slopes of the valleys through which the Göksu River flows. Göksu Delta also has Special Environmental Protection Region (SEPR) status and is a Ramsar site protected by the international agreement to which Turkey is a party. Silifke district, to which the study area is located, is surrounded by Erdemli in the east, Mut and Gülnar districts in the west, Karaman province in the north and the Mediterranean Sea in the south. Founded on both banks of the Göksu River, Silifke is at the junction of the highway network connecting Southeastern Anatolia, Eastern and Western Mediterranean, and Central and Western Anatolia, and is 80 km away from Mersin.

The altitudes within the borders of Silifke district, which covers the study area, vary between 0 and 2509 m. While gently sloping terrain is rarely encountered along the coastal zone, the topography becomes more dynamic towards the north, characterized by valleys and steep slopes with high

inclinations. The predominant land use within the study area is agricultural activities, constituting the most significant aspect of the working landscape. Intensive agricultural activities are predominantly conducted in the expansive plains of the Göksu Delta (Silifke Plain), particularly along the coastal zone, characterized by extensive flatlands. The Göksu Delta (Silifke Plain) is divided into eastern and western shores by the Göksu River. The soil structure and climate, which play a role in determining agricultural potential, lead to the diversification of production patterns and an increase in production quantity. The structure of the Göksu Delta enables the cultivation of both temperate climate and warm climate crops, thereby creating a highly diverse agricultural landscape, with the potential for the cultivation of a rich variety of crops.

2.1.2. Land use and land cover (LUC) maps

LUC maps are indispensable tools for assessing landscape changes and urbanization patterns. They aid in environmental planning, resource management, and policy formulation (USGS, 2006; EEA, 2018). CORINE LUC maps are vital tools for understanding LUC dynamics. They offer valuable insights into environmental changes, facilitating sustainable land management and policy development (EEA, 2019).

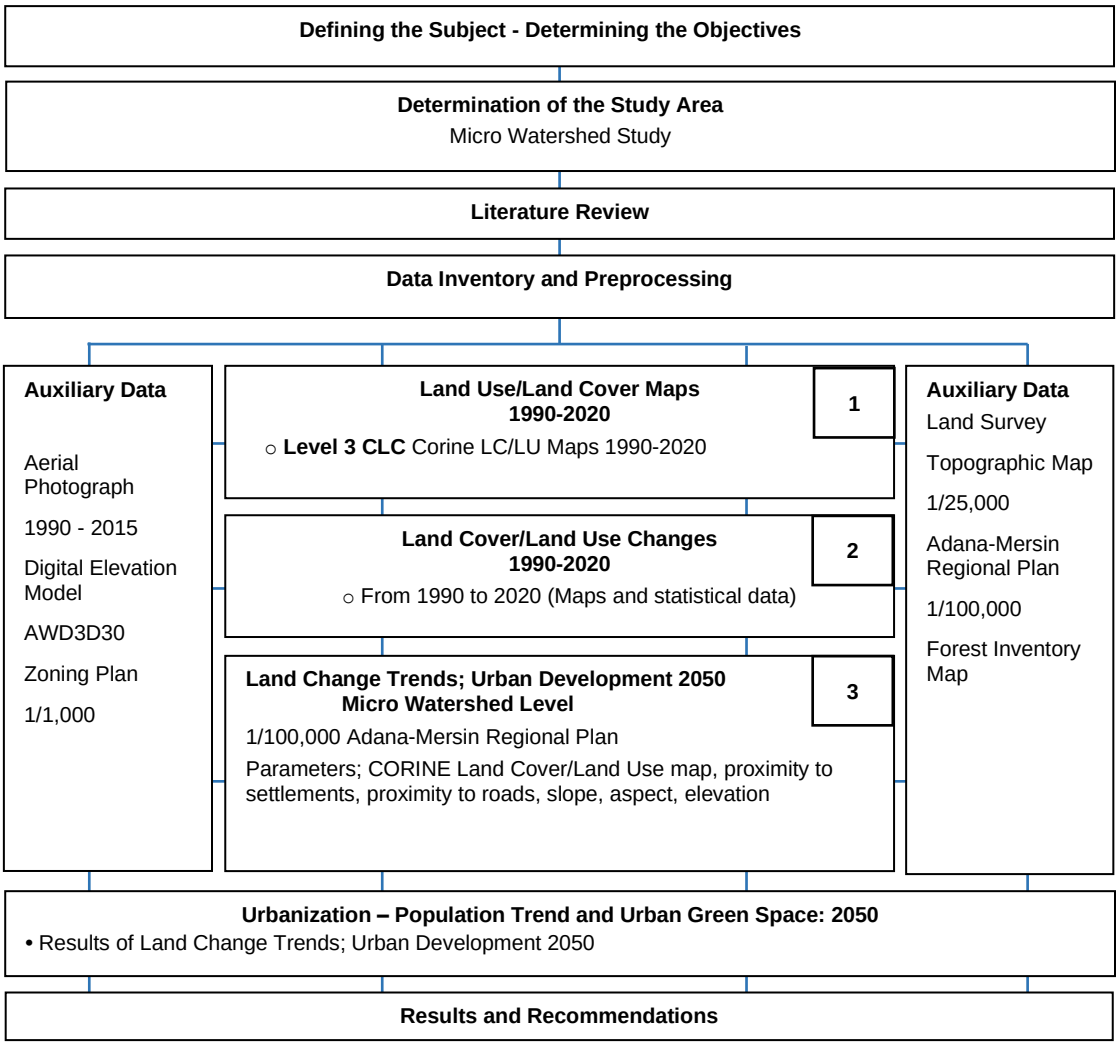
The CLC classification system is a standardized framework developed by the European Environment Agency (EEA) for mapping LUC across Europe. It categorizes land into 3 levels and 44 classes such as forests, urban areas, wetlands, and agricultural land, providing valuable data for environmental monitoring and policy-making (EEA, 2017). CLC 1990 and 2020 LUC maps, which are the main component of this study, were produced by revising the data obtained from the Copernicus Land Monitoring Service (CLC 1990 and CLC 2018) (LMS, 2020). The LUC maps were revised based on aerial photographs taken in 1990 and 2015, acquired for this study. Additionally, the 2020 LUC map was rerevised based on current status information, including data from other supplementary sources such as Google Earth, forest inventory maps, topographic maps, and field surveys.

The LUC maps for 1990 and 2020 were included in the land change model to determine the land change trends for the research area in 2050.

2.2. Method

As mentioned above, the boundaries of the research area were determined on the basis of the micro-watershed study. Considering the defined research area boundary, subsequent studies were conducted at both the micro-watershed level and the scale of urban planning to ensure compatibility with the scales of the research. After defining the boundaries of the research area, the studies were primarily divided into two main parts. In the first stage, LUC changes occurring between 1990 and 2020 were identified. Based on these changes, along with other parameters, land change trends for urbanization in 2050 were determined. In the second stage, land change trends in the study area were re-evaluated at the existing urban planning level. Thus, the status of urban development areas within the relevant urban planning boundaries outlined in the Adana-Mersin Regional Plan for 2050 was elucidated. Additionally, the population projection for 2050 was determined, and an assessment was conducted regarding the urban green space needs of these areas. The basis of this study is formed by urban areas. Therefore, the study was conducted taking spatial plans into account. Zoning boundaries were obtained from Silifke Municipality as three separate data sets (Silifke Center and Taşucu - Kum Neighborhood). In this study, zoning boundaries are discussed in two parts. These are the Silifke Center zoning boundary and the Taşucu – Kum Neighborhood zoning boundary located on the coastline. The purpose of this study is to make an evaluation based on the results of the study using the current spatial plans and to integrate these results into the plans. In other words, in this study, no evaluation has been made on the correctness or incorrectness of the plans or decisions produced and implemented so far. In terms of the essence of this study, an evaluation was made based on the current situation. As a result, it has been revealed how the urban development trend within the zoning boundaries of Silifke and Taşucu-Kum Neighborhood will be in 2050. Based on these results, evaluations were made and suggestions were presented. The flow diagram is given in Table 1.

Table 1. Flow diagram of the study



2.2.1. Land change trend

Land change trend analysis is vital for understanding patterns of urbanization, deforestation, and habitat loss. It helps identify drivers of landscape change and informs sustainable land management practices (Lambin et al., 2003). "Land Change Trend" method analyzes historical LUC changes to identify trends and drivers of landscape transformation. It aids in land management and conservation planning (TerrSet, 2016). This study elucidates land change trends for the study area in terms of future urban development through a 2050 projection, aiming to delineate prospective land transformation tendencies. In this context, using the Land Change Modeler module of the TerrSet software, the changes in LUC between the years 1990 and 2020 within the micro-watershed level of the study area have been identified. The process of change prediction within the Land Change Modeler progresses sequentially through change analysis, transition potential modeling, and ultimately change prediction, constituting a step-by-step and experimentally guided procedure.

Projecting future scenarios for land change prediction relies on historical changes observed in LUC maps over the period from the first to the second time step (TerrSet, 2016). The initial step in the change prediction process consists of change analysis. The Transition Potentials tab categorizes transitions between two LUC maps into a series of sub-models, each defined by a set of drivers or explanatory variables. The Change Prediction tab provides controls for a dynamic LUC change prediction process. Once the end date is determined, the amount of change at each transition is modeled either through a Markov Chain analysis or by determining a transition probability matrix from an external model (TerrSet, 2016).

3. Research Findings and Discussion

3.1. Land Change Trend for Urban Development: Projection 2050

Within the scope of spatial planning, projections made based on the current state are crucial tools for identifying potential disruptions or issues that may arise in the event of the continuity of ongoing processes, and for taking necessary actions against them.

In this section of the study, land change trends related to urban development in the research area for the year 2050 have been identified. Thus, by determining the direction and magnitude of changes, an assessment can be made based on the current situation. Additionally, population estimates for the year 2050 have been determined. This is because it is aimed to identify the green areas needed based on population estimates for the areas that will be urbanized by 2050.

In this context, LUC changes between the years 1990 and 2020 within the research area were determined using the Land Change Modeler module of the TerrSet software. Based on these changes and in conjunction with other parameters known to be significant for spatial development, land change trends for the year 2050 were delineated. LUC maps at Level 3 of the CLC classification system for the years 1990 and 2020 were prepared for use by cutting them according to the boundaries of the research area for the identification of changes between 1990 and 2020 (Figure 2 and Table 2).

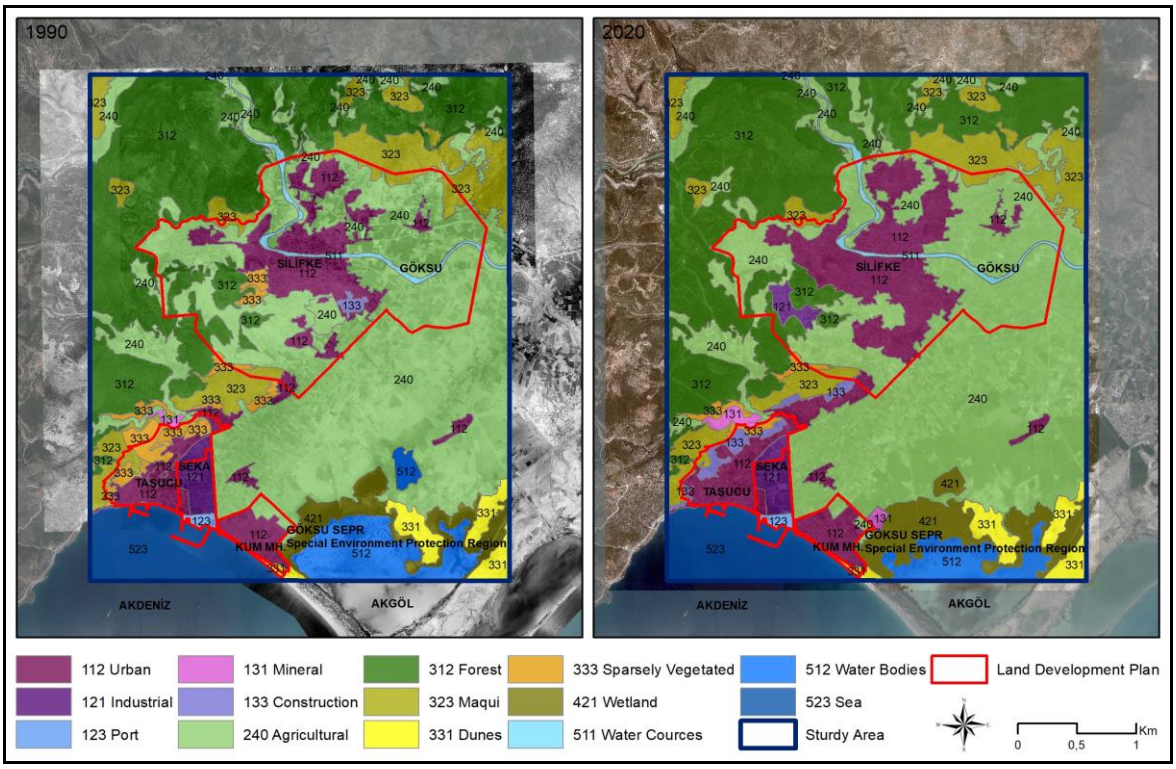


Figure 2. CLC LUC maps for the years 1990-2020

Table 2. Statistical information for the CLC LUC maps for the years 1990 and 2020

CLC	CLC Name	1990	2020	CLC	CLC Name	1990 (ha)	2020 (ha)
112	Urban Fabric	1362	1901	323	Maquis	1266	1140
121	Industrial Units	167	245	331	Dune	323	314
123	Port Areas	32	32	333	Sparsely Vegetated	349	96
131	Mineral Extracrion Site	19	75	421	Wetlands	448	629
133	Construction Sites	28	130	511	Water Cources	132	131
240	Agricultural Areaa	6589	6431	512	Water Bodies	656	364
312	Forest	3699	3583	523	Sea	775	774
					Total	15845	15845

3.1.1. Changes in LU/LC (CORINE LUC 3rd level) between 1990 and 2020

When examining the LUC maps at the micro-watershed level for the years 1990 and 2020, along with their associated statistical data, it is observed that urban areas have increased by approximately 600 hectares. Upon inspection of the LUC map for the year 2020, it is evident that a significant portion of this urban expansion is attributed to the enlargement of the Silifke urban center. Industrial areas, on the other hand, have experienced an increase of around 80 hectares from 1990 to 2020. The construction sites in the process of being developed have shown approximately a fivefold increase over the course of 30 years. Construction areas, which had an approximate spatial extent of 30 hectares in 1990, have expanded to 130 hectares by the year 2020. This situation presents very concrete indicators regarding the rate of increase in construction activities.

When examining the current situation in rural-inclined areas, it is observed that agricultural areas have decreased by approximately 150 hectares. Similarly, there is a decrease of approximately 120 hectares in forested and shrubland areas, which constitute natural and semi-natural areas. Bare areas, which had an approximate spatial extent of 350 hectares in 1990, have receded to approximately 100 hectares by 2020. One reason for the increase in wetlands is the transformation of the water surface, located southeast of the 1990 LUC map in a patchy shape, into a saline marshland classified under the wetlands class. The other reason is the expansion of reed beds, also classified under the wetlands class, on the shores of the lagoon within the Göksu SEPR. The decrease in water surfaces is again depends on the expansion of reed marsh areas in the Akgöl lagoon. In 1990, the size of the mining area located only north of the Taşucu settlement center was 19 hectares, whereas by 2020, the size of the mining areas increased fourfold to reach 75 hectares. This is due to both the expansion of the existing mining area and the opening of new mining areas in the Göksu SEPR for salt extraction purposes.

The 3. level CLC LUC map classes have been generalized for the land change trend study. Under the category of artificial areas, urban texture, industrial areas, construction sites, and port areas have been generalized as "urban." Water-related classes such as wetlands, waterways, and water surfaces have been generalized as "water." Additionally, changes occurring within the water class have been thoroughly examined, and the direction of changes at the subclass level is specified in the following section. Bare areas, dunes, shrubs, forests, agricultural areas, and mining sites have been considered as separate classes. As a result of the generalization, a total of 8 classes have been identified, and these classes have been used to determine land change trends for the research area with the 2050 projection. In change studies, determining not only the magnitude but also the direction of changes is of great importance. This enables a concrete demonstration of the quantities and orientations of changes, facilitating evaluation regarding transitions between classes. Consequently, such assessments lay the groundwork for actions to be taken in line with identified needs. The LUC changes between 1990 and 2020 are presented in Table 3.

Table 3. Direction and statistical information of changes between 1990 and 2020

CLC Code			
1990	**2020**	**LUC Change Directions from 1990 to 2020**	**Amount of Change (ha)**
240	112	From Agricultural to Urban	431
312	112	From Forest to Urban	19
323	112	From Maquis to Urban	75
333	112	From Sparsely Vegetated to Urban	191
240	131	From Agricultural to Mineral Extracrion	28
421	131	From Wetland to Mineral Extraction	15
312	240	From Forest to Agricultural	123
323	240	From Maquis to Agricultural	75
331	240	From Dune to to Agricultural	11
421	240	From Wetland to Agricultural	94
333	312	From Sparsely Vegetated to Forest	26
333	323	From Sparsely Vegetated to Maquis	34
		Total	1122

Upon examining the direction and statistical data provided in Table 3 regarding the changes between 1990 and 2020, it is evident that the predominant trend has been towards urban areas. A significant area totaling 993 hectares, comprising 431 hectares of agricultural land, 191 hectares of bare land, 75 hectares of shrubland, and 19 hectares of forested area, has transitioned into urban areas over the 30-year period from 1990 to 2020. During this timeframe, approximately 30 hectares of agricultural land have been converted into mining areas, resulting in the expansion of the existing mining site. The areas transformed from wetlands to mining areas constitute locations where salt production takes place within the Göksu SEPR. Furthermore, over the 30-year period, a total of 303 hectares of land, including 123 hectares of forested area, 75 hectares of shrubland, 11 hectares of dune area, and 94 hectares of wetland area, have been converted into agricultural land. Areas transitioning from bare land to shrubland and forest predominantly consist of rejuvenated areas resulting from afforestation or cutting activities within the scope of forestry operations. During the period from 1990 to 2020, the majority of the built-up areas in Taşucu were formed by the transformation of the bare areas in the immediate vicinity of the existing settlement into urban areas. Similarly, in Silifke, most of the built-up areas were formed by the conversion of agricultural areas adjacent to the existing urban settlement into urban areas. The spatial distribution of LUC changes between 1990 and 2020 is provided in Figure 3.

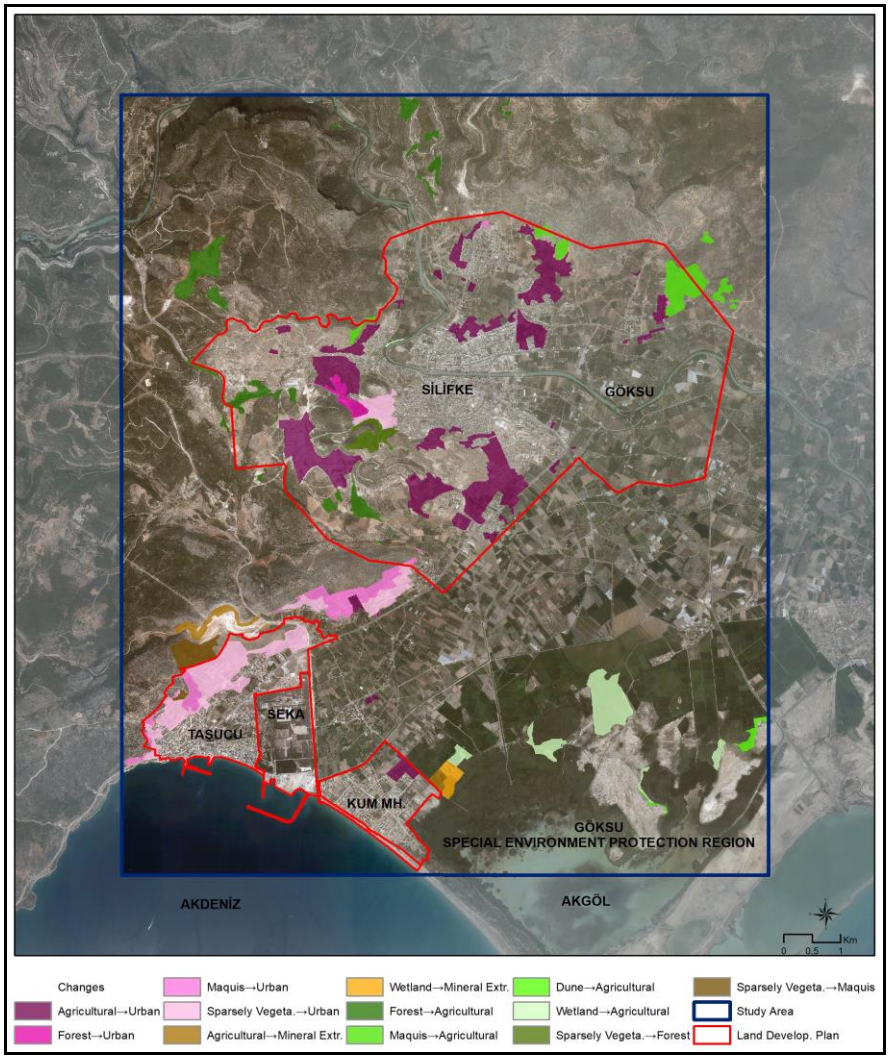


Figure 3. The spatial distribution of LUC change between 1990 and 2020

3.1.2. 2050 LUC changes: urbanization trend

Especially concerning physical spaces, estimations about the future based on current conditions serve as crucial tools for identifying potential disruptions or issues that may arise if ongoing processes persist, and for taking necessary actions to address them. In this section of the study, an attempt has

been made to elucidate land change trends for the research area in terms of future urban development, focusing on the projection for the year 2050.

The basis of this study is formed by urbanized areas. Therefore, when discussing the land change trends for the year 2050, the areas transitioning from bare lands, agricultural lands, shrublands, and forests to urban fabric are referred to. When determining the trend of transformation into urban areas from the specified classes, certain parameters have been defined. These parameters are determinants and constraints that need to be included in the assessment phase in terms of suitability for settlement. These include the CLC LUC map, proximity to settlements, proximity to roads, slope, aspect, and elevation maps. The parameters of input data values used in land change trend analysis are essential for understanding and predicting LUC changes. CLC LUC maps provide information on the spatial distribution of different LUC categories, serving as a foundational dataset for land change analysis (EEA, 2020).

Proximity of Settlement measures the distance of land parcels or pixels to urban or built-up areas, indicating the degree of urbanization and potential expansion (Yuan et al., 2007). Proximity of Road, it evaluates the distance of land features to road networks, which influences accessibility, transportation infrastructure, and patterns of urban development (Yang et al., 2018). Slope represents the inclination or steepness of the terrain, affecting land suitability for various uses, erosion susceptibility, and the potential for infrastructure development (Fan et al., 2020). Aspect refers to the compass direction that a slope faces, influencing factors such as solar radiation exposure, vegetation distribution, and microclimate conditions (Masek et al., 2008). Elevation represents the height of the land surface above sea level, affecting temperature gradients, precipitation patterns, and land use suitability. All maps prepared based on the scoring information provided in Table 4 are presented in Figure 4.

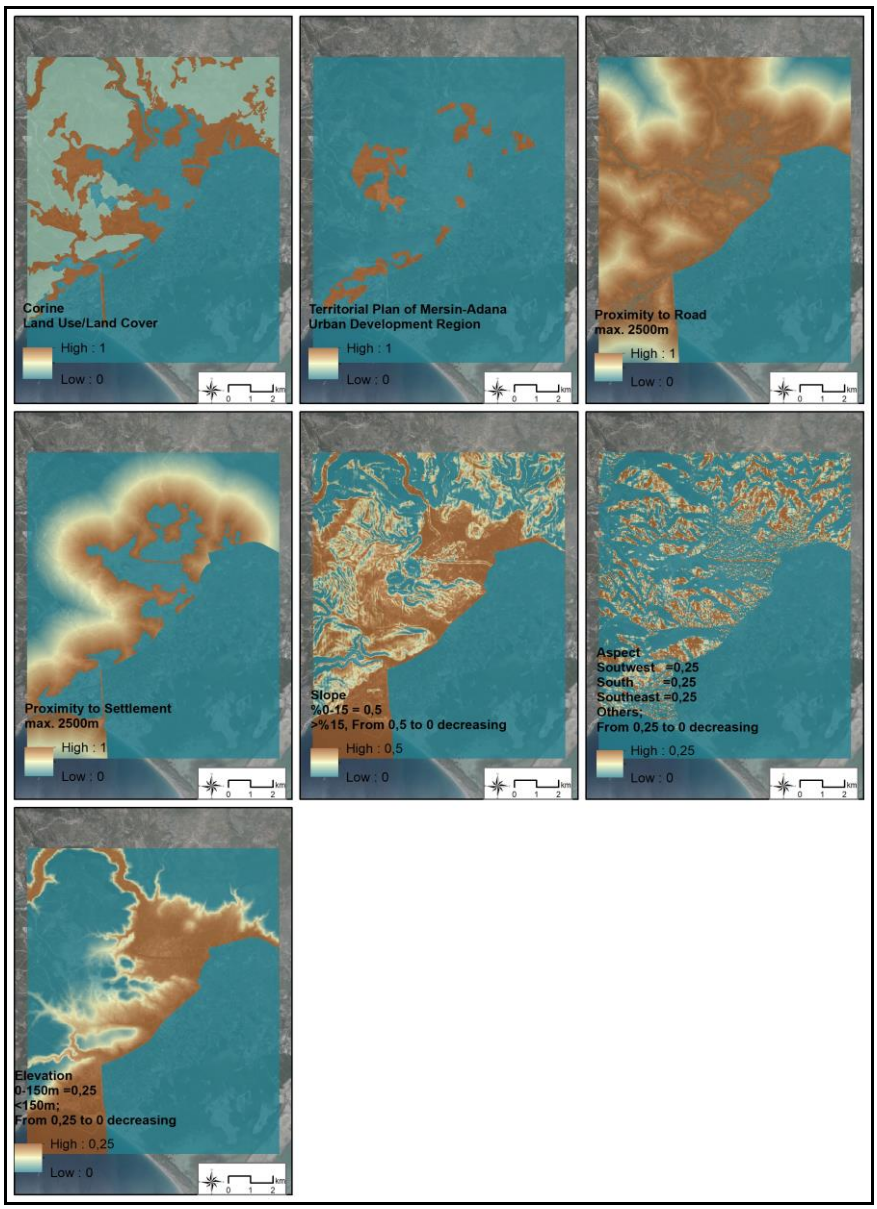


Figure 4. The input data used in land change trend analysis

These parameters, when integrated into land change models and analyses, provide valuable insights into the dynamics and drivers of LUC changes, supporting sustainable land management and planning efforts.

The parameters have been scored according to suitability for settlement. Similar parameters used in previous studies were examined for scoring, and determined according to the nature of this study (Feng et al., 2011; Silva & Clarke, 2002; Li et al., 2018). Additionally, when determining parameter values which used distance units, the distance from the center of the zoning plan to the boundary of the zoning plan was also taken into account. The impact levels of parameters have been normalized according to their maximum values. If the numerical sum of maximum values is assumed to be 5, which corresponds to one hundred percent, then the parameter with a maximum value of 1 will have a 20 percent effect, the parameter with a value of 0.5 will have a 10 percent effect, and the parameter with a value of 0.25 will have a 5 percent effect. Additionally, in this study, considering the current situation, the urban development areas specified in the 1/100,000 scale Adana-Mersin Regional Plan have been utilized to filter the study area boundary. The boundaries of the Göksu SEPR indicated in the same plan have also been evaluated as areas unsuitable for urban development. For this purpose, the lowest score has been assigned to the locations corresponding to the boundaries of the Göksu SEPA in the data used in the land change trend analysis. The information regarding the scoring used in the production of the maps presented in Figure 4 is provided in Table 4.

Table 4. The parameters of the input data used in land change trend analysis

Data Name	Impact	Max.	Min.	Description	Assigned Value
CORINE 3th Level LUC Map	% 20	1	0	Urban Water Sparsely Veg. Agricultural Maquis Forest	0 0 1 1 0,25 0,25
Urban Development Regions	% 20	1	0	According to 1/100,000 scale Mersin-Adana territorial plan	
Proximity of Settlement	% 20	1	0	Evaluated for a max. distance of 2500m.	
Proximity of Road	% 20	1	0	Evaluated for a max. distance of 2500m.	
Slope	% 10	0,5	0	Slope Degree values; %0-15=0,5, ≥%15=	
Aspect	% 5	0,25	0	Aspect values; South, soutwest/east = 0,25,	
Elevation	% 5	0,25	0	Elevation values; 0-150m = 0,25, ≥150m =	

To determine land change trend, used in many studies the Multi-Layer Perceptron (MLP) Neural Network model within The Transition Potentials Tab of the TerrSet Land Change Modeler was utilized (Sahaa et al., 2022; Symeonakis, 2016; Sankarrao et al., 2021). The MLP Neural Network is extensively developed to offer an automatic mode that does not require user intervention and provides valuable insights into the contributions of explanatory variables (Eastman et al., 2005). The accuracy rate of the MLP Neural Network model result should be at least 50%, and if a result lower than this value is obtained, necessary checks should be performed, and the model should be rerun (TerrSet, 2016). In this study, a relatively high accuracy rate of 79.3% was achieved. The map showing the areas with the probability of urban transformation for the year 2050 is presented in Figure 5, while the statistical information regarding this map is provided in Table 5.

When examining the urbanization expectation for the year 2050 through the land trend study, it is observed that almost all of the urban development areas specified in the 1/100,000 Adana-Mersin Regional Plan are expected to be urbanized. In only some parts of the urban development areas located to the west and north of the Silifke settlement center, there is no expectation of urbanization until 2050. All of the areas expected to be urbanized within the Silifke zoning plan boundaries consist of agricultural lands (202 ha). All of the areas expected to be urbanized within the zoning plan boundaries of Taşucu-Kum District consist of bare lands (46 ha). These areas are located within the boundaries of areas designated as urban development zones without being included in any protection class in the Environmental Plan. As mentioned in previous sections, rather than claiming to evaluate based on what should be, this study has conducted an assessment in line with its objectives focusing on the current situation and the existing conditions outlined in approved plans.

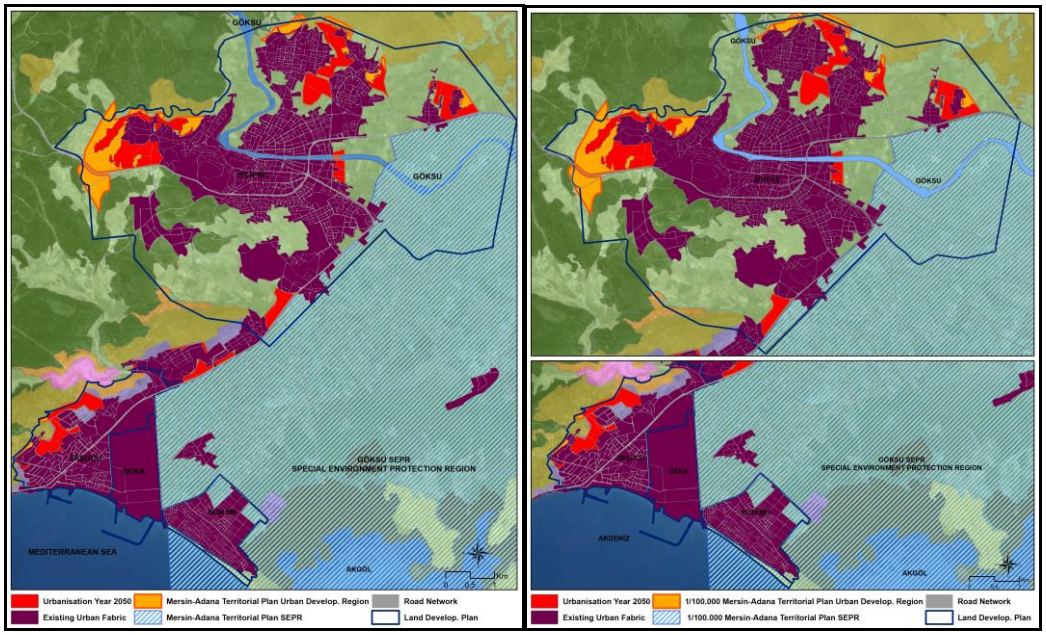


Figure 5. Urbanization projection for land change tendency in 2050

Table 5. Statistical information on urbanization projection for land change tendency in 2050.

The Classes that expected to transform into the urban fabric	Silifke	Taşucu	Between Silifke and Taşucu	Total
From Sparsely Vegetated Areas to Urban Fabric	-	46 ha	2 ha	48 ha
From Agricultural Areas to Urban Fabric	202 ha	-	12 ha	214 ha
	Total			262 ha

3.2. Population Trend

Evaluating the land change trend results for urban development in 2050 while considering population trends will provide valuable data for determining the per capita green area requirement in areas expected to urbanize. For this purpose, a population trend study for the year 2050 was conducted, taking into account the current population status of the neighborhoods within the zoning boundaries of Silifke and Taşucu-Kum District. As a result of the study conducted in 2013, the names and boundaries of certain neighborhoods have been changed, and some new neighborhoods have been added. Therefore, Taşucu has been named as the "Taşucu neighborhood" as the sole neighborhood. Current population statistics for the neighborhoods within the zoning boundaries are provided in Table 6.

Table 6. Population census results for Silifke and Taşucu Neighborhoods. (TÜİK, 2021)

Silifke			
Neighborhood Name	**Population (People)**	**Neighborhood Name**	**Population (People)**
Gazi Mh.	15.428	Pazarkaşı Mh.	1.640
Göksu Mh.	14.396	Tosmurlu Mh.	1.237
Mukaddem Mh.	6.675	Bucaklı Mh.	1598
Sarıcalar Mh.	6.056	Ulugöz Mh.	1.160
Sayağzı Mh.	5.208	Kabasakallı Mh.	956
Yeni Mh.	3.563	Say Mh.	954
Toros Mh.	3.452	Camiikebir Mh.	910
Atik Mh.	2.990	Burunucu Mh.	826
Saray Mh.	1.762	Total	68.811
Taşucu			
Neighborhood Name			**Population (People)**
Continued from Table 6			
Taşucu Mh.			13.215
		Total	82.026

The total population in the neighborhoods within the Silifke zoning plan boundaries is 68,801 people, while the population census of Taşucu Neighborhood, the only neighborhood within the Taşucu zoning plan boundary, is 13,215 people. The current population census in both zoning plan boundaries is 82,206 people. The results of the population projection for the year 2050 using the linear trend analysis model based on the address-based population registration system results for the year 2021 are presented in Table 7. The Linear trend analysis model, also known as time series analysis, aims to determine the best-fitting line to the observed values in past years in the form of the model *'y = a + bx'* using the 'Least Squares' method, which minimizes the sum of squared deviations. Then, assuming that the linear trend (tendency) will continue in the future, predictions are made (Hess et al., 2001).

Table 7. Silifke and Taşucu population: projection of 2050

Years	Silifke (People)	Taşucu (People)	Years	Silifke (People)	Taşucu (People)
2020	68007	11383	2035	85141	18085
2021	68811	11815	2036	86326	18534
2022	69729	12253	2037	87512	18983
2023	70915	12701	2038	88697	19431
2024	72100	13150	2039	89883	19880
2025	73286	13599	2040	91068	20329
2026	74471	14047	2041	92254	20777
2027	75657	14496	2042	93439	21226
2028	76842	14945	2043	94625	21675
2029	78027	15393	2044	95810	22123
2030	79213	15842	2045	96996	22572
2031	80399	16291	2046	98181	23021
2032	81584	16739	2047	99367	23469
2033	82770	17188	2048	100552	23918
2034	83955	17637	2049	101738	24367
			2050	102.923 People	24.815 People

According to the projection results, the expected population in 2050 is estimated to be 102,923 for Silifke and 24,815 for Taşucu. In this study, a linear trend analysis model was used, and the MAPE (Mean Absolute Percentage Error) value remained below 10%. The claim that the MAPE value below 10% in trend analysis is considered high accuracy is commonly considered in the literature (Tatlıdil, 1992) (Figure 6).

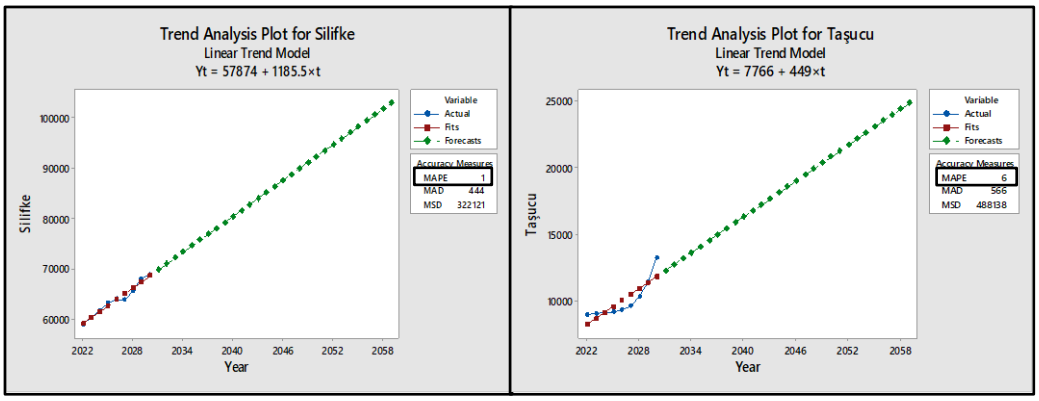


Figure 6. Accuracy values for trend analysis

According to the population projection for the year 2050, it is estimated that there will be approximately 102,923 people residing within the zoning boundaries of Silifke. According to the current spatial planning and construction regulations, the minimum green area per capita should be 10 m². Therefore, by 2050, within the zoning planning boundaries of Silifke, the green area should cover at least 1,029,230 m². In Taşucu Neighborhood, it is estimated that there will be approximately 24,815 people residing within the urban boundaries. According to the current spatial plans and

construction regulations, by the year 2050, within the urban planning boundaries of Taşucu Neighborhood, the green area should cover at least 248,150 m².

3.3. Urbanization - Population Trend and Urban Green Space Status: 2020 and 2050

The assessment of urban ecosystem services requires a definition based on existing indicators and data, and the status of urban green infrastructure is crucial in defining the status of these services. Before initiating the classification study to produce maps serving the identified spatial scale, it is necessary to clarify the spatial boundaries of urban ecosystem services and determine the typology of urban green infrastructure (MAES, 2016). Gezer & Gül (2009) classify urban open and green spaces based on their usage into three groups: Public (General) Open and Green Spaces, which are generally accessible to urban residents and cater to their recreational needs (e.g., city and neighborhood parks, urban forests, cemeteries, botanical and zoological gardens, fairgrounds, sports facilities); Semi-Private Open and Green Spaces, accessible only to employees and their families or specific groups under certain conditions (e.g., schoolyards, military areas, public institution and factory campuses); and Private Open and Green Spaces, exclusively for use by owners or residents of single or multi-storey private properties (Gezer & Gül, 2009). In the Urban Atlas (UA) classification, classes relevant to urban ecosystem services consist of 14100 urban green areas and 14200 sports and leisure facilities. Urban green areas represented by code 14100 include publicly accessible green spaces primarily for recreational use, suburban natural areas transformed into city parks, and forests or green areas extending from the surroundings to urban areas bordered by structures. Sports and leisure facilities represented by code 14200 encompass all sports facilities, whether managed publicly or commercially, along with associated green spaces, parking lots, etc., for public use in various sports activities (EU, 2016). The Spatial Plans Preparation Regulation, which came into effect in 2014 and is currently in force, defines "Social infrastructure areas" in its "Definitions" section as "the general term for open and green spaces such as playgrounds, parks, squares, neighborhood sports areas, botanical parks, recreation areas, which are designed by the public or private sector for meeting the cultural, social, and recreational needs of individuals and society and for enhancing quality of life in a healthy environment" (MBS, 2014). According to Appendix-2 Table titled "Standards and Minimum Area Sizes of Minimum Social and Technical Infrastructure Areas in Different Population Groups" of the same regulation, open and green spaces in planning within district boundaries should consist of playgrounds, parks, squares, neighborhood sports areas, botanical parks, picnic areas, and recreation areas, and the minimum area per capita of open and green spaces should be at least 10m² (MBS, 2014). Green areas defined in the "Definitions" section of the Planned Areas Zoning Regulation, prepared based on the provisions of the Zoning Law No. 3194 dated 3/5/1985 and the Law Decree on the Organization and Duties of the Ministry of Environment, Urbanisation and Climate Change No 644 dated 9/6/2011, currently in force as of 3/7/2017, are described as follows: "The total of playgrounds, children's gardens, resting, walking, picnicking, entertainment, recreation, and recreational areas allocated for the benefit of the society (Metropolitan-scale fairs, botanical and zoological gardens, and regional parks fall within these areas.), including the functions and building conditions specified in the 19th article" (MBS, 2017).

In this stage of the study, based on all these definitions, the results of Derse's (2023) production of 4th level Corine Urban Atlas maps were utilized to identify urban green areas providing urban ecosystem services within both Silifke and Taşucu-Kum Districts' zoning boundaries. In Derse's (2023) study, the current per capita green area amounts were evaluated by considering both the classifications indicated in the classification system used and the definitions specified in the current legislation, the Spatial Plans Construction Regulation. The findings from Derse (2023)'s study were considered together with the results generated in this study. Table 8 presents the population of Silifke center and Taşucu-Kum neighborhood within the municipal boundaries in 2020, the status of urban green areas according to different definitions, the population projection for 2050, the required quantity of urban green space and the anticipated amount of urbanized areas.

Table 8. Population and urban green space situation according to Urban Atlas and Spatial Plans Construction Regulation (SPCR): Between 2020 and 2050 (Revised using the data from Derse (2023)

	Population		According to Urban Atlas		According to SPCR		Size of the Area expected to transform into the urban fabric in 2050
	Year	People	Urban Green Space Quantity	Per Capita Urban Green Space Quantity	Urban Green Space Quantity	Per Capita Urban Green Space Quantity	
Silifke	**2020**	68.811	533.000m²	7,75 m²	265.000 m²	3,85 m²	
	2050	102.923	1.029.230m²	10m²	1.029.230m²	10m²	2.020.000m²
	The size of UGS needed		496.230 m²	25% of the area expected to be built in 2050	764.230 m²	%38 of the area expected to be built in 2050	
Taşucu - Kum mh	**2020**	13.125	233.000m²	17,8m²	163.000 m²	12,3 m²	
	2050	24.815	248.150m²	10m²	248.150m²	10m²	460.000m²
	The size of UGS needed		15.150m²	%3 of the area expected to be built in 2050	85.150m²	%18 of the area expected to be built in 2050	

SPCR: Spatial Plans Construction Regulation UGS: Urban Green Space

As seen in Table 8, it is evident that for the central settlement of Silifke, neither the urban green space quantity determined according to the Urban Atlas classification system nor those defined in the Spatial Plans Implementation Regulation meet the minimum requirement of 10m² of green space per capita stipulated in the current legal regulations.

For the central settlement of Silifke, according to the Urban Atlas, the per capita urban green space quantity remains at 7.75 m², while according to the spatial planning regulation, it stands at a significantly insufficient with 3.85 m². Based on population projection studies conducted for 2050, it is estimated that the population will reach 102,923 individuals. Considering the required green space stipulated in the regulations, it is concluded that by 2050, the minimum urban green space within the urban planning boundaries of Silifke should be at least 1,029,230 m². With the urban green space in Silifke central area in 2020 being 533,000 m² according to the Urban Atlas classifications, at least 496,230 m² of new urban green space facilities need to be constructed within the planning boundaries by 2050.

This implies that at least 25% of the anticipated 2,020,000 m² (202 ha) area to be developed by 2050 should be designated as urban green space. However, the situation is more unfavorable when considering the urban green space quantity calculated based on the current regulations. The urban green space area defined in the SPCR for 2020 is 265,000 m². To meet the minimum per capita green space requirement, at least 764,230 m² of new urban green space facilities need to be constructed within the planning boundaries by 2050. This suggests that at least 38% of the anticipated developed area in Silifke central area by 2050 should be allocated as urban green space.

Unlike the central settlement of Silifke, for Taşucu-Kum neighborhood, both the urban green space quantity determined according to the Urban Atlas and The spatial planning regulation comply with the legal requirement of at least 10 m² of green space per capita. According to the Urban Atlas classifications, the per capita urban green space quantity is determined as 17.8 m², while according to the spatial planning regulation, it is calculated as 12.3 m².

For the year 2050, it is estimated that the population will be 24,815 individuals. According to the minimum per capita green space requirement stipulated in the regulations, the urban green space area within the Taşucu-Kum neighborhood planning boundaries should be at least 248,150 m² by 2050.

Considering the classifications in the Urban Atlas, the urban green space area in 2020 is 233,000 m², indicating the need for the construction of 15,150 m² of new urban green space facilities by 2050. Thus, at least 3% of the anticipated 460,000 m² (46ha) area to be developed by 2050 should be allocated as urban green space. Overall, while Taşucu-Kum neighborhood appears to be relatively well-off in terms of existing urban green space quantity, the situation of urban green spaces determined according to

the current regulations is more unfavorable. The urban green space area defined in the SPCR for 2020 is 163,000 m². To meet the minimum per capita green space requirement, at least 85,150 m² of new urban green space facilities need to be constructed within the Taşucu-Kum neighborhood planning boundaries by 2050. This implies that at least 18% of the anticipated developed area in the Taşucu-Kum neighborhood planning by 2050 should be allocated as urban green space.

3.4. Discussions

Several studies have examined the per capita urban green space quantity in various cities across Turkey, highlighting both the current status and the need for improvement in urban planning and management strategies.

In a study conducted by Gül and Küçük (2001) in Isparta, it was found that the existing regulated active open-green areas, including city and neighborhood parks, playgrounds, and recreational areas, averaged at 3m² per capita. However, when considering additional potential green spaces such as roads, cemeteries, urban forests, and groves, this figure was estimated to rise to 14.6 m² per capita. The authors underscored the significance of meticulously planning, designing, and managing open-green spaces from scientific, ecological, and technical standpoints to foster the development of a contemporary, and habitable urban environment.

Similarly, Türker and Gül (2022) analyzed 29 green areas at the neighborhood scale in Uşak city center and determined the per capita green space quantity to be 8.50 m², with a playground area of 3.37 m² per child. However, they noted that this fell below the legal standard of 10 m² per capita, indicating an inadequate, uneven, and fragmented distribution of green spaces in terms of numerical and areal sizes within the neighborhoods.

In Selçuklu district, Önder et al. (2011) utilized GIS to assess the adequacy of active green areas in terms of spatial quantity and accessibility. They found that the existing active urban green areas covered 57,632.75 m², resulting in a per capita ratio of 12.53 m², which was higher than the legal requirement. However, they highlighted disparities, particularly noting that areas outside city parks fell below established standards. Despite plans for additional green spaces, implementation remained limited, indicating a lack of sufficient contribution to urban life.

Hepcan & Hepcan (2018) focused on Bornova's urban landscape, identifying natural and vegetated components using land-use maps. They determined that only 45% of the urban development area comprised potential components for an urban open-green space system. Their findings underscored the need for a comprehensive green infrastructure plan, revealing insufficient quantities and low landscape continuity within urban areas.

In conclusion, these studies collectively emphasize the importance of adequate per capita urban green space for fostering sustainable and livable urban environments in Turkish cities, while also highlighting the necessity for improved planning, management, and implementation strategies.

4. Conclusion and Suggestions

Urban areas are among the most affected places by the environmental issues caused by the globally recognized problem of climate change. Additionally, the issues stemming from urbanization itself are quite comprehensive and diverse. Consequently, one of the most defining challenges of our time will be creating healthy and livable urban spaces for societies. The objective of this research is to analyze land change trends in Silifke (Mersin) over time, spanning from 1990 to 2020 and projecting to 2050, with a focus on enhancing urban resilience to global climate change impacts.

In this study, the study area was delineated to encompass Silifke's central settlements using micro-watershed analysis. Land change trend analysis determined areas slated for development by 2050, based on existing urban development zones in the 1/100,000 scale Adana-Mersin Regional Plan. Population projections for 2050 were made for Silifke Center and Taşucu and Kum Neighborhood. Urban green spaces were assessed in relation to projected 2050 population, and findings were compared with Derse's (2023) study.

In the examination of land change trends conducted at the micro-watershed level for the years 1990 and 2020, a notable increase in urban areas by approximately 600 hectares is observed. Particularly, the LUC map for the year 2020 highlights a substantial expansion of the Silifke center contributing significantly to this growth. Over the same period, industrial areas have also experienced an increase of around 80 hectares. Moreover, there has been a remarkable surge in construction sites under development, indicating a fivefold increase over the span of 30 years. For instance, the spatial extent of construction areas, which encompassed roughly 30 hectares in 1990, has expanded to 130 hectares by 2020, underscoring the rapid pace of construction activities. These findings provide concrete evidence of the escalating trend in urbanization and construction endeavors within the study area. Such insights gleaned from the analysis of LUC maps serve to elucidate the dynamic changes in land use patterns and underscore the need for comprehensive planning strategies to manage and mitigate the impacts of urban expansion.

When the urbanization expectations for the year 2050 were examined, it was observed that nearly all of the urban development areas specified in the 1/100,000 Adana-Mersin Regional Plan are expected to be developed. Additionally, within the boundaries of the Silifke zoning plan, it was noted that all areas expected to undergo urbanization are comprised entirely of agricultural lands.

The analysis revealed that the central settlement of Silifke falls short of meeting the minimum requirement of 10m² of green space per capita as mandated by current legal regulations. According to the Urban Atlas, the per capita urban green space quantity stands at 7.75 m², while spatial planning regulations estimate it at a significantly insufficient 3.85 m².

Considering population projections for 2050, with an estimated population of 102,923 individuals, it is concluded that by 2050, the minimum urban green space within the urban planning boundaries of Silifke should be at least 1,029,230 m². However, existing urban green space in Silifke's central area in 2020, totaling 533,000 m² according to the Urban Atlas classifications, falls short. At least 496,230 m² of new urban green space facilities need to be developed within the planning boundaries by 2050, implying that at least 25% of the anticipated 2,020,000 m² area to be developed by 2050 should be designated as urban green space.

The situation is even more unfavorable when considering the urban green space quantity calculated based on current regulations. The urban green space area defined in the SPCR for 2020 is 265,000 m². To meet the minimum per capita green space requirement, at least 764,230 m² of new urban green space facilities need to be constructed within the planning boundaries by 2050, suggesting that at least 38% of the anticipated developed area in Silifke central area by 2050 should be allocated as urban green space.

In contrast, for the Taşucu-Kum neighborhood, both the Urban Atlas and spatial planning regulations comply with the legal requirement of at least 10 m² of green space per capita. The per capita urban green space quantity is determined as 17.8 m² according to the Urban Atlas and 12.3 m² according to spatial planning regulations. With an estimated population of 24,815 individuals by 2050, the urban green space area within the Taşucu-Kum neighborhood planning boundaries should be at least 248,150 m² by 2050. However, existing urban green space in 2020 is 233,000 m², indicating the need for the construction of 15,150 m² of new urban green space facilities by 2050. Thus, at least 3% of the anticipated 460,000 m² area to be developed by 2050 should be allocated as urban green space in Taşucu-Kum neighborhood.

Overall, while Taşucu-Kum neighborhood appears to be relatively well-off in terms of existing urban green space quantity, the situation of urban green spaces determined according to the current regulations is more unfavorable. The urban green space area defined in the SPCR for 2020 is 163,000 m². To meet the minimum per capita green space requirement, at least 85,150 m² of new urban green space facilities need to be constructed within the Taşucu-Kum neighborhood planning boundaries by 2050. This implies that at least 18% of the anticipated developed area in the Taşucu-Kum neighborhood planning by 2050 should be allocated as urban green space.

In conclusion, while the Taşucu-Kum neighborhood seems relatively well-off in terms of existing urban green space quantity, the situation of urban green spaces in Silifke's central area is more unfavorable, highlighting the urgent need for strategic planning and investment in urban green infrastructure to ensure sustainable urban development and enhance the quality of life for residents.

Understanding land change trends, especially the conversion of agricultural land into urban areas, is crucial for sustainable urban planning and mitigating the adverse effects of urbanization on ecosystems and biodiversity.

Urban green spaces play a vital role in enhancing urban resilience, mitigating climate change impacts, improving air and water quality, and providing recreational and aesthetic benefits to urban residents. Thus, recognizing the importance of urban green spaces is essential for promoting healthy cities.

Based on the findings of this study, it is recommended that urban planning authorities prioritize the preservation and expansion of urban green spaces within Silifke (Mersin) and other urban areas. This can be achieved through policies and initiatives aimed at conserving existing green areas, integrating green infrastructure into urban development projects, and promoting community engagement in urban greening efforts.

Furthermore, promoting sustainable land management practices and incorporating nature-based solutions into urban planning processes can help enhance the resilience of cities to climate change while improving the overall quality of urban life.

Collaborative efforts between government agencies, local communities, and environmental organizations are essential for achieving these goals and creating healthier and more sustainable urban environments for current and future generations.

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Urfa Pazar (Hodja Ahmet) Mosque Repair and Conservation Practices

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Abstract

Located in the central part of the Southeastern Anatolian region, Urfa is a multi-layered and multi-cultural city that bears the traces of many states and principalities to the present day. The city, at the crossroads of Eastern and Western civilisations, has religious buildings belonging to different faiths. It is known that there were 34 mosques in the city in the 16th century and 22 mosques in the 17th century. The Pazar Mosque, which is the subject of this study, is located in the traditional Kovacı Arcade in Urfa Haşimiye Square. Kovacı Arcade with which the mosque has become integrated is made up of indoor and outdoor shops. The fact that the mosque has always been preferred for special occasions such as Friday Prayers and Salaat Al Eid for religious rituals and the fact that shopping has been done before and after such religious services have enhanced the appeal of the mosque along with its surroundings. However, this situation, had led the way for various additions to be made to the shops and the structure itself which in turn had given rise to a change in its original form. The aim of the study is to convey the informed and uninformed interventions that the mosque had been subjected to in relation to its use from the year 1987 when it had been registered as a listed building and the year 2023 and also to convey the approaches undertaken for the mosque for which the damages *and problems have been documented within 2012 under the consultancy of the author.*

Keywords: *Şanlıurfa, Pazar Mosque, restoration.*

Urfa Pazar (Hoca Ahmet) Camii Onarım ve Koruma Çalışmaları

Öz

Güneydoğu Anadolu Bölgesi'nin orta kesiminde yer alan Urfa, birçok devlet ve beyliğin izlerini günümüze ulaştıran çok katmanlı ve çok kültürlü bir kenttir. Doğu ve Batı medeniyetlerin geçiş alanı içinde olan kent, farklı inançlara ait dini yapılara sahiptir. Kentte 16. yüzyılda 34 adet cami, 17. yüzyılda 22 caminin varlığı bilgisine ulaşılmaktadır. Bu çalışmaya konu olan Pazar Cami, Urfa Haşimiye Meydanı'nda Kovacı Çarşısı'nın içinde yer alır. Caminin bütünleştiği çarşı açık ve kapalı dükkanlardan oluşmaktadır. Caminin Cuma namazı ve Bayram namazı gibi özel günlerde dini ritüeller için tercih edilmesi, ibadet öncesi ve sonrası çarşıda alışveriş yapılması cami ve çevresinin cazibesini artırmıştır. Ancak bu durum beraberinde dükkanların ve yapının zamanla çeşitli eklemelerle özgün biçiminin değişmesine neden olmuştur. Çalışmanın amacı, 2012 yılında yazarın danışmanlığında belgelenen, hasar ve sorunları belirlenen caminin, korunması gerekli yapı olarak tescillendiği 1987 yılından 2023 yılına kadar kullanım sürecine bağlı olarak karşılaştığı bilinçli veya bilinçsiz müdahaleler ve restorasyon sürecindeki yaklaşımların aktarılmasıdır.

Anahtar kelimeler: *Şanlıurfa, Pazar Cami, restorasyon.*

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1. Introduction

Historical sights are fabrics made up of the cultural, climatic and topographic integrity of historic, archaeologic, monumental and civil architecture products. Throughout history, each civilisation has built upon the lands of the previous civilisation. Such construction processes have taken place in the form of demolishing the previous one and building from scratch or in the form of using the existing buildings and making new annexes.

Mosques, one of the most important buildings in Islamic society, are places where Muslims gather to worship. Mosques and masjids, the basic structure of religious architecture in the conquered lands in the historical process, were built in different sizes according to the geographical conditions, building materials and techniques of the places where they were built. The first place of worship for the pioneer of mosque architecture was the Cuban mosque built by the Prophet Muhammad. The second building is the Masjid-i Nabawî built in Medina. The masjids built in the early years were simple structures with mudbrick walls and covered with palm branches (Akın, 2016, p.180).

The states that adopted Islam developed mosque architecture by using local techniques and materials. The Umayyad Mosque in Damascus, built in the early Islamic period, influenced later mosque architecture with its courtyard and transverse typology. Since the Abbasid period, architectural elements such as the mihrab, mimbar, pulpit (vaiz kürsüsü), women's cloister (kadınlar mahfili), portico, iwan and shadirvan have been added to mosques. The addition of minarets to mosques built during the Karakhanids, ornamentation during the Mamluk period, and the multi-domed plan of the Seljuk period with four iwans and the great mosque (ulucami) type brought innovation to mosque architecture. The single-domed mosques of the Principalities period were preferred and developed in every period of the Ottoman Empire. In the classical period of the Ottoman Empire, the plan scheme of the single-domed space expanded with the second dome or half domes stands out (Akın, 2016, p.183; Baltacı, 1985, p.225; Eravşar, 2009, p. 81-84).

Kuban (1958) classifies the typology of the mosques of the Ottoman period on the basis of the space into a longitudinal space, a transverse space and a central space. Many researchers group mosques as single-domed, multi-domed and inverted T-type (zaviyeli) according to the use of the dome, which influenced the Ottoman mosque form (Eren, 2018, p.21-24).

Having been named as Ur, Urhai, Orhai and Edessa; Urfa is located in a geographical terrain where an experience of 12000 years had hosted and bore witness to various and numerous civilisations (Şahinalp, 2005, p.24). The city came under the rule of the Islamic army in 639. During this period it was called Er Ruha. The sovereignty of the city passed to the Umayyads in 661 and to the Byzantines in 1071 (Şahinalp, 2005, p.110-112). In this respect, Urfa is one the rare cities where a rich architectural variety has been brought down to the present day with its places of worship, defence structures, accommodation, water features, public buildings, archaeologic remains and houses.

The city had hosted commercial and military routes within the axis of the East and the West. These routes arrived at Mosul from Mardin and Nusaybin over River Tigris in the East and at Aleppo over Birecik, İskenderun and Antakya in the West (Bayraktar, 2007, p.199). The city being located within the sphere of influence of different civilisations made it possible for communities of various religions, faiths and races to co-exist. Such interaction thus made it possible for various works of art and cultural structures to remain intact till the present day.

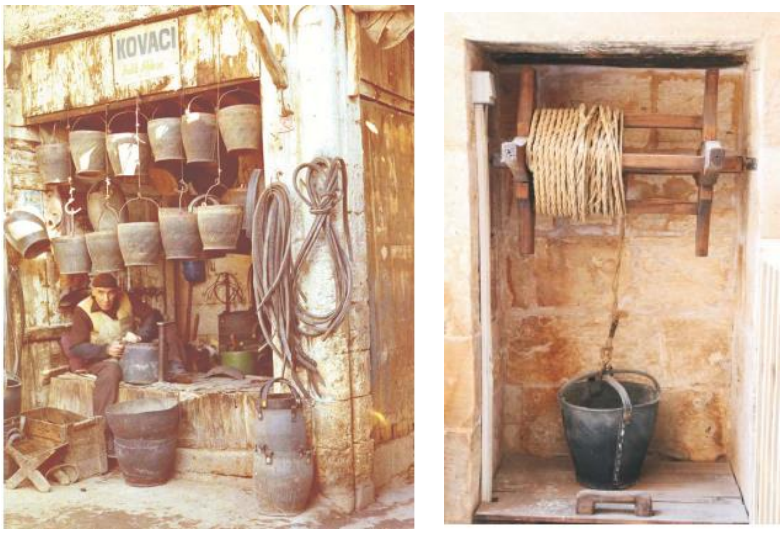
Urfa is a city of religious buildings of different faiths. The Great Mosque of Harran, built by the Umayyads in 744, influenced many mosques in the region in terms of layout and decoration. According to research, there were 34 mosques and masjids in Urfa in the 16th century, and 22 mosques and 67 masjids in the 17th century. They have features in common with the Ottoman mosque typology. The mosques in the city have 11 different types of plans: two-nave mosques with domes in front of the mihrab, mosques with the central dome extending to the sides, mosques with several equal domes, single-domed square mosques, vaulted square mosques, vaulted mosques with single nave parallel to the mihrab, vaulted mosques with double nave parallel to the mihrab, vaulted mosques with single

nave perpendicular to the mihrab, vaulted mosques with double nave perpendicular to the mihrab, mosques converted from basilicas/churches, and cave masjids (Kürkçüoğlu, 2013, p.22).

The Great Mosque of Urfa is one of the first monumental buildings in Anatolia to feature Zengi art. In terms of plan scheme, it is in the same group with Pazar Mosque, which has a dome in front of the mihrab. The Şehhenderiye Mosque was constructed using the same plan as the Ulucami, but on a smaller scale. The Halilürrahman Mosque, constructed in 1211 on the site where the Prophet Abraham is said to have fallen into the fire, and the Ömeriye Mosque, one of the oldest in the city, were built in a style where the central dome expands towards the sides. The Rıdvâniye Mosque was built in a style with several equal domes. Hızanoğlu Cam Hüseyin Paşa Mosque and Mevlevihane Mosque are single-domed square mosques that were built during the Ottoman period. Hayrullah Mosque and Behramlar Mosque have a vaulted mosque style with naves parallel to the mihrab, while Mevlid-i Halil Mosque and Hüseyniye Mescidi have a vaulted mosque style with naves perpendicular to the mihrab (Kürkçüoğlu, 1993a, p.71-72).

Sourcing from the Pool of Abraham, the route of Halil-Ür Rahman Stream had been effective in the planning of the historical city. The subject of this study Pazar Mosque is located in Kovacılar Arcade built on the water groove under which Halil-Ür Rahman Stream flows. The mosque, with the axis it forms with the wall gate, is positioned as to facilitate access to lodgings and shops belonging to various occupations lined up throughout the route availing the religious services and shopping for the arrivals from both within and outside of the walls. The fact that the mosque has always been preferred for special occasions such as Friday Prayers and Salaat Al Eid for religious rituals and the fact that shopping has been done before and after such religious services have enhanced the appeal of the mosque along with its surroundings.

The joint planning of the market place and the mosque is a common urban characteristic of the Middle East (Kuban, 1975, p.121; Üstündağ, 2005, p.157). In the Ottoman legal system, a settlement had to have commercial areas and a Friday Prayer Mosque for it to be recognised as a city (Kejanlı 2010, p.294). The food and drink joints, herb shops, jewellery shops, cloth merchants, shoe makers, coppersmiths and bookshops would be placed closest to the mosque (Can, 1995, p.129), similar occupations would have their shops around each other and they would be called with their own names.



a) **b)**

Figure 1. a) A bucket maker in 1983 at Kokacı Arcade b) A well and a bucket in an Urfa house (Kürkçüoğlu & Kürkçüoğlu, 2011, p.161-162)

Pazar Mosque has been located within the historical fabric of the city in the traditional Koğacı /Kovacı Arcade (Bazaar). The arcade was called “Koğacı or Kovacı Arcade” because buckets were made here out of the old truck and car tires (Kürkçüoğlu, 2011, p.83) (Figure 1). Koğacı Arcade is made up of approximately forty shops irregularly heaped together on both sides of a street. Some of the shops are designed as closed premises with a vault cover on top and some are only covered with vault on top

and have an open design. Although the proper ashlar stone and vault covered shops are preserved with their original forms; the open design shops on the West of the Pazar Mosque and the spaces between the shops have been occupied in time and closed down. There are shoe makers, herb shops, bucket makers, cloth merchants are located around the mosque as well as small restaurants and barbers especially for villagers who come for shopping for their personal needs.

Pool of Abraham's discharge canal passes through the courtyard of the mosque. The water groove was covered previously however it was opened after the restoration. It is also known that this water groove used to get the mill running which was on the East of the Pazar Mosque (Kürkçüoğlu, 2011, p. 252).

2. Material and Method

The cosmopolitan structure of the city that preserved its significance in every age of history had changed starting from 1900s. Having allowed a large scale immigration starting from 1950s, the city started growing without any planning which affected the historical urban sights and the civilian and monumental structures within such sights and caused the formation of unchecked demolishes and alterations.

The Şanlıurfa Pazar Mosque, which is the focus of this study, has experienced an uncontrolled process of deterioration in a traditional area that is gradually declining. After the 1950s, the original structure of the mosque was altered. This study focuses on the repair, intervention, and restoration process of Pazar Mosque. At first, literature review on the building has been performed. The second phase consists of the analysis of the written and visual materials containing the intervention, repair and restoration processes from the year 1997 when the mosque was registered as a listed building to the year 2023.

In this respect the archives of Şanlıurfa Regional Directorate for Foundations and Şanlıurfa Regional Directorate for Conservation of Cultural Heritage had been examined alongside thesis, books and other scientific studies about the city. In addition, the personal archive of Cihat Kürkçüoğlu who has a rich knowledge on the city has been made use of.

2.1. Location of Şanlıurfa Pazar Mosque

Pazar (Hodja Ahmet) Mosque is within the boundaries of urban archaeological site and Şanlıurfa urban development plan in Haşimiye Square Pınarbaşı District Block 253, Plot 2. The building belongs to the General Directorate for Foundations (Figure 2).

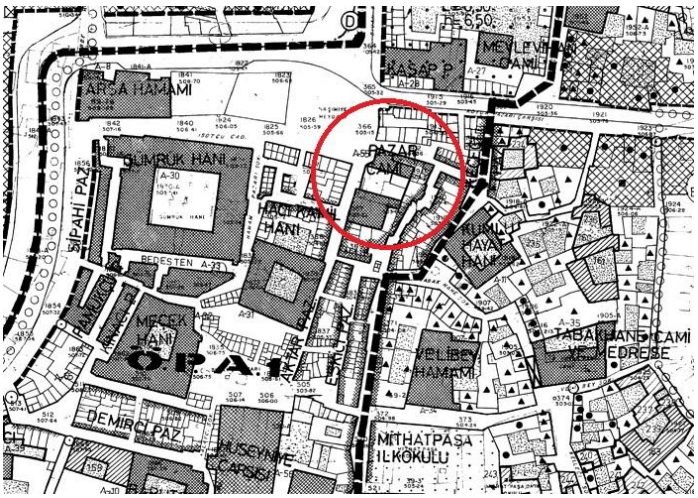


Figure 2. Pazar Mosque and its surroundings (Şanlıurfa Regional Board for Conservation of Cultural Heritage Archive, 2023)

The mosque has been registered with the resolution number 02.07.1987/3453 of the Higher Board of Immovable Cultural and Natural Heritage. The registered mosque has been defined as grade I with the resolution number 21.09.2018/3814 of Şanlıurfa Regional Directorate for the Conservation of Cultural Heritage.

2.2. History

Information regarding the history of Pazar (Hodja Ahmet) Mosque is provided by Kürkçüoğlu and Mahmut kürk who has read the inscriptions (Kürkçüoğlu, 1993b, p.38-39; Karakaş, 1986, p.87). Since the inscriptions in the mosque are repair inscriptions, it is not known when and by whom the building was built. The epigraphs are kept inside the mosque at the portico.

In accordance with the information gathered from Kürkçüoğlu; the oldest inscription at the mosque is the repair inscription over the mihrab on the east of the portico and being commissioned in Hegira 1250 (M 1834) by Fenarizade Ahmet Efendi. The following information is mentioned within the inscription placed over the pulpit (mimbar) gate dated Hegira 1275 (M 1858); the pulpit (mimbar) which was narrowing down the space has been removed, the pulpit (mimbar) has been changed into a balcony with access from the stairway built using the thickness of the wall has been got done by a citizen by name Hadji Recep. The inscription placed on the kiblah wall inside the mosque dated Hegira 1280 (M 1863) contains an explanation as to two windows being opened on that façade (Kürkçüoğlu, 1993b, p.38-39).

The inscription on the portico's Eastern wall dated Hegira 1291 (M 1874) mentions that this place has been rebuilt. The knotted and boultel mouldings on the minaret and the script style of the Islamic Confession of Faith on the Western façade show ornamental features of Zengid Dynasty Era (12th Century (Kürkçüoğlu, 1993a, p.42).

The mosque is mentioned as being near the rag picker's bazaar called 'Hodja Ahmet Mosque' in the foundation certificate of Hadji Abdülfettah Bin Şaban dated Hegira 1038 (M 1628) and in the foundation certificate of Rızvan Ahmet Pasha dated Hegira 1153 (M 1740), and in the foundation certificates dated Hegira 1238 (M 1822). The mosque is also referred to as Narincili Al Masjid Sharif (apart from Narıncı Mosque) within the records at Directorate of Foundations (Kürkçüoğlu, 1993a, p.42).

2.3. Plan Characteristics

Located in the bazaar area to the south of Haşimiye Square, the mosque is located to the south of the courtyard and has a rectangular plan.The courtyard has two entry gates one on the North and the other on the West. The building falls into the category of mosques with a dome in front of the altar (mihrab) (Kürkçüoğlu, 1993a, p.20).

The sanctum sanctorum (harim) of the rectangular planned mosque has two naves parallel to the altar (mihrab) (Kürkçüoğlu, 2013, p.20). The prayer space of the mosque has been separated into six sections with two stone columns having rectangular cross-sections. In the first nave of the mosque there is a rimless dome and one cross vault on each side; in the second nave there is a star vault and one cross vault on each side. Among the mosques of Urfa, the Pazar Mosque is the only to have a star shaped vault in the centre, formed by a decoration of intersecting geometric shapes. The dome is made up of smooth stones and its vaults carry the walls on the sides with two independent stone columns in the centre. There are four windows towards the East and two windows towards the South of the sanctum sanctorum (harim). There are two embrasures above each of the rectangular windows to the east and west. The building is similar to the Yusuf Pasha Mosque of 1709, which is covered by a dome supported by two square columns in the centre and has an interior divided into six sections. On both sides of the altar (mihrab), there are small marble columns decorated with stalactite work (muqarnas) and Rumi pattern composition headings. The altar (minber), as it has been mentioned within its epigraph, is in the form of a balcony.

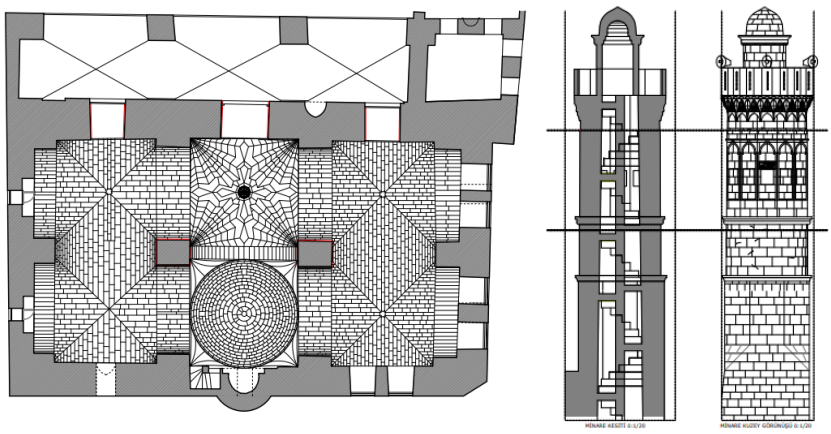
Over the single balcony minaret made up of dimension stones on the Northwest side of the courtyard, there are superficial knotted arches constructed out of boultel mouldings reminiscent of the Zengid Dynasty Era. This minaret had a great influence on the minaret of Dabbakhane Mosque, which was built in 1562 (Kürkçüoğlu, 2013, p. 23).

The arch circumference of the half dome stone portal of the entry on the North of the courtyard has Rumi pattern decorations. Such a portal form is similar to the portal at the West entrance of the Mosque (Kürkçüoğlu, 1993a, p. 42).

According to the research performed and information gathered at Pazar Mosque, it has been understood that the building has been built in the 17th Century. It has been determined that in its original construction it had a plan where the mosque prayer service section on the South, ablution room on the East, minaret and the toilets on the North, and outdoor and indoor shops on the North and West walls outside.

2.4. Construction Technique and Materials

The main load bearer of the building is rubble and rough masonry stone walls. It is built in the stone masonry technique. The structure is constructed with ashlar stones on the sides. The area for the religious services has been separated into six sections with two naves in a parallel line with the altar (mihrab). The front of the altar (mihrab) has a dome and the sides are cross vaulted. On the continuation of the altar (mihrab), there is a star vault in the middle on the second nave. In terms of the technique and artistic considerations, this star vault is the only example in Urfa with a central section decorated with intersecting geometric shapes (Kürkçüoğlu, 1993a, p.42). The portico (son cemaat yeri) is cross vaulted and sits on four stone pillars in two rows in the centre. On the Northeast corner of the courtyard, the minaret is built using ashlar stones and sits on a square pedestal. The body of the minaret with a single balcony, has been divided into four sections with three mouldings. The first, third and fourth sections have a dodecagon plan whereas the third section is decorated on every surface with sharp arched niches. Four rectangular windows were opened in the niches facing the main directions (Figure 3).



a) **b)**

Figure 3. a) Interior view of covering system b) Minaret construction system (Dağtekin Archive, 2023)

As for the construction material, light yellow shade limestone has been used which is also known as Urfa stone. The door and window profiles are wooden and metal. Dimensional cut lime stones are used for the walls, lime mortar is used for the joints, rubble stones for the vaults, Khorasan mortar, lime and soil fillings have been used. The columns in the centre bearing the load of the vaults and the area for the religious services of the mosque have been built out of ashlar stones. The groundwork of the courtyard and the flooring inside the mosque are of stone.

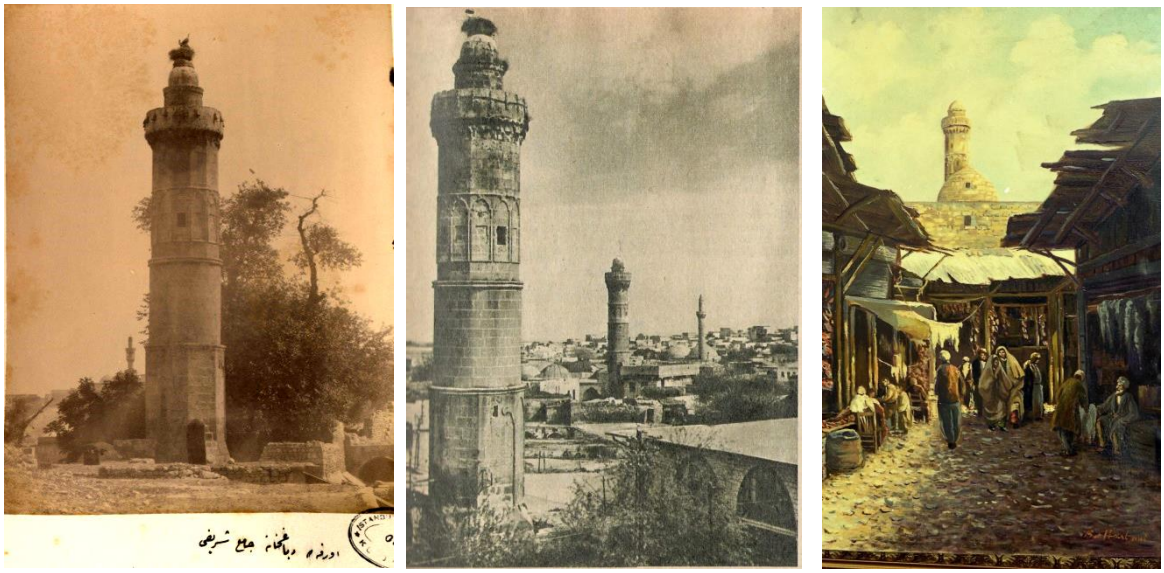
3. Findings and Discussion

The mosque has been registered with the resolution number 02.07.1987/3453 of the Higher Board of Immovable Cultural and Natural Heritage. Although the scope of the study covers the period from when the structure had been registered as a listed building to the present day, two visual documents that have been obtained during the archive research and that would provide a contribution to the study have also been included herewith, one belonging to the years between 1880 to 1890 and the other belonging to the year 1963. The interventions, repair and restoration works have been dissociated by analysing the written and visual sources that have been obtained in this respect. Within this context;

The years between 1880-1890: The very first visual information regarding the building is found in the "Sultan Second Abdülhamit's Yıldız Photography Album" where the minaret was pictured. The tall trees around, the minaret and the arch space of the portico with three sections on the courtyard could be observed in the picture. The area where the minaret is seated is where the ablution room is placed today on the entrance gate on the North wing of the mosque. The irregular stones around the pedestal of the minaret makes us think that there had been an intervention for the repair of the structure (Figure 4a).

The year 1963: The second photograph in respect of the building is taken from the book by Kürkçüoğlu published in 2011 with the title "Once upon a Time Urfa with Photographs". In this photograph, we observe that the arches that were originally open in the portico had been closed from the point of the joist hanger. On the East of the courtyard of the mosque, the roof of a structure on a lower elevation and trees within the courtyard could be seen.

The third undated photograph of the building comes from Kürkçüoğlu's personal archive and is a hand drawing of the mosque from the Rag Pickers' Bazaar. The mosque's masonry walls, dome and minaret appear to be structurally sound (Figure 4).



a) **b)** **c)**

Figure 4. a) The minaret of Pazar Mosque (Kürkçüoğlu, 2009, p.53) b) The minaret of Pazar Mosque in the year 1963 (Kürkçüoğlu, 2011, p.356) c) Pazar Mosque from the Kovacılar Arcade (Kürkçüoğlu, 2011, p.236)

The year 1987: The first written document obtained in relation to the building is an inventory form of 1987. The original and first built section of Pazar Mosque is the area for the religious services located on the South side. According to the written and visual information in the inventory, a reinforced concrete mezzanine floor had been added to the three-part portico and the portico had been covered with wooden materials. The access to the mezzanine floor had been provided through a reinforced stairway positioned on the western façade. On the street where the entrance to the mosque is located, the shops and their eaves have not yet obstructed the view of the building (Figure 5).

a) **b)** **c)**

Figure 5. a) Northern entry gate b) The mezzanine floor on the portico c) The altar (mihrab) d) The minaret (The inventory form (Şanlıurfa Regional Board for Conservation of Cultural Heritage Archive, 1984)

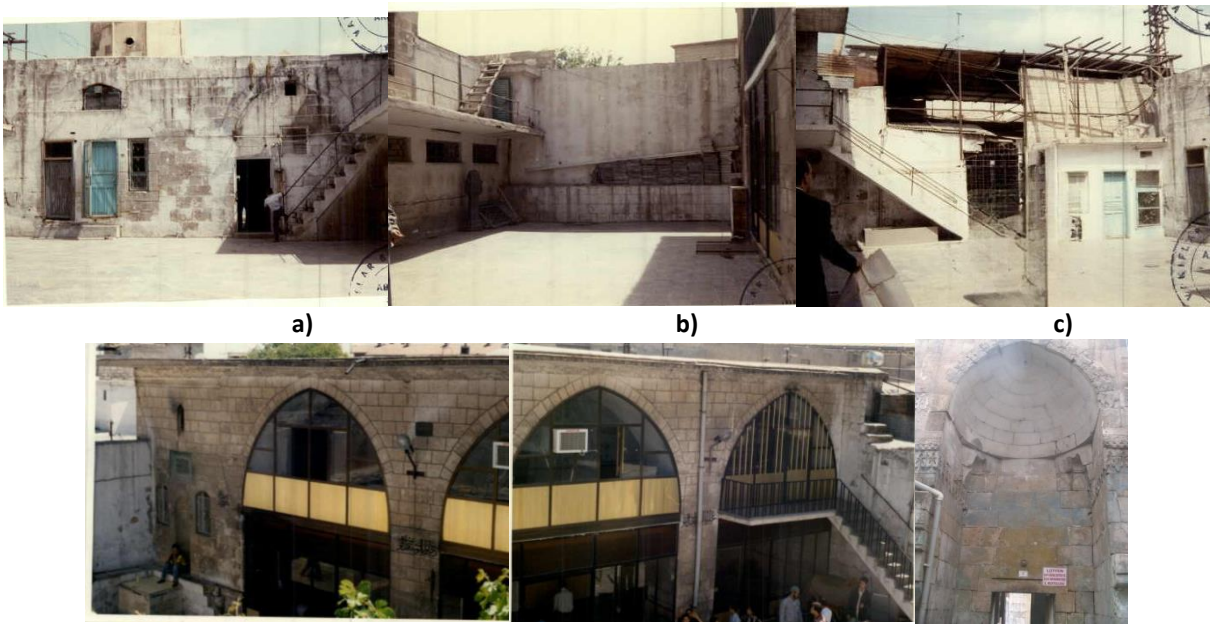
The years between 1987-1992: Some kind of congestion had come up in the Kovacılar Arcade, where the entrance to the mosque is, and the areas around the mosque were occupied. On the Western façade of the building, the arch where the second entrance gate is located had been closed and a passageway was provided by leaving a gap for a doorway. Washbasins had been added to the Northeast side, and the stone walls to the left and right of the ablution room on the east side had been plastered in places (Figure 6).

a) **b)** **c)**

Figure 6. a**)** The shops on the North wall of the mosque b) The closed archway on the Western wall of the mosque c) The ablution room on the Eastern side of the courtyard (Şanlıurfa Regional Board for the Conservation of Cultural and Natural Heritage Archive, 1990)

The year 1992: In 1992, the Diyarbakır Regional Board for the Conservation of Cultural and Natural Heritage decided to designate Haşimiye Square, where the Pazar mosque and its surroundings are located, as a conservation area. The General Directorate of Foundations had requested the expropriation of the blocks occupied by unqualified buildings around the mosque and within the conservation zone, and the construction of extensions inside the mosque.

A project has been prepared to add a new building to the North and East of the courtyard. The height and design of the addition that had been made had not been found appropriate by the Heritage Board. Besides, an offer had been brought for the construction of an L-shaped structure with a floor height not exceeding 2.85 metres within the courtyard of the mosque for spaces such as Imam's room etc... and the toilets and ablution room required.



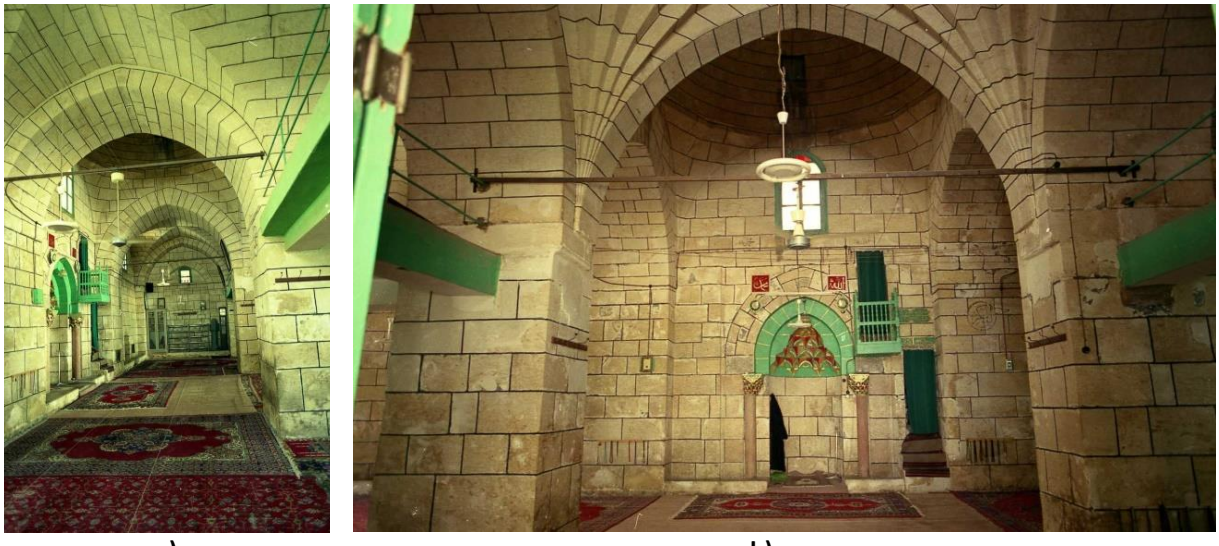
a) b) c)

d) e) f)

Figure 7. a) The closed archway on the North wall of the courtyard b) The closed ablution room on the East side of the courtyard c) The added new structures on the West entrance of the courtyard d, e) The shut down portico f) The entrance the mosque from Kovacılar Arcade (Şanlıurfa Regional Board for the Conservation of Cultural and Natural Heritage Archive 1984-1992)

It has been established that in the same period, the iwan of the Northern entrance gate of the courtyard was closed and access was provided through a small door gap, the entrance arch of the ablution room to the East was also closed, a new structure was added on the West, the portico was closed with metal materials, and that the portal of the northern entrance door was painted over (Figure 7).

The year 1993: The interventions carried out during this period were identified using the photographs from the book Şanlıurfa Mosques by Cihat Kürkçüoğlu. In the photographs taken inside the religious services section, it was observed that women's gathering section has been built using reinforced concrete mezzanine floors, the stone surface and the altar (mihrab) have been painted over and thus the original form has been damaged (Figure 8).



a) b)

Figure 8. a) Sanctum sanctorum (harim) and the reinforced concrete mezzanine floor (Kürkçüoğlu, 1993b, p.49) b) The painted altar (mihrab) and the pulpit (mimbar) (Kürkçüoğlu, 1993b, p.49)

The year 1996: This is the period when the structure had been subjected the highest number of interventions within the courtyard. A restoration project was submitted to Şanlıurfa Regional Board for the Conservation of Cultural and Natural Heritage for the construction of an Imam room, an ablution room and a toilet in the North and East of the courtyard with the excuse that the congregation of the mosque had increased, and this project was approved within the framework of the board's proposals, however, the certified restoration project was not implemented. Instead, two-storey buildings were constructed to the North and East of the courtyard. The wing added to the North of the courtyard had seven arch openings each with a façade to the courtyard and had toilets on the ground floor and was used as Qur'an Course classes on the second floor behind the arches on the top floor. The Eastern wing also had two floors, the ground floor being used as an ablution room and the second floor as an Imam's room. This new arrangement shrank the dimensions of the courtyard of the mosque, ~~and~~ thereby avoiding the recognition of the original religious site (Figure 9).

a) **b)** **c)**

Figure 9. a) The section added to the East side of the courtyard b) The section added to the North side of the courtyard c) The portico (Dağtekin Archive, 2023)

The year 2009: The detailed documentation work in respect of the building had been undertaken during this period. Survey, restitution and restoration projects were drawn up and analysed. The outer circumference of the mosque had been completely occupied within this period, the open-plan shops had been transformed into enclosed spaces and additional shops had been built. The perception of the mosque from the street had been completely lost. New structures were added to the East and West sides of ~~on~~ the courtyard, and the walls and the flooring were renewed using materials such as tiles, etc. Along with the portico that had been shut down, the mosque had been subjected to aesthetic and physical deterioration. During this period, the stalactite work (muqarnas) of the altar (mihrab) niche in the sanctum sanctorum (harim) section and its joints were painted over, metal profiles were added to the reinforced concrete gathering places, wooden wainscots were applied to the walls, and a broken wind was constructed (Figure 10).

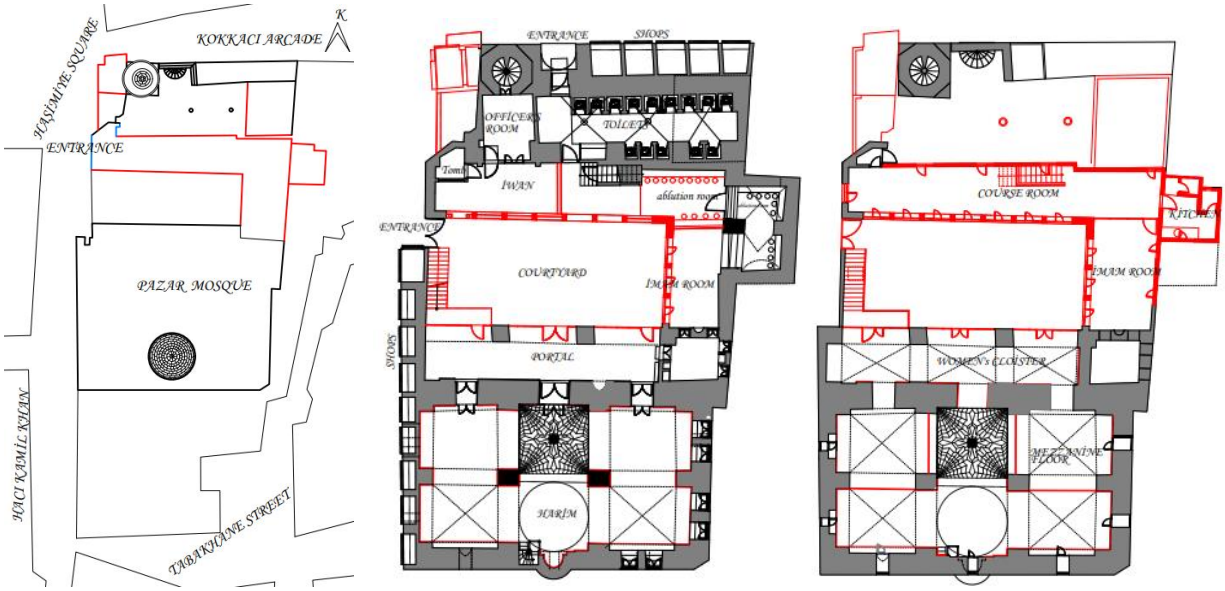
a) **b)** **c)** **d)**

Figure 10. a) The wooden wainscotts added to the sanctum sanctorum (harim) b) The breakwind section that was added to the entryway c) The painted over altar (mihrab) d) The added reinforced concrete flooring (Dağtekin Archive, 2023)

The stones on the surface of the building and the minaret, the muqarnas and the ornaments on the entrance door of the mosque were found to be contaminated by physical and natural weather conditions, and the ornaments were found to be flaking and broken.

Plaster spillage had occurred in the interior spaces due to humidity. The use of metal and the polyvinyl chloride (PVC) materials that are not compatible with the historical building has caused visual pollution.

The year 2012: The survey carried out during this period provided detailed documentation by identifying the additions and alterations made to the mosque harim area and courtyard since the 1960s, as well as the physical interventions that disturbed the originality of the building. It was observed that the ablution room in the east of the courtyard was removed, the toilet rooms in the north direction were changed, new two storey buildings were built on both wings, the western and northern entrance doors of the courtyard were surrounded by shops etc. from outside and inside, and a mezzanine floor was created with a reinforced concrete deck to create a women's mahfil in harim and a portico (Figure 11). In the restoration project of the building approved in 2012, the new structures in the courtyard were not intervened due a lack of administrative budget.



a) **b)** **c)**

Figure 11. a. The layout plan (the year 2012) b. Ground floor plan c. First floor plan (Dağtekin Archive, 2023)

Between the years 2017-and 2019:-During this period, the restoration project of 2012 was revised due to the demands for the removal of all additions inside and outside the mosque and the reorganisation of the courtyard. The revised restoration project proposed the removal of new structures added to the courtyard, reinforced concrete mezzanines, metal closures and wooden wainscots added to the mosque's worship and portico, cleaning and joint repair of painted stone surfaces, and expropriation of shops on the exterior façade to reduce density.

The solution to the problems caused by the removal of reinforced concrete floorings In the worship areas and the other interventions were undertaken using scientific approaches. During the restoration process, interventions were carried out for cleaning, consolidation, removal of additions, renewal and reintegration. In this respect;

The shops to the North of the mosque which belong to the General Directorate of Foundations have been repaired and their façades re-arranged.

The shops on the west façade of the mosque were expropriated and removed, and the entrance door was reconstructed using arch traces and comparative studies.

The overflowing joint grouts and paint remains on the stalactite and covering stones over the mosque entrance door on the North façade have been cleaned, the stones with a surface loss more than five centimetres have been rotten and the fractures on the stones have been consolidated.

a) b) c)

Figure 12. a) The removal of the additions to the portal b) The removal of the added stories onto the North side c) Cleaning in the minaret (Şanlıurfa Regional Board for the Conservation of Cultural and Natural Heritage and Şanlıurfa Regional Directorate for Foundations Archive, 2017).

The surfaces of the stones have been cleaned by preserving the patina layers against tarnishes due to weathering on the surfaces of the mosque and the minaret, the joint grouts filled with cement have also been cleaned and the joints have been remade using lime-based joints. The painted stone surface on the altar (mihrab) have been cleaned (Figure 12- 13).

a) b)

Figure 13. a) The North wing arrangement after the restoration b) The mezzanine floors and the tension bars that have been removed (Dağtekin Archive, 2023)

The two-storey additional structure on the North and East wings of the mosque has been removed, and the courtyard of the structure has been provided to be recognised in its original form (Figure 14).

a) b) c)

Figure 14. a) The roof and the courtyard after the repair works (Ölmez Archive, 2023, Şanlıurfa Regional Directorate for Foundations Archive, 2023) b) Portico (Topalan Archive, 2023). c) The Eastern façade of the courtyard and the water groove of the PoolAbraham (Dağtekin Archive, 2023)

The reinforced concrete mezzanine of the sanctum sanctorum (harim) and the portal and the window walls have been removed. In order to avoid possible situations such as fractures and demolishes, etc... through the effects of the removed reinforced concrete flooring on the religious services area and the portico of the mosque, the top cover has been opened up and then re-enforcement works have been undertaken by wrapping with the seam method and glass mesh application. The arches have been tied

to each other using steel tension rods in the religious services area and portico of the-building (Figure 15).

a) **b)** **c)**

Figure 15. a) The added reinforced concrete flooring which was removed after the repairs b) The wainscotts removed within the sanctum sanctorum (harim) c) Arrangements at the entrance gate (Dağtekin Archive, 2023)

An arrangement for the ablutions room, women's, men's and disabled toilets have been done on the North and East of the courtyard.

The door and window profiles have been renewed using wooden material and the barring has been renewed using boxed iron joinery materials.

The wainscots added on the walls of the mosquen were removed, the surface of the stone wall has been cleaned and the decaying stones have been replaced.

Lighting, cameras, projectors, sound instalments and installations, power counters for the lighting and heating have been renewed both for the interior and exterior spaces of the mosque and for the minaret.

The Halil-ül-Rahman water groove that had been closed in the courtyard of the building was opened and the water was allowed to flow through an open duct.

4. Conclusion and Suggestions

The first step in conservation of historical structures is documentation. Documentation of the current state of the structure using modern techniques, historical research into the processes it has undergone, construction techniques and materials will ensure that the structure is passed on to the future. Regardless of whether the damage~~s~~ is man made or natural, intervention ~~to~~ on documented structures becomes faster and more reliable.

Pazar Mosque is located within Urfa Urban Archeological Site. The mosque and its surroundings have an impressive value together with many cultural assets such as religious, defence, bathing, accommodation and shopping structures belonging to various civilisations. It bears an architectural and technologic value with its inscriptions and solitions in its construction techniques. Factors such as the mosque's location in the city's most popular bazaar area, and the fact that the mosque's community was becoming more crowded for rituals such as Friday prayers and Salaat Al Eid, led to the addition of new spaces to the mosque, as well as some changes. Although the repairs carried up to the 20^{th} century did not alter its original identity, the mosque had been changed has undergone significant changes especially since 1987. An analysis of the documents obtained between 1963 and 2017 and the current state of the mosque revealed that the additions and alterations that had been made had resulted in differences to the original form of the mosque, the original ablution rooms in the courtyard, and the architectural and spatial traces, such as the water groove, had been closed or erased. After 1990, the gathering floor created with a reinforced concrete being added to the worship area of the mosque, the shutdown portico, painting over the altar (mihrab) and stone walls, and the two storey building added to the courtyard have all brought forth the deterioration of the integrity and originality of the mosque. The shops added in a manner that would spoil the silhouette of the building and a manner that would block the entrance gate into the bazaar space adjacent to the mosque walls (Figure 16).

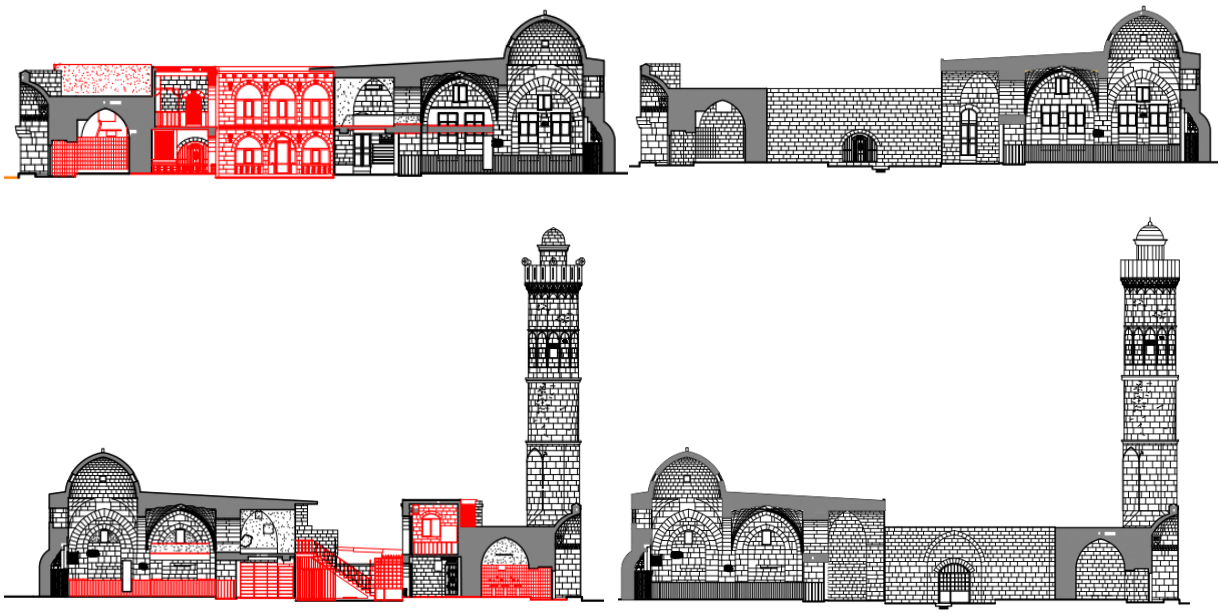


Figure 16. a) Additions made inside and outside the mosque b) The original state of the mosque (Dağtekin Archive, 2023)

The restoration process for Pazar Mosque was initiated in the year 2017 and it has been undertaken in the light of the documentation and deliberation studies performed on a scientific basis in 2012. In this context, the building was considered in relation to its surroundings, and it was ensured to reach its original fabric and form with the removal of additions, cleaning, consolidation and reconstruction interventions.

The Pazar Mosque has the rarity value with its star vault, which is not seen in any other mosque built in Urfa and is the only one of its kind. The building, which has original planning and architectural elements, is to be protected in order to preserve the diversity of cultural heritage as stated in the Nara Certificate of Authenticity, to raise awareness among institutions and individuals for the preservation of cultural heritage together with religious architecture and other buildings in the city, to carry out continuous maintenance and repair, and to develop a sustainable and comprehensive conservation plan.

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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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Exploring Modern Contextualization: Bologna University Walter Bigiavi Library

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Abstract

The objective of this research is to contribute to the literature by examining the correlation between architecture and the phenomenon of contextualization, focusing on prominent approaches to "infill design." The text discusses design attitudes and tactics applied to modern infill within the dialectic of contextualization and conceptualization introduced by Tschumi in the Event-Cities series. From the series' triad of tactical indifference, conflict, and reciprocity, it is inferred that the dominant design attitude becomes legible through the tectonics: morphology-settlement, orientation-function, and form-mass-material. Qualitative research methods were used for data collection and analysis. The results reveal that the predominant design attitude of the library is 'conflict,' which is evident in the morphology, facade, materials, mass, and orientation, contrasting with compositional elements and the unity of buildings, indicating 'reciprocity.' This research's findings contribute to the existing body of knowledge by demonstrating how design-context dialogue can be created, potentially influencing future infill design practices.

Keywords: *Contextualization, infill design, attitude-tactics, qualitative research.*

Modern Bağlamsallaşma Üzerine Bir Araştırma: Walter Bigiavi Ekonomi Fakültesi Kütüphanesi

Öz

Bu araştırmanın amacı, mimari ve bağlamsallaşma olgusu arasındaki ilişkiyi, özellikle "infill tasarımı" konusundaki önde gelen yaklaşımlara odaklanarak literatüre katkıda bulunmaktır. Metinde, Tschumi'nin Event City Serisi'nde yer alan bağlamsallaşma ve kavramsallaşma diyalektini doğuran ilişkiler, modern bir infill tasarım örneklemi olan Bologna Üniversitesi Walter Bigiavi Kütüphanesi tavır ve taktikleri kapsamında tartışılmaktadır. Serinin taktik ilgisizlik, çatışma ve karşılıklılık üçgeni üzerinden kurulan kavramsal arkaplan, yapının morfoloji-yerleşim, yönlenme-işlev ve biçim-kütle-malzeme tektonikleri üzerinden okunmaktadır. Bağlamsallaşma sürecinin görünür kılınması amacıyla araştırmada veri toplanması ve değerlendirilmesi kapsamında niteliksel araştırma yöntemleri olan: görsel analiz, teknik belge inceleme, mekansal değerlendirmeden yararlanılmıştır. Sonuçlar, yapıda benimsenen hakim tasarım tavrının 'çatışma' olduğunu göstermektedir ki bu, morfoloji, cephe, malzemeler, kütle ve yönlenme kararları ile görünür hale gelirken; kompozisyonel unsurlar ve ayrık, komşu yapıların dil birlikteliği ikincil tasarım tavrı olan 'karşılıklılık'ı işaret etmektedir. Bu araştırmanın bulguları, tasarım-bağlam diyaloğunun nasıl oluşturulabileceğini göstererek mevcut bilgi birikimine katkıda bulunmakta ve gelecekteki infill tasarım uygulamalarını potansiyel olarak etkilemektedir.

Anahtar kelimeler: *Bağlamsallaşma, infill tasarım, tavır-taktik, nitel araştırma.*

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1. Introduction

"Architects invent nothing; they redefine the value of form by virtue of its relationship to other elements in a composition."

Alvaro Siza

Siza's discourse shifts the axis of creative endeavor in architecture from the assumed role of the architect as a god-like figure who performs the act of creation out of nothing to the transformation of the existing. In the current design scene, creativity is associated with the ability to create extraordinary connections among existing entities rather than creating something out of nothing. This perspective on 'what happens in the city' and 'new architectural designs that establish extraordinary relationships' within design practice allows for various interpretations of the ongoing trialectics of context, concept and content. Cities are living organisms, and just as living things undergo transformations throughout their lives, cities also transform as new layers are added to align with the flow of life. Examples of these transformations are evident in urban patterns, particularly in infill designs that are integrated into the existing urban fabric. Debates on how to preserve the original qualities of the land within built environments and integrate them into current urban living practices have been increasingly present in the architectural agenda, especially as a consequence of the urban losses caused by disasters. Buildings contextualize themselves within a complex, multi-layered and temporarily connected network. The process of contextualization is a composite of relationships between the abstract and concrete layers that make up the network and is influenced by both historical and contemporary actors. It is the state of harmony and integrity of all cultural and physical components that keep this organism alive, such as public spaces, transportation networks, landmarks, social factors, life rituals and historical remains. Each new architectural design that is added to the existing built environment is in fact a form of intervention, and its success depends on the richness of the meaningful relationships that the design has with the urban context. In other words, the contextual frame of a design is a combination of the intellectual and physical qualities of that design and its relationship with all components around it. This combination is a complex network, which is why an understanding of this coexistence is required in every case that relates to an urban area necessitates understanding of this cohabitat. As Demiri (2013) expresses, "Any intervention in the historical context should not be considered in isolation, but in harmony with the existing architecture by relying on the interpretation of the space." Therefore, when contemplating the contextualization of a building, it is essential to first examine the relationships that form the context at various scales.

The literature on infill architectural design frequently emphasizes the revitalization of urban fabric, sustainability, socio-cultural compatibility, design and aesthetics, and economic value. Furthermore, the needs of local communities, the preservation of cultural heritage, energy efficiency, environmental sustainability, and the integration of green building technologies and renewable energy are prominent subjects addressed within the design-infill framework. Nonetheless, certain aspects remain underexplored in the literature. Although the issue of achieving "compatibility" in diverse urban settings, particularly in historic environments, is frequently debated within the design discipline, there is a relative paucity of in-depth examinations of the conceptual foundations underlying infill proposals and their practical implications. This study, therefore, seeks to problematize the dialogue between contextualization and design within the architectural discipline, interrogating how design attitudes and tactics shape both the design proposal and its contextual integration. The research aims to elucidate the relationships between the theoretical and practical dimensions of architectural design through tectonics, utilizing a case study to render these connections visible. These insights are posited as a potential model for informing future design approaches.

2. Material and Method

This research aims to understand the correlation between architecture and the phenomenon of contextualization by prominent design approaches. Within the scope of the text, the contextualization of new building designs in historic built environments is discussed, focusing on the example of Walter Bigiavi Library for the Faculty of Economics at the University of Bologna, designed by the Italian architect Enzo Zacchiroli. The research is conducted on the basis of qualitative research methods.

Whilst examining a building through the discipline of architecture, it is customary to simultaneously address both technical and social dimensions. Qualitative research methodologies were used to facilitate in-depth understanding and contextual process of the settlement analaysis. In this regard, the review was conducted by combining the qualitative research methods.

2.1. Aim, Scope and Material

Based on the research framework, the approaches and ideas of prominent theorists on context and the contemporary attitudes and tactics adopted in infill designs are linked to a case study. Considering the physical surroundings, geographical location, and environmental interactions of the building, an on-site analysis was conducted. Observation of the behaviour of the people using the building provided information about the use of the urban space and the functional activities in the immediate vicinity of the settlement. A meeting was conducted with Zacciroli Design Office to obtain documents of the building.

Architectural drawings and published articles related to the building were acquired through the meeting, which facilitated the gathering of information regarding the design process, decisions and aesthetic choices. Visual elements such as photographs and drawings of the building and videos were examined to analyze characteristic features of modern style, facade design, and other visual aspects such as compositional elements of the building. Visual materials served as an important source of information about the designer's vision and attitude. Architectural plans, design reports, technical drawings, and other documents were scrutinized. These documents provide information about structural features, material specifications, and the construction process along with the orientation and settlement attributes. Interior spatial arrangements, the functional purposes of materials used, and the use of light were considered and reviewed in the analysis. The analysis also includes an examination of spatial arrangements, space organisation and interactions within the urban space. The characteristics of materials used in the building; including durability, aesthetics, and sustainability, were examined. The analysis evaluated the impact of material choices on design and functionality while discussing the contextualization process (Figure 1).

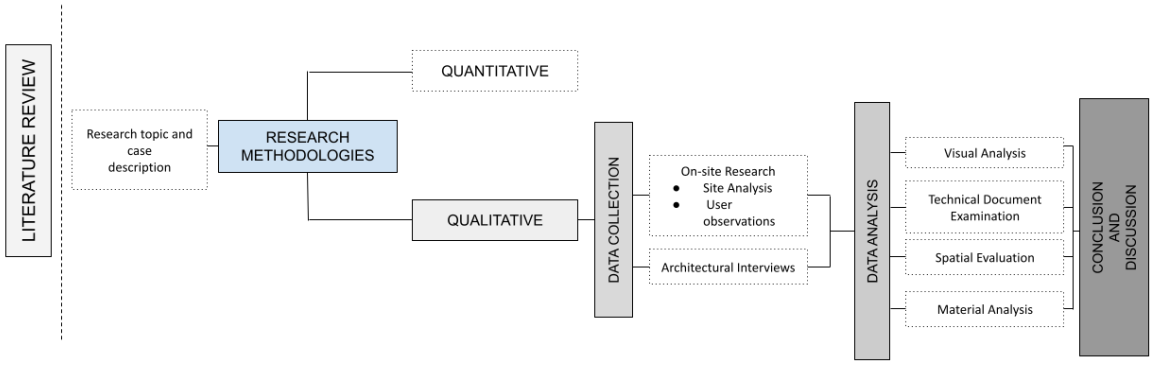

Figure 1. Research framing flowchart

2.2. Data Collection and Analysis

While analyzing the data, visual, spatial, and material analysis methods were adopted, alongside the examination of technical documentation. Themes and prominent features are identified to make sense of the design characteristics of the bulding design and settlement. In the results and discussion section of the research, the findings obtained were explaned through a table. Consequently, the phenomenon of contextualization is conveyed through an examination of the architectural tectonics of the library building using the concepts of discussion. The conducted metods are chosen for a specific case. Integrating these methods in different forms, it is possible to gain a comprehensive understanding for further research, considering both the technical and social contexts of a design.

3. Findings and Discussion

New architectural designs that respond to individual and social urban and structural needs and are intended to fill voids within the existing, often entrenched, ongoing built environment or structure for various reasons are summarized under the generic term 'infill' design. Infill design approaches are fundamentally related to three main disciplines: architectural design, urban planning, and heritage conservation. In the literature, the term 'infill' is associated with both the absence of a single structure in urban design and the collective presence of multiple structures that enable transitions between various urban zones and are often associated with a lack of texture in the memory of the city. This approach, which focuses primarily on urban textures, is discussed in the literature under the terms 'urban infill' and 'infill development' (Sheppard, 2006). Urban infill is defined by the continuity/sustainability of urban development, the creative transformation of surplus/vacant land, relatively small urban interventions, decaying areas and changing urban practices and needs. On the other hand, infill design notion is discussed under the aspects of orientation, site, function and form (Sotoudeh & Wan Abdullah, 2012; Vallance, Perkins & Moore, 2005). In this context, the concept of 'infill' in architectural design not only focuses on filling an urban void but also addresses losses in the existing fabric embedded in urban memory and examines how areas can once again become part of urban life.

3.1. Attitude and Tactics on the Contextualization of the Concept

The infill design concept problematizes the settlement in the void and emphasizes the conceptual interpretation of occupied space. Therefore, the conceptual interpretation of the occupied void in infill designs intersects with the phenomenon of contextualization by reflecting the dynamics of the values, judgments and production of its era. In spite of the fact that this kind of approach differs from the repetition of the past, it aims to establish extraordinary connections within the existing environment. The highlighted contextualization, as a way of settlement, involves the association of the unique and time-dependent data of the space through the defined conceptual framework. It is possible to discuss two fundamental components that generate relationships in the conceptualization and contextualization process; the existing context and the new design proposal.

Demiri (2013, p.44) states that the dialectic between these two phenomena is related to contemporary interpretation, which is shaped by the meaning and values that the designer attributes to architectural buildings. When analyzing the attitudes and tactics of designers in the current architectural environment, it is observed that there is a polyphonic environment in infill design. While architects and architectural offices such as Daniel Libeskind, Sanaa, OMA, Frank Gehry, Peter Eisenman tend to break the relationship between the new design proposal and the past approaches with contradictory methods, there are also design orientations of architects such as Raymond Erith and Norm Tyler who prioritize harmony with the historical texture. Gharebaglou, Ebrahimi & Ardabilchi (2019) categorize the architectural proposals that emerge in the contemporary architectural environment into three main attitudes: Preservationist, Contemporarist or Moderationist. Depending on the attitude adopted in design, design tactics characterize the new proposal. These tactics can be summarized under two main headings (Brolin, 1980): replication and contrast. To replicate the existing context, the designer may use facsimile, correlation, simile, metaphor, or develop tactics that contrast the qualities of the existing context. In contemporary infill proposals, oppositional and replicative attitudes sometimes coexist and the context and concept are 'collided' and hybridized. Ironically, this act of collision is in fact a method of interaction and the result of the dialog between concept, context and content dialogue emphasized by Tschumi (2005). Tschumi (2005) argues that context and concept can be related in three different ways: tactical indifference, reciprocity and conflict. In cases where tactical indifference is adopted, it is argued that the context in the current environment is not rich or fruitful and the conceptual framework established in design thinking focuses on the inside rather than the outside of the building envelope, with a tabula rasa approach. The context and concept are not interactive and remain independent of each other within such instances. Regarding reciprocity, there is a dialog between the concept and the existing context. It can be said that the concept is harmonized with the context through symbolic elements in the building envelope (material texture, construction

method, etc.) and becomes closer to the context through imitation or resemblance. In these cases, the concept influences the context just as much as the context influences the concept, resulting in a symbiotic partnership. Conflicts, on the other hand, the concept is not indifferent to the context, but on the contrary is in conscious opposition to it. The conceptual framework is structured by differentiating it from the contextual qualities. Mutually, the context transforms the concept and the concept transforms the context.

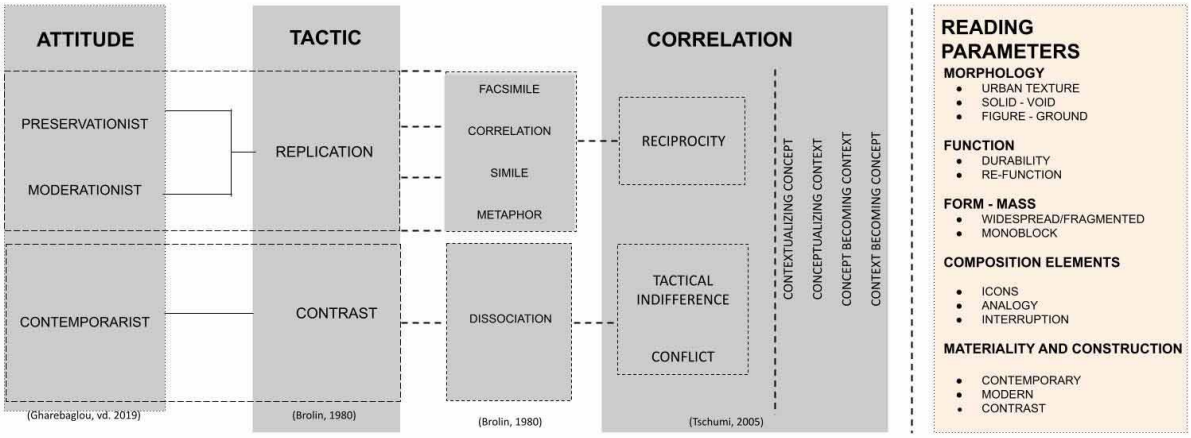

Figure 2. Conceptual background based on literature review: attitude - tactics - correlation

Tschumi (2005) classifies the associations between concept and context in the text Event Cities-3 with the definitions " contextualizing concept", " conceptualizing context", "concept becoming context" and "context becoming concept". Güleç (2012) says of these classifications, "The first one, which leads to the development of self-similarity designs, refers to the adaptation of a concept to the conditions of the context; the second one refers to making the conditions and limitations of the context the driving force behind a concept. The "concept becoming context" associated with the former means that large-scale buildings transform the urban context, while the "context becoming concept" associated with the second term means the emergence of designs that are integrated into the environment." In this conception, the design in Tschumi's architecture interacts with events, places, actors and time within the context.

In contrast to a total negation or repetition of the past by the new design proposal, the current quest is rooted in the internalisation of the existing built environment and the spirit of place rather than in an analogical resemblance, in the implicit interpretation of the old, and in the relationships established through intensity and conflict. Therefore, as Demiri (2013) states, all contemporary attitudes and tactics are somehow linked to the identity of the place, and the interpretation of this identity through the new building proposal depends on the meaning the designer attributes to the existing (historical) environment. These conceptual extensions provide a framework to explore how the attitudes and tactics adopted in the design of the Walter Bigiavi Library for the Faculty of Economics at the University of Bologna, discussed later in the text, influence the process of conceptualization and contextualization (Figure 2).

3.2. University of Bologna Walter Bigiavi Library

"la dotta, lagrasa, la rossa'"

" - knowledgeable, fat, red -"

Walter Bigiavi Library for the Faculty of Economics is located in the city center of Bologna. Local names for Bologna, capital of the Emilia-Romagna region in northern Italy: 'La dotta' for the university, considered the oldest in the Western world, 'Lagrasa' for the reputation of the regional cuisine, 'La rossa' for the warm, terracotta-colored brick and plaster of the old medieval city center, and 'La rossa' for the left-wing local government of the post-war period, which tried to preserve the porticoed red streets of its 'center' (Pinto, 2021). In the 1960s, when the design and construction of the library began, debates in Italian cities, as in many Western European countries, revolved around the relationship

between the urban past and modern life and a national debate about who cities are for. In the same period, a new urban planning approach focused on the preservation of the centro storico, which was at the center of political tensions and uprisings in Bologna in the 1960s and 70s, based on the participation of local residents in urban planning decisions was adopted by the Italian left-wing government, which advocated an anti-development stance on the preservation of the historic built environment. This approach to urban conservation was intended as a response to the 'destructive consequences of growth-oriented urban planning' (Hatherley, 2015). It was crucial that conservation was carried out for the benefit of urban dwellers rather than contributing to their eventual displacement, and the attitude was summarized in the motto 'the old city for a new society'. When the current morphology of the city is examined, it is evident that the historic center (centro historico), which maintains a dense, organic building texture, contrasts with the grid plan type and relatively high-rise building texture found in the relatively new residential areas surrounding the center (Figure 3). The historical center is characterized by the presence of fortified walls, city gates at the intersections of the walls, medieval buildings and public circulation patterns connecting these buildings to each other and urban circulation (Miller, 1989; Miller, 2000; Thurber, 1999). The local building material is brick and the buildings in the historic center have hipped tile roofs. Today, the city walls have been replaced by the main transportation axes connecting the city center with the peripheral settlements, but the city gates and the two towers (due torri) in the center of the radial axes have been preserved as city symbols. The historic buildings in the center have courtyard plan type; the courtyards of the buildings are integrated with the city squares of various scales through continuous porticoes extending under almost every building in the historic center, and this porous structure provides both visual and kinetic transitions and continuity in public space. The facades of the buildings within the historic center have red colors and tones derived from local materials, while the peripheral area has examples of new buildings using contemporary building materials and production techniques, as well as traditional building materials with contemporary construction methods (Figure 2). Within the boundaries of the center, there are relatively few new architectural proposals within the existing, protected, dense and ossified urban fabric. The Walter Bigiavi Library is one of these few examples of modern architecture built in the city center.

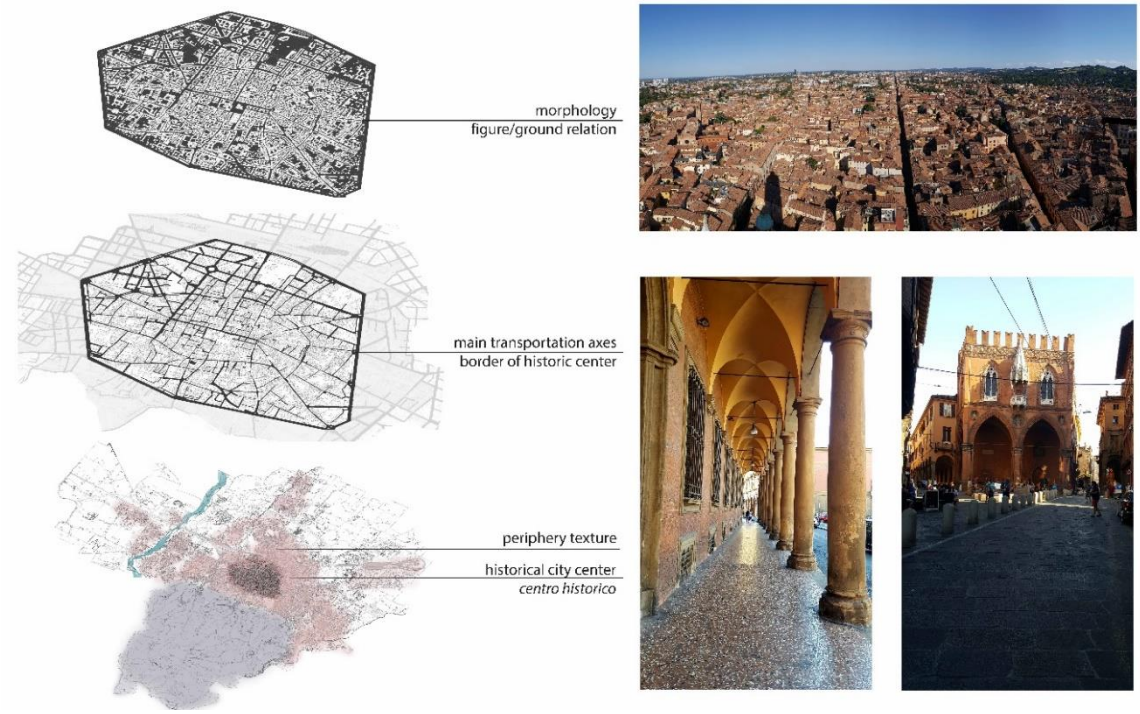

Figure 3. The morphology (left) and identity elements (right) of Bologna (Author's archive)

The University District, in which the library building is located, is a fluid and multi-layered urban space with spatial transitions between different buildings and urban spaces from different eras. The urban axis, which starts from the San Donato Gate and extending to Due Torri, together with Zamboni and

Bella Arti Streets, is used by the young population, mostly students. Within this network, the island on which Bologna University Walter Bigiavi Library is located is located on Bella Arti Street, where the educational buildings of the University of Bologna are concentrated. The urban openness of the library's facade is part of a public open circulation that connects to Scaravilli Square, the Rectorate Building of the University of Bologna and the courtyards of the Faculty of Chemistry (Figure 4). This area contains a rich urban and structural relationship in which; the participation of a contemporary infill building design in the urban pattern, the attitude and tactics adopted in the new design. Therefore the current conflicts and compromises between the existing texture and the new design proposal can be examined. From this point of view, the library building considered in this study is read through the effects of the attitudes and tactics adopted in its design on Tschumi's (2005) dialectic of conceptualization and contextualization; this investigation is compiled under the titles morphology-settlement, orientation-function,-form-mass-material, which are the discussion concepts of architectural tectonics.

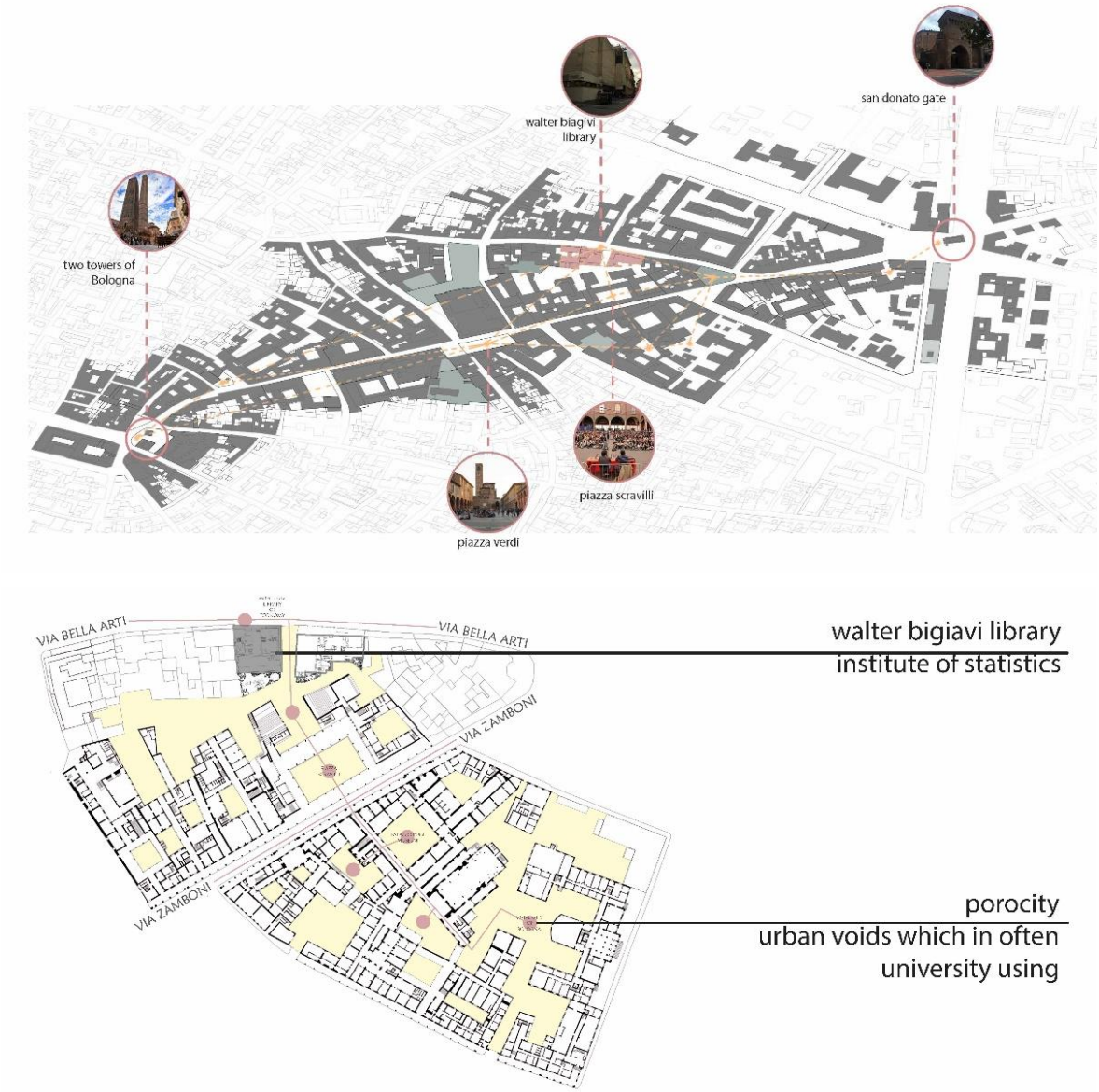

Figure 4. The porous urban pattern between Due Torri and San Donato Gate (top) and the focal points of the University area (bottom)

3.2.1. Morphology - settlement

Walter Bigiavi Library, designed and built between 1963 and 1972 by Enzo Zacchiroli, is an example of the avant-garde architecture of its time. The design is inspired by Le Corbusier's brutalist phase, which

was later revived in the UK as New Brutalism (Andreola, 2013). The library is both a historical and collective identity element within the city and a landmark due to its design choices. The building island on which the library is located was damaged by the bombing of the city during the Second World War, creating a gap in the urban fabric into which the library building was placed. In contrast to the typology of the courtyard buildings of the historic center, the void in the library is interpreted with a monoblock mass. The library was designed by Enzo Zacchiroli together with the facade of the 19th century palace on XX Ottobre 1940 Street, seventy percent of which has been demolished, restored and re-functionalized as the Institute of Statistics. This similarity created a unity in the urban perception (Figure 4). "The two buildings, separated by a narrow street, are arranged as a kind of gateway to the heart of the city, communicating with each other through the same expressive language" (Andreola, 2013). Although the library building is designed as a monoblock, a dialogue between the building envelope and the urban space is constructed with a conceptual, interpretive approach by association with the existing building, the Institute of Statistics. In this regard, instead of a repetition in the morphology, building style and envelope of the building, a 'reciprocity' attitude was adopted and contextualization was sought through the tactics of association (existing upper scale) and analogy (neighbor building facade). Similarly, while the buildings on Bella Arti Street are often connected to the street with porticoes, the entrance facade of the library building on Bella Arti Street was consciously designed as solid; the porticoes of the old building were removed and the facade of the building was pulled back, creating a waiting and entrance area. An association-based connection is established between the old porticoes and a prismatic compositional element added to the building entrance. This situation emphasized the conflicting attitude of the building with a reference to the brutalist aesthetic elements of the building's era; a clear differentiation was achieved in the old-new distinction (Figure 5).

Figure 5. Walter Bigiavi Library for the Faculty of Economic's monoblock form and the facades' dialog between the Institute of Statistics and library (Author's archive)

3.2.2. Orientation - function

The library, like many other public buildings in Bologna, is open to both university students and city residents. This accessibility reflects the city's conservation approach, which is rooted in a human-

centered philosophy. In the historic center of Bologna, building facades are connected to streets or avenues by porticoes, and openings are oriented parallel to the street on the upper levels of the porticoes. In the library building, in contrast to this traditional orientation, the main openings are placed on the back facade instead of the front facade and directed towards Scaravilli Square. Zacciroli, isolated the reading rooms from street noise by placing them at the back, while the front facade facing Via Della Bella Arti is reserved for the entrance on the ground floor and a storage room for the library on the upper floors. On the back facade, which has been significantly emptied by ribbon windows, the study rooms, designed at two storeys in height, are positioned to overlook the back garden opening onto Scaravilli square (Figure 5). The vertical circulation in the building is taken to the side facades and all horizontal and vertical circulation is associated with either a vertical window or a roof opening. This functional scheme has created a legible formal differentiation on the facade of the building. Interior design decisions, such as the retraction of the floor to the first floor, resulting in a double-height band on the ground floor, create spatial richness and complexity despite the limited dimensions of the building (Andreola, 2013). In the design of the library, decisions regarding urban orientation and function placement are consciously made to contrast with the traditional fabric. This approach allows the building's envelope qualities and massing decisions to be function-oriented. (Figure 6).

Figure 6. From left to right, surface characteristics of the back, side and front facades of the Walter Bigiavi Faculty of Economics Library (Author's archive)

3.2.3. Form - mass - material

The continuity of pedestrian circulation in the City of Bologna is a potential asset in terms of accessibility. However, the fact that the urban users relate to the buildings only through the porticoes weakens the visual relationship of the citizens with the building facades. The porticoes, characteristic components of the historic center buildings, have been intentionally removed from the front facade of the Walter Bigiavi Library by the designer's conscious choice. This situation points to a distinct separation in mass formation; in this respect, the tactics of shaping the masses are similar to the gestalt principle of completion. The building mass is designed with solid facades except for the reading rooms opening to the backyard, the vertical circulation line, the balcony connected to the administration floor and the skylight symbolizing the entrance. Specialized functions in the building form are made legible with mass movements and material changes. Another effective tactic in the form organization is the gradual retreat of the entrance facade of the building to make it a waiting and gathering point despite all its solid feature. This design tactic creates a form-ground relationship, turning the library's largely solid, wide entrance facade into a backdrop for urban actions and events. This setback disrupts the continuous arcade sequence leading up to the building; the surface is detached from the urban portico system, and the facade is incorporated directly into the urban continuum and streetscape. However, an added prismatic compositional element softens and gradualizes this dramatic transition (Figures 5 and 6). The presence of this compositional element indicates that the infill building develops a

'reciprocal' attitude at the scale of the building component, even though it conflicts with the urban context. Similarly, the Library mass enters into a physical relationship with the existing neighboring buildings with which it establishes a dialogue on all facades through height, depth and alignment decisions, creating a visual continuity.

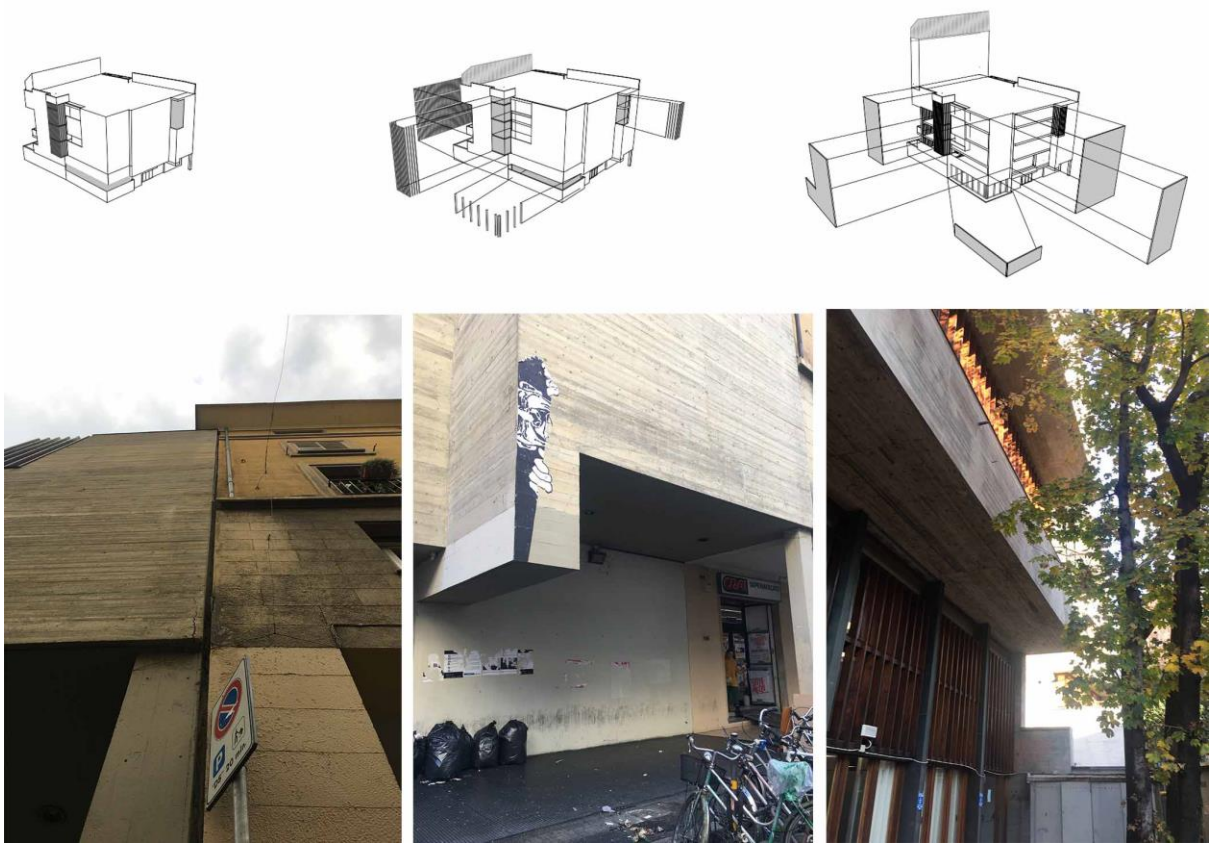

Figure 7. Walter Bigiavi Library's mass formation and analysis of composition elements (top) and material features (bottom) (Author's archive)

In contrast to the infill buildings, which were constructed in a similar period, the Bigiavi Library, which has become a grey landmark in the red image of Bologna due to the local building material, prefers reinforced concrete as a construction system and exposed concrete surfaces as well as steel elements on the facade. This differentiation in materials, on the one hand, differentiates the design from the traditional building texture that speaks a similar language; it is an example of the 'new brutalist' movement by Enzo Zacciroli. The building material of the Bigiavi Economic Library has become a language of communication between the Institute of Statistics, with which it is part of a similar history: "They communicate with each other through the same expressive language: raw concrete with dense grain patterns, copper roofing, wooden door and window frames, and some details in dark metal" (Andreola, 2013). Although these two building facades differ from their immediate surroundings, the unity of mass and material-based language that they establish between themselves evocatively represents the common historical rupture that harbors the traces of past destruction like a scar. In this respect, it is possible to say that a conceptual approach developed by the designer has led to the contextualization process of an infill sample through design attitudes and tactics (Figures 5-6-7). Kocyigit (2022) expresses the relationship between the design proposition and the context as follows: In line with the value-oriented architectural critique of the existing situation, the context also provides norms for the design activity. In this case, different options can be put on the agenda between the existing context and the new design object within a rough axis of acceptance and rejection. Between the context and the new design object, various options such as harmonization by merging with the context, analogy, articulation and becoming part of the whole, ignoring, changing, transforming, rejecting can be put on the agenda. Not just one, but more than one of these options can be effective in determining the normative framework of the new design object. Deciding which option is chosen

for which purpose is more important for determining the problematic and general conceptual strategy of architectural design.

4. Conclusion and Suggestions

Walter Bigiavi Library for the Faculty of Economics which constitutes the case study for this research is located in a multi-layered environment in terms of historical and urban configuration. The building, which is discussed in the text as an example of modern infill design, involves the reinterpretation of a building block damaged during the II. World War in the context of the contemporary needs of urban life. Designed by Italian architect Enzo Zacchiroli, the library building provides an inclusive potential base for the articulation of new architectural design in the existing historic environment, and for the discussion of the diversity and sustainability of the relationships established with the contextualizing process.

Within the framework of Tschumi's (2005) triad of tactical indifference, conflict and reciprocity, it can be inferred that the dominant design attitude adopted for the library is 'conflict', which becomes legible through parameters that urban morphology, facade quality, materials, massing and layout-orientation decisions, especially in terms of its differentiation from the context at the urban scale. On the building scale, the similarity sought through design tactics such as added compositional elements and the unity of language established between two different buildings points to the attitude of 'reciprocity'. In this respect, the library oscillates between the attitudes of conflict and reciprocity and all the attitudes and tactics adopted in this oscillation make it possible for the building to settle and contextualize (Table 1).

Table 1. The contextualization process with attitudes and tactics of the Walter Bigiavi Library (Author's archive)

	1 parameter	2 attitute	3 tactic		4 correlation	
morphology		contemporarist	contrast	differentiation	conflict	concept becoming context
settlement		moderationist	replication	correlation	reciprocity	conceptulizing context
orientation		contemporarist	contrast	differentiation	conflict	conceptulizing context
function		contemporarist	contrast	differentiation	tactical indifference	concept becoming context
form		moderationist	replication	metaphor	reciprociy	contextulizing concept
mass		contemporarist	contrast	contrast	conflict	concept becoming context
compositional elements		moderationist	replication	metaphor	reciprocy	conceptulizing context
material		contemporarist	contrast	differentiation	conflict	contextulizing concept

The dichotomy proposed by Tschumi (2005) in the contextualization-conceptualization dialectic becomes legible in the new library structure and the old urban fabric. The attitudes and tactics adopted, in some acts the context drives the concept, sometimes the concept drives the context, and the content is the mediator that enables the interaction between these two phenomena. The building may be considered as avant-garde in the sense that it creates a new urban focus in the existing environment and reflects the architectural and aesthetic values of its period. It is original in the sense that it evaluates all the physical and cultural qualities of the context with a set of conscious attitudes

and tactics, even though it differs from its historical context (Table 1). This attitude is an example of contemporary infill design proposals: via refer again to Siza's discourse, the designer has not created something out of nothing, but has developed a unique dialogue between the design and the space in which it is located. The conceptual framework of design establishes new connections that do not exist between what is and has found its contextual counterpart. The conceptual framework of design establishes new connections that do not exist between what is and has found its contextual counterpart. It can be said that the unique approach that sets the University of Bologna Walter Bigiavi Library apart from its contemporaries makes it worthy of discussion beyond its own region and era. Urban losses of varying degrees, caused by destruction such as wars, migrations and natural disasters, are a frequent problem in the field of urban planning and architecture today, as they have been throughout history. For this reason, the question of how the resulting gaps participate in the continuity of urban life and with which parameters new designs are created, as well as the contribution of the attitudes and tactics to be adopted in the design to the contextualization of the building, is an important topic of discussion. In this sense, it is possible to draw the following conclusions about the context-design dialectic of new design proposals:

- It is important to create a hybrid combination of multiple design attitudes and tactics in new design proposals.

- It is possible to consider the context as a set of possibilities with which the design is in constant dialogue, and not just as a phenomenon in which the design proposal is embedded.

- Every new design is a conductor between past, present and future: mere isolation or mere repetition can lead to inadequate approaches to the contextualization of the design proposal.

- Although the prevailing attitude in design is contemporarist, a dialogue with the existing urban texture and built environment will be effective at different scales for urban integrity.

- Ideas can be developed about the possibilities of concept decisions to transform the context within the parameters of the context that do not serve current needs of era.

- Rather than creating a design recipe to be adopted in new design proposals, it is appropriate to develop contextual relationships for the semantic, intellectual and physical relationships that each tectonic establishes with the current environment and with each other.

This assessment highlights the strengths of the new architectural design and offers recommendations for future infill designs. The review outlines a qualitative research approach focused on the design attitude lead to contextualizing process and affected by the context. The research methodology established within the scope of the text can be adapted to the requirements of different cases and contexts. The conclusions and design recommendations presented at the end of the study are intended to provide a guidance for the future infill designs.

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Author Contribution and Conflict of Interest Declaration Information

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Examining Preschool Education Buildings with Sustainable Architectural Approach: Two Examples in Konya, Selçuklu

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Abstract

Within the scope of the study, two kindergartens that use an ecological approach and are located in the Selçuklu district of Konya province—one connected to the state and the other to a private institution—were chosen in this regard. Even though the sample schools did not have any sustainable architecture certificates, they were selected because they adopted an ecological approach. Three steps make up the study methodology. The source scanning phase is the first. The second phase, the field study, entails gathering information about the structures chosen for the field study through observation, interviews, photography, and measurement. The evaluation stage is the final step, during which it is determined whether the model schools have ecologically, socially, and economically sustainable architectural elements, and recommendations for improvement are made. As a result, building buildings with a sustainable architectural approach is necessary for the foundation of environmentally sensitive societies.

***Keywords:** Child, environmental awareness, preschool education buildings, sustainable architecture.*

Okul Öncesi Eğitim Yapılarının Sürdürülebilir Mimari Yaklaşım ile Analizi: Konya Selçuklu'da İki Örnek

Öz

Çalışma kapsamında Konya ili, Selçuklu ilçesinde yer alan biri devlet, diğeri özel bir kuruma bağlı olan ekolojik yaklaşımı benimsemiş iki anaokulu seçilmiştir. Örneklem okulların herhangi bir sürdürülebilir mimari sertifikası olmasa bile ekolojik yaklaşımı benimsemiş olması açısından seçilmelerinde etkili olmuştur. Çalışma metodolojisi üç aşamadan oluşmaktadır. Birinci aşama; kaynak taramasıdır. İkinci aşama; alan çalışması olarak seçilen yapılarla ilgili gözlem, görüşme, fotoğraflama, ölçü alma gibi eylemlerin gerçekleştiği saha çalışmasıdır. Son aşama ise ekolojik, sosyal ve ekonomik sürdürülebilir mimari bileşenlerin örneklem okullarda mevcudiyetinin tespit edilerek, iyileştirmeye yönelik önerilerin sunulduğu değerlendirme aşamasıdır. Sonuç olarak yapıların sürdürülebilir mimari yaklaşımıyla inşa edilmesi çevreye duyarlı toplumların temeli için gereklidir.

***Anahtar kelimeler:** Çocuk, çevresel bilinç, okul öncesi eğitim yapıları, sürdürülebilir mimari.*

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1. Introduction

I hear and I forget. I see and I remember. I do and I understand.
(Confucius)

Today, with interconnected actions like urbanization, industrialization, population growth, and irregular migration on the rise and the threat of diminishing natural resources, the concept of "sustainability" is very prominent. Every facet of daily life is affected by the notion of sustainability, ranging from the economy to the environment, from architecture to education. While the literature generally believes that the concept in question was first introduced in 1713, serious discussions about it in the context of the environment began after 1970 (Şen, Kaya & Alparslan, 2018). When it comes to the field of architecture that is directly related to the environment, sustainability rules over design approaches that envision a fair distribution of resources, seek to maintain social progress and concentrate on the planet's future with the primary goal of enhancing environmental conditions. Because of this, sustainable architecture is a design philosophy in the field of architecture that highlights environmental issues that pose a threat to human health and shields the environment from the damaging effects of the industrial age (Reid, 1995). In this context, environmental, economic, and social aspects of sustainable architecture must be taken into account as a whole (Sakınç, 2006). The concept of sustainability ought to extend beyond the present and become a way of life for generations to come. To safeguard and conserve natural resources for future generations, people should be environmentally conscious (Kocabaş & Bademcioğlu, 2017). To address the concept of sustainability as a whole in its environmental, social and economic dimensions, it is crucial to raise environmental awareness beginning in the pre-school years (Kaya & Kaya, 2019).

Child and education are two powerful keywords in raising environmental consciousness in society because fostering environmental consciousness at a young age is a crucial first step in increasing social awareness. Young children who receive environmental education are more likely to grow up to be environmentally conscious adults who respect the natural world's balance and see themselves as a part of it rather than its rulers (Kayıhan & Tönük, 2008; Shahli & Akasah, 2019). Because of this, compared to other types, educational buildings have a great deal of importance and potential because they can teach future generations about sustainability in addition to education (Evran, 2012). Environmental responsibility can be instilled in young people by actively living sustainable design principles, as educational buildings serve as places of learning and experience for all (Government Architect New South Wales, 2018). Numerous researchers have highlighted how sustainable educational buildings improve students' learning outcomes (Kayıhan &Tönük, 2010; Ramli, Masri, Taib & Hamid, 2012; Sivri Gökmen, 2012; Şahin & Dostoğlu, 2015; Yanılmaz & Tavşan, 2021). Schools must address sustainability, as a building featuring sustainable design elements can help students manage the uncertainties of the future (Zurita, 2008). Sustainable building practices are the subject of countless studies in the field of architecture. A few of these have to do with how sustainable school buildings are. Several sustainability criteria are established and the prerequisites are enumerated in the studies covered in this regard. However, theoretical discussions dominated the discussion of these studies (Tavşan & Yanılmaz, 2019). Although there are many initiatives for sustainable school design (Şahin & Dostoğlu, 2015; Zhang, Wang, Wang, Gao, Zhu & Song, 2021), the number of studies focusing on existing school buildings is rather inadequate. Schools are more than just actual buildings. Its architectural layouts and spatial arrangements can provide students with a quiet language for experiencing ecological living. To promote environmental awareness, Newton, Wilks & Hes (2009) highlight educational buildings with ecological features, noting that "buildings that perform well in terms of environmental impact offer excellent opportunities as a teaching tool".

However, using the existing building stock rather than demolishing and rebuilding the building will provide general environmental, economic, social and cultural benefits—given that every new building will harm the environment during the construction process. Reevaluating existing buildings with an ecological approach is a crucial step towards sustainable architecture for a sustainable approach, as it ensures the best possible use of diminishing resources and yields economic benefits (Aydın & Okuyucu 2009). Therefore, minimizing harm to the environment by making ecological improvements to existing buildings is a crucial step in the development of sustainable architectural approaches. Sustainable work

can still be done even in cases where there is an excess of existing building stock (Karadayı, Yüksek & Tunçbiz, 2017). As of 2020, there are 68,589 schools in Turkey offering formal education, according to data from the Ministry of National Education (2012). Preschool education buildings make up 11,485 of these schools (Turkey's education-training statistics announced, 2020). In this instance, preschool buildings make up about 17% of all school buildings used for formal education. Hence, a large amount of our nation's basic education facilities are located in preschool education buildings, so ecological renovation or improvement of these facilities will go a long way toward laying the groundwork for a society that is environmentally conscious. With well-designed educational structures that can accommodate a variety of child needs, a child can receive the desired quality education during the pre-school years, when the child develops identity and skills (Tonguç & Özbayraktar, 2017). Preschool buildings can therefore be utilized as a possible educational tool to encourage children to be environmentally sustainable.

Given this, the vast majority of preschool structures were constructed without taking environmental issues into account. A challenge for the study is the requirement to both construct new buildings with ecological features and renovate/improve existing ones to have them. Because early childhood is a time of learning and discovery when a child is most influenced by their surroundings and naturally develops a sense of curiosity, preschool buildings were selected as the study area. From the Selçuklu district of Konya province, two environmentally delicate kindergarten buildings were chosen: one was a public school and the other was a private. Private school budgets are funded by the person or people who own the school, whereas public school budgets are funded by state taxes levied on citizens (Kandemir, 2015). Therefore, the design and construction of school buildings are influenced by economic factors. The aforementioned schools were scrutinized based on sustainability components. Building-related issues were found through qualitative data collection techniques like document analysis, on-site observation, interviews, and photography. Sample schools were then compared in light of the findings.

Financial concerns are the primary cause of deficiencies found in schools. The ecological characteristics of these schools are also affected by the varying budgets. Unfortunately, there is a lack of research on sustainability as it is not yet a popular concept in society. Thus, focusing on educational facilities can greatly increase national consciousness of environmental issues. To achieve this, sustainable school design guidelines and model projects can expose future engineers and designers to sustainability at a young age. It is important that we do not disregard this objective and view it as a significant advancement in the field.

2. Material and Method

Institutions of higher learning are settings that give kids the chance to take the initial step toward gaining an awareness of the environment and raising enough awareness. Nevertheless, the concepts that ought to be considered when developing sustainable educational buildings both domestically and abroad are overlooked. The low number of applications in the world and our nation that consider sustainable design principles is criticized by Şahin & Dostoğlu (2015). Furthermore, they stress the need for further application and research efforts, although there has been a recent surge in interest in the topic in Turkey. It is especially valuable to take even modest actions within this framework to increase public awareness of sustainability. According to Murphy & Thorne (2010), "education for sustainability" programs must begin in the preschool years. They compare schools to laboratories in terms of stimulating society in terms of sustainability apart from the education they provide. Thus, it is important to maintain existing buildings in addition to developing new sustainable ones since only a small portion of the stock of existing buildings is new construction (Tonguç, 2012).

In this regard, it is important to determine the preschool buildings that currently exist and take action to enhance their ecological qualities. Different academic fields have discussed sustainability and environmental awareness in preschoolers; this study highlights educational structures that provide environments where children can experience and learn about these ideas. The first steps in this direction included developing a conceptual framework for environmental consciousness in early childhood education and the sustainability of early childhood education institutions. The information

gathered led to the design of the study methodology. The working method is described in detail under the second and third method headings as a result of the information gathered.

2.1. Environmental Awareness in Preschool Education

In the twenty-first century, preschool education is becoming more and more crucial since children's first five years of life are when they develop most rapidly, not only in terms of their cognitive and perceptual abilities but also in terms of personality, social skills, and emotions (Uysal, 2006). The preschool years, which span from birth to the end of six years of age, are among the most significant life transitions (Turaşlı, 2007). "Pre-school education institutions" are all establishments that offer instruction to children in the current educational system and assist with their development, ranging in age from 0 to 6 (Oktay, 1999). The first educational setting in which a person enters their academic career is a preschool. It is also the first step toward producing aware and valuable citizens. Early infancy is when social and moral values that shape a child's future are first transmitted. Because it imparts fundamental knowledge and skills, preschool education is crucial during this time (Kalemci, 1998; Şahin, 2005; Yavuzer, 2002). Preschool education, which is depicted in different ways in various sources, was defined in the Fourteenth National Education Council as "providing rich stimulants and environmental opportunities appropriate to the developmental levels and individual characteristics of children in the 0–77-month group, supporting their physical, mental, emotional and social development, and supporting them in the society of the society." It is clarified as "an educational process within the integrity of basic education that guides students in the best way in line with cultural values and prepares them for primary education (Turaşlı, 2007). Early childhood education facilities can help prepare a child for social life in their early years. The goals of preschool education programs are to provide children with the fundamental life skills they need and to make sure they spend this time in a healthy and productive manner in accordance with their physical, social, emotional, and cognitive development. As a result, social awareness will start to develop at a young age (Yağlıkara, 2006). All people must take part in the process of developing social awareness, and it's critical to start laying the groundwork for awareness at a young age.

Preschool education institutions can help prepare young children for social life in the early years (Cömert, 2004). Environmental awareness is one of the skills, attitudes, and knowledge that preschool education should instil in children. In 2006, Türküm defined environmental awareness as "the individual can respect both himself/herself and nature without forgetting yesterday and today, past and future," acknowledging it as a social and personal responsibility. By guaranteeing environmental protection and identifying workable solutions to environmental issues, people's environmental awareness helps to create a sustainable and livable environment. Environmental education is essential for the growth of environmental consciousness because it enables people to identify all the factors that upset the natural balance, examine the connections between these factors, and recognize the value of natural resources and living things (Geray, 1997). Ünal, Mançuhan & Sayar (2001) describe environmental education as a process that can be offered with a variety of learning environments and instructional approaches. To increase environmental awareness, education must use appropriate teaching strategies, relevant materials, and hands-on learning (Doğan & Akaydın, 2000). The characteristics of the target audience should be considered when offering environmental education. Because this is a way to raise environmentally conscious kids and teens. Preschool-aged children are the target audience's initial step in developing environmental awareness (Yıldız, Sipahioğlu & Yılmaz, 2000). Thus, preschool is a good time to lay the groundwork for raising sensitive people.

To be productive, constructive, and aware in every subject, it can be argued that it is critical that young children—who will grow up to be adults—go through an efficient preschool education process and start to develop environmental values (Çabuk, 2003). The first step in helping a child develop environmental awareness is for preschool education institutions to raise enough awareness about the environment (Ural, 1993). One step toward environmental awareness is environmental awareness. It makes up the environmental awareness's cognitive component. By beginning to recognize his/her surroundings, the child develops awareness (Atasoy, 2006). A preschooler's environment is made up of his or her entire living situation. "Knowing his environment and protecting it" refers to the

knowledge that children can acquire about their surroundings. Preschoolers raised in diverse cultures can exhibit a heightened sensitivity to the natural world, according to research. It has been observed that when children's natural curiosity and interest in the environment are appropriately directed, they perceive the environment and environmental problems better (Haktanır & Çabuk, 2000). Given that children are the demographic most impacted by environmental issues, environmental education must begin early (Göka, 1997; Kocakurt & Güven, 2005). Furthermore, children who are exposed to information about plants, animals, and the environment from an early age have the chance to get to know nature better, which serves as a foundation for their love of and desire to preserve it (Nazlıoğlu, 1991).

Growing urbanization brought on by population growth distances people from the natural world and, consequently, from children. Additionally, it is insufficient to instill in kids who grow up in urban areas without exposure to the outdoors the knowledge that they are a part of it. Raising awareness of the environment in cities can be achieved in part by designing buildings with sustainable features (Kaya & Kaya, 2019). Yürekli & Yürekli (1999) emphasize that "children are impacted by good and bad, as well as ugly and beautiful, very quickly because they have larger memory banks and perceive their surroundings more quickly than adults. According to him, "school is the place where people are most affected after home and family", which highlights the significance of education in promoting environmental awareness. Children can acquire environmental awareness at a young age by being exposed to sustainable architecture in preschool education buildings (Mehrabansehgonbad, Falahatdoost & Mohammadkhani, 2019; Shahli & Akasah, 2019; Zhang et al., 2021).

2.2. Sustainable Architecture in Preschool Education Buildings

Sustainable architecture, also known as green architecture or ecological architecture in the literature, has been defined in a variety of ways by different scholars. According to Sev (2009), sustainable architecture is "any activities of creating structures that protect people's health and comfort," and it is "one that prioritizes the use of renewable energy resources, is environmentally friendly, uses energy, water, materials, and the area effectively, taking into account future generations in its current conditions and every period of its existence." Three categories of sustainable architecture principles are identified by Kim & Rigdon (1998): life cycle design, efficient use of resources, enhancing human well-being, and aesthetics. The life cycle is defined as the phases of design, construction, operation, maintenance, and demolition. Effective use of resources is defined as an important principle that begins with the production of building materials and continues throughout the building life cycle, reducing the use of non-renewable energy. According to Kim & Rigdon (1998), enhancing the quality of human life means protecting human health and comfort as well as raising and improving living standards, as well as the cultural, social, and physical environments. In summary, sustainable architecture uses available resources and conditions in a production-oriented rather than consumption-oriented manner, taking into account the benefits to the surrounding environment throughout the building's life cycle. Basic standards for building environmental assessment and certification systems are provided by this surveillance (Utkutuğ, 2011). Among the widely used building environmental assessment systems globally, LEED and BREEAM are regarded as crucial instruments for implementing global sustainability goals in local spaces (Özçevik, Ertekin, Eyüboğlu, Oğuz, Akbulut, Çelik, Sandıkçı & Kantemir, 2018).

Within the context of sustainability, the US Green Building Council developed L.E.E.D. (Leadership in Energy and Environmental Design) in 1993 using standards that promote sustainable and environmentally friendly building practices. Sustainable spaces, efficient use of water, energy, and atmosphere, materials and resources, interior environmental quality, and the growth of creativity and design are the primary LEED evaluation criteria. B.R.E.E.A.M. is an additional green building rating system. The Building Research Council first introduced B.R.E.E.A.M. in England in 1990. The first certification program based on criteria is the Environmental Assessment Method of the Building Research Establishment. Reducing the long-term detrimental effects of buildings on the environment is the goal of B.R.E.E.A.M. Ten categories make up the system: materials, waste, energy, management,

health and happiness, transportation, water, land use and ecology, pollution, and development (Tonguç, 2012), (Table 1).

Table 1. LEED and BREEAM Certification evaluation system criteria (created by the author using Tonguç, 2012)

LEED Certificate Assessment System Criteria	Energy Transportation	Building Area Use and Ecology Health and Comfort Management	Pollution Water Building Materials
BREEAM Certificate Assessment System Criteria	Transportation Innovation Materials and Resources	Innovation and Design Sustainable Lands Water and Water Activity Interior Quality	Energy and Atmosphere Construction Materials

The majority of LEED-certified buildings in Turkey are found in the provinces of Istanbul, Ankara, and Izmir. The number of certified buildings in Bursa (5), Konya (4), Antalya (5), and other provinces is growing daily (LEED Certified in Turkey Buildings, 2022). The majority of certified buildings in Turkey are office and residential structures; educational buildings lag behind these advancements (Tonguç, 2012; Evran, 2012). Table 2 shows that the majority of Turkey's educational buildings with BREEAM or LEED certifications are found in Istanbul, Ankara (1), and Bursa (1). The only LEED-certified kindergartens in Turkey are the Ankara Metropolitan Municipality Çayyolu Barrier-Free Nursery Building and Bahriye Üçok Kindergarten, which are separate and not attached to the educational campus. Table 2 makes it clear that kindergartens in our nation are insufficiently sustainable, given that preschoolers spend the majority of their time in educational settings.

Table 2. Educational Buildings with LEED and BREEAM Certificate Evaluation System in Turkey (Made by the author using LEED Certified in Turkey Buildings, 2022; Şahin & Dostoğlu, 2015)

LEED Certified Educational Buildings in Turkey		
Project Name	**Evaluation Note**	**Location**
TED Renaissance College	Golden Certificate	İstanbul
Acıbadem University Faculty of Medicine	Golden Certificate	İstanbul
Özyeğin University Building 2	Golden Certificate	İstanbul
Özyeğin University Engineering Building	Golden Certificate	İstanbul
Özyeğin University Student Center	Golden Certificate	İstanbul
Kadıköy Atatürk Science High School	Platinum Certificate	İstanbul
Acıbadem University Kerem Aydınlar Campus Vocational School	Golden Certificate	İstanbul
Acıbadem University Faculty of Medicine	Golden Certificate	İstanbul
Terakki Foundation Private Şişli Terakki Tepeören Campus	Golden Certificate	İstanbul
Cihangir Bahçeşir College	Certified	İstanbul
TED Renaissance College	Golden Certificate	İstanbul
Bahriye Üçok Kindergarten	Platinum Certificate	İstanbul
Ankara Metropolitan Municipality Çayyolu Barrier-Free Nursery Building	Golden Certificate	Ankara
BREEAM Certified Educational Buildings in Turkey		
Project Name	**Evaluation Note**	**Location**
Piri Reis University	Very Good	İstanbul
Automotive Industry Exporters Association Technical and Industrial Vocational High School	Very Good	Bursa
Erkut Soyak High School	Good	İstanbul
Sabancı University Nano Technology Building	Very Good	İstanbul

In addition to raising awareness of sustainability, sustainable education programs help kids and other community members adopt a sustainable lifestyle. According to Nair & Fielding (2013), "a dynamic

model that explains sustainable design, architecture, engineering, construction, environmental science, and harmony with nature in a school environment is an excellent learning tool.", adding that sustainable education spaces are described as an applied laboratory environment.

Numerous researchers have proposed the fundamental objectives and tenets of sustainable learning environments. According to Kocabaş & Bademcioğlu (2017), the following are the green school requirements for raising awareness of the need to preserve and protect the environment for coming generations:

- The primary and most crucial objective when developing or operating a green school is safeguarding and maintaining the environment.
- As much natural light as possible should be utilized. By boosting their productivity and success, this has a positive impact on building users' physical and mental health.
- There are several ways to enhance indoor air quality. Users of a building can avoid developing asthma or allergies by maintaining good indoor air quality.
- It is crucial that the building has the highest caliber water-saving fixtures installed.
- Reducing energy use and making efficient use of renewable energy sources are critical.
- It is important to keep noise levels in the classroom within reasonable bounds and to keep outside noise at bay.
- Materials that won't damage the environment or the health of students or teachers should be used to select the equipment for use in the school building and classrooms.

It is anticipated that the green school will guarantee that the next generation is raised with an awareness of sustainability. The following is a list of the objectives that can be met by sustainable schools, according to the Sustainable School Design guidelines (Dorsey & L'Es-perance, 2000):

- Raising student achievement and attendance;
- Imparting sustainable design concepts;
- Harmonizing with the environment;
- Providing excellent lighting;
- Using less energy;
- Conserving natural resources and materials;
- Enhancing the indoor environment;
- Safeguarding waterways.

The spatial and social integrity of educational buildings must meet the requirements for sustainability (Göktekin, 2015). At this point;

- Selecting the right site (one that will protect users from outside sources of pollution, have the least detrimental effect on the ecosystem, and be suitable for the design of buildings that meet sustainable criteria).
- Creating a thorough transportation plan that reduces environmental pollution (which ought to begin during the land selection phase),
- Reducing the building's life cycle expenses (construction, operation, maintenance-repair, demolition),
- Including active (solar collectors, photovoltaic systems, etc.) and passive (greenhouses, roof windows, heat-storing walls, solar chimneys, etc.) systems in the construction to lower energy needs,
- Boasting environmentally friendly and locally sourced building materials, roof gardens, natural ventilation systems, rainwater collection, ample daylight, acoustic comfort, and high-quality indoor air quality, among other sustainable attributes,
- Reducing and managing waste through the application of material reuse and recovery policies both during and after building construction.
- Being adaptable to changing circumstances and enhancing users' training performance,
- The structure serves as a teaching tool for sustainability awareness and is incorporated into educational initiatives,

- Creating open areas with varied experience environments to foster a child's connection with nature,
- Ensuring everyone's safety and accessibility, regardless of disability
- Ensuring that the local community benefits from the building's amenities is one of the design criteria for sustainable school buildings.

Kindergartens are crucial for the growth of the early childhood sustainability learning process among green school buildings. Children's needs must be taken into consideration when designing a building and its surroundings because they spend a significant amount of time and receive education in the school area (Shahli & Akasah, 2019). Recent studies that define the expected environmental conditions for schools have emphasized the significance of sustainable design. The use of daylight, clean air, and materials with low chemical properties is believed to be important in school buildings that adopt sustainable design principles to create a healthier and more productive environment for children. Schools should have natural light, clean air, a view, comfortable temperatures, acoustic conditions that enhance learning, opportunities for sports, the ability to use the environment as a learning resource, access to clean drinking water, social facilities, the promotion of friendship and social development, and security-sensitive features. According to Murphy & Thorne (2010), a sustainable school encompasses various aspects such as conserving energy and water, reducing waste, avoiding potential pollution, preserving and promoting the environment, making efficient use of material resources, and honouring the involvement of individuals. In this regard, it is crucial to integrate economic, social, and ecological sustainability components into the design process as evenly as possible to construct preschool educational buildings following the sustainable design approach.

According to Vivien (2008), *economic sustainability* involves using energy and resources wisely, as well as recycling and reusing items after they have been used. There are requirements for building form, material selection, space organization, building envelope, and building orientation under the category of economic sustainability (Tonguç, 2012). The environmental dimension—also referred to as *ecological sustainability*—focuses on waste reduction, recycling, and environmentally friendly production and consumption that doesn't negatively impact the ecosystem (Morelli, 2011). The selection of a residential area, water conservation, energy and atmosphere, transportation, natural lighting, and natural ventilation are all considered aspects of ecological sustainability (Tonguç, 2012). The *social dimension of sustainability* pertains to enhancing users' educational performance and promoting equality of opportunity, solidarity, and sharing among members of society (Des Jardins, 2006). It includes design requirements for social-cultural sustainability, such as understanding social needs and desires, creating a building that harmonizes with its surroundings, educating people about the preservation of natural resources and their future generations, bringing life to the immediate surroundings through user mobility, and promoting the city through the building (Tonguç, 2012).

In this regard, one of the first schools to be constructed and accredited with consideration for sustainability is the Dragen Children's House, which was established by the Odense Municipality in Denmark in 2009. In the building, where energy consumption and consequently carbon dioxide footprint have been significantly reduced, the use of environmentally harmful materials has been rejected. The building is situated in the middle of the neighbourhood apartments. The building was designed in the shape of a cube with a straightforward geometry, taking into consideration the best form selection depending on the climate. The building's surface area is reduced by its cube shape and lack of numerous protrusions and indentations. Trees are separating it from the road frontages. In addition to reducing traffic pollution and protecting children, trees also serve as noise cancellers. The building is a two-story educational facility with a high aspect ratio that prioritizes the safety of the kids inside (Figure 1).

Figure 1. Visuals from Dragen Children's Home (Children's House Dragen, 2012)

Large openings were made on the south-facing facade to maximize passive solar heating and daylight, while smaller, single windows were utilized on the north facade. The structure can maximize its natural lighting. The purpose of artificial lighting is to enhance natural lighting. To optimize the use of natural lighting, careful consideration was given to space organization and orientation (Figure 2).

Figure 2. Visuals from Dragen Children's Home (Children's House Dragen, 2012)

The entire structure was built using Nordic Swan-labeled wood products, which are recyclable, healthful, and friendly to the environment. The stairs and railings inside are made of wood. Reinforced concrete makes up the building's exterior shell. Outside, permeable materials like grass and sand were used to stop rainwater from seeping below the surface. The view was attained and natural light was used with the help of skylights. In addition, natural lighting brightens the building's ground floor corridors, which visually link the floors with the well-planned gallery space (Figure 3).

Figure 3. Visuals from Dragen Children's Home (Children's House Dragen, 2012)

The components of economic, ecological, and social sustainability must be incorporated into buildings from the design phase onward for the sake of future generations. While meeting human needs, comfort, originality, and aesthetics are the primary considerations in the design process (Yurtgün & Çınar, 2023), considering ecological issues sets the standard for better and higher-quality educational buildings. Consequently, in order to more successfully integrate sustainable design into the education agenda going forward, it is important to develop, enhance, and support currently constructed educational facilities (Gelder, 1998).

2.3. Method

It is stressed in literature reviews that a conscious social infrastructure depends on teaching the ecological and environmental learning model through experience starting at a young age.

Nevertheless, the research findings indicate that there aren't nearly enough sustainable projects in our nation's educational buildings. Specifically, there are remarkably few sustainable certified independent kindergartens (2). This is believed to be caused by political sanctions, economic worries, and a lack of environmental awareness in the general public. On the basis of this concept, sustainable elements ought to be incorporated into kindergarten construction projects going forward, beginning with the design phase. It is more crucial than ever to move quickly to identify and create viable sustainable elements in kindergartens that are currently in operation. Thus, this study is crucial to ascertain the potential of kindergartens that have adopted an ecological approach, even though there isn't a sustainable kindergarten certificate in our nation. Even though Konya is home to four LEED-certified projects, the city was chosen as the study area because none of the buildings are educational. Furthermore, two kindergartens—one public and the other private—were chosen; even though neither has a sustainable evaluation certificate, they have implemented an ecological approach in an effort to increase children's awareness of the environment.

Three steps make up the study methodology. The first step is a review of the literature in which numerous studies by various researchers are looked at. These studies cover topics like sustainability, preschoolers, and educational structures. The second phase, known as the field study, entails gathering information about the structures chosen for the field study through observation, interviews, photography, and measurement. The evaluation phase, which is the last part of the process, involves analyzing the buildings based on their sustainability components using all the data, documents, reports, and interviews that were gathered. Accurate information is attempted to be obtained by the inductive method from part to whole by using the qualitative research method. The discovery of theory, according to Glaser & Strauss (1967), should be predicated on data that is systematically gathered throughout the research process (Özdemir, 2010). The proper formation and completion of the evaluation phase are facilitated by the systematic construction of the field study and the scanning of sources (Figure 4).

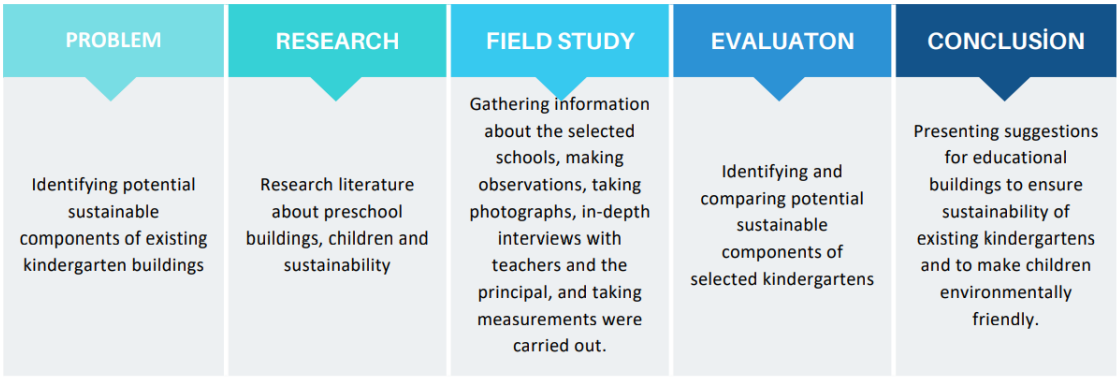

Figure 4. Methodological approach scheme of the study (Created by the Author)

2.3.1. Field study

The field study for the research included two types of schools: Konya/Selçuklu Private Ekolojik Kültür Kindergarten, a private school, and Selçuklu Municipality Sabır Kindergarten, a public school located in the Selçuklu District of Konya. Preschool education programs at both schools incorporate ecological awareness as a common feature. There are, nonetheless, discrepancies between the schools in question's physical attributes and curricula concerning social, ecological, and economic sustainability. In Turkey school buildings funded by the state were constructed without regard for standard climate and environmental considerations (Gültekin, Aruntaş & Gün, 2014). In its broadest definition, private schools are, on the other hand, establishments where instructional procedures are actively carried out and where the institution's operating costs are not met by state funding. These institutions' budgets for physical education and recreation are overseen by individuals, groups, or institutions. Due to advertisements that highlight students' academic success, private schools today shape families' preferences through their physical layouts, and evaluations also consider the beneficial effects of spatial conditions (Yaman, 2021). Because of this, two kindergartens—a public and a private one—

were chosen randomly for the field study, and their sustainability components were analyzed. To guarantee that the environmental conditions (topography, climate, etc.) were comparable, great care was taken to ensure that they were situated in the same region during the selection process.

2.3.2. Selçuklu Municipality Sabır Kindergarten in Konya/Selçuklu

The Selçuklu Municipality Sabır Kindergarten is located at Alım Street No. 38 in the Yazır District. The academic year 2019-2020 has started and the kindergarten currently has 380 enrolled pupils aged between four and five. The facility employs a total of twenty-four staff members, including sixteen teachers, two administrative managers, and six support staff members (Figure 5).

Figure *5*. Location and entrance facade of Selçuklu Sabır Kindergarten (Google Map,2023; Sungur, 2023)

The school covers a land area of 2850 square meters, out of which 950 square meters are green areas. This amounts to an average of 3 square meters of green space per student. The entrance is located in the south, and the building has a rectangular shape running in the north-south direction. The school has three floors: basement, ground, and first floor. In the basement, there is a warehouse, a water tank, a natural gas installation room, an electrical room, a science workshop, a prayer room, an ablution room, a multi-purpose hall, and a music workshop. On the ground floor, there is an information desk, three classrooms, a library, a deputy principal's room, a dining hall, and a kitchen. Additionally, you can access the garden through the door next to the kitchen area. On the first floor, there are five classrooms, an art workshop, a principal's office, and a guidance service. Each floor has a toilet for the disabled, in addition to separate student toilets for boys and girls. The school's heating is provided by a central heating system, which uses floor heating (Figure 6).

Figure 6. Immediate surroundings and floor plan of the building (Graphical arrangement belongs to the author)

Outdoor Features

The building is surrounded by garden walls on all four sides. The neighborhood has four to five-story residential buildings, a recreational area, and a market area. The building can be accessed via a six-

step staircase or a disabled ramp. Even though it is near a public transportation route, the school administration stated that the majority of students come to school by private vehicles. The car parking area is located outside the building boundaries. Some parts of the exterior of the building have soil/grass playgrounds and asphalt playgrounds designed. Outdoor areas include wooden play equipment, plant planting, and an animal care area. The recreation area adjacent to the school is also used for various activities. Previously, there were chickens in the animal care field, but they are no longer available. The planting area has different types of plants, and they are grown using the drip system. A rainwater collection system has been created for garden irrigation to save water. Solar panels were included in the project planning phase, but they are not available due to their high cost (Figure 7a, 7b, 7c, 7d).

Figure 7a. Recreation area and parking area in the immediate vicinity

Figure 7b. Outdoor seating area and green texture

Figure 7c. Plant growing and animal care area

Figure 7d. Stairs and ramp providing access to the building, rainwater collection tank, wooden play equipment

Figure 7. Different images of outdoor spaces (Sungur, 2023)

Classrooms/Workshops, Common Areas

Space in classrooms can be arranged to suit a variety of activities. In preschool education spaces, workspaces created using a flexible space approach are essential. The ground-floor and first-floor

classrooms and workshops have windows that let in natural light and air. In locations where wooden furniture is the primary type of furniture, plastic-based materials are also present. Although parabolic lighting is typically used in surface-mounted lighting applications, pendant lighting is also utilized in some locations (Figure 8)

Figure 8. Images from the classrooms/workshops located on the ground and first floors (Sungur, 2023)

Artificial lighting features are used to provide education in the science workshop located on the basement floor, the music room, the museum corner, and the mathematics street. Children are deprived of natural ventilation and daylight when windows are absent (Figure 9).

Figure 9. Images from the classrooms/workshops and halls on the basement floor (Sungur, 2023)

All floors' wet areas are equipped with nothing to conserve water. To maximize natural lighting and ventilation, the dining room and kitchen should be situate on the ground floor. The classroom hallways' lengthy and narrow layout means that natural light is inadequate and must be supplemented by artificial lighting. After being evaluated for its work under the Eco School Project, Selçuklu Municipality Sabır Kindergarten was awarded the "Green Flag Award" for its efforts in the Eco School, Forest School,

Seed Bank, and Zero Waste projects. To encourage students' awareness of recycling, a designated area has been established within the school where various waste types are gathered (Figure 10).

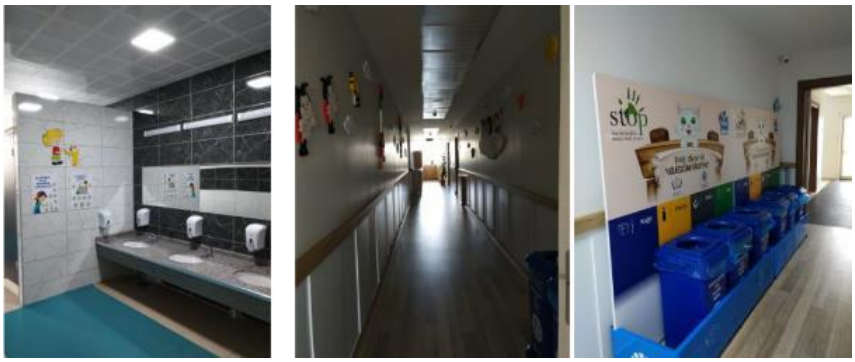

Figure 10. Images from wet areas and corridors (Sungur, 2023)

2.3.3. Private Ekolojik Kültür Kindergarten in Konya/Selçuklu

The Private Ekolojik Kültür Kindergarten is situated on Hısım Street No:10 in the Buhara District. The school welcomed its first batch of students in the academic year 2020-2021, catering to children aged between 3 to 6 years. Currently, the school has a total of 120 students and 19 employees, including 12 teachers, 1 manager, 1 accounting personnel, and 5 assistant staff members (Figure 11).

Figure 11. The Private Ekolojik Kültür Kindergarten's location and entrance facade (Google Map, 2023; Sungur, 2023)

The school is built on a land area of 1917 m² and has a floor area of 586 m², spread over three floors. The basement floor covers an area of 488 m², while the ground and first floors are both 586 m². The school's total closed area is 1660 m². The front garden measures 450 m², while the side and backyard gardens together cover 855 m², making the total garden area 1305 m². There is an average of 10 m² of green space per student. The building has a rectangular shape in the north-south direction and houses a total of 16 classrooms, including 12 classrooms that are 30 or more m² in size, and 4 workshops that are 20 m² each. The school has four different sections, including a 180 m² gym, a 200 m² dining hall, a 150 m² sleeping room, and a 40 m² dream room. The school is heated by a central heating system with floor heating (Figure 12).

Figure 12. Immediate surroundings and floor plans of the building (Graphical arrangement belongs to the author)

Outdoor Features

The building is enclosed by garden walls on all four sides, and there are two or three-story residences nearby. However, it is located far from the public transportation routes, and most students do not reside in the immediate vicinity. Pedestrian and public transportation are not preferred. The car parking area is located outside the garden boundaries of the building. The front garden of the building is paved with stone, and the backyard is covered with a large green area that can be utilized for various activities. The students can interact with nature by planting and cultivating areas and taking care of different species of animals that are housed in animal shelters. The building has two entrances, north and south, and the garden area can be accessed from the south side via stairs and a ramp. Additionally, the waste food is composted and used as fertilizer for both plants and animals (Figure 13a, 13b, 13c).

Figure 13a. There is an exit to the animal shelters and plant growing area from the south side of the building

Figure 13b. Garden area located in the south direction, allowing different activities

Figure 13c. Area and rainwater collection reservoir where various animals are kept, different types of plants are grown and organic waste is composted

Figure 13. Images from the Ekolojik Kültür Kindergarten outdoor area (Sungur, 2023)

Classrooms/Workshops, Common Areas

Workshops and classrooms can be set up to accommodate activities that promote children's development. Wood is used for fittings and furnishings. To take full advantage of natural light, the windows reach the floor. Even with laminate flooring, non-slip play mats and antibacterial floors can create limited space in classrooms and workshops. When it comes to energy efficiency, using suspended ceiling LED luminaire lighting is crucial. The basement floor's hand washing station, dining hall, sleeping room, and sports and gymnastics hall all have artificial lighting, but band windows help partially meet the building's natural light and ventilation requirements (Figure 14).

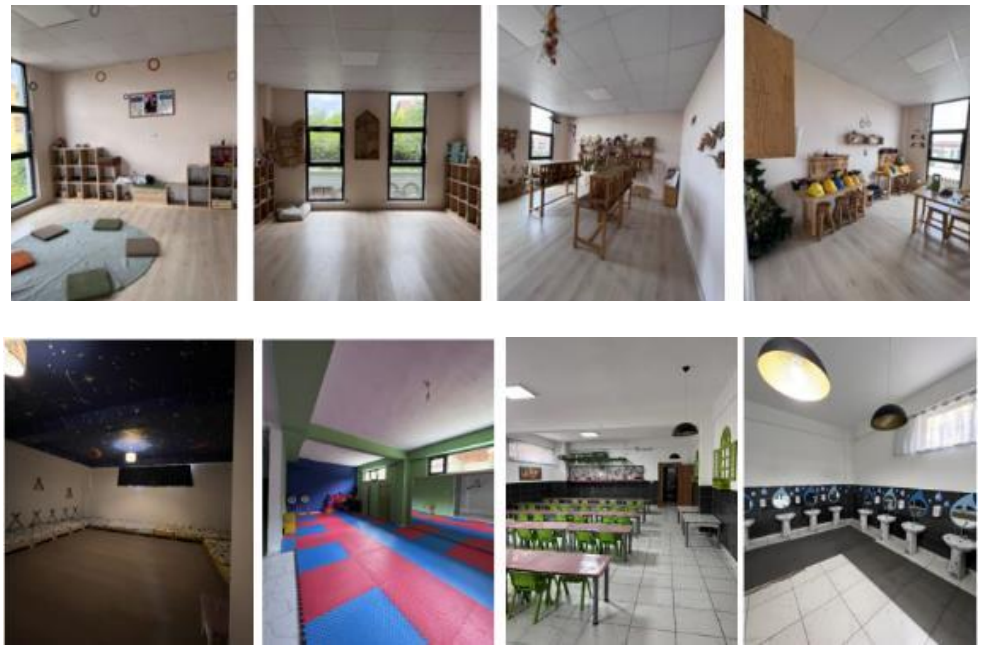

Figure 14. Images of the classrooms on the ground and first floors, as well as the sleeping room, gym and cafeteria area on the basement floor, respectively (Sungur, 2023)

All floors' wet areas are equipped with nothing to conserve water. The classroom-to-courtyard corridors are open to a courtyard illuminated by roof lanterns, providing ample natural light throughout. The translucent surfaces of the classrooms that face the courtyard play a major role in letting in natural light from the outside and the roof lantern. The courtyard, which is heavily used as a space for social interaction, is supported by greenery. In addition to connecting the corridors, the first-floor wooden bridge gives the building a distinct viewpoint (Figure 15).

Figure 15. Images of the meeting area with roof lanterns and the wet area in the middle axis of the building (Sungur, 2023)

The Private Ekolojik Kültür Kindergarten's mission of "a living school for generations that produce, not consume" led to the adoption of the ecological approach during the building's design process. Budgetary constraints prevented the installation of solar panels on the roof, despite their inclusion during the project phase. Children felt like they were a part of nature when the classes were named after natural phenomena, such as the sun, ocean, spica, water, soil, and bud. Additionally, it works well

to raise awareness that not all trash is waste by placing recycling bins at strategic locations throughout the hallways. Herbarium applications are noteworthy for being placed on hallway wall surfaces so that students can identify the plants. These applications give students the chance to see and examine plants at any time of year (Figure 16).

Figure 16. Sun, Ocean, Spica, Water, Soil, Bud Class labels and images of ecological approach (Sungur, 2023)

3. Findings and Discussion

As part of a field study, the sustainable preschool education structures of two kindergartens—one run by the state and the other by a private organization—were compared. Several conclusions were drawn from the measurements, photos, and observations that were made, along with teachers and manager interviews. These findings are tabulated according to ecological, social and economic sustainability criteria (Table 3-4)

Table 3. Evaluation of Selçuklu Municipality Sabır Kindergarten with Sustainable Components (Created by the Author)

EVALUATION OF SELÇUKLU MUNICIPALITY SABIR KINDERGARTEN WITH SUSTAINABLE COMPONENTS		
ECOLOGICAL SUSTAINABILITY	**Selecting the Residential Area**	**Transportation**
	• The building is situated in a central area • The building's integrated use with the existing park area on the adjacent parcel expands the green area's size • The building is situated in a low-noise area.	• The building has made arrangements for alternate modes of transportation • Parking spaces are positioned near the road, away from kid-friendly play areas.
	Energy and Atmosphere	**Natural Ventilation and Natural lighting**
	Regarding the building's energy production from renewable energy sources, no data was discovered.	• Artificial lighting is intended to support natural lighting. • Applying light colored paint to the areas. • By incorporating open and closeable joineries into every building design, controlled natural ventilation is made possible.
	Water Conservation	
	• Local plants that don't need a lot of irrigation were carefully chosen. • Efficient irrigation techniques were employed to collect and utilize rainwater for landscape irrigation. As a result, less clean water is being used for irrigation.	
SOCIAL SUSTAINABILITY	• Encouraging societies to actively participate in the process of designing their own living spaces •User mobility adds life to the immediate surroundings. •Educating people about the future generations' access to natural resources. • Recognizing the wants and needs of society. • The structure aids in the city's promotion. • Preserving diversity in social and cultural contexts. • Preserving the linkages among social organizations. • Congruent design with surrounding context.	
ECONOMIC SUSTAINABILITY	**Space Organization**	
	•Creating thermal zones within the building by grouping areas that are used for similar activities. • Standardization can be attained by evaluating the project using the grid system. • Designating a space in the school garden where kids can nurture plants and interact with, feed, and learn about animals. •The building's ability to take advantage of natural light coming from all directions.	

	Building Shell and Orientation	
	• The windows and external surfaces of the building have been equipped with thermal insulation. The double layer design of the glasses stops heat loss.	
	Material Selection	**Building Form**
	•The building was built with reinforced concrete carcass system. •Furniture is produced with wooden material.	The building was designed in a rectangular form with a simple and plain geometry.

Table 4. Evaluation of Selçuklu Municipality Sabır Kindergarten with Sustainable Components (Created by the Author)

EVALUATION OF ECOLOGICAL CULTURE KINDERGARTEN WITH SUSTAINABLE DESIGN CRITERIA		
ECOLOGICAL SUSTAINABILITY	**Selecting the Residential Area**	**Transportation**
	•The existing land was preserved and the design was made to suit flat land conditions. •Due to the low-rise residential structure around the building, it is located in an area where the noise level is low. •Sufficient lighting is provided around the school.	Transportation axes are established, and vehicles, pedestrians, and bicycles can all enter the building. • The parking lot is situated away from playgrounds for kids and next to the road. In this manner, children are shielded from the negative effects of traffic pollution while safety is guaranteed.
	Energy and Atmosphere	**Natural Ventilation and Natural lighting**
	•There is no data on energy production from renewable energy sources in the building.	•The design incorporates sky windows to facilitate natural lighting. • Using floor to ceiling glass in the classroom design to maximize natural light. • Applying light colored paint to the areas.
	Water Conservation	
	• Rainwater collected on the roof provides the necessary water for landscape irrigation.	
SOCIAL SUSTAINABILITY	• Encouraging societies to actively participate in the process of designing their own living spaces •User mobility adds life to the immediate surroundings. •Educating people about the future generations' access to natural resources. • Recognizing the wants and needs of society. • The structure aids in the city's promotion. • Preserving diversity in social and cultural contexts. • Preserving the linkages among social organizations. • Congruent design with surrounding context. • A sign encircling the structure	
ECONOMIC SUSTAINABILITY	**Space Organization**	
	•The large hallway that runs the length of the building serves as a social hub in addition to connecting the classrooms. •The interior dividers are completely composed of glass blocks, which allow teachers to visually connect spaces and keep an eye on the students. •The building's facades are constructed with floor-to-ceiling glass, which lets natural light into the interior spaces even on cloudy days. • Creating visual connections between floors and using galleries to let natural light into the interior. • Designating a space in the school garden where kids can nurture plants and interact with, feed, and learn about animals. •The building's ability to take advantage of natural light coming from all directions.	
	Building Shell and Orientation	
	•The windows and external surfaces of the building have been equipped with thermal insulation. The double layer design of the glasses stops heat loss.	
	Material Selection	**Building Form**
	• The structure was constructed using a reinforced concrete carcass system • Wooden materials are used in the production of furniture.	• The building's geometry is straightforward and simple, with a rectangular shape.

Researchers who studied sustainable preschool education structures in literature sources gathered and tabulated the sustainable preschool education structure criteria they had established. By designating the criteria in the table as present, partially present, or absent in the schools under investigation, they could be compared (Table 5).

Table 5. Sustainable Preschool Education Structure Criteria (Dorsey & L'Es-perance, 2000; Ramli et al., 2012; Göktekin, 2015; Kocabaş & Bademcioğlu, 2017 studies were used).

Sustainable Preschool Education Structure Criteria	**Schools in Field Study**	
	Selçuklu Municipality Sabır Kindergarten	The Private Ekolojik Kültür Kindergarten
Appropriate Location Selection	●	●
Alternative Transportation Option	◐	◐
Ease of Maintenance and Use	○	◐
Passive Energy System (Trombe wall, solar chimneys, etc.)	○	○
Active Energy System	○	○
(Solar collectors, photovoltaic systems, etc.)	●	●
Rainwater Collection System	○	○
Indoor Air Quality		
Daylight	◐	●
Natural Ventilation	◐	●
Acoustic Comfort	◐	●
View	●	●
Disabled/Barrier-Free Access	●	●
Security (Single Story status)	○	○
Outdoor playground	●	●
Area to recognize and feed different types of animals	◐	●
Area to recognize and grow different types of plants	●	●
Policies for Recycling	●	●
Education Policies Regarding Sustainability	●	●
Environment Contribution to public awareness	◐	●

● (Available- 1 point) ◐ (Partly Available -0,5 point) ○ (Not Available - 0 point)

The land in both schools permits the desired orientation with the right location choices, and there is no barrier to light and natural illumination entering the building. It is the process of reducing the amount of energy used for transportation and the negative effects it has on the environment by making public transportation, walking, and other non-private vehicle modes of transportation more popular. The bulk of kindergarten students are transported by private vehicle, with only a small percentage using public transportation. Thus, some coverage is provided for alternate modes of transportation. Materials and products that do not require much maintenance and repair are not preferred in Sabır Kindergarten and are partially available in Private Ekolojik Kültür Kindergarten. Although Private Ekolojik Kültür Kindergarten's basement floor has band windows for natural light and ventilation, Sabır Kindergarten's basement uses only artificial lighting, which uses a significant amount of energy. There isn't a roof garden, but both kindergartens have systems in place to collect rainwater. The lack of windows on the basement floor of Sabır kindergarten has a negative impact on indoor air quality, even though schools are low-rise structures with a green neighbourhood feel. It was determined that both buildings' disabled ramps were appropriate for disabled access. Although Poyraz & Dere (2003) emphasize that preschool buildings should be single-story structures, the three-story schools in the sample are unsuitable for young students. For pre-school education, school gardens should be planned with an area of 3 m² per child, according to the Ministry of National Education Regulations (Poyraz & Dere, 2003). The outdoor garden space at Sabır Kindergarten is adequate, albeit

restricted to one child per household. The outdoor garden area at the Private Ekolojik Kültür Kindergarten is sizable, providing ample opportunity for learning about various animal and plant species and experiencing nature firsthand. Recycling policies have been adopted and put into effect by both schools. While Sabır Kindergarten partially implements sustainable education policies, the other's primary goal is to achieve this. The public's awareness is also enhanced by regularly getting together with the families of students for various activities that take place outside of the building's designated learning times. As a result, the school is crucial to the area's symbolic development. The Ekolojik Kültür Kindergarten has been reported to regularly conduct ecological activities involving family participation, while reports have indicated that the Sabır Kindergarten's large student body limits such interactions. As a result, in the comparison between the two schools, available features were quantified as 1 point, partially available features were evaluated as 0.5 points, and non-available features were evaluated as 0 points. Compared to the Selçuklu Municipality Sabır Kindergarten (11 points), the Private Ekolojik Kültür Kindergarten's ecological criteria (14 points) exhibit more ecological characteristics.

As a result of the study findings, determining the general characteristics of a sustainable school is important for developing and building a sustainable school design, which coincides with the study of Ramli et al., (2012). The idea that adapting sustainability criteria and applying them in kindergartens will reduce energy consumption as well as provide a comfortable environment for users is similar to the research of Al-Mashaqbeh (2022). Although the idea of building sustainable new buildings is not very common in our country, it is similar to the result obtained by Sivri Gökmen (2012) that it is important to raise awareness about the improvement of existing buildings and to include the concept of sustainability and its requirements among the design criteria in new school buildings.

4. Conclusion and Suggestions

Educational structures are a crucial component of a healthy and prosperous society. Research supports that ecological design can have a significant impact on education, and there is mounting evidence that the quality of a student's learning experience is closely connected to the environment in which they learn. The primary objective of ecological schools is to provide high-quality environmental education to children, with the ultimate goal of finding sustainable solutions to environmental issues in the future. Additionally, these schools aim to increase awareness among students about the efficient use of energy resources such as water, electricity, and natural gas. Finally, another critical objective is to ensure that students receive education in a healthy environment. To create an environmentally conscious society, individuals must have a thorough understanding of the environment in which they live. Early childhood education is the key to achieving this goal, which is why it is essential to establish and implement sustainability standards for preschool education buildings. Pre-school education should be given the necessary attention, and educational buildings should be designed and improved to be more ecologically sustainable.

In Turkey, the residential and office sectors have been the only ones to adopt sustainable architecture; educational buildings have not kept up with these developments. In terms of educational structures specifically, our nation is still gathering and processing data at a conceptual level. According to research, there are remarkably few preschool education structures in our nation that hold sustainable evaluation certificates. Therefore, to have ecological kindergartens, it is emphasized in this study that designers, engineers, and politicians must figure out why proposals for ecological improvement or renewal are not made. This can be done by identifying the sustainable potential features of current kindergartens.

After conducting the research and interviews, it was found that the economic resources available play a significant role in the ecological differences between the structures that were examined. Public schools are given an inadequate budget, and sustainability is not given much importance, resulting in fewer sustainable practices. Private schools, on the other hand, have more financial resources at their disposal, allowing them to shape their physical structures and achieve sustainability. It's important to note that constructing a new building requires more energy than evaluating an existing one. Therefore, building new educational buildings with a sustainable architectural approach and identifying the potential for ecological improvement in existing buildings is crucial for increasing environmental

awareness in society. In our country, it's essential to increase the number of legislation and political regulations that consider renewable energy sources in different types of buildings, particularly educational buildings. This will allow for the choice of environmentally friendly materials and systems, promoting a cleaner environment and society.

As a result of these evaluations, the following suggestions can be made for improving existing preschool education structures ecologically:

- Considerable efforts should be made to increase the use of public transportation and foot traffic.
- The layout of the school garden should help kids comprehend the natural world and their own existence. They should also be able to learn about environmental characteristics, discover their physical and emotional well-being, and engage with society.
- Given the rapidly growing residential areas' artificial environmental conditions, these gardens—which serve as the majority of children's first natural intersection—should be planned to accommodate a variety of play tools for varying developmental stages.
- Creating a garden with a variety of plant species and placing shelters to provide food for different animals will improve the bond between children and nature.
- Adaptable Classroom settings should be designed to support kids' physical, mental, emotional, and social needs.
- It is crucial to take into account the usage of both active and passive energy systems.
- Water conservation should be guaranteed by applying a green roof
- Photovoltaic panels and solar collectors should be used to harness solar energy within the building.
- Water consumption can be minimized by making sure that the building and furniture materials are eco-friendly and simple to clean.
- Steps should be taken to improve the quality of the air indoors (natural ventilation, daylight, acoustic comfort, view).
- Garden areas should be irrigated with rainwater collected outside the building.
- It is best to use equipment with sensors that can cut down on water use in wet areas.
- To increase ecological and environmental awareness, family-friendly joint activities should be planned with the primary goal of educating students and their families.
- The preschool education building ought to be transformed into an environmental symbol within its surroundings.
- It is vital to establish and distribute fundamental standards for sustainable and architectural design in educational buildings.

In summary, the study highlights the need for political, economic, technological, and cultural infrastructures to be in place in educational buildings so that early childhood learners can experience a physically suitable learning environment and internalize the idea of sustainability. Once more, even though studies articulate the design principles for sustainable educational buildings, assessing the prospective sustainability status of current buildings and making recommendations in line with that assessment demonstrates the significance of the study in the scientific community. In this sense, assessing the current structure rather than constructing a new one is a tiny step for the global community but a significant step for ecological life.

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The article has a single author and there is no conflict of interest.

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Interior Architecture Project Approach with Design-oriented Thinking Model: Clinic Designs

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Abstract

Interior architecture can be described as the activity of a designated space to produce solutions that are appropriate to its purpose and to solve existing problems in accordance with the decisions made. However, sometimes using conventional learning techniques to comprehend and solve real-world problems is insufficient. Therefore, through the integration of many disciplines, educational models are being developed to produce new solutions that will influence the knowledge and thinking acquired. Design-oriented thinking is also becoming more and more important in the design education process, as creativity, problem-solving and innovation are indispensable. As part of a 14-week studio study for the Interior Architecture Project-V course, the study was conducted with fourth-grade students from Selçuk University's Faculty of Architecture and Design in the fall semester of 2022–2023. The study is based on a design-oriented thinking method. The objective of the four-stage study is to enable the student to produce original and innovative projects specific to the identified problems by staying attached to a method. This will enable the student to identify the learning outcomes in the process of creative thinking and transforming thinking into an idea when designing the current clinical premises.

Keywords: *Clinic design, design-oriented thinking model, design, interior architecture, problem-oriented solution.*

Tasarım Odaklı Düşünme Modeli ile İç Mimari Proje Yaklaşımı: Klinik Tasarımları

Öz

İç mimarlık; tasarlanan mekânın verilen kararlar doğrultusunda amacına uygun çözümler üretmesi ve var olan problemi çözme faaliyeti olarak adlandırılabilir. Fakat geleneksel öğrenme metotları ile gerçek dünya sorunlarını anlamak ve çözmek zaman zaman yeterli olamamaktadır. Bu nedenle birçok disiplinin entegrasyonu ile edinilen bilgi ve düşünme biçimini etkileyecek yeni çözümler üretebilmek üzere oluşturulan eğitim modelleri geliştirilmektedir. Tasarım odaklı düşünme modeli de yaratıcılığın, problem çözmenin ve yenilikçiliğin vazgeçilmezi olduğundan tasarım eğitim sürecinde giderek daha önemli hale gelmektedir. Çalışma; Selçuk Üniversitesi, Mimarlık ve Tasarım Fakültesi İç Mimarlık Bölümü 2022-2023 güz yarıyılı 4.sınıf öğrencileri ile İç Mimari Proje-V dersi kapsamında 14 haftalık stüdyo çalışması kapsamında gerçekleştirilmiştir. Çalışma tasarım odaklı düşünme metodu üzerine kurgulanmıştır. Dört aşamadan oluşan çalışmanın amacı; öğrencinin bir metoda bağlı kalarak belirlenen problemler özelinde özgün ve yenilikçi projeler üretmesini sağlamaktır. Bu sayede güncel klinik mekânlarını tasarlarken yaratıcı düşünme ve düşündüğünü fikre dönüştürme sürecinde öğrenciye kazandırılan öğrenim çıktıları belirlenebilecektir.

Anahtar kelimeler: *Klinik tasarımı, tasarım odaklı düşünme modeli, tasarım, iç mimari, problem odaklı çözüm.*

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1. Introduction

We witness innovation in all facets of our lives, including those resulting from technological advancements, which has necessitated certain transformations. As a result of shifting demands and dynamics, design-oriented education programs have started to take a fresh look at established design education techniques in an effort to produce innovative and creative learning outcomes while also keeping up with the time and market competition. Transferred by (Akdemir, 2017)*;* "Design is multi-variable, multi-data, multi-faceted, multi-subjective, and therefore multi-disciplinary and multi-environmental". According to Teymur's 1998 statement, several design-oriented models have been introduced as a result of the design's adaptability. All design disciplines can now collaborate to create new programs and conduct new searches in the pursuit of knowledge and solutions to problems (Öztürk, 2016). Throughout the interior architecture education process, a variety of techniques are employed to demonstrate a student's capacity for design. The implementation of studio experiences that will support students' versatile development and their impact on their design proficiency is assessed as a result of the integration of various disciplines in design education. Design education is a set of procedures that takes into account current theoretical and applied courses in an integrated way. These procedures include the unity of perception, concept, creative thinking, research, discussion, and practice. By integrating the formal, spatial and structural knowledge learned in other courses, design education seeks to reveal creativity and produce design solutions (Çınar & Sungur, 2022). Students create designs in a methodical and sophisticated manner. Within this framework, it is rather important to support students' observations and creativity while also attempting to give them problem-solving skills. The foundation of design and creativity is intimately tied to a student's capacity for independent thought and mental work. By disclosing this viewpoint, this is made possible (Acici, 2017). Contends that design education ought to deviate from conventional learning paradigms and equip students with background knowledge and critical thinking skills. Design is seen as a holistic idea for cognitive learning, and design styles that communicate the designers' thought processes rather than the things they make, bolstering constructive changes, are what designers believe (Razali et al., 2022).

Students in the interior architecture department are shown the design process through a series of patterns in this study, which is based on the design-oriented thinking method to create a new learning strategy. Design-oriented thinking is used as a tool to develop people who ask questions and come up with solutions because it is basically the process of putting ideas into practice. The study's objective is to apply design-oriented thinking to the processes of empathy, definition, idea generation, prototype development, and testing. Thus, it is expected that students will be able to produce original and creative projects by reflecting on the design acquisition obtained during the theoretical and practical education process and space organizations on design. They will also be expected to think creatively, concentrate, create human-centred designs, and produce correct and innovative solutions to problems. The fact that the space has been experienced will allow the perception of the space and the observation of all the details. In this way, a sense of belonging will develop (Argan & Atabeyoğlu, 2023).

Private clinics housed within medical facilities were particularly used for this study. The impact of applying the design-oriented thinking method's processes within the Interior Architecture Project-V course to the design skills of fourth-year interior architecture students and the course learning outcomes will be assessed after the four-stage studio study.

1.1. Design-Oriented Thinking in Interior Architecture

One could argue that design is an activity of human consciousness, guided by the demands of both the material and spiritual realms. Creativity is, on the other hand, the intellectual process of viewing problems from a fresh angle. By identifying opportunities in the rapidly evolving market and technology, creativity allows for the generation of novel concepts and methods (Akdemir, 2017). Creative thinking is the foundation of design. Thinking creatively means taking every aspect of a process or event into account. Cen & Ma (2013) state that the ability to think creatively, take initiative, and disclose the nature of objective reality are all components of innovative thinking. Innovative thinking, according to (Wong, 1972), is a way of thinking that influences designers' analysis, intuition, rationality, and sensitivity rather than an outcome. This is the origin of design and inspires individuals

to investigate and reorganize their issues. Broadly speaking, it can also mean visualizing a phenomenon as a whole in the mind, organizing it schematically, illustrating it as a pattern or model, and beginning to formulate an action plan (Ünügür, 1989). Beyond just forming an object, design is an abstract idea. In essence, design is an idea, a solution to a problem, a thought, a behavior, or an essence. Meanwhile, the designer employs experts from related fields and the inductive method—a method of reasoning that moves from the particular to the overall or from the parts to the whole—to solve problems. An individual who can create solutions for issues in both his or her field and other fields is called a designer (Demiraslan & Demiraslan, 2020).

The term "design-oriented thinking method" refers to a process that generates various solutions for issues involving human-centered thought processes. (Arifin & Mahmud, 2021) state that creativity, innovation and problem-solving all depend on design and design-oriented thinking. Design thinking is a human-centered innovation process that prioritizes observation, teamwork, idea generation and visualization, according to (Lockwood, 2010). (Gruber et al., 2015) express that the design thinking process is an application of an integrative approach that emphasizes the need for a deeper examination of a problem to develop a contextual understanding. (Pruneau et al., 2019) define design thinking as an all-encompassing approach to problem-solving that centers on comprehending the objectives, realities, and limitations of those impacted by a particular issue. Design-oriented thinking's primary goal is to offer a viewpoint for approaching issues and generate various solution recommendations. (Wong, 1972). "*The profession of interior architecture creates solutions to give users the best possible design within an architectural space based on structural, functional and aesthetic criteria.*". Human-oriented design principles have emerged as a result of the requirement for multi-dimensional consideration of interior architecture, which essentially focuses on people and human needs (Yurtgün & Çınar, 2023). Individual learning habits, space perception and interpretation skills, and the ability to express various expression techniques through solution-based design are all goals of the interior architecture design process (Akçaova & Doğan, 2019). As the definitions make clear, both ideas—which essentially center on human needs—are predicated on treating the issue from a designer's point of view and emphasizing the problem over the solution in contrast to traditional research methods. The design-oriented thinking method was first introduced by (Brown, 2008). Brown applied design thinking as a methodical approach to problem-solving, putting people and human needs at its core. According to this definition, design thinking is related to both the process (method) and the personal trait (sensitivity) of design. The five fundamental steps of the design-oriented thinking process are empathy, definition, idea generation, prototype development, and testing (Figure 1).

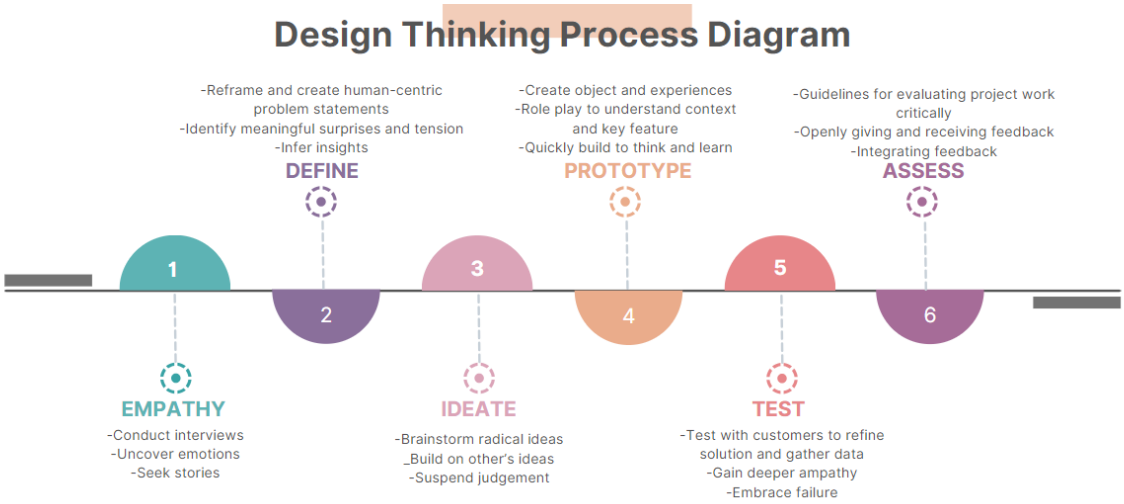


Figure 1. Design-oriented thinking method diagram

The cornerstone of a human-based design process is "*empathizing*" the first step in the design thinking process. The work done as part of the design process to understand people, their physical and

emotional needs, their perspectives on the world, and the things that hold significance for them is known as empathy. The designer concentrates on the problem to solve during the design process; these are problems that pertain to a particular set of people. The only way to design for this group is to develop empathy for their values and identity. You can infer a lot about this group of users' thoughts and emotions by watching what they do and how they interact with their surroundings, as well as what they need. "*Defining*" in the context of the design thinking methodology refers to giving the design field focus and clarity. Making sense of data gathered in light of the user and context is what a designer does. Making a significant and workable problem statement is the aim. The "*Idea Generation"* stage is employed to come up with creative solutions by visualizing the advancement of the process in terms of opinions and outcomes. Coming up with ideas entails coming up with suggestions for fixing issues and designing user-friendly areas. "*Prototype development"* is a process that offers answers to issues that will move the designer closer to the ultimate solution in the design-oriented thinking method. This iterative stage facilitates error prevention by anticipating issues that may arise during the design phase. The "*testing*" phase involves reassessing, refining, and reshaping the project in response to user feedback regarding the user prototypes produced using the design-oriented thinking methodology. Designers can employ design thinking as a strategy to find innovative and long-lasting solutions to environmental issues because they frequently employ both creative and analytical types of reasoning (Liedtka, 2015). Design thinking has a positive impact on learning, motivation, participation and creativity. It can offer rich learning opportunities in a collaborative, efficient and accessible setting. Identifying the instructional strategies that apply design thinking and coming up with multidisciplinary solutions can spark students' interest and promote active learning.

2. Material and Method

The study was conducted as part of Interior Architecture Project-V, a 14-week studio course offered by Selçuk University's Faculty of Architecture and Design, Department of Interior Architecture, for the fall semester of 2022–2023. The design-oriented thinking methodology forms the basis of the study. The design-oriented thinking approach seeks to identify user needs, generate new approaches to traditional viewpoints, identify issues and generate creative solutions for the end product. Design thinking, according to Brown (2008), is a methodology that fills a human-centered design ethos throughout the whole range of innovation activities. To put it simply, it's a discipline that matches people's needs with what is technically feasible and that a viable strategy can turn into a user opportunity. It does this by utilizing the sensibility and methods of the designer.

There are four stages to the studio work, which was created using the design-oriented thinking methodology. According to the study's methodology, a working diagram defined each step of the studio work, and the process was controlled based on the diagram's inputs (Figure 2).

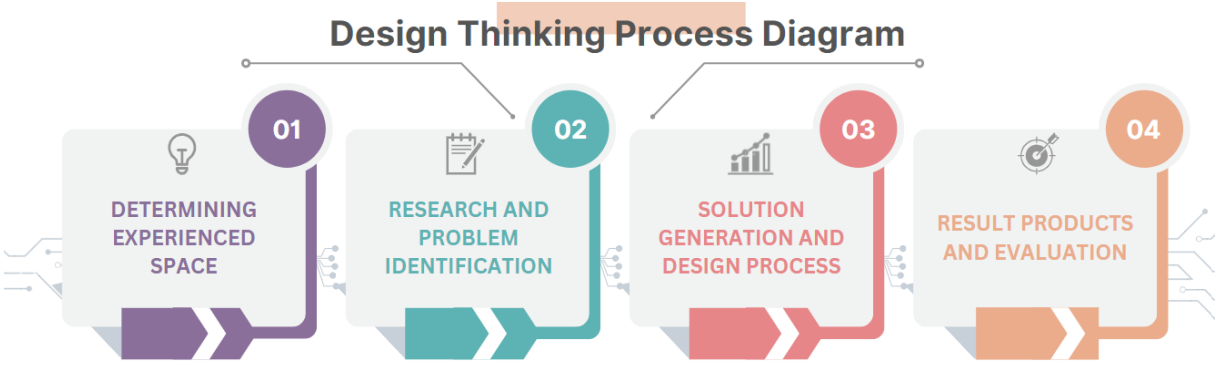


Figure 2. Interior architecture project-v process diagram

The students were asked to select a clinical setting they had visited in the first round. Establishing empathy, understanding the user, and ascertaining their requirements and expectations are the goals of the experience process. In the second phase, they had to identify the issues with the clinic spaces' design by studying and observing them. Then, they developed a needs assessment regarding the shortcomings and issues that they had found. In the third stage, the study's outlines were completed.

By coming up with solution suggestions for empathy, definition, idea generation, prototype development, and testing on the fundamental elements of the design-oriented thinking method appropriate for the user of the space created in accordance with the needs program, they were asked to produce creative and unique designs. The students' designs were examined for suitability to the design-oriented thinking method during the 14-week research and critique phase. Appropriate assessments and critiques were provided. Students' projects and learning objectives in the design education program were assessed in a jury setting by interior architecture faculty members using design-oriented thinking and experiential learning approaches. In this manner, while designing the current clinic spaces, learning outcomes were established by jury evaluation in the process of creative thinking and turning thoughts into ideas.

3. Findings and Discussion

The students were given the same plan scheme as a working area in the studio process, which was created using the design-oriented thinking method, so they could come up with unique designs while having equal constraints. The *1095 m²* project area, which was worked on in groups, includes the *377 m²* basement, *377 m²* ground floor, and *341 m²* first floor. During the studio study's "*Experienced Space Determining*" phase, the students were required to name various clinical spaces with distinct functions that they had personally used. Consequently, the project subject was determined to be clinical spaces serving seven distinct functions: an eye clinic, a center for adult and pediatric psychotherapy, a nutrition and dietician, an oral and dental health center, an aesthetics clinic, and a center for complementary medicine.

3.1. Project Implementation Process

Students were required to conduct scientific research and gather data on space organizations appropriate for the functions of clinic spaces in accordance with the Turkish Health Buildings Minimum Design Standards (T.C. Sağlık Bakanlığı, 2010) during the two-step *"Research and problem definition"* phase. The spaces' need programs have been identified and classified based on the minimal design standards and function organizations. The students were required to visit clinical locations within the borders of Konya province that were appropriate for the determined function during the "*Problem Identification*" phase. They were also required to conduct examinations and analyses, take pictures of the problems they saw and write a report (Figure 3).

Figure 3. Research and observation images of private clinical locations (Author's archive).

The design-oriented thinking method's stages of empathy, definition, idea generation, prototype development, and testing were applied within the "*Solution Generation and Design Process*" (Brown, 2008).

- ✓ Building empathy: It was stressed that for each function, groups must have previously experienced the space they will design or a relative must have witnessed the treatment process. For instance, it helps to see the space from the user's point of view, identify needs and desires, and empathize during the design process that the project group creating an oral and dental health center has previously received care in a clinic serving this purpose. Additionally, to view the clinic from the viewpoint of a different user during their research trips, the students were asked to have brief conversations with the physicians, staff and patients who used the spaces. In addition, they were requested to report any inadequacies in the way the space was organized, as well as any inconsistencies related to color,

light, form, texture and size of the design elements that influence how space is perceived, in accordance with the requirements program. By developing empathy, one can see the environment from the viewpoint of the user and understand their beliefs, experiences and actions. Having these visions will make abstract concepts concrete and enable the design formation process to produce a user-friendly final product. Creative solutions that meet human needs will be created in this way.

- ✓ The characteristics, preferences and insights of the various user groups were taken into consideration during the definition phase. Through in-class report presentations, the clinical spaces that were to be designed with various functions were assessed from the user's point of view. There were talks and oral presentations about the suggested solutions that the groups were to come up with. Students were now instructed to respond to the solutions to the identified problems with a "Why" question. The "why" question is essential to integrating a well-defined solution into a coherent system.
- ✓ During the idea generation phase, students' evolving concepts and viewpoints about the user and the issues become apparent. The degree of subject focus is directly correlated with an appropriate perspective. Only by accurately focusing on the problem will creative and accurate solutions be achievable. At this point, students were encouraged to come up with ideas because they had received feedback and assessments from the professors in the classroom. Weekly suggestions were reviewed, students' missing or incorrect aspects were assessed, and new constructs regarding problem's evaluation direction were suggested to be developed. Several proposals for solutions have been made in an effort to find the best one.
- ✓ The prototype development phase is known to be the process of turning proposed concepts into a design with some modifications or additions. At this point, the students used two-dimensional, sketch, and three-dimensional design software to create models for the clinical areas that matched the proposed concept scenario. Through prototype development, students were able to define the variables they identified, concentrate on several ideas while leading their projects and make decisions by fusing their design and creative aspects at the problem's applicability stage. To produce the most accurate design possible, they generated several ideas throughout the design process that attempted to address the issues of what the user wanted and how he or she behaved. When it came time to make a decision, the students who worked together to create multiple design proposals came up with the most accurate solution. The table in table 1. presents the project process, which followed the design-oriented thinking method, along with the subject, problem, concept, final products and learning outcomes.
- ✓ The final studio study step, testing, was completed by presenting the completed projects to the course instructors in a jury-style setting, in line with the design-oriented thinking methodology. The project groups' work is displayed online along with presentation videos that walk viewers through each step of the procedure. The jury members assessed the projects based on whether the clinical spaces with various functions were planned using the established methodology, rather than on personal preference. The questions used in the evaluation were relevant to the methodology.

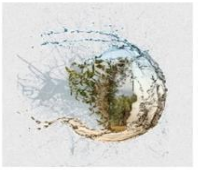
  -Did the student manage to identify the appropriate user profile in the empathy stage?

  -Did the student use the information that was provided to define the problem accurately?

  -Did the student provide suggestions for solutions that are appropriate for the issues and observations?

  -Did the student properly convey the requirements, issues, and suggested solutions into design?

Table 1. Project process; topic, problem, concept, result products and learning outcomes

SUBJECT	QUESTİON	CONCEPT	RESULT PRODUCTS	LEARNING OUTCOMES
Eye Clinic	-The requirement to provide solution recommendations in the context of form, color, texture, light color temperature, and other design elements that influence how space is perceived, - Evaluating the space in terms of design for everyone.			-Describing -Observation -Research -Discovery -Establishing Empathy -Expression And Communication -Criticism -Color-space Relationship -Texture-space Relationship -Form-space Relationship -Abstract Thinking -Creating Solutions
Child Psychotherapy Center	-The requirement to identify the child as a type of user, -The requirement to address the space design at a level that will reduce the child's anxiety and fear, -Evaluating the space design for all users, - Requirement of producing space solutions that suit the needs of children in the context of color, light, texture and size, which are among the design components that affect the perception of space.			-Observation -Research -Discovery -Establishing Empathy -Awareness -Criticism -Visual Ability -Form-space Relationship -Color-space Relationship -Light Color Temperature-space Relationship -Concept Creation- -Solution-oriented Approach
Adult Psychotherapy Center	- Evaluating the space in terms of design for everyone, - Requirement of producing appropriate solutions for individuals with psychological disorders in the context of color, form and size, which are among the design components that affect the perception of space.			-Observation -Research -Discovery -Establishing Empathy -Awareness -Form-space Relationship -Color-space Relationship -Size-space Relationship -Concept Determination -Material Recognition -Design Development
Nutrition and Dietician	- Requirement of producing solutions applicable to the emotional states of patients with obesity or anorexia, which are psychological disorders, in the context of color, one of the design components that influence the perception of space. - Evaluating the space in terms of design for everyone.			-Observation -Research -Discovery -Establishing Empathy -Awareness -Experiential Learning -Design Thinking -Transforming The Idea Into Design -Color-space Relationship -Functional, Structural And Spatial Design -Multidimensional Evaluation
Oral and Dental Health Clinic	-Requirement of sufficient daylight and ventilation levels -Requirement of the space width be at least 12 m², -Requirement of sound insulation for the compressor, -Requirement of clean wastewater installation -Requirement of heating and cooling air conditioning systems, -Requirement of floor and wall covering materials be antibacterial materials.			-Observation -Research -Discovery -Establishing Empathy -Awareness -Concept Determination -Prototype Development -Functional, Structural And Spatial Design -Multidimensional Evaluation
Center for Complementary Medicine	-Requirement of producing suitable solutions for people with disabilities, -Requirement of ensuring privacy in application rooms, -Requirement of appropriate lighting and ventilation systems in examination rooms, -Requirement of disinfectant and storage areas for the treatment equipment.			-Observation -Research -Discovery -Establishing Empathy -Awareness -Idea Generation -Describing -Design For Everyone -Functional, Structural And Spatial Design -Use Of Appropriate Materials
Aesthetic Clinic	-Requirement of ensuring privacy in application rooms -Requirement of appropriate air conditioning, heating and cooling systems, -Requirement of appropriate ventilation of all areas used by patients and staff, -Requirement of providing adequate natural and artificial lighting, -Requirement of floor and wall covering materials be antibacterial materials.			-Observation -Research -Discovery -Establishing Empathy -Awareness -Functional, Structural And Spatial Design -Use Of Appropriate Materials -Multidimensional Evaluation -Design Thinking

When the final products of the studio work completed in accordance with the design-oriented thinking method are evaluated following the above-mentioned stages;

Eye Clinic; The snake figure—a symbol of medicine—was taken into consideration during the design concept phase. According to Greek belief, the snake was employed in healing rites dedicated to Asclepius and the snake's venom had curative qualities. The notion that the project was designed with the snake as a symbol of rebirth and renewal served as the foundation for the design concepts. The work is named Optusa after the mythical big-eyed creature from Greek mythology. Optusa is believed to have been used as a talisman and protective force in sarcophagi, and her eye is honored by being placed in the center of the vertical circulation space in the shape of an eye. The floor plans utilized "organic form" to refer to the snake form, and the project's colors and textures were chosen based on the concept and the healing properties of the color blue as documented in the literature (Figure 4).

Figure 4. Eye clinic; Project result products.

In the problem identification stage, the students' information and analyses from their technical visits to the eye clinic centers were used to develop project solution suggestions that aligned with the problems they observed. In light of the fact that color, texture, light color temperature, and form are some of the design elements that influence how space is perceived, appropriate solution recommendations for eye clinics were generated, and the area was assessed in terms of the inclusive design dimension. The learning outcomes for the Project V were identified as observation, research, discovery, empathy, expression and communication, criticism, color-space relationships, texture-space relationships, form-space relationships, light color temperature-space relationships, abstract thinking, and problem-solving in the project study conducted using the design-oriented thinking method, which all came from the jury's evaluation of the eye clinic project.

Child Psychotherapy Center; Art provides the means for the person, who has grown monotonous in the robotized world, to move from the real world into the realm of dreams. The person will be able to more readily communicate his sentiments through art if he is unable to do so verbally. It is evident that throughout history, art has been employed as a therapeutic technique. A person suffering from a psychological disorder may experience physical and psychological damage, but art can help them find a healthy balance between their dream and the real world. In this instance, the project concept was based on the term "vitriol." Vitriol is an alchemical expression that denotes enlightenment and the

idea that one should travel within oneself and ponder the cosmos in great detail. Enlightenment brings man back to his true nature and helps him discover who he is. In the project's concept, psychology and going back to oneself are combined. In this way, play—the most fundamental need for kids in the 5–6 age range—is integrated into the environment with art in an attempt to assist kids in discovering their essence. Thus, the child's cognitive development needs will be satisfied, including decision-making regarding games, teamwork, or leadership, and contemplating shapes and forms in the surroundings and the urge to reshape. In the phase of problem identification, the students developed solution suggestions for the project based on the data and analysis they had gathered from technical visits to child psychotherapy centers, taking into account the problems they had observed (Figure 5).

Figure 5. Child psychotherapy center; Project result products.

The need to identify the child as a user type, create a treatment center with color, form, and size appropriate to the child's needs, create space design solutions that will reduce the child's fear and anxiety, evaluate the space in terms of design for everyone, consider color and light as design elements that affect the perception of space, and create space solutions suitable for children's needs in the context of texture and size have all resulted in appropriate solution suggestions. The learning outcomes for the Project V were identified as observation, research, discovery, establishing empathy, awareness, criticism, visual ability, form-space relationship, color-space relationship, light color temperature-space relationship, concept creation-solution-oriented approach in the project study conducted using the design-oriented thinking method, which all came from the jury's evaluation of the child psychotherapy center project.

Adult Psychotherapy Center; The human body's systems have to cooperate. A breakdown in any of these systems also impairs the body's overall ability to function. Treatment must therefore be approached from multiple angles. This highlights the significance of what is commonly referred to as holistic physiotherapy. The design concept incorporates natural breezes and their balance, bringing the human body's equilibrium with that of the environment into harmony. In holistic physiotherapy, manual therapy is at the forefront. These treatments have a profound impact on human psychology. The project 'Sense' because the treatment provided by touch focuses primarily on feelings and sensations. The project's design language was determined by the organic forms that were produced by stylizing the pebbles used in the tactile therapy phase in Zen philosophy. Once more, the project

incorporated natural colors while incorporating the Zen philosophy's belief about the healing properties of color (Figure 6).

Figure 6. Adult psychotherapy center; Project result products.

In the problem identification phase, the students developed project solution suggestions based on the data and analysis they had collected from their technical visits to adult psychotherapy centers. The need to assess the space in terms of design for everyone, the requirement to provide suitable solutions for people with psychological disorders in the context of color, form, and size—three design elements that influence how people perceive space—as well as the adaptation of the design idea for everyone to the space have all been addressed accordingly. The learning outcomes for the Project V were identified as observation, research, discovery, establishing empathy, awareness, form-space relationship, color-space relationship, size-space relationship, concept determination, material recognition, design development in the project study conducted using the design-oriented thinking method, which all came from the jury's evaluation of the adult psychotherapy center project.

Nutrition and Dietician; The process of nutrition is what allows the human body to get the nutrients it needs to survive and stay healthy. Relevant nutrients give the body the energy it needs to grow, support tissue regeneration, and ensure that bodily processes operate as intended. Promoting healthy living, the rosemary plant served as the inspiration for the project concept. Due to the rosemary plant's antiseptic qualities throughout history, it is known to have numerous positive effects on human health, including immune system stimulation, mouth and throat irritation, digestive nutritional support, and wound healing support. Rosemary has additionally been linked to people with nutritional disorders like obesity or anorexia being able to handle the stress they will encounter when on a diet, based on its ability to balance stress in an individual's life (Figure 7).

Figure 7. Nutrition and dietician; Project result products.

'Overlap' was chosen as the project name in this context because it denotes transcending cognition, passing beyond the conscious mind, and confusion. The organic shapes and textured surfaces, along with the color and form of the plant, were reflected in the space's design language. In the phase of problem identification, the students developed project solution suggestions based on the data and analysis they had gathered from technical visits to nutrition and dietitian centers, taking into account the problems they had observed. Because color is one of the design elements that influence how space is perceived, appropriate solution suggestions have been generated regarding the need to assess the space in terms of design for everyone as well as to provide solutions appropriate for the emotional states of patients with obesity or anorexia, which are essentially psychological disorders. The learning outcomes for the Project V were identified as observation, research, discovery, establishing empathy, awareness, experiential learning, design thinking, transforming the idea into design, color-space relationship, functional, structural snd spatial design, multidimensional evaluation in the project study conducted using the design-oriented thinking method, which all came from the jury's evaluation of the nutrition and dietician project.

Oral and Dental Health Clinic and in Orthodontic Clinics; Since wheat is the primary food source for humans and the foundation of nutrition, it was chosen for the project concept. DentIconium derives its name from Iconium, Konya's previous name. Iconiumikon means symbols. The shape and arrangement of teeth has been likened to that of wheat. Reconciling the necessity of teeth for human life and wheat for life was the way the project's scenario was handled. The sequential repetition principle used for the order was emphasized with the materials used, and the floor plans were created with reference to this linear arrangement in mind (Figure 8).

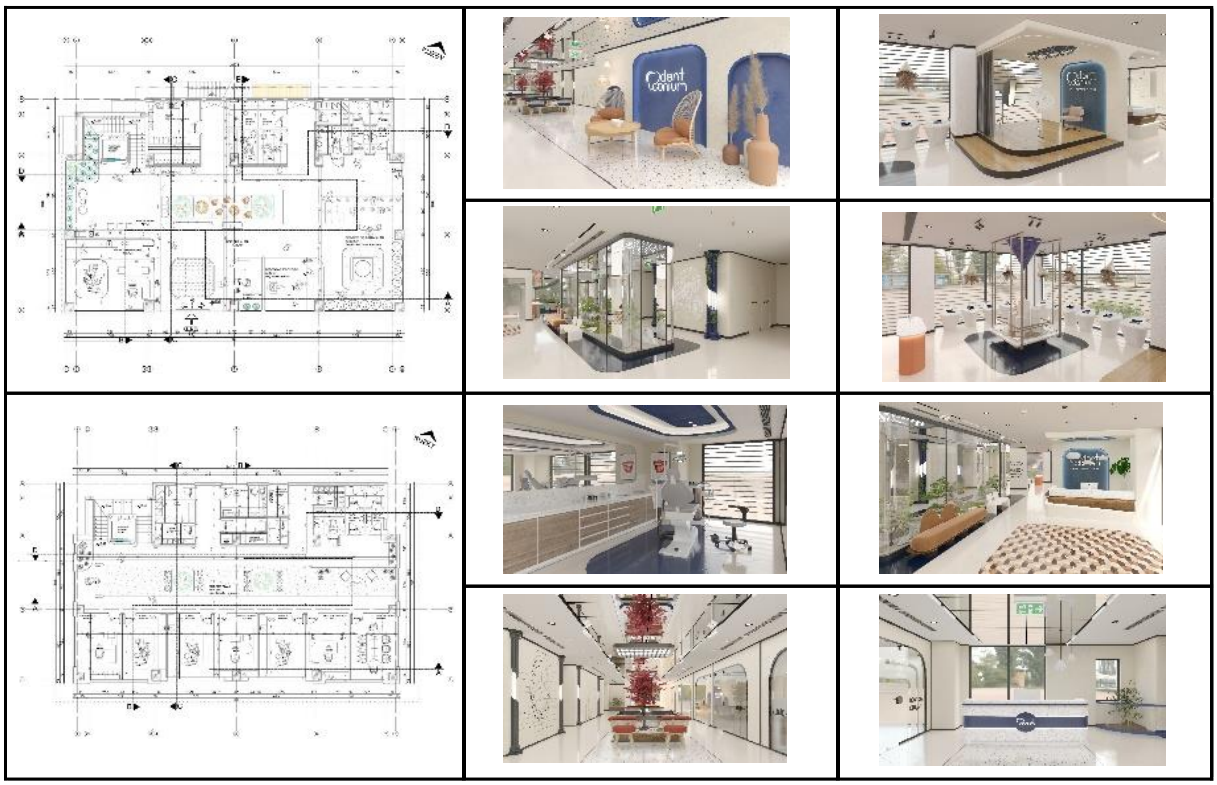


Figure 8. Oral and dental health clinic and in orthodontic clinics; Project result products.

In the phase of problem identification, the students developed solution suggestions for the project based on the data and analyses they had acquired from their technical visits to oral and dental health and orthodontic clinics, taking into account the problems they had observed. Oral and dental health centers must therefore have adequate natural light and ventilation, and their width must be at least 12 m². Appropriate solution recommendations have also been generated based on the requirements for antibacterial wall covering materials, compressor and sound insulation, the requirement for clean wastewater installation, and air conditioning systems with features like odor control, heating, and cooling. The learning outcomes for the Project V were identified as observation, research, discovery, establishing empathy, awareness, concept determination, prototype development, functional, structural and spatial design, multidimensional evaluation in the project study conducted using the design-oriented thinking method, which all came from the jury's evaluation of the oral and dental health clinic and in orthodontic clinics project.

Center for Complementary Medicine; A method used to prevent, diagnose, and treat physical and mental illnesses as well as to maintain overall health is called complementary and traditional medicine. It is a collection of customs founded on culturally specific theories, beliefs, and experiences. The olive tree was chosen as the focal point of the Center for Complementary Medicine initiative. The olive tree is prized for its endurance and longevity despite its slow and laborious growth. The tree was referred to as 'vivax oliva', which means seven living creatures, in the time of the ancient Romans. Known as the immortal tree in mythology and botany, it also refers to healthy life and longevity in the project setup. The space's design line was inspired by the circular shape of the olive tree and the olive pit. Throughout the room, there are amorphous lines and shades of green and brown that are modeled after the patterns and hues found in natüre (Figure 9).

Figure 9. Center for complementary medicine; Project result products.

During the problem identification phase, the students' information and analyses from their technical visits to clinics for complementary and alternative medicine were used to develop project solution suggestions that addressed the problems they had observed. As a result, appropriate solution suggestions for the disabled have been generated. These include the need for storage and disinfection areas for the treatment equipment used, as well as the assurance of privacy in treatment and therapy application rooms, the use of lighting elements in examination rooms based on appropriate Kelvin values, and the design of ventilation systems at a level appropriate for treatment spaces. The learning outcomes for the Project V were identified as observation, research, discovery, establishing empathy, awareness, idea generation, describing, design for everyone, functional, structural and spatial design, use of appropriate materials in the project study conducted using the design-oriented thinking method, which all came from the jury's evaluation of the center for complementary medicine project.

Aesthetic Clinic; The golden ratio was identified as the project concept. The ratio of the larger to the smaller is the basic definition of the golden ratio in mathematics, but it can be found in all facets of life. Since ancient times, the golden ratio has been used to express the finest and most beautiful things, particularly in architecture and art. It is the cornerstone of harmony and beauty in all of art. In this instance, the aesthetic clinic's design concept was identified as achieving beauty since the idea of beauty—perceived as perfection in the project setup—matched the golden ratio. The linear golden ratio was utilized to design floor plans with symmetry and harmony in mind. Proportion balance was also maintained in the selection of furnishings and materials, and color preferences were ascertained using the golden ratio (Figure 10).

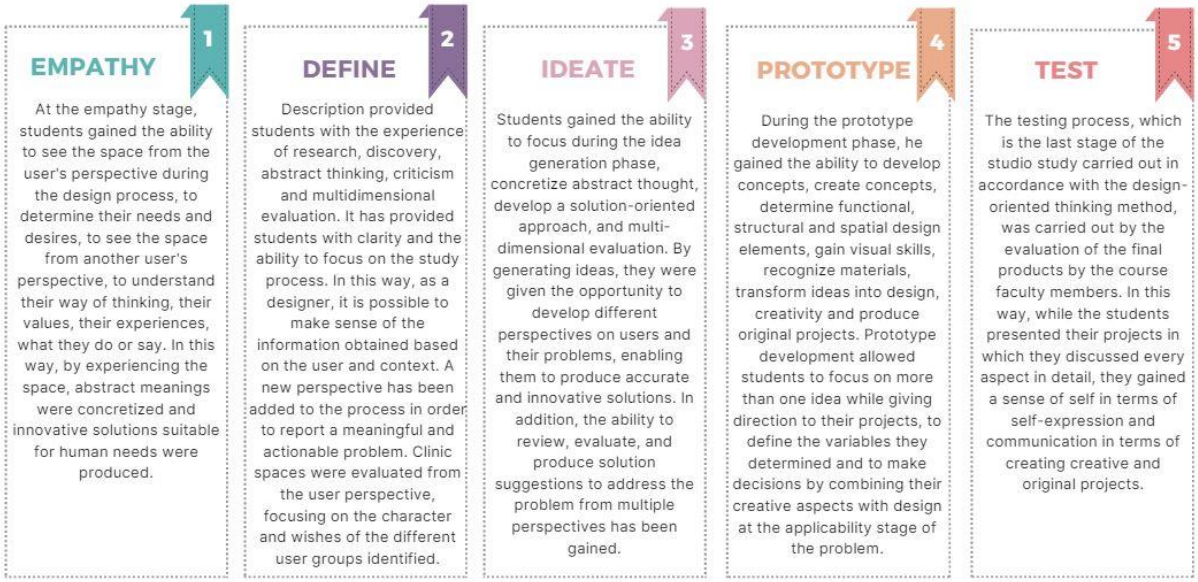
Figure 10. Aesthetic clinic; Project result products.

During the problem determination phase, in line with the information and analyses obtained by the students as a result of technical visits to aesthetic clinics, solution suggestions have been developed following the observed problems such as the need for antibacterial materials for floor and wall covering materials, the necessity of ensuring privacy in the application rooms of aesthetic clinics, the necessity of appropriate air conditioning, heating and cooling systems, the appropriate ventilation of all areas used by patients and staff, and the provision of adequate natural and artificial lighting. The learning outcomes for Project V were identified as observation, research, discovery, establishing empathy, awareness, functional, structural and spatial design, use of appropriate materials, multidimensional evaluation, design thinking in the project study conducted using the design-oriented thinking method, which all came from the jury's evaluation of the aesthetic clinic project.

4. Conclusion and Suggestions

Students learned the design creation process by experiencing the space through empathy, seeing the spaces to be designed in the interior design process from the user's perspective, as per the learning outcomes obtained through the jury evaluation of the final products of the studio work carried out in accordance with the design-oriented thinking method. Students' awareness of the need to create designs for everyone has increased as a result of this. Students gained experience in research, discovery, abstract thinking, criticism and multidimensional evaluation during the definition phase. During the idea generation phase, students developed the ability to focus, concretize abstract thought, develop a solution-oriented approach and evaluate multidimensionally. Students learned how to generate concepts, identify functional, structural and spatial design elements, acquire visual skills, identify materials, transform ideas into designs, be creative, and produce original projects during the prototype development phase. They developed self-confidence in their ability to communicate and express themselves when presenting their projects, which covered every detail during the testing phase, and in coming up with unique and creative projects (Table 2).

Table 2. Learning outcomes with design thinking method



Experimenting with novel and alternative instructional approaches in the field of design education can enhance students' awareness of design, foster their capacity for abstract thought, and give them hands-on experience in managing events from various perspectives.

The studio study provides a framework that attempts to teach students design through hands-on experience, which was created using the design-oriented thinking method. Students will learn the value of the human-centered design principle in interior architecture project studios when this model is positioned at the center of design education. The inadequacies of the design techniques that students must learn in conventional studio settings will be addressed in this way, leading to the production of qualified and unique projects.

The study holds significance in fostering the capacity to cultivate empathy, concentrate on issues, and propose alternative resolutions. Students will be able to create project scenarios that are well-informed and grounded in reality by living in the space, observing it, asking questions and learning from experience, which will elevate their design skills. The problems' content and the variety of suggested solutions will grow as a result of the jury's in-class evaluation of the prototype stage proposals, which should provide students with a foundation for multifaceted thinking.

Students create designs in a methodical and sophisticated manner. Under the right guidance from educators, they can acquire the necessary skills for this process. Students will be guided by the design-oriented thinking method, which comprises a flexible set of processes, in determining which idea to focus on and which steps to take. The present study appears to be a fitting instrument for the instruction and learning of the design-oriented thinking approach in interior architecture education.

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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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Visualization of Mythological Places Using Today's Technologies and Examining the Understanding of Culture-Place

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Abstract

"Certainly, there cannot and shouldn't be a universal understanding of the concept of myth. It is an inherently elusive concept, and its value lies in its continuous development as well as in its definition" (Esseb, 2008). Mythological stories bear a trace of themselves in different cultures. Therefore, mythology is suitable for comparative examination. Mythological scenes have been depicted through paintings, sculptures, or written texts till nowadays. Today, artificial intelligence technology includes new options and methods to make these scenes vivid and impressive. In this article, it has been ensured that some places/scenes selected from the mythological narratives that have survived to the present day are turned into visual outputs by using the data routing and processing of artificial intelligence from different platforms (Playground, BlueWillow).Visualization of mythological scenes using AI provides an example of art and technology working together and can increase the vitality of mythology, intercultural interaction, and curiosity.

Keywords: *Myth, mythological places, artificial intelligence, fictional space, imagery.*

Mitolojik Mekanların Günümüz Teknolojileri Kullanılarak Görselleştirilmesi ve Kültür-Mekân Anlayışının İncelenmesi

Öz

''Elbette mit kavramının evrensel bir anlayışı olamaz ve olmamalıdır. Doğası gereği anlaşılması zor bir kavramdır ve değeri tanımında olduğu kadar sürekli gelişiminde de yatmaktadır'' (Esseb, 2008). *İnsan üretimi olan mitolojik hikâyeler farklı kültürlerde kendinden bir iz taşır. Tam da bu sebeple mitoloji karşılaştırmalı olarak incelemeye uygundur. Geleneksel olarak, mitolojik sahneler resim, heykel veya yazılı metinler aracılığıyla tasvir edilmiştir. Ancak, günümüzde yapay zekâ teknolojisi, bu sahneleri daha canlı ve etkileyici hale getirmek için yeni seçenekler ve yöntemler içermektedir. Makalede günümüze kadar ulaşmış mitolojik anlatılardan seçilen bazı mekânların/sahnelerin, farklı platformlardaki (Playground, BlueWillow) yapay zekânın veri yönlendirmesi ve veri işlemesi kullanılarak, mekân tasvirlerinin görsel çıktı haline getirilmesi sağlanmıştır. Mitolojik sahnelerin yapay zekâ kullanılarak görselleştirilmesi, sanat ve teknolojinin birlikte çalışmasının bir örneğini sunar ve mitolojinin canlılığını, kültürlerarası etkileşimi ve merakı, sanat-teknoloji ilişkisinin birbirleriyle olan ilgisini ve artırabilir. Kurulacak görsel etkileşim mitolojik sahnelerin ve farklı kültürlerin günümüzde yaşatılması ve daha geniş kitlelere ulaştırılması mümkün kılabilecektir.*

Anahtar kelimeler: *Mit, mitolojik mekânlar, yapay zekâ, kurgusal mekân, tasvir.*

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1. Introduction

Before embarking on the study of mythology, it is necessary to understand the meaning of the word. "Mythos" is a term that refers to a tale, a story, or a legend. The term 'logos' pertains to rational order, and just as there is a logos in the body and soul of humans, there is also a logos of the universe and nature (Erhat, 2007). Mythology has been an important element that has influenced people's imagination and creativity throughout history. The "legends" with different themes, spread all over the world, have taken it upon themselves to explain the universe and humanity. Myths, which we encounter in almost all cultures, that is, the creation and nature of humanity and the universe, the stories of beliefs and practices specific to traditions; epics, and fairy tales have the ability to revive the instinct of imagining space with the help of intuition. On the other hand, the new generation's fictional places naturally include the transformation of these images and the pictures that we create in our minds into concrete ones in the virtual environment. In this article, the relationship between the places in various mythological stories and today's fictional and surreal places will be examined and explored.

With today's technological developments, the increase in people's perception awareness, and the fact that individuals have become more open to new ideas, the concept of Metaverse has started to develop rapidly by coming to light from the depths of humanity's fictional past and attracting great attention. When we look at the history of humanity, we can see that the past humanity was more prone to the creation of fictional space and its transfer to new generations than the present, and how favorable the conditions of the period were for this. The cognitive creativity of the generations that grew up with the fairy tales told to us from childhood and even birth in our history, the books read, and the cartoons that are watched more today prove that the foundations of "fiction" have been laid in today's terms. The concept of editing is transferred from the past to the present with the growth of scale. In the early days of history, there was a small device construction, but now large-scale universes are being built and ideas are being made about them. Since the creative instincts of individuals and the brain's imagination capacity have increased, we continue to produce and meet in new fiction. The world, which has been felt or believed since the beginning of humanity, is being brought to the visible world.

Cultural perception is formed by factors such as physical and social environment, beliefs, lifestyle, and methods. The layered accumulation of different cultures has led to the direction of today's design understandings. In the stories or myths told, it cannot be expected that a uniform place will come to life in everyone's dreams. The differences that will distinguish the dream landscapes from each other will be examined in the article.

1.1. Metaverse / Multi-Conceptual Universe Concept and Fictional Architecture

The metaverse, or multi-conceptual universe, can be defined as a virtual world accessible over the internet where people can interact in real time. It is a result of imagination, creativity, and productivity, and contributes to the transfer of human cognition to another physical environment. The metaverse signifies that the boundaries of technology are expanding and adaptation to this new world should be accelerated, as it has already started to replace some professional groups and presents situations where it allows cooperation with others. To create this universe, a certain degree of fictionality and transformation is required, which enables the design of architecture, wearable technology, social activities, and even a new fictional persona. All these possibilities make the metaverse accessible to everyone and promote interaction that creates a sense of belonging regardless of reality.

The concept of a multi-conceptual universe, also known as the Metaverse, has led people to create spaces to feel a sense of belonging by constructing places within this universe. Whose existence, in reality, seems impossible in today's conditions, these spaces are described differently from the real world and often exist only in the virtual universe. As a result, a contrast is created between reality and imagination. In today's high-tech world, virtual and fictional platforms are frequently used to develop spatial understandings. Fictional spaces are those that cannot be experienced in reality. They provide people with the opportunity to have experiences in a virtual environment that simulate real-world conditions (Özdoğlar, Kavut, Yalçın, Kalay, & Yılmaz Yatır, 2022)

1.2. Comparative Analysis of Mythological Stories of Different Cultures

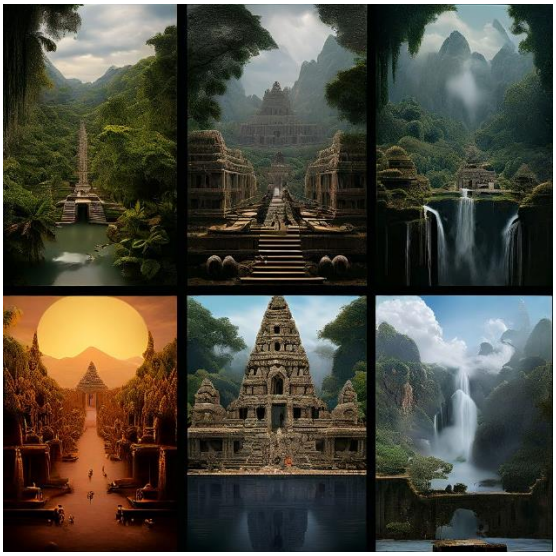


Figure 1. Visuals of mythological places of different cultures (Özer, Generetad From Playground AI, 2024)

Civilization and mythology are two concepts that complement each other. It is not possible to talk about mythology that has not been attached to a civilization or a civilization that has not created its characters and stories (Özdoğlar, 2023). There are different narratives and epochs created by each society. These myths, which sometimes emerge in relation to each other, develop in the footsteps of each other, and sometimes they are created regarding the independent imaginations, beliefs, social lives, and social structures of societies. *''… myth need neither be entirely true nor entirely false. Its power lies not in its correspondence with truth but with naturalized societal and individual beliefs''* (Esseb, 2008).

Similarities and differences can be found in the mythologies of societies. Differentiation is essential in creating a cosmology of myths used by communities to distinguish themselves from others (Shields, 1991). The place where we live and the environment that surrounds us are crucial elements for both the individual and the community. The ground we stand on is not only important for our physical existence, but it also serves as a reference point for our cultural heritage and the values that are attributed to it by the community. Every society has a distinct territory that it occupies and manages. This territory is adorned with symbols and signs that are associated with both material and non-material cultural features. Material cultural features include physical structures such as fields, houses, streets, and cities. Non-material cultural features include things such as place names, shrines, and boundaries. This helps to enhance the landscape of the territory and make it unique to the society that occupies it (Lando, 1996).

There are noticeable similarities between Greek and Roman mythologies. According to different discourses, Roman mythology was largely inspired by Greek mythology. Mythological characters or events may melt or change shape within the borders of different geographies, similar stories may be constructed, and similar creatures may appear. So much so that the monster and creature characters include the sea monster Kraken in Norse mythology, the snakes Abra and Yutpa living in the underground sea in Turkish mythology, and the cult character Dragon in Chinese mythology. These characters can bounce between different mythologies and undergo drastic or partial changes as a result. The equivalent of the witch in European mythology in Turkish mythology is Albis. This character, who wears black in Europe, is remembered for his red costume in Turkish civilization (Özdoğlar, 2023). The creation of the universe is one of the main issues that is covered and tried to be resolved in all world myths. When we consider this issue, it is mentioned in Chinese myths that the universe was formed by "ying-yang," that is, the emergence of order from chaos by two different gods; In Turkic mythology, it has been seen that the creation of the universe developed from water. Differences in personal and social values inevitably lead to diversity in mythological narratives.

1.3. Mythology and Place

Architecture and mythology have a close relationship that has developed together over time (Özdoğlar, 2023). Mythological stories often feature supernatural beings and forces, as well as extraordinary heroism. The settings in these stories can be miraculous, supernatural, sacred, or legendary, making them fascinate to read. Most of the events in these stories take place in realizable places, such as forests, islands, and dungeons. However, the events themselves are often fantastical, featuring phenomena such as rivers that flow upside down and grains of water covered in fire.

Place is a complex concept that involves the coexistence, juxtaposition, and intertwining of physical, informational, and esoteric elements. Mythology creates a unique "informational space existence" that is specific to human beings, their lives, and their beliefs. As such, the places where mythological events take place are important for future generations to understand the period and its traditional spatial layouts and fittings (Atalayer, 2006). Naturally, the discipline of architecture, which we accept as a reflection of culture in physical space, has also been influenced by myths to perpetuate social practices or beliefs (Kolektif, 2018).

The most well-known being on the monster-creature plane is the Dragon. When evaluated together with architecture, it can be seen that mythological elements are depicted in both exterior and interior designs in Far Eastern civilizations (Özdoğlar, 2023). Shields has studied the concept of collective 'place-myths', which shape not only how people perceive a place but also its physical makeup. These place myths, also known as space myths, are made up of a collection of place images that result from stereotyping or prejudice. They are oversimplified meanings that consist of a set of place images that become associated with a place or region, regardless of their alignment with reality (Esseb, 2008).

The practice of creating space with the inner belonging of humanity develops reflexively from birth; similarly, mythological stories, narratives, fairy tales, and surreal stories occupy a place in our perceptual boundaries from the womb and it is possible to find traces of them in our primitive instincts. When we think about it from this point of view, we can see a similarity between space and mythology in terms of human formation and development. Scenes, epic moments, gods, heroes, and fantastic creatures play the leading roles in the striking events described in mythology.

1.4. The Relationship of Mythological Narratives with Today's Fictional Places

In the formation of the cultural memory of societies, myths, epics, and fairy tales have been effective. With this type of oral narrative that has survived to the present day, the main foundations of different cultures have been laid. Different cultures around the world have reflected their lifestyles and social needs in different ways within the fictional universe. Every society has its mythology. Turkish, Egyptian, Greek, Indian, Chinese, and Iranian Mythologies are somewhat familiar to us. However, other nations, even backward communities, and tribes that we do not consider nations, still have mythologies that they believe in (Bazyar, 2016). Myths are a part of current life, although they have been experienced in the past. They are not a thing of the past (Duman, 2022).

Fictional places are the settings of stories that depict various time periods, including the present (Özdoğlar & Kavut, 2018). The contemporary fictional universe has made it possible for us to access surreal worlds of intangible cultures. The inclination towards fiction, which dates back to ancient times, has been influenced by the devotion to extraordinary powers or individuals, leading to the emergence of various forms of expression. In this context, the existing cultural infrastructure will inevitably affect fictional spaces. Therefore, the imagination of each culture is shaped by the knowledge it acquires, ultimately resulting in the final product.

When considered in the context of space, editing is carried out physically in the primary order. The relationship, hierarchy, sequence, and order of spaces are the elements that should be planned first in line with the needs when considering functionality and sustainability. Then it is time to construct spiritually and psychologically so that colors, textures, shapes, and forms communicate with the brain through the human senses at this point. Finally, the data received from the environment goes to a deeper point. The senses and the cognitive process create imagery. In this cognitive process, the interpretation and perception of space are provided by the images created. Although imagery seems

to be carried out under the cover of individuality and interiority, some of the most important factors in the formation of the self are traditions, environment (physical and social), society, opportunities, and important events. "Important events" are encoded in a small part of our collective memory, and that's how we come into the world. When we solve the equation, perception and understanding, which is a stage of our construction of ''place'', benefit from our imagination power. Our imagination takes place when we reveal ourselves, and one of the basic elements that make up our self is culture. In short, any act of editing is directly related to our cultural accumulation.

The concept of "mythology," which is the subject of this research, has survived to the present day to vary in every society and has been engraved in social identities. Myths, which have been the subject of different branches such as painting, literature, and theater from past to present, have found themselves in many areas of fiction. In the theater, the stage décor was designed in a mythical atmosphere; in literature, words were carefully chosen as imaginative associations; and in painting, the painter staged those extraordinary events in legendary places. From this point of view, mythology has been fictional for centuries. Today, the advanced conditions of technology have made it possible to make stories visible in their development without touching the individual point of view. It is not the person who has an impact on this fiction, but the virtual environment. The virtual environment also actually contains cumulative information from society.

1.5. Embodiment of Fictional Places

The materialization of imaginary spaces is encountered and necessary in creative genres that evolve and diversify through technology, such as science-fiction films, starting from animated cartoon series and movies. Although they are mostly computer-aided, the drawings, which start in mind through imagination, are then transferred onto paper in color with sketches and traditional methods and finally result in the virtual environment and constitute the concretization process of the fiction. Especially nowadays, a new perspective has been brought to the types of concretizations that have been adopted for years. With the collaboration of the human brain and technological intelligence, it is possible to say that all these processes are in a more practical and faster way with the aid of language. The embodiment that we can discuss here serves only our sense of sight from our 5 sense organs, that is, the resulting products/designs are only visible and have a place in the virtual environment. Future technologies may enable the production of these "places" tactically. These scenes can be visually revived with today's experience and augmented reality in the future.

1.6. The Understanding of Place in the Future Years in the Light of Contemporary Mythology

The way we perceive the world is not constant. It differs from the way our parents see it, and it will be different from how our children will see it. The earth is constantly changing, and every generation discovers new facts and ideas to cope with those changes. Heraclitus observed that ‘’You cannot step into the same river twice because fresh waters are always flowing in.’’ Similarly, geographers must create a new vision of the world for every generation, not only because reality changes but also because human concerns vary (Lowenthall, 1961).

A particular way of interpreting the world is reshaped by changes in social order and cultural references. G. Olsson's theory from 1980 suggests that the way we perceive reality is determined by the categories we use to understand it. In other words, our interaction with something is only possible through the concepts we create and associate with it (Olsson, 1980) (Lando, 1996).

Mythology is still an emerging field of research. In light of the new information and achievements that have emerged today, facts that will shape the future are created and transferred to the next generations through cultural memory. It is possible to come across mythical traces in the type of behavior that modern people show to seek solutions to their problems, reveal their hidden longing, and achieve this. Futuristic science fiction films created today attempt to depict the future to understand the social and physical structure of humanity. From this point of view, we are witnessing similar developmental processes as those of past mythology (Kolaylı, 1998).

2. Material and Method

This academic study aims to examine the epic and fantastic creations of different cultures in the context of ethnography, communication, and place. It will be achieved by using mythological narratives and analyzing the main differences or similarities between them. To examine the development scope of the concepts and to strengthen the relationships, a literature review was conducted, and a qualitative research method was used. This study will contribute to the literature by analyzing the depictions of the interior in the myths selected from the sources that have survived to the present day. It aims to reveal the traditional interior elements or interior fiction in different geographies in the process up to the present day. To achieve these aims, the study focuses on how mythological narratives are constructed with spaces and how scenes partner with the plot visually from different perspectives by using artificial intelligence and today's technologies. As a result of this development process, the study aims to establish strong bridges between art, technology, and culture while examining the development of mythology and other oral narrative genres in human history and contemporary myths.

3. Research Findings

Each civilization has mythological stories and epics that form the basis of oral communication with different narratives. Transmission between cultures and generations has been carried out for centuries by word or of mouth. Marking and showing places in mythological places has been a subject that people have thought about and realized before. The merging of mythology with the field of geography is actually not a new process. For years, sacred places have survived to the present day by being marked on maps, and even in the ruins and museums of Greco-Roman mythologies, they are often within our reach. Maps are a means of navigating and communicating different aspects of the world like legends. Cartography, the art of map-making, has helped bring to life mythical locations such as Atlantis, the Garden of Eden, Heaven, and Hell, which were transmitted through myths, religious texts, or oral traditions. These fictional places have inspired cartographers and explorers throughout history (Esseb, 2008) (Lowenthall, 1961).

While some of the sources that we can access in today's facilities directly contain the list of mythological places, others indicate some places of place with importance in their storytelling. Where and under what conditions the events take place is vital considering the context of the narrative, its place in the plot and the message to be delivered. For this reason, in the research includes carefully selected depictions of places from mythological stories that have been a partnership and guide from the beginning of humanity to the present day. The depictions of spaces are associated with different branches of art and are embodied by various methods. Today, while imagining all these narratives in our minds, artificial intelligence allows us to concretize the spaces we create with various application options and to put them into visual data. Also, visual interaction will make it possible to keep mythologies of cultures alive today and to reach wider audiences.

In the findings section, it is aimed to investigate questions such as:

-How individual are the fictional places we depict in mythological stories?

-What do these scenes look like in real life?

-What are the differences between the mythological sites of different societies?

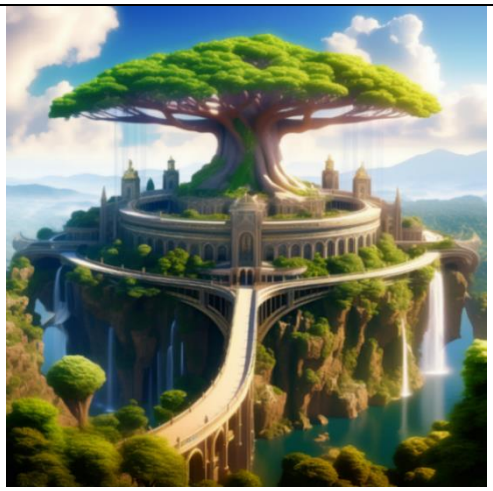
The embodiments below are fictional images obtained by entering the depictions of popular places, which are frequently included in mythology stories that have survived to the present day, into artificial intelligence as data. In terms of the accuracy and testability of the information, the keywords (prompts) used in creating each image are indicated in the tables. In the findings section, places from Scandinavian, Greek, Indian and Mesoamerican Mythologies were determined.

3.1. Norse Mythology

3.1.1. Asgard City

"Asgard" is one of the nine sacred realms mentioned in Norse mythology. This celestial realm is not only a place where the deceased can rest, but also the home of the Aesir gods. Asgard also encompasses "Bifrost", the rainbow bridge connecting the city to the world of humanity ("Midgard") (Apel, 2022).

Table 1. Data entered for Figure 2 and Figure 3

Figure 2	**Figure 3**
[a rainbow bridge, a place of unearthly size, grandeur and beauty, upon the world tree Yggdrasil, the high placed city of the gods, realistic, smooth, hd]	[a rainbow bridge, a place of unearthly size, grandeur and beauty, upon the world tree Yggdrasil, the placed city of the gods]
	
Figure 2. Depiction of Asgard (Özer, Created With BlueWillow AI, 2023)	**Figure 3.** Depiction of Asgard (Özer, Created With Playground AI, 2024)

3.1.2. Valhalla

Valhalla, which means "hall of the slain" in Old Norse, is a mythical hall in Norse mythology that serves as a home for those who died heroically in battle. The concept of Valhalla was an integral part of the religious, mythological, and cosmological beliefs of the Scandinavian and Germanic peoples (Valhalla, n.d.) (McKay, 2022).

Table 2. Data entered for Figure 4 and Figure 5

Figure 4	Figure 5
[The ceiling is made of golden shields, with rafters made from spears. That has 540 rooms. A wolf hangs in the doorway to the hall and there are eagles flying overhead. There are areas for fighting, areas for living, and, of course, areas for feasting. Huge tables seat hundreds of warriors. Outside the hall stands a golden tree called Glasir that is said to be among the most beautiful things in all of the world.]	[A glorious afterlife hall. The ceiling is made of golden shields, with rafters made from spears. There are areas for fighting, areas for living, and areas for feasting. Huge tables seat hundreds of warriors. Outside the hall stands a golden tree called Glasir that is said to be among the most beautiful things in all of the world.]

Figure 4. Depiction of Valhalla
(Özer, Created With BlueWillow AI, 2024)

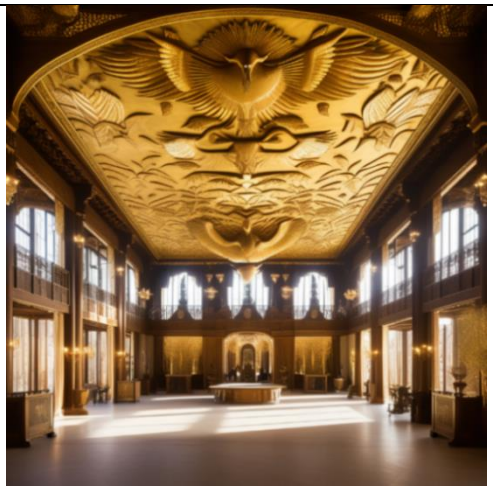


Figure 5. Depiction of Valhalla
(Özer, Created With Playground AI, 2024)

3.2. Greek Mythology

3.2.1. Tartaros

In Greek mythology, Tartarus is depicted as an underworld region used as a dungeon to punish evildoers. It also serves as a prison for Titans. According to Plato, souls are judged here after death, and the wicked are subjected to divine punishment (Tartarus).

Table 3 Data entered for Figure 6 and Figure 7

Figure 6	**Figure 7**
[a place in the dark underground, deep abyss and deep pits, flows a flaming river, hd, high quality, it is surrounded by three perimeter walls,high quality,1080p, place,dark scene]	[a place in the dark underground, deep abyss and deep pits, flows a flaming river, hd, high quality,It is surrounded by three perimeter walls,high quality,1080p, place,dark scene]

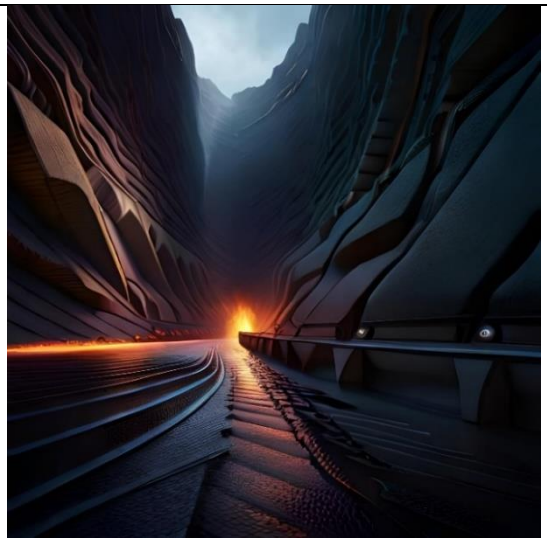



Figure 6. Depiction of Tartaros (Özer, Created With BlueWillow AI, 2023)	**Figure 7.** Depiction of Tartaros (Özer, Created With Playground AI, 2023)

3.2.2 Oceanus

Oceanus is often referred to as a place, rather than a person. It is considered to be a great river that surrounds the world. Both Hesiod and Homer describe Oceanus as "backflowing" because it encircles the earth and eventually flows back into itself (Oceanus, n.d.). Oceanus has been mentioned as an island where the spirits of the best mortals are sent to live in eternal peace and prosperity. Despite being a paradise-like island, it is associated with many shores and other islands, and contrary to convention, it is located in the deep realms of the underworld (Irmak Tanrısı Okeanos (Oceanos), 2020).

Table 4. Data entered for Figure 8 and Figure 9

Figure 8	Figure 9
[river which encircled the entire world, backward flowing, It was located somewhere on the deep shores of the underworld, surrounded by Oceanic waters. This river is the source of all the rivers, seas, underground waters and streams in the world	[river which encircled the entire world, backward flowing, It was located somewhere on the deep shores of the underworld, surrounded by Oceanic waters. This river is the source of all the rivers, seas, underground waters and streams in the world]
	
Figure 8. Depiction of Oceanus (Özer, Created With BlueWillow AI, 2023)	**Figure 9.** Depiction of Oceanus (Özer, Created With Playground AI, 2023)

3.3. Indian/Hindu Mythology

3.3.1. Agartha

According to rumors, the legendary kingdom of Agartha is said to be located in the inner part of the world. This concept is also associated with the belief in a ‘’Hollow Earth System ‘’ or ‘’Hollow Earth theory ‘ (Agartha). Agartha is the name of a legendary underground organization mentioned in Tibetan and Central Asian traditions. It is believed to be located in the mountain ranges of Asia and is said to have tunnels that belong to it. These tunnels have also been found in other places such as Türkiye (around 40 in the Nevşehir region), the United States, and Brazil (Agarta, n.d.).

Table 5. Data entered for Figure 10 and Figure 11

Figure 10	Figure 11
[a kingdom located on the inner surface of the Earth, hollow Earth, tunnels, underground organization]	[there is an organization inner world, hollow Earth, underground, a kingdom located on the inner surface of the Earth, there are mountain ranges, a large cave complex, there is no human, myth place]
	
Figure 10. Depiction of Agartha (Özer, Created with BlueWillow AI, 2023)	**Figure 11.** Depiction of Agartha (Özer, Created with Playground AI, 2023)

3.3.2. Samavasarana

Samavasarana or Samosharana ("Refuge for All") is a divine sermon of the Tirthankara. It is said that there are more than 20,000 stairs in the hall. The word Samavasarana comes from two words; "sama" meaning general, and "avasara" which means opportunity (Samavasarana, n.d.).

Table 6. Data entered for Figure 12 and Figure 13

Figure 12	Figure 13
[Divine preaching hall. There is a four-layered circular structure. In the middle of the hall there is a sacred tree. The hall should have gates enclosing all the sides of the hall. There are more than 20.000 stairs in it. There is a platform with manifold jewels; on it dais of incomparable gems.]	[Divine preaching hall. There is a four-layered circular structure. In the middle of the hall there is a sacred tree. The hall should have gates enclosing all the sides of the hall. There are more than 20.000 stairs in it. There is a platform with manifold jewels; on it dais of incomparable gems.]

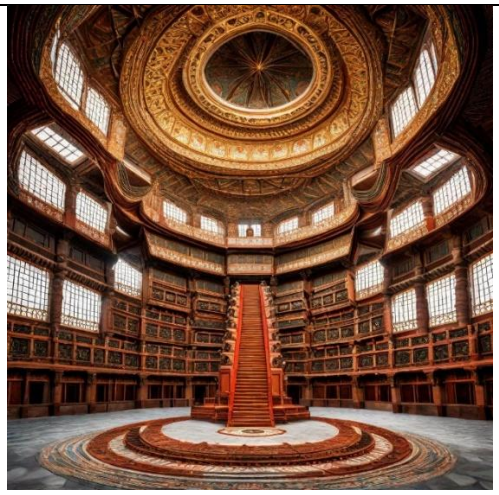



Figure 12. Depiction of Samavasarana (Özer, Created with BlueWillow AI, 2024)	**Figure 13.** Depiction of Samavasarana (Özer, Created with Playground AI, 2024)

3.4. Mesoamerican Mythology

3.4.1. Mayan Mythology: Xibalba

''Xibalba'' is the name of the underworld in K'iche Maya culture, meaning "place of fear or fright" (Geller, 2016).

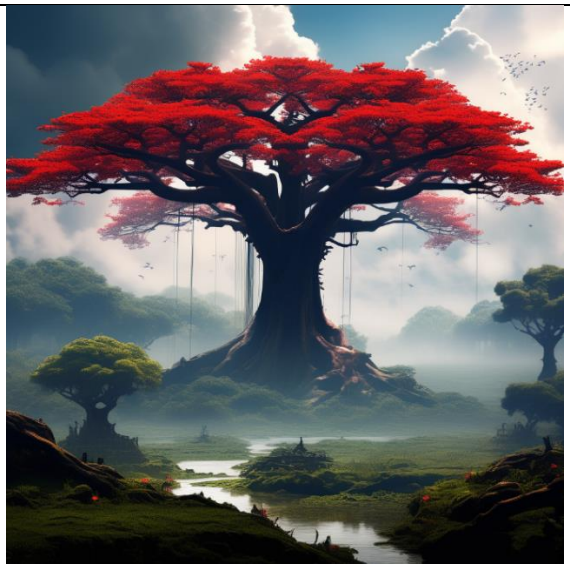
Table 7. Data entered for Figure 14 and Figure 15

Figure 14	Figure 15
[this is an ''underworld'' city which has 6 houses.] [Dark House], [Rattling House], [Cold House], [Jaguar House], [Bat House] [Razor House], [Hot House.] [Xibalba has a large palace] , [there is a council place of the Lords][,there are homes of the Lords, gardens, traps for anyone,][there are roads to Xibalba were filled with obstacles:] [first a river filled with scorpions, a river filled with blood, and then a river filled with pus] realistic)]	[this is an ''dark fear underworld'' city which has torture 6 houses.] [Xibalba has a large palace], [there is a council place of the Lords] [there are homes of the Lords, gardens, traps for anyone,][there are roads to Xibalba were filled with obstacles:] [first a river filled with scorpions, a river filled with blood, and then a river filled with pus] realistic and with blood red river]
	
Figure 14. Xibalba Depiction (Özer, Created with BlueWillow AI, 2024)	**Figure 15**. Xibalba Depiction (Özer, Created with Playground AI, 2024)

3.4.2. Aztec Mythology: Tamoanchan

Tamōhuānchān is a legendary place of origin that was recognized by the Mesoamerican cultures of central Mexico. According to mythological traditions and creation stories, Tamoanchan was considered to be a paradise where the gods created the first human race. The symbol for Tamoanchan depicts a cleft tree that blooms and sheds blood, representing life and rebirth. (Tamoanchán Aztec Mythology , 2020) (Tamoanchan , n.d.).

Table 8. Data entered for Figure 16 and Figure 17

Figure 16	Figure 17
[legendary place, underground, place of misty sky. Moist, lowland region. There is a split tree that blooms and spreads blood.]	[legendary place. There is one split tree that blooms and spreads blood. Terrestrial paradise. place of misty sky. Moist, lowland region. paradise where the gods created the first of the present human race out of sacrificed blood and ground human bones]
	
Figure 16. Depiction of Tamoanchan (Özer, Created with BlueWillow AI, 2024)	**Figure 17.** Depiction of Tamoanchan (Özer, Created with Playground AI, 2024)

4. Discussion and Conclusion

Mythmaking and place are intertwined with identity (Wortham-Galvin, 2008). Myths are encountered in almost all cultures, and they deal with humanity, the creation and nature of the universe, beliefs, and practices specific to traditions, the functioning of the universe, and the rules, rewards, and punishments. Naturally, the main places where these myths are encountered are parallel to this situation. So much so that the most striking places deal with depictions of heaven, where mortals will be rewarded for the good deeds, they have done in their lives, or the dungeons of torture and suffering where they will be punished for eternity. Similar places can be found in different mythological stories of different cultures. Good is usually defined in the heavens and evil on earth, which is why today's beliefs hold that the ''creator (God)'' is in the heavens and that evil (the devil) is underground. These definitions have taken their place in our memory centuries ago. In this respect, mythology is considered by some to be the beginning of heavenly religions, while others consider it to be the beginning of science and literature. For these reasons, trying to make sense of the accumulation of humanity by using mythology is still one of the most logical options. Fiction cannot truly reach the level of mythology unless people believe in it and there is a connection to the spiritual (or psychological) experience (Çağdaş Mitoloji, 2017).

Mythology has survived to the present day and sheds light on the future. The boundaries of the past that cannot be delineated with a red pen, the ongoing uncertainty and variability pique our curiosity, and any information that we cannot analyze is open to our interpretation. For this reason, mythology invites us to be transported to the future. Myth is a highly complex concept that can be interpreted in many ways and it is a cultural phenomenon (Bazyar, 2016). In the world of mythology, changes and developments are observed among the sources day by day. The origin of mythology sources is still controversial. Therefore, expecting different cultures to be completely autonomous in their mythmaking and not affected by transitions would cause us to obtain incomplete information. Although the variability of the information obtained during the research it was noticed that it was difficult to reach completely objective statements or sources.

As individuals, we learn most rapidly about the world not by paying close attention to a single variable, but by superficially scanning a great variety of things (Lowenthall, 1961). Similarly, the concept of artificial intelligence is a system that gradually develops by imitating human intelligence and perception and produces output with the data obtained from the environment (Baran Ergül, Varol Malkoçoğlu, & Acun Özgünler, 2022). Artificial intelligence is rapidly evolving to imitate humanity's perception and cumulative reasoning skills at a magnificent level. Accordingly, it is progressing with different methods every day. From this point of view, it is necessary to consider that the possibility of the outputs we create at digital environment by entering data will be completely in accordance with the given instructions, and they will be closer to the desired result each day. In this line of development, it can be expected that the images discussed in this article will be more advanced and detailed in the future. Therefore, some of the data entered to form the images in the study may not be fully reflected in the visuals or may not fully match the word.

In this study, the places mentioned in the myth narratives of different cultures were selected, and a visual was created with the same data by using different artificial intelligence interfaces. In the article, the words depicting the places were taken from the sources (mentioned in the findings section) as they were, without editing. Thus, images that would consist of the raw information were obtained. When the visuals are examined, completely different results emerge from the same given area, which is striking. This result supports diversity and subjectivity. Created scenes can be revived visually with today's experience and augmented reality in the future. In this way, the lively and contact-based interaction will make it possible to keep mythological scenes and different cultures alive today and reach wider audiences. The visualization of mythological scenes using artificial intelligence provides an example of art and technology working together and can increase the vitality of mythology, intercultural interaction, and the relevance of the art-technology relationship to each other. This article has become an indicator of what these two different species can do as a result of joint work.

Although the research prioritized the "interiors" mentioned in mythology, it is observed that the samples in this study were mostly selected from environments such as mountains, seas/rivers, skies, plains, and underground. This is because, due to the structure and development of mythology, the events considered important in most cultures, or the places attributed to holiness are largely selected from the closest or farthest points to God in the universe by human consciousness at that time. The fact that the literature does not delve deeper into these points has caused limitations in this study.

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

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Reading 21st Century Architecture through the Concept of Chaos: A Method Suggestion

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Abstract

The dynamic and productive process experienced in architecture has led to new phenomena in how chaos can be expressed in architecture. This study is a case study in line with its aims and assumptions. In the first stage of the study, it was considered important to understand chaos and determine what it refers to conceptually. For this purpose, content analysis was performed by reaching the definitions expressing chaos within a limited framework, and concept categories and sub-concepts expressing chaos were obtained. A testing tool was created through the selected categories and sub-concepts. With this testing tool, descriptive case studies were carried out on 20 buildings. As a result of these studies, a relation diagram that helps to determine the chaos-building relationship was organised for each building. These diagrams were evaluated by establishing links between where and how the concept categories in the conceptual chaos diagram gained meaning throughout the structure. As a result of these evaluations, an attempt was made to explain the readability of architecture depending on the effect of chaos on the meaning and evaluation of the building and its accompanying space.

Keywords: *Chaos, concept, chaos-building relationship, chaos-space relationship, case study.*

Kaos Kavramı Üzerinden 21. Yüzyıl Mimarisini Okumak: Bir Yöntem Önerisi

Öz

Mimarlık içinde yaşanan dinamik ve üretken süreç, kaosun mimarlık ile birlikte nasıl ifade edilebileceğine dair yeni olguların oluşmasına yol açmıştır. Bu çalışma, amaçları ve varsayımları doğrultusunda bir durum çalışması niteliği taşımaktadır. Çalışmanın ilk aşamasında kaosu anlamanın ve kavramsal olarak ifade ettiklerini belirlemenin önemli olduğu düşünülmüştür. Bu amaçla sınırlandırılmış bir çerçevede kaosu ifade eden tanımlara ulaşılarak içerik analizi yapılmış, kaosu ifade eden kavram kategorileri ve alt kavramlara ulaşılmıştır. Belirlenen kategoriler ve alt kavramlar aracılığıyla bir sınama aracı oluşturulmuştur. Bu sınama aracı ile belirlenen 20 adet yapı üzerinden betimleyici durum çalışmaları yapılmıştır. Bu çalışmalar sonucunda her yapı için kaos-yapı ilişkisini belirlemeye yardımcı ilişkiler şeması düzenlenmiştir. Bu şemalar kavramsal kaos diyagramında yer alan kavram kategorilerinin yapı genelinde nerede ve ne şekilde anlam kazandığına dair bağlantılar kurularak bir değerlendirme yapılmıştır. Yapılan bu değerlendirmeler sonucunda kaosun yapı ve beraberindeki mekanı anlamlandırma ve değerlendirme üzerindeki etkisine bağlı olarak mimarinin okunabilirliği açıklanmaya çalışılmıştır.

Anahtar kelimeler: *Kaos, kavram, kaos-yapı ilişkisi, kaos-mekan ilişkisi, durum çalışması.*

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1. Introduction

It can be accepted that the human being, who has an entirely complex structure physically, also has a complex intensity spiritually. This complex structure, far from uniformity, constantly produces contradictions within itself and finds itself in a constant search. Because human beings are exposed to an unstoppable process of change in the context of their age, they tend to search for the new and different.

The process of seeking innovation can be interpreted as an expression of opposition to the old. The opposition to the old is an endeavour to go beyond what is customary, which is the precursor of chaos. In this context, chaos is a new state of order and the process of searching for the new. Chaos, which is perceived as emptiness, nothingness, or disorder, is a production endeavour constantly changing, transforming, emerging, and disappearing at an infinite speed (Ballantyne, 2012). It is an indeterminable void that appears to disappear simultaneously, containing all possible particles and attracting all possible forms. An infinite speed of emergence and dissolution is the cause of all becoming (Deleuze & Guattari, 1992).

When the situation is evaluated on the scale of architecture, a process of chaos has been experienced in every period of time when the architectural understanding has changed. This process, further supported by the Enlightenment movement, has encouraged more questioning, interpretation, and expression in the architectural environment. This dynamic process has led to an increase in pluralism as a part of every architectural movement and the beginning of new movements open to continuous production and change (Kortan, 1985).

The undeniable effect of modernity, which is expressed in the Enlightenment movement, on human beings and the process of change initiated by this effect in many fields have revealed the existence of chaos, which has always existed but could not be expressed much. This intellectual and physical effect of chaos, which has started to gain importance in scientific terms, has initiated a process of change within architecture. This process of change, which started with modern architecture, has been renewed layer by layer under the influence of factors such as technology and globalisation, has continued until today, and will continue in the future by accelerating even more. Especially since the 1960s, ground-breaking computer technology innovations have opened up new horizons in architectural design. Thus, the opportunity has arisen to produce extraordinary independent architectural examples, transcending borders and open to redesign and production. This door to continuous renewal and freedom in terms of design and production has carried design to entirely different dimensions in terms of the experience process (Choo, 2004; Çağdaş, Bacınoğlu & Çavuşoğlu, 2015).

In this study, which was prepared to reveal the presence of chaos in architecture and express the chaos-construction relationship, it is important to understand chaos and determine what it refers to conceptually. In this way, a conceptual chaos diagram was created, and an abstract testing tool was created for the structures to be examined. With the help of the conceptual chaos diagram, an attempt was made to explain the readability of architecture depending on the effect of chaos on the understanding and evaluation of the building and the accompanying space. The aim, assumptions, and methodology of the study were evaluated and formed through this framework.

1.1. Definition of Chaos and Its Importance

Chaos, which exists at every moment of creation, first appears in mythological stories. Hesiodos (2018), in his “Theogonia”, stated that the first formation of the universe started with chaos, saying that chaos existed before everything else. In some Middle Eastern myths, it is stated that the essence of everything consists of chaos and order. This formation, which was perceived as a whole, turned into a separation and splitting from the state of being together, and as a result, it formed the first state of the universe we live in today. Chaos, which was also used in ancient civilisations, represents the state of the universe before creation and the common environment of the world in terms of shape and structure (Dürüşken, 2004; Çakmak, 2004; Gündüz, 2004).

The phenomenon of chaos became a subject of curiosity and discussion in philosophy after mythology. Deleuze said that by accepting the positivity of chaos and opening up to chaos despite chaos, one can produce a state of being inspired by its dynamic and mobile state (Deleuze, 1983; Arpacı, 2010). While this situation enables the formation of different, new, unconventional wholes in line with the speed and direction determined by chaos itself, it also puts itself into a new ordinariness by keeping up with the passing work of time. As a precursor of a new chaos movement, this ordinariness is thought to continue in a dynamic cycle until the end of life.

Chaos did not find much presence in science until the time when the absolute assumptions of classical physics rules began to be questioned. However, new and different forms of thought that came with the Age of Enlightenment questioned many taboos that seemed to be known and unchangeable. Chaos, which started to take an important position in physics and other disciplines working in common with physics, has now become a source of inspiration for studies as a theory.

Joseph Fourier's study in 1881 can be regarded as the first scientific step towards chaos (Prigogine & Stengers, 1998). However, at that time, the definitive acceptance of the Newtonian approach, which is beyond doubt, caused the results of this study to be expressed as contradictory, and the study was left in the background. In 1906, the results of Jacques Hadamard and Pierre Duhem on chaos provided a scientific basis for chaos. In 1912, Henri Poincare won a prize in a competition to prove whether the solar system was stable or not and determined that the initial conditions of the systems could not be known with certainty.

Many scientists, such as George David Birkhoff, Mary Lucy Cartwright, John Edensor Littlewood, Andrey Nikolaevich Kolmogorov and Stephen Smale, conducted studies on chaos, but for many years, research on chaos remained silent due to insufficient technological infrastructure. After the second half of the 20th century, the rapid progress in technological developments and the innovations brought by this progress for computers enabled new studies to be carried out on chaos. In 1961, Edward Lorenz's work in the field of meteorology led to the use of new expressions for weather forecasts. Lorenz's work inspired James York's new work in mathematics and physics. David Ruelle also worked on this subject, investigating dynamical systems. On the other hand, Benoit Mandelbrot's innovative explanations on coastline calculation changed the interpretation that Euclidean geometry was sufficient to describe the world, and a new understanding of geometry called fractals emerged. Fractal geometry has shown that the objects in the world we live in cannot consist of simplified forms expressed by Euclidean geometry but can be represented through the forms they have one-to-one (Ruelle, 2001; Ural, 2004; Sardar & Abrams, 2011; Gleick, 2016). The perspective provided by Chaos has become an important subject in other disciplines such as biology, sociology, economics, and engineering, especially in light of the studies carried out after the 1960s. It is thought that chaos, which has an important place as a subject of curiosity in such a new research field, is a concept that can be discussed within the discipline of architecture and can open new horizons. When the studies conducted until today are analysed, the field of interest of architecture in this direction has been through the quantitative properties of chaos (Salingoros, 1997; Ediz, 2003; Akbulut, 2004; Leyton, 2006). It is undeniable that chaos has existed in every sense from the beginning of the life process to this day and will exist in the future. Even in the smallest area where life continues to exist, the disorder of chaos is visible within its order (Hayles, 2010). In this sense, the idea that chaos can be evaluated for the discipline of architecture not only through its quantitative data but also through its qualitative (semantic) dimension emerges. As a result of the literature review, it has been observed that until recently, in the discourses in the field of architecture, the chaos-construction binary has not been fully evaluated together in the intellectual dimension; it has not been discussed as a subject that is handled alone, except for a small number of comments by important architects and designers of the architectural literature. Especially after the 1960s, the scientific importance of chaos and the reflections of the developments in computer technology on the design method, process, and final product (Mitchell, 1977; Choo, 2004; Stevenson, 2013; Şenyapılı, 2015; Çağdaş et al., 2015; Hasol, 2017) have further strengthened the intellectual importance of the chaos-structure relationship.

The Italian architect Massimiliano Fuksas, one of the most important names of recent architecture, was the inspiration for the uncertainty in physics and life and expressed that the understanding of order in chaos was reliable. In his understanding of design, he accepted chaos, which embodies this uncertainty and disorder, as an order of fluidity (Altuğ, 2004). Gehry stated that there are no rules, no rights and no wrongs, and no judgement can be made about what is ugly and what is beautiful (Kortan, 1996). In fact, this situation is a consequence of the scientifically explained chaos theory. Zaha Hadid, with her works that have the feature of being incomplete, has interpreted the fluidity understanding of chaos with the geometries she used in some of her designs (Esin & Uluoğlu, 1996).

While the human being is such a part of chaos and the human-building relationship is a necessity of life, the fact that chaos has not been discussed within the discipline of architecture can be characterised as a deficiency. The building and its accompanying space have a significant role in the center of life, surrounding life and shaping the way of life, and they gain meaning through human experience. Therefore, it can be said that the mutual effect of chaos is undeniable when talking about the relationship between man and structure. When the triad of chaos-human-building is brought together, the intellectual interpretation of the chaos-construction unity can offer the answer to a search effort in making sense of the structure and the space with it. This endeavour, while allowing us to interpret the building differently in each period, can also make the investigations dynamic and lively.

2. Material and Method

This study, designed to read the architecture of the 21st century through the concept of chaos, was considered a case study considering its purpose and assumptions. This case study was adapted and planned according to the application stages in the literature (Simons, 1980; Yin, 1984; Datta, 1990; Stake, 1995; Bogdan & Biklen, 1998). Chaos, which is accepted as the basic phenomenon of the study within the scope of the defined problem, was transformed into a conceptual testing tool with the help of content analysis, and a descriptive evaluation was carried out through architectural examples. The following table shows the stages that constitute the methodology of the study (Table 1).

Table 1. Case study steps

CASE STUDY	1ST STEP	Identifying and defining research questions			
	2ND STEP	Content analysis	Reaching qualitative information	Reaching the definitions of chaos through literature review	
			Identifying concepts	Reaching the concepts from definitions that characterizes chaos	
			Creating conceptual diagrams	Creating meaning clusters, collecting and categorizing similar concepts in the same meaning cluster	
			Creating conceptual diagrams	Collecting categories and meaning cluster in a diagram	
		Descriptive case study	Identifying structures	Making a descriptive analysis with the help of the information obtained and presenting it as a table	
			Accessing visual data of the structures		
	3RD STEP	Evaluating and analyzing the data		Preparing and evaluating the chart for each structure with the help of the data obtained in the descriptive case study	
	4TH STEP	Reaching conclusions		Explaining general conclusions and recommendations	

As indicated in the table, the study was designed and completed in four stages. Within the scope of the study, it was found necessary to search for answers to the following questions in order to complete the first stage of the case study:

• How can chaos, considered as a phenomenon, be tested and evaluated through architectural examples?

• Can chaos itself be a testing tool, and how can the data that will constitute this tool be analysed?

• What kind of a tool can be designed with the help of the data obtained?

• In which framework is this designed tool tested based on architectural examples, and in which framework does it gain meaning?

Each question was designed in a complementary manner to decide, perform, and reach the results of the analyses to be carried out within the scope of the study.

The first research question (i.e., "How can chaos, considered as a phenomenon, be tested and evaluated through architectural examples?) was actually asked in accordance with the general purpose of the study and in a way that covers the other research questions. At this stage, a tool was needed to read the concept of chaos through architectural examples. The concept of chaos, which is taken as a phenomenon in this sense, was accepted as a tool to be used for testing the examples. To use chaos as a tool, it is considered important to analyse it within the conceptual framework and determine the sub-concepts it expresses.

A conceptual analysis was conducted, and content analysis was applied to reach the sub-concepts of chaos and transform these concepts into a tool. The content analysis was carried out through the definitions explaining chaos, and the concepts expressing chaos were reached through the definitions. The definitions used were limited to the definitions of creation stories, mythology, eastern philosophy, and definitions in different disciplines in the process from the 1960s to the present day. These obtained concepts are data for the conceptual chaos diagram to be created for the next study stage. At this stage, an attempt was made to answer whether chaos itself can be a testing tool, and how the data that will constitute this tool can be analysed.

Qualitative data (concepts) obtained as a result of content analysis were transformed into a subjective diagram, and a tool called a conceptual chaos diagram was created. Thus, an attempt was made to answer the question "What kind of a tool can be designed with the help of the data obtained?".

A descriptive case study was conducted on the architectural examples determined in order to answer the question "In which framework is this designed tool tested based on architectural examples, and in which framework does it gain meaning?".

3. Findings and Discussion

The second stage (determining analysis techniques, selecting cases and collecting data) mentioned in the method section of the study is addressed in this section. Firstly, analysis techniques were determined (content analysis and descriptive case study), cases were selected (20 structures), and the implementation phase started.

3.1. Content Analysis

A content analysis was applied to the definitions explaining chaos; as a result, the obtained qualitative data (concepts) were transformed into a subjective diagram and transformed into a tool called a conceptual chaos diagram, as shown in Figure 1.

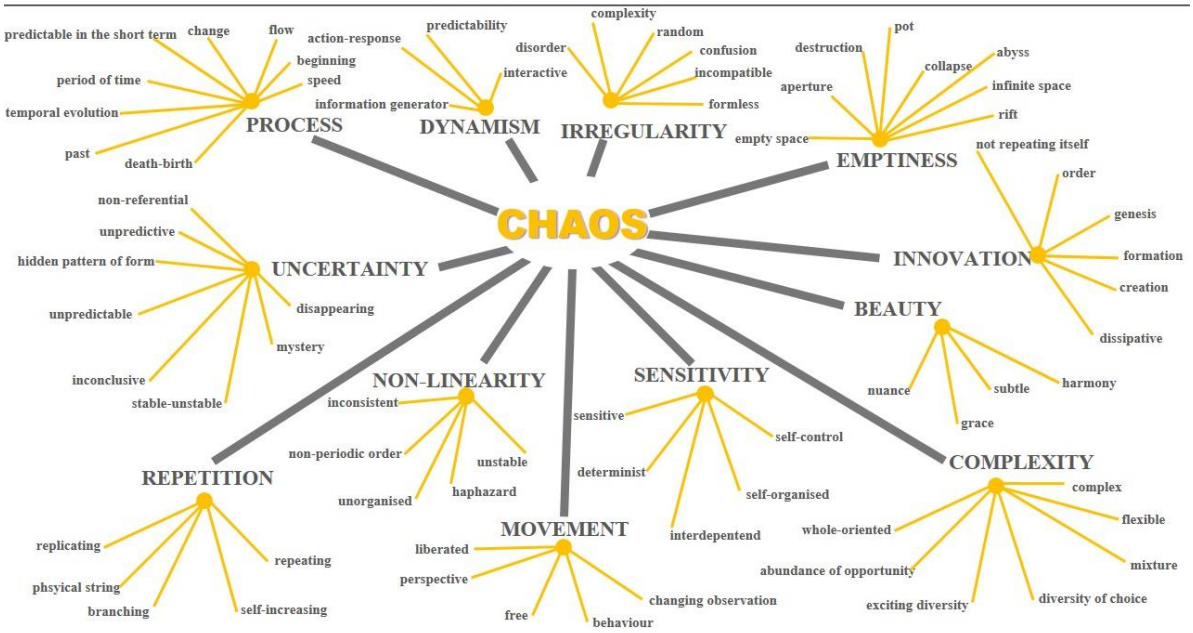


Figure 1. The conceptual chaos diagram

As a result of the content analysis conducted on the concept of chaos, twelve concept categories were identified: emptiness, uncertainty, dynamism, non-linearity, sensitivity, disorder, beauty, movement, complexity, process, repetition, and innovation. Each concept title forming these categories was brought together with a meaning cluster consisting of sub-concepts to support that concept. These data, shaped by the diagram, were used as a tool for the descriptive case study to be conducted in the next step.

3.2. Descriptive Case Study

Each architectural example to be selected for the descriptive case study was evaluated as the case of the study, and certain criteria were established for their selection. It was ensured that the selected architectural examples belong to the recent period and support the purpose of the study. For this purpose, the time period from the 2000s to the present day was determined as the study limit, and buildings meeting the following criteria were included in the study.

Criterion 1: To be present on many websites on the discipline of architecture in the digital environment (archdaily.com, architectmagazine.com, architecturaldigest.com, arcspace.com, arkitektuel.com, arkitera.com, designboom.com, dezeen.com, domusweb.it, mimarizm.com, worldarchitecturenews.com)

Criterion 2: To be the subject of architecture and design journals in printed publications (Abitare, Architectural Design, Domus, Architecture, Design, Structure, XXI)

Criterion 3: To be a building that has received an award in the field of design or has been designed by award-winning architects

Criterion 4: To be able to provide, formally and spatially, the semantic equivalent of the concepts in the conceptual chaos diagram

Criterion 5: To have a sufficient number of online videos of the architect or those who have experienced the building and fully explain the building

Criterion 6: To be a building that enables the collection of multifaceted information such as animations, photographs, oral and written sources

With the help of this table, an examination group consisting of buildings completed after 2000 and fulfilling at least three of the criteria was formed. Within this examination group, 20 buildings fulfilling all of the criteria specified in the table were selected as the buildings for the descriptive case study.

Since the chosen sample group could not be tested one-to-one in the real environment due to many constraints, special attention was paid to the 5th criterion. By means of this criterion, it was possible to comprehend the whole building, the interior and exterior spaces of the building, and the relationships between the spaces through the architect or the experiencers of the building and to describe the building with a conceptual chaos diagram thanks to this understanding. Considering these criteria, the 20 buildings selected are listed as follows: Walt Disney Concert Hall (1996-2003), Frederic C. Hamilton Building (2000-2006), Michael Lee-Chin Crystal (2003-2007), Porsche Museum (2005-2008), Guangzhou Opera House (2003-2010), Busan Cinema Center (2005-2012), Dalian International Conference Center (2008-2012), Eye Film Museum (2005-2012), Dongdaemun Design Plaza (2007-2013), Polin Museum (2005-2013), Biomuseo (2002-2014), Fondation Louis Vuitton (2004-2014), Heydar Aliyev Cultural Center (2007-2014), Musee Des Confluences (2001-2014), Arnhem Central Transfer Terminal (1996-2015), Harbin Opera House (2010-2015), Leixões Cruise Terminal (2004-2015), MAAT (2012-2016), MOCAPE (2007-2016), and Tianjin Binhai Public Library (2009-2017).

During the descriptive case study, videos of the architect of the building or people who experienced the building in terms of interior and exterior spaces were watched, and two-dimensional drawings and photographs of the building were examined. Through this investigation, data collection was conducted for the descriptive case study. During the data collection, screenshots were taken from the videos watched when the photographs of the building obtained from the literature were insufficient, and the data were supported. A conceptual chaos diagram of each structure was created with the help of these data. In each diagram of the building, the concepts considered semantically present in the building within the meaning clusters and the categories belonging to those concepts are marked more prominently, and other concepts and categories are left in the background.

A special descriptive case study table was created for each building in the next stage. In order to create this case study table, the videos, two-dimensional drawings, and photographs of the building were examined. As a result of the examination, a conceptual chaos diagram of the building was created. The conceptual chaos diagram of the structure was prepared as a preliminary study for the next stage. A descriptive article analysing the structure in depth was written based on this preliminary study. In the article, the concepts and categories in the conceptual chaos diagram of the structure are indicated in bold.

The Heydar Aliyev Cultural Center is cited as the best example among the 20 buildings examined for its potential to be read through the concept of chaos. Below, in Figures 2 and 3, a conceptual chaos diagram and a descriptive case study of the structure are provided.

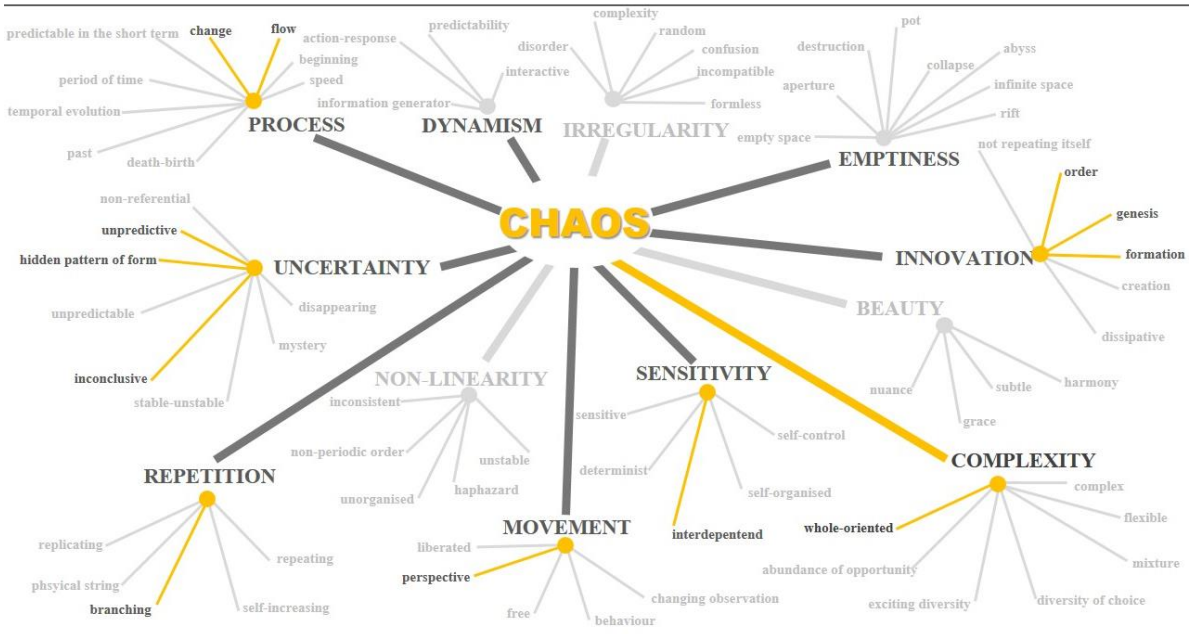


Figure 2. The conceptual chaos diagram of Heydar Aliyev Cultural Center

The descriptive case study text of the structure was prepared through this conceptual chaos diagram of the structure. The descriptive case study of the sample structure is given in Table 2.

Table 2. Heydar Aliyev Cultural Center descriptive case study

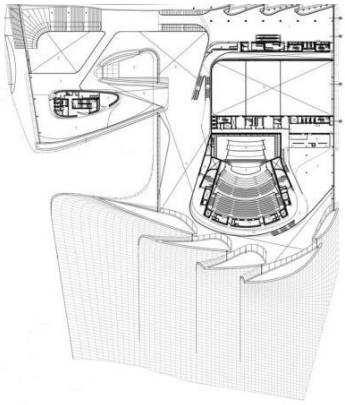
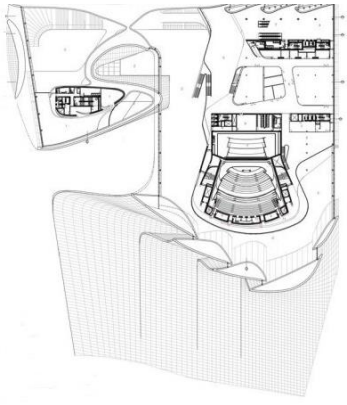
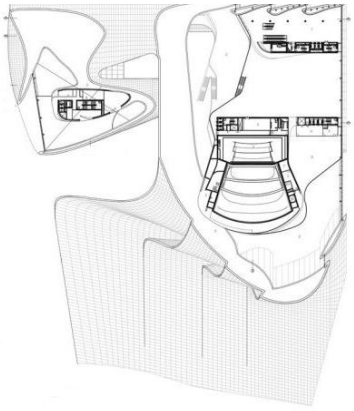
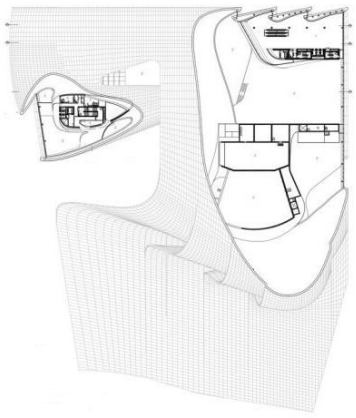
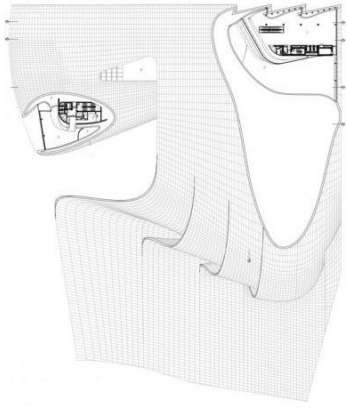
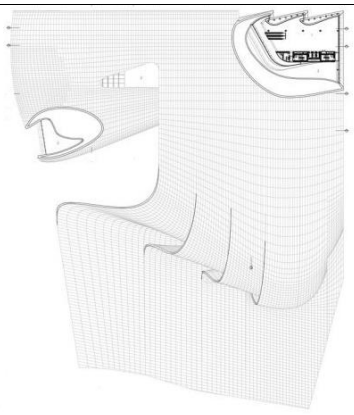
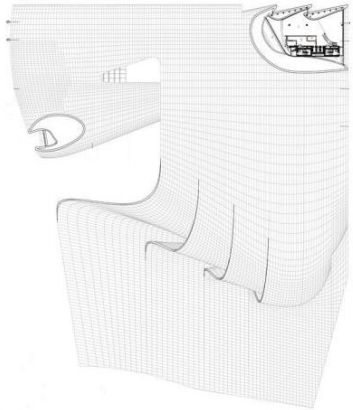
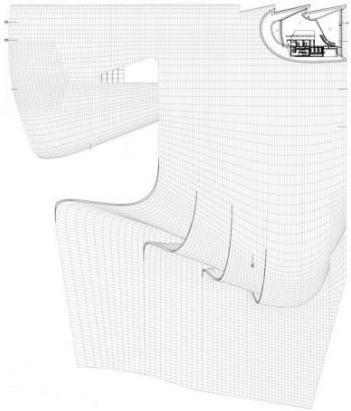
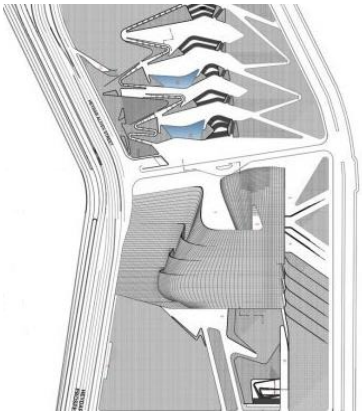
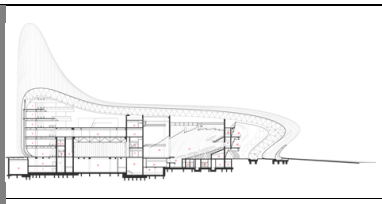
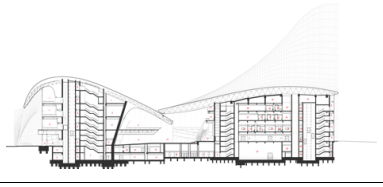
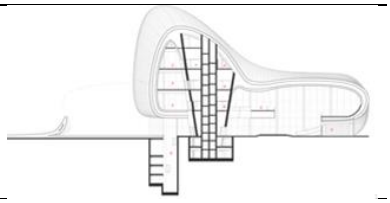
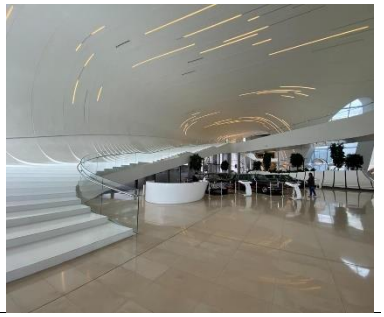
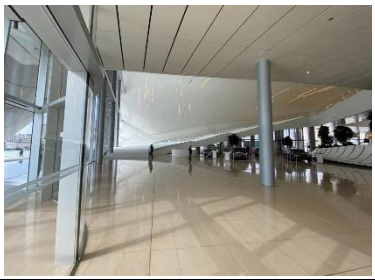
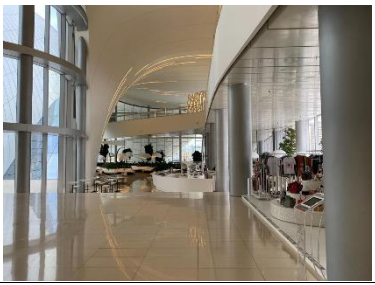
13	Name of the Structure	Heydar Aliyev Cultural Center	
	Year of Construction	2007-2014	
	Architect	Zaha Hadid Architects	
PLANS	 Ground Floor Plan; Zaha Hadid Architect 1, 2018a	 1st Floor Plan; Zaha Hadid Architect 1, 2018a	 2nd Floor Plan; Zaha Hadid Architect 1, 2018a
	 3rd Floor Plan; Zaha Hadid Architect 1, 2018a	 4th Floor Plan; Zaha Hadid Architect 1, 2018a	 5th Floor Plan; Zaha Hadid Architect 1, 2018a
	 6th Floor Plan; Zaha Hadid Architect 1, 2018a	 6th Floor Plan; Zaha Hadid Architect 1, 2018a	 Situation Plan; Zaha Hadid Architect 1, 2018a

Table 2. Heydar Aliyev Cultural Center Descriptive Case Study (continue)

SECTIONS			
	Section 1; Zaha Hadid Architect 2, 2018b	Section 2; Zaha Hadid Architect 2, 2018b	Section 3; Zaha Hadid Architect 2, 2018b
IMAGES			
	Structure as a whole, taken by the author	Front façade, taken by the author	Entrance, taken by the author
IMAGES			
	Exhibition space, taken by the author	First floor, taken by the author	Circulation, taken by the author
			
	Exhibition space, taken by the author	Circulation, taken by the author	Circulation, taken by the author

DESCRIPTIVE CASE STUDY

Sourced from YouTube videos of the architect or those who experienced the "Heydar Aliyev Cultural Center", fully explaining the structure as indoor and outdoor (Anonymous, 2018a; Anonymous, 2018b; Anonymous, 2018c; Anonymous, 2018d; Anonymous, 2018e; Anonymous, 2018f; Anonymous, 2018g) videos, the following descriptive case study text was created.

The Heydar Aliyev Cultural Center, located in Baku, Azerbaijan's capital, is a Zaha Hadid design. Completed in 2013, the building can be interpreted as an expression of continuity in terms of its positioning on the topography and the relationship between the topography and the main mass. The fluidity that emerges with the continuity effect of the topography merges with the groundmass and offers the beginning of an exciting adventure to the experience. When the structure is considered as a whole, the branching, increasing, and decreasing effect of chaos is felt. The repetition of two separate hills, which form the main mass, in the form of a continuation of each other but in different sizes, forms the roof starting from the ground with a wave effect, then loses its effect for a while, and then corresponds to a movement that re-occurs and disappears again. This movement also gives the building a dynamic effect.

The outer ground and the uncertainty arising during the combination of this ground with the structure surround the structure as a precursor of chaos. The sculptural integrity arising from this ambiguity is like a treasure that contains hidden patterns. The curiosity for this unpredictable order invites the experiencer perfectly into the interior. The chaos effect that begins with the absorption of the structure into itself initiates a process that can be considered as the beginning of the pleasure of multiple interpretations for the experiencer. This process, which begins to be defined together with perspective and movement, tends to answer questions that are willing to arise from the uncertainty of chaos. The welcoming area, which forms the main entrance of the building, creates a balcony arising in the void as a reflection of the effect of the building on the facade inside and draws two separate road maps for the experiencer, right and left.

When an orientation towards the left side from the main entrance is preferred in the building with mixed-use possibilities, the pass that appears under the balcony formed as a result of the reflection of the outside into the inside suddenly turns into a large void surrounding the exhibition space. Moving to the right side from the main entrance leads the experiencer to the stairs that provide access to the concert hall with a circular orientation and an intriguing effect. This effect of change, where the result cannot be predicted at the first moment, can be interpreted as a feature of chaos that can be expressed through space in the intellectual infrastructure.

The staircase connecting the exhibition space to the upper floor emerges as a result of the continuing fluidity effect of the walls. Horizontal planes, where walls unpredictably turn into ceilings or staircases, offer an uninterrupted perspective. In addition, the configuration of this interior space offers the possibility of fluid transitions between horizontal planes.

The concert hall, which forms an important part of the building, is designed as a sensitive space that embraces the experience. This sensitivity can be seen as the result of an organized control of the parts that make up the void in a repetitive and interdependent manner. These repetitions and the endeavour to complete the formation depending on each other can be seen as reflections of the existence of chaos in space.

The formations in the other interior spaces of the building welcome the experience at different levels and guide them with smooth transitions to develop different perspectives.

This descriptive case given as a sample table was applied to the other 19 structures within the scope of the study. This descriptive case study aimed to obtain findings that would help reveal many insights to explain the chaos-structure relationship.

The evaluation and analysis of the data, which has been defined as the third stage in the methodology section of the study, is covered under the title of Findings in the next section. The fourth stage, Reaching Conclusions, is addressed under the title of Results following it.

3.2. Descriptive Case Study

Within the scope of the study, descriptive case analyses were conducted on 20 buildings in order to explain the chaos-structure relationship. As a result of these analyses, the physical (facade, plan, section, and interior space) features and semantic (description) values of the buildings were examined. The data obtained as a result of the analyses are discussed in this section with the help of the relationship diagram prepared for each structure, and a basis for explaining the results is created. The prepared relationship diagram is evaluated by establishing links between the concept categories in the conceptual chaos diagram and determining where (application areas) and how (expression style) the concept categories gained meaning throughout the structure. Figure 3 below shows an example of a relationship diagram for one of the structures analysed.

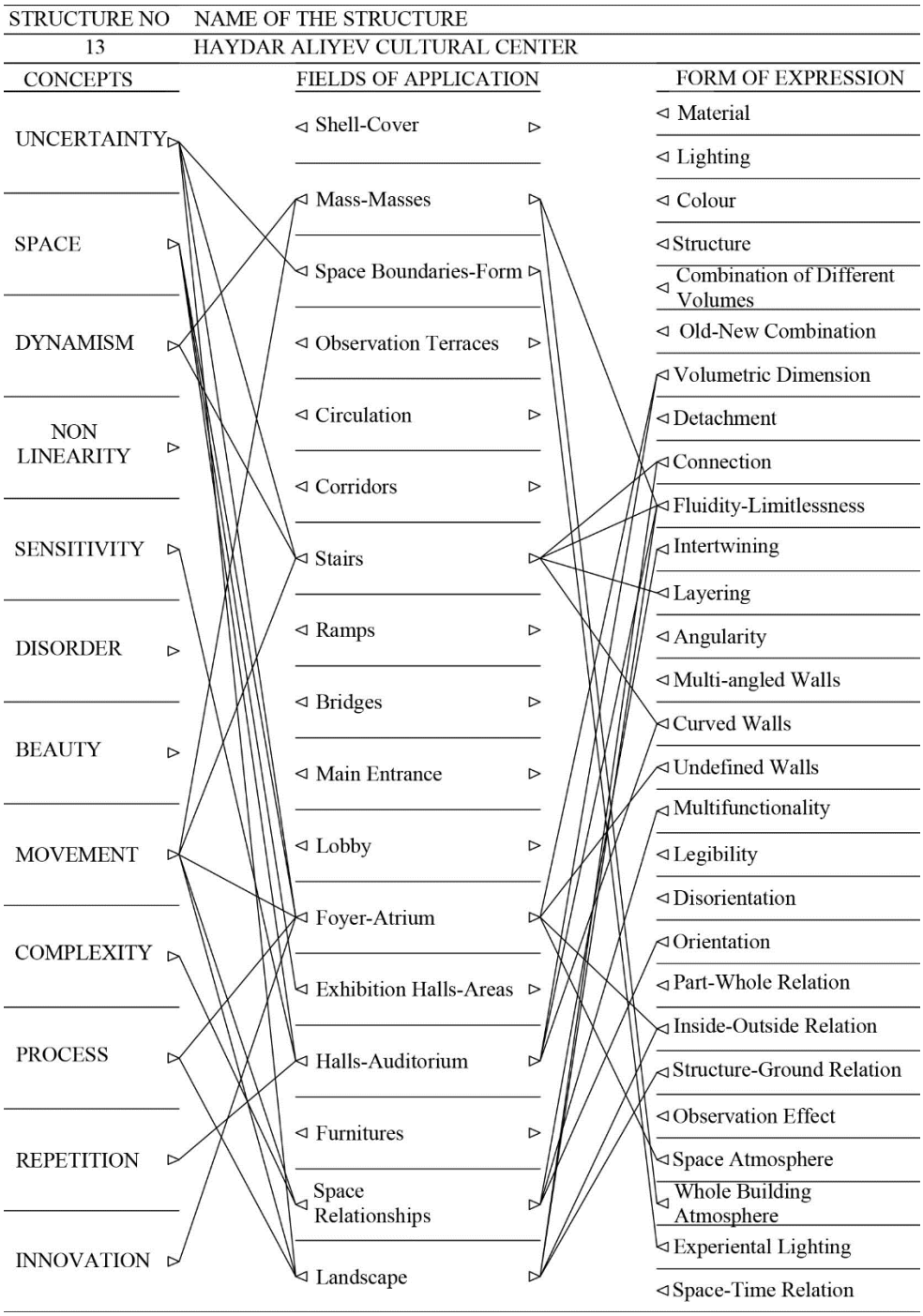


Figure 3. The relationship diagrams of Heydar Aliyev Cultural Center

Based on the relationship diagrams, the following findings were obtained in general terms:

When the concept of ambiguity is formed under a category heading within the scope of the study, it has a meaning cluster consisting of the concepts of mystery, hidden form orders, non-referential, stable-unstable, disappearing, unpredictable, inconclusive, and unpredictable. It can be said that ambiguity and the meaning cluster it creates attract attention in terms of formal features in application areas such as shell-cover, mass-masses, space boundaries-form, and space relationships in the analysed buildings. As a form of expression that enables uncertainty to gain meaning in these areas, it is supported with the help of forms of expression such as material, structure, volumetric dimension, fluidity-unboundedness, and structure-ground relationship.

The void category covers the meaning set of openness, empty space, pot, collapse, infinite space, abyss, rift, and destruction. Among the analysed buildings, the void is semantically evaluated as volumes that are formed and gain meaning through forms of expression such as mass-masses, crust-cover, layering within the boundaries that form the building as an external environment, angularity, and part-whole relationship. In the interiors of the buildings, it can be thought that the void, space boundaries-form, main entrance, atrium-foyer, lobby, and halls-auditorium support the interpretation.

The dynamism category is supported by the concepts of action-response and interactivity, which produce knowledge. These concepts have found expression in application areas such as shell-cover, mass-masses, circulation, corridors, stairs, ramps, bridges, and spatial relationships in buildings. The use of materials and lighting, the structure that forms the building, the combination of different volumes, and the building wholes formed by the established space-time relationship can be interpreted as supporting the formation of this situation. Additionally, it is thought that the walls that limit the spaces or are designed with the effect of limitlessness are formed in angular or curved forms, increasing the effect of dynamism.

The category of non-linearity formed a cluster of meanings with the concepts of unbalanced, haphazard, unorganised, non-periodic order, and inconsistent. However, among the structures analysed, there were no points to be evaluated in terms of application area and form of expression.

The sensitivity category consists of the concepts of interconnected, deterministic, sensitive, self-organised, and self-control. It can be interpreted that these concepts gain meaning in mass-masses, shell-cover, space boundaries-form, halls-auditorium, and reinforcements. It can be said that this state of gaining meaning is supported with the help of forms of expression such as material, structure, combination of different volumes, old-new combination, volumetric dimension, connection, and part-whole relationship.

The irregularity category consists of the concepts of formless, chaos, confusion, disorder, random, and incompatible. This category and its constituent concepts are thought to be supported by forms of expression such as structure, combination of different volumes, volumetric dimension, undefined walls, and disorientation in application areas such as mass-masses, space boundaries-form, circulation, main entrance lobby, atrium-foyer, and reinforcements.

Beauty is a category consisting of the concepts of subtlety, nuance, subtlety, and harmony. When the buildings and the spaces that make up the buildings are brought together, it can be considered that they represent a whole arising from harmony with the fields of application and the way they are expressed in these fields.

The movement category consists of the concepts of point of view, behaviour, changing observation, liberated, and free. Movement can be interpreted as a category that gains meaning at every point and with every form of expression when the structures are considered as a whole.

The complexity category consists of the concepts of whole-oriented, flexible, abundance of opportunity, exciting diversity, mixture, and richness of choice. Complexity can be interpreted as a meaning formed by combining different volumes established between shell-cover, mass-masses, and the relationship between parts and whole. It can also be said that complexity gains importance for the building thanks to the many functions that many whole buildings have.

The process category is a category limited by the concepts of flow, beginning, certain time period, change, past, speed, predictable in the short term, and death-birth within the scope of the study. The process is expressed in terms of shell-structure, mass-masses, ramps, corridors, circulation, and spatial relationships. This form of expression is thought to be created by combining the old and the new in the application areas, establishing connections, interweaving, and inside-outside and part-whole relationships.

Repetition, on the other hand, is a category limited by the concepts of multiplying, branching, physical sequence, self-increasing, and repeating. It can be thought of as a category that gains meaning through shell-cover, mass-masses, space boundaries-form, foyer-atrium, lobby, halls-auditorium, and

reinforcements. In the analysed buildings, stratification is the most effective expression of repetition. The innovation category consists of the concepts of dissipative, emergence, order, non-repetition, formation, and creation. The innovation category can be said to be a response to the form of formation in which the analysed structures come together and the effort to find the new to express this form. When the buildings are evaluated individually, they are designed as completely different buildings in terms of architectural form, although they functionally include many functions such as culture, trade, transport, and education.

4. Conclusion and Suggestions

Architecture is also a part of this occurrence. Architecture is an important and indispensable phenomenon for the individual who makes sense of the universe, that is, the experiencer. The space, which can be interpreted as the heart of architecture, has different characteristics for each experiencer and can be interpreted from very different perspectives because the experiencer is also physically and intellectually in a chaotic structure. The intellectual features supported by the physical features that enable the experiencer to make sense of the space due to its chaotic structure may differ for each experiencer. As a result, it may provide a completely different understanding and interpretation of the space. In fact, this diversity is part of the chaos. The unpredictable convergence of its diversity and its endeavour to create order in a surprising way is the reason for the existence of chaos. When the architectural reflection of this situation is analysed, the Walt Disney Concert Hall and the Biomuseo can be considered as the result of a whole arising from the convergence of diversity.

Another phenomenon that supports the formation process of chaos is that it proceeds in such a way that it adheres to the initial conditions. It carries traces from the past and transmits them to the future with a completely different evolution. Michael Lee-Chin Crystal, Frederick C. Hamilton Building, and Polin Museum show a tendency to transfer the influences from the past to the future in a change by combining time between past, present, and future in the organisation of the interior space. It reflects a chaotic process of presenting the old and the new together, experiencing temporal feedbacks, and producing the new by depending on the old.

The progression of chaos in the formation process by adhering to the initial conditions brings about stratification and repetition. When the buildings analysed in this framework are evaluated, a layering effect is created in the exterior spaces of Dongdaemun Design Plaza and Harbin Opera House with the help of landscape in the relationship of the building to the ground. In the Eye Film Museum and Tianjin Binhai Public Library examples, layering that both limits the interior space and envelops and repeats the space as a reinforcement is observed.

The series of order and disorder that define the progression of chaos within the process can be interpreted as another effect through place. Busan Cinema Center, Eye Film Museum, Polin Museum, and Fondation Louis Vuitton reflect this series of order and disorder as a reality with their hall designs.

Chaos states that the temporal flow, which proceeds depending on the initial conditions, will be completed with an unrecognisable and undetermined end, either within the moment or towards the future. It is possible to perceive the spatial expression of this process, which starts with a small movement without realising it and ends with an unpredictable result, in the Porche Museum.

Another important reality of chaos is that it takes nature's own process of formation and change as an example. When this nature-sensitive expression is evaluated through the analysed buildings, it is seen that Frederick C. Hamilton Building has an outer shell that refers to the topography where it is located. When the chaos-structure relationship is evaluated through the interior space in this sense, Michael Lee-Chin Crystal can present elements that support this relationship. In the buildings of Heydar Aliyev Cultural Center, Harbin Opera House, and Guangzhou Opera House, a large cave space was designed in a fluidity effect perfected by the wind by defining a large cave space in the areas that functioned as auditoriums.

The branching, increasing, and decreasing effect of chaos (Briggs & Peat, 1999) creates an alternating fluidity that begins and ends, with a new beginning and an ending triggered by the ending. The fluidity effect offered by this state of beginning and ending was tried to be expressed in Heydar Aliyev Cultural

Center, Harbin Opera House, Leixoes Cruise Terminal, Dongdaemun Design Plaza, and MAAT Museum, which were also described in the descriptive case studies.

Chaos creates order within disorder, or disorder emerges from order, forming a series of intertwined and complementary processes. When this transition is expressed in terms of space, the presentation of the interior as an exterior space and the disappearance of the distinction between exterior and interior can also create a chaotic effect. Mocape, Muse des Confluence, Heydar Aliyev Cultural Center, and Busan Cinema Center have atmospheres that reflect this contradictory situation.

This conclusion, supported by examples, seems to explain the assumption that architecture can be readable through the concept of chaos with the help of an abstract tool produced as a conceptual chaos diagram. Within the framework of this readability, it can be said that meaning can be attributed to the structure and the space that forms the structure. It is also considered to have important content as a supportive background for future studies within the scope of the subject.

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Examination of the Design Competence of Superstructures and Outdoor Facilities in the Dilek Peninsula Büyük Menderes Delta National Park

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Abstract

The design proficiency of recreational areas, superstructures, and outdoor facilities in national parks is a crucial aspect in the context of the identity of the National Park and visitor satisfaction. This research endeavors to assess the adequacy of 20 frequently utilized superstructures and outdoor facilities within the Dilek Peninsula Büyük Menderes Delta National Park, focusing on 16 design criteria. Observations conducted for this purpose revealed that directional signs received the highest rating, while trash bins received the lowest. Among the observed locations, the main axis location achieved the highest success percentage, whereas Kavaklıburun Bay scored the lowest. Considering the average success percentage across all locations, it was concluded that the Dilek Peninsula Büyük Menderes Delta National Park attained a partial success rate of 65.76%. In light of the results, new designs are proposed to enhance the d of the superstructures and outdoor facilities in the national park.

Keywords: *Protected area, national park, outdoor facilities, design, recreation.*

Dilek Yarımadası Büyük Menderes Deltası Milli Parkı'nda Bulunan Üst Yapı Tesisleri ve Donatı Elemanlarının Tasarım Yeterliliğinin İncelenmesi

Öz

Milli parklarda rekreasyon alanlarının tasarımı, üst yapı tesisleri ve donatı elemanlarının tasarım yeterliliği milli parkın kimliği ve ziyaretçi memnuniyeti bağlamında önemli hususlardan biridir. Bu araştırma, Dilek Yarımadası Büyük Menderes Deltası Milli Parkı içerisinde sıklıkla kullanılan 20 üst yapı ve dış mekân tesisinin yeterliliğini 16 tasarım kriterine odaklanarak değerlendirmeyi amaçlamaktadır. Bu amaçla yapılan gözlemler ve değerlendirmeler sonucunda en yüksek puanı yön tabelaları, en düşük puanı ise çöp kutuları almıştır. Gözlemlenen lokasyonlar arasında en yüksek başarı yüzdesini ana aks lokasyonu elde ederken, en düşük başarı yüzdesini Kavaklıburun Koyu elde etmiştir. Tüm lokasyonlardaki ortalama başarı yüzdesi dikkate alındığında Dilek Yarımadası Büyük Menderes Deltası Milli Parkı'nın %65,76 oranında kısmi başarı oranına ulaştığı sonucuna varılmıştır. Sonuçlar ışığında milli parktaki üstyapı tesisleri ve donatı elemanlarının tasarım yeterliliğini artıracak yeni tasarımlar önerilmiştir.

Anahtar kelimeler: *Korunan alan**,** milli park, donatı elemanları, tasarım, rekreasyon.*

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1. Introduction

The continual impact of human intervention on the natural environment precipitates substantial disruption within the ecological life chain and the depletion of finite resources. The persistence of humanity is contingent upon the existence and sustainable management of natural resources (Yücel & Babuş, 2005). Globally, there is a concerted effort to address the negative impacts on the environment (Caner, 2007; Kılıç & Kervankıran, 2019). In this context, modern conservation approaches focusing on internationally protected areas have emerged since the 19th century (Yücel, 1995; Atmış, Günşen, & Yıldız, 2020). During the early 20th century, policies formulated for the enhancement and preservation of the natural environment facilitated the spread of national parks and other protection statuses. (Dearden, Bennett & Johnston, 2005). The national park idea presented by American artist George Catlin, inspired by natural areas after her trip to America in 1832, pioneered the establishment of national parks in America (Cırık, 2007). Yellowstone, designated as the inaugural national park in America in 1872, catalyzed global conservation initiatives. These measures propelled conservation efforts internationally, inspiring the creation of the initial national parks in Australia (1879) and Canada (1885). The first national park in Europe was declared in Sweden in 1909. Meanwhile, in Turkey, Yozgat Çamlığı National Park was officially designated as the country's first national park in 1958 (Gülgün, Sayman & Aktaş, 2008).

In the National Park Law No. 2873, enacted in 1983 in our country, National Parks are defined as "pieces of nature with scientific and aesthetic, national and international rare natural and cultural resource values and conservation, recreation and tourism areas" (Demirayak, 2006).

National parks provide significant benefits in maintaining biodiversity by contributing to the protection of endemic plant and animal species, preserving water reservoirs, and improving weather conditions within green areas. Additionally, they play a crucial role in safeguarding important archaeological and historical sites found within national park boundaries.

National parks serve as crucial resources for nature education and research, offering scientists, students, and visitors valuable opportunities to explore and understand the natural environment. Furthermore, these parks promote engagement with nature, providing diverse avenues for recreational activities. Direct exposure to the natural environment is known to positively impact individuals' psychological and physical well-being. National parks not only afford visitors the chance to alleviate stress, unwind, and appreciate the beauty of nature but also contribute to the development of ecotourism in the park and its vicinity. This, in turn, supports a sustainable tourism model, making significant economic contributions to the region. The establishment of recreational opportunities within national parks creates employment prospects for local residents and bolsters the local economy through tourism-generated revenues. Additionally, national parks play a pivotal role in reinforcing regional identity by highlighting local culture and natural features.

Numerous superstructures and outdoor facilities are essential for accommodating recreational activities within the confines of national parks. Also, the design of recreational areas within these parks plays a pivotal role in shaping their identity. The selection and placement of superstructures and outdoor facilities in natural environments necessitate a meticulous design process that considers factors such as aesthetics, functionality, and environmental harmony. In these regions, it is imperative to prefer superstructures and outdoor facilities that are visually congruent with the natural surroundings, seamlessly integrating with both natural and cultural elements. Such elements should reflect the unique identity of the national park and the broader region while presenting an aesthetically pleasing appearance. However, materials used in these natural areas must exhibit resistance to extreme climatic conditions. Equally significant is the visual coherence of all equipment and superstructure facilities, their balanced placement in appropriate locations, and their provision in quantities sufficient to meet demand without causing confusion. Additionally, functionality is paramount; the chosen superstructure and outdoor facilities should be practical, perceptible, and exhibit a balance of size and proportion to cater to users of all abilities. Attention should be directed towards designing areas accessible to disabled individuals and children, prioritizing safety, and ensuring regular maintenance (Aksu, 2015).

Dilek Peninsula Büyük Menderes Delta National Park, which was determined as the study area, is one of the most visited national parks in Turkey. It also offers different recreational opportunities to visitors due to its diverse ecosystems, floristic and faunistic richness and vibrant topography. In this study, it was aimed to investigate the design adequacy of the superstructure facilities and reinforcement elements in the Dilek Peninsula Büyük Menderes Delta National Park. In this regard, 20 superstructure and outdoor facilities with different functions in the national park were evaluated on a 5-point Likert scale using 16 determined design criteria, deficiencies were identified and solution suggestions were presented.

2. Material and Method

2.1. Study Area: Dilek Peninsula Büyük Menderes Delta National Park is situated within the confines of Aydın province, encompassing an expansive area of 27,675 hectares. The park is a confluence of two distinct geographical formations, namely the Dilek Peninsula and the Menderes Delta. The Dilek Peninsula segment of the National Park was designated protected status in 1966, followed by the inclusion of the Büyük Menderes Delta in 1994. The highest elevation within the National Park is Dilek Tepe, boasting an average altitude of 650 meters and towering at 1237 meters, from which the park derives its name. Accessibility to the National Park is facilitated by the İzmir-Söke-Milas-Muğla state highway, with distances of 16 km from Söke, 24 km from Kuşadası, 41 km from Selçuk, 87 km from Aydın, 138 km from Çeşme, and 174 km from İzmir (Figure 1). Situated opposite the Greek island of Samos, this National Park marks the terminus of the Samsun Mountains extending towards the Aegean Sea. The northeastern region of the Dilek Peninsula section is bordered by the Güzelçamlı settlements, while the southeastern part is adjacent to Tuzburgazı settlements. Similarly, in the eastern expanse of the Menderes Delta section, residential areas such as Batıköy, Balat, and Akköy are present (Anonymous, 2016; Bingöl, 2011).

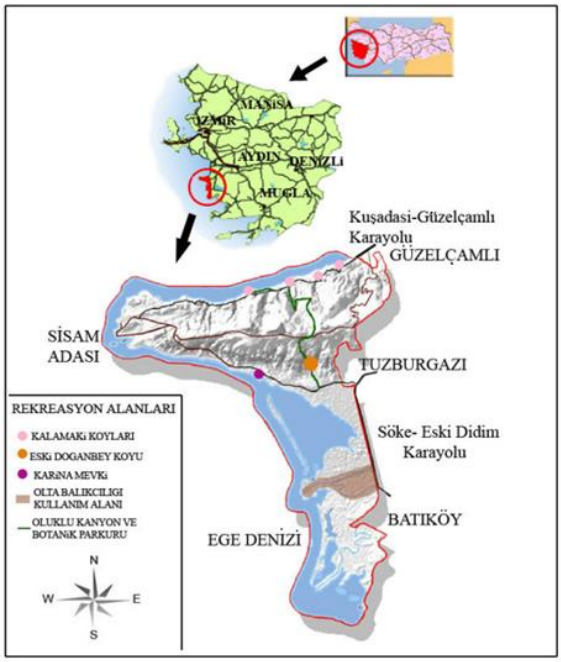


Figure 1. Geographical location of the National Park (Göktuğ, 2011)

The National Park stands as a preferred destination for residents of surrounding provinces and districts, particularly for daily recreational pursuits. The park comprises four designated daily-use areas, collectively known as Kalamaki Bays, strategically allocated to address the daily needs of visitors. These bays, namely İçmeler Bay, Aydınlık Bay, Kavaklıburun Bay, and Karasu Bay, serve as daily-use zones commencing from the national park's entrance. İçmeler Bay is situated 800 meters away from the National Park entrance, while the farthest bay, Karasu Bay, is located at a distance of 11 kilometers from the entrance gate. Among the various activities available, swimming, sunbathing, and picnicking are the most favored by visitors. Additionally, the park accommodates other recreational pursuits such

as trekking, cycling, botanical tours, photography, bird watching, and angling activities within its premises (Figure 2).

Figure 2. Dilek Peninsula Büyük Menderes Delta recreational map (Göktuğ, 2011)

In this study, an examination was conducted on the superstructures and outdoor facilities situated along the Kalamaki Bays and the primary road axis connecting these bays to the entrance gate of the National Park (Figure 3). The overall physical attributes of the locations, as well as the superstructures and outdoor facilities scrutinized, along with their respective quantities, are detailed in Table 1.

Table 1. Working locations and features

	Içmeler Bay	**Aydınlık Bay**	**Kavaklıburun Bay**	**Karasu Bay**
Area sizes/lengths	45.000 m²	62.100 m²	80.600 m²	40.400 m²
Distance to entrance	800 m	5 km	7 km	11 km
Superstructures and OutdoorFacilities and Along with Their Quantities				
Informative and warning signs	22	28	34	26
Restaurants	2	1	2	1
Product sales points / Kiosks	4	5	3	3
Trash cans	12	10	13	10
Toilets	2 (12 kabin)	3 (18 kabin)	4 (24 kabin)	3 (18 kabin)
Picnic tables	202	320	334	130
Benches and covered picnic tables	15	9	0	1
Fountains	12	12	11	5
Stairs	4	0	0	0
Parking lots	100 araçlık	145 m²	2000 m²	305 m²
Directional signs	2	6	3	4
Showers	4	7	6	5
Dressing cabins	4 (12 kabin)	4 (12 kabin)	4 (12 kabin)	4 (12 kabin)
Children's playgrounds	2	0	2	0

	Main Road Axle
Area sizes/lengths	13 km
Superstructures and OutdoorFacilities and Along with Their Quantities	
Entrance unit/Box Office	1
Walking path length	1 km
Landscape viewing terraces	3
Bus stops	5

Içmeler Bay (Anonymous, 2020)

Aydınlık Bay (Anonymous, 2022a)

Kavaklıburun Bay (Anonymous, 2022b)

Karasu Bay (Bahadori, 2018)

Figure 3. Kalamaki Bays

2.2. Method

The methodology comprises four distinct stages. Initially, an extensive literature review pertaining to the subject and field of study was conducted in the first stage. Following this, observation forms encompassing superstructures and outdoor facilities, and design criteria were developed in the second stage. Subsequently, the study team completed these forms during on-site field monitoring and observation studies conducted within the National Park. In the third stage, the data collected in the observation forms were transcribed into the Microsoft Excel program, and average scores were computed. In consideration of these points: 1-An examination was conducted on the scores and total scores assigned to each superstructure and outdoor facility at each location based on every success criterion. 2-The total score and success percentage achieved by each superstructure and outdoor facility in each operational location were scrutinized, and a comparison was made across all locations. 3-The total score and success percentage attained by each superstructure and outdoor facility, concerning design criteria throughout the entire national park, were computed and analyzed. 4-A comprehensive integration of all data encompassing the National Park was undertaken, culminating in the revelation of the overall success rate. In the final stage of the methodology, diverse design suggestions were researched, developed, and presented to address the identified deficiencies in the design of superstructures and outdoor facilities.

In the study, 20 different superstructures and outdoor facilities within the National Park were examined using 16 design criteria (Tables 2 and 3).

Table 2. Superstructures and outdoor facilities

Code	Superstructure and Outdoor Facilities	Code	Superstructure and Outdoor Facilities
A	Informative and warning signs	**K**	Parking lots
B	Restaurants	**L**	Directional signs
C	Product sales points/Buffets	**M**	Vehicle roads
D	Trash cans	**N**	Showers
E	Toilets	**O**	Dressing cabins
F	Picnic tables	**P**	Children's playgrounds
G	Bench and other rest elements	**R**	Entrance unit/Box office
H	Fountains	**S**	Walking path and limiting elements
I	Footpaths	**T**	Landscape viewing terraces
J	Stairs	**U**	Bus stops

Table 3. Design Criteria

No	Design Criteria	No	Design Criteria
1	Use of natural materials	**9**	Material compatibility
2	Being in harmony with nature	**10**	Good location
3	Use of durable materials	**11**	Compatibility with the identity of the national park and the region
4	Being well-groomed/clean	**12**	Be detectable
5	being functional	**13**	Being aesthetic
6	To be safe	**14**	Compatibility with other equipment
7	Being ergonomic	**15**	Uses for disabled people
8	Size/ratio balance	**16**	Adequacy - meeting the need

The study leveraged the work of Atabeyoğlu & Bulut (2007) and Aksu (1998) for the formulation of design criteria, while the research conducted by Karakaya & Kiper (2011) and Aksu (2014) was utilized to assess these criteria. Each location, superstructure, and outdoor facility's adequacy concerning each design criterion was appraised using a 5-point Likert scale (0 = none, 1 = very inadequate, 2 = inadequate, 3 = partially sufficient, 4 = sufficient, 5 = very adequate). The resulting scores were then averaged.

For each observation area, the design scores for all superstructures and outdoor facilities were calculated, and the overall design success of the observation areas was expressed as a percentage by comparing the total obtained score to the maximum achievable total score. Additionally, the design success of each superstructure and outdoor facility throughout the study area was determined as a percentage. The success categories were classified as follows: the 0-30% range denoted unsuccessful, the 31-45% range denoted inadequate, the 46-60% range denoted partially successful, the 61-85% range denoted successful, and the 86-100% range denoted very successful.

3. Findings and Discussion

The photographs of the outdoor facilities observed in Dilek Peninsula Büyük Menderes Delta National Park are provided in Figure 4.

Entrance unit/Toll booths

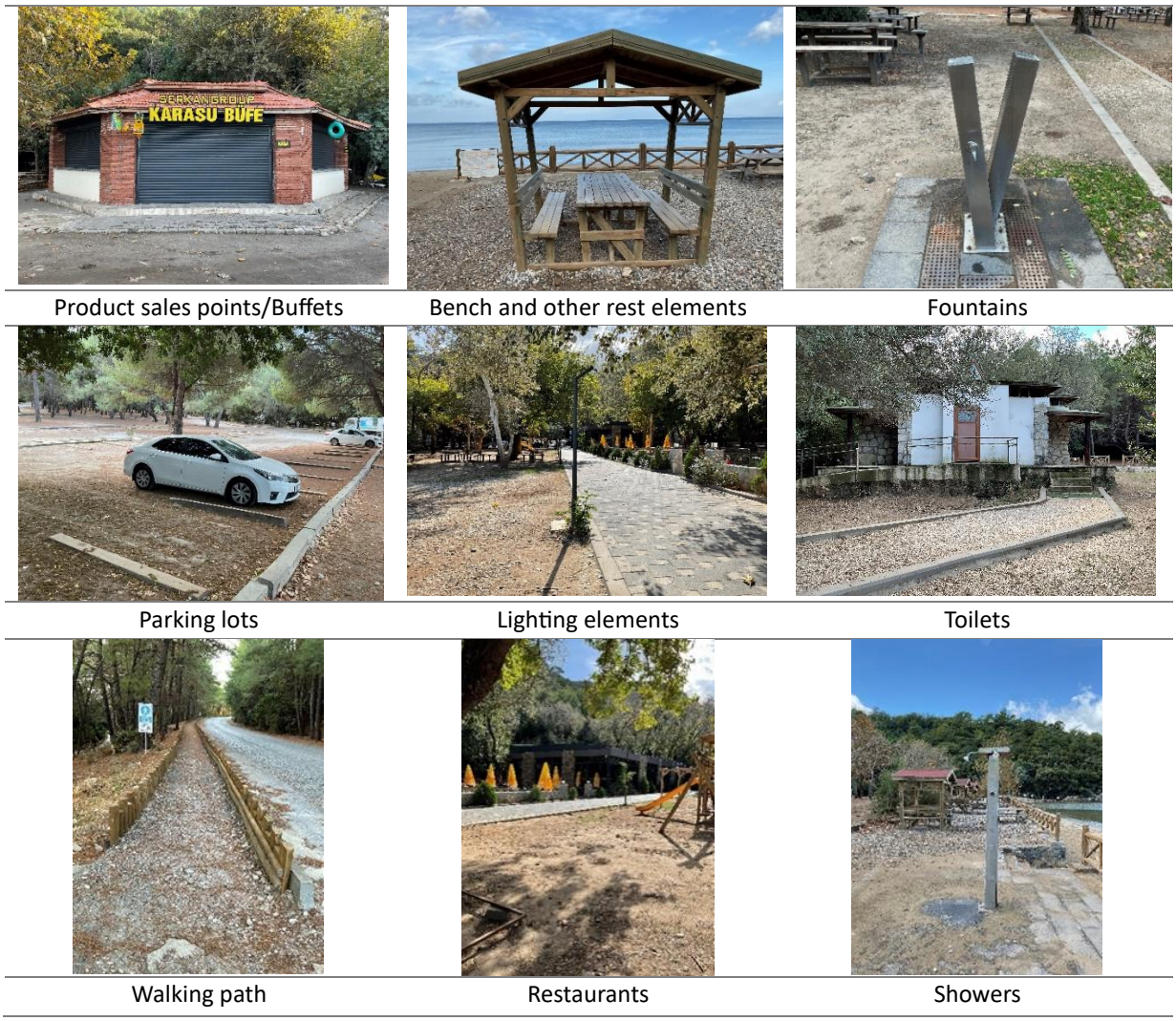
Landscape viewing terraces

Bus stops

Informative and warning signs

Picnic tables

Directional signs



Product sales points/Buffets | Bench and other rest elements | Fountains

Parking lots | Lighting elements | Toilets

Walking path | Restaurants | Showers

Figure 4. Some outdoor facilities in the National Park (Eşlik & Göktuğ, 2023a)

The scores assigned to the superstructures and outdoor facilities in Kalamaki Bays, as evaluated on a 5-point Likert scale, are presented in Table 4. Within the table, the respective Design Criteria are denoted by their corresponding numbers.

Analysis of Table 4 reveals that the superstructures and outdoor facilities in İçmeler Bay exhibit a generally ergonomic design (mean: 4.41) and appropriate positioning (mean: 4.41). However, shortcomings were identified in the use of natural materials (mean: 2.76) and overall harmony with the natural surroundings (mean: 2.94).

Similarly, in Aydınlık Bay, the superstructures and outdoor facilities are generally deemed adequate in number (mean: 4.60) and appropriately situated (mean: 4.40). Nonetheless, shortcomings were noted in the maintenance and cleaning of these facilities and equipment (mean: 2.87).

In Kavaklıburun Bay, it was determined that the superstructures and outdoor facilities are generally available in sufficient numbers (mean: 4.25) and appropriately positioned (mean: 4.00). However, considerations for disabled individuals (mean: 1.63) and aesthetic design (mean: 2.50) were found to be lacking.

Lastly, in Karasu Bay, it was observed that the superstructures and outdoor facilities are generally present in adequate numbers (mean: 4.07) and properly situated (mean:3.93). However, deficiencies were identified in the consideration of the needs of disabled individuals (mean: 1.93) and the aesthetic appearance of the designs (mean: 2.71).

Table 4. The evaluation of the superstructure and outdoor facilities in Kalamaki Bays according to the design criteria on a 5-point Likert scale.

(0 = none, 1 = very inadequate, 2 = inadequate, 3 = partially sufficient, 4 = sufficient, 5 = very sufficient)

(1-Use of natural materials, 2-Being compatible with nature, 3-Use of durable materials, 4-Being well-maintained/Clean, 5-Being functional, 6-Being safe, 7-Ergonomic, 8-Balance of size/proportion, 9 -Material compatibility, 10-Good location, 11-Compatibility with the identity of the national park and the region, 12-Being perceptible, 13-Aesthetic, 14-Compatible with other equipment, 15-Use for the disabled, 16-Adequacy - meeting the needs)

	İçmeler Bay																**Aydınlık Bay**															
Design Criterion No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Informative and warning signs	3	3	3	3	3	4	4	3	3	3	3	3	3	4	2	5	3	3	3	4	3	3	3	3	3	4	3	4	2	4	1	4
Restaurants	2	1	3	5	5	4	5	2	3	5	1	3	4	2	3	1	3	2	4	3	5	5	4	3	2	3	1	2	2	3	1	5
Product sales points/Buffets	4	4	4	5	5	4	5	1	4	5	3	5	4	3	4	1	3	3	5	5	5	5	5	2	2	5	2	5	3	2	4	2
Trash cans	1	1	4	2	4	3	3	4	1	3	1	3	2	1	2	3	3	3	3	2	4	3	4	4	2	3	1	2	2	2	2	2
Toilets	3	3	3	3	4	3	3	3	2	3	2	2	2	2	2	4	2	3	3	3	4	3	3	4	3	3	2	3	3	3	2	4
Picnic tables	4	4	4	3	4	5	4	5	4	5	4	4	3	5	3	2	5	5	3	1	4	3	5	5	5	4	5	4	3	5	4	2
Bench and other rest elements	4	4	4	5	4	4	5	5	4	5	5	4	4	5	3	4	4	4	4	4	4	4	5	5	4	5	5	4	4	5	4	4
Fountains	1	2	5	4	4	5	5	5	5	4	1	4	4	2	4	4	3	3	2	1	1	3	3	3	1	4	3	2	1	4	2	4
Footpaths	1	2	2	3	3	3	3	2	2	4	2	2	2	3	1	3	3	4	3	3	3	3	2	3	3	3	4	3	3	2	1	3
Stairs	5	5	4	4	5	4	5	5	5	5	5	4	5	5	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parking lots	3	3	2	3	3	3	3	3	3	3	3	2	2	5	1	2	2	2	3	2	3	3	2	2	3	3	1	1	2	2	1	5
Directional signs	5	5	4	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	4	5
Vehicle roads	2	2	5	4	5	5	5	4	4	5	2	4	3	2	1	5	2	2	5	4	5	5	5	4	4	5	2	4	3	2	1	5
Showers	1	2	5	4	4	5	5	5	5	4	1	4	4	2	4	4	3	3	2	1	1	3	3	3	1	4	3	2	1	4	2	4
Dressing cabins	3	3	3	3	4	3	3	3	2	3	2	2	2	2	2	4	5	5	3	1	3	2	3	3	5	5	4	3	3	5	1	4
Children's playgrounds	4	4	3	4	5	4	5	5	3	3	3	4	3	4	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean Score	2,76	2,94	3,59	3,76	4,24	4,12	4,41	4,00	3,76	4,41	3,18	3,94	3,82	3,88	3,12	4,29	3,13	3,27	3,33	2,87	3,67	3,73	3,93	3,80	3,47	4,40	3,47	3,73	3,33	4,13	3,00	4,60
	Kavaklıburun Bay																**Karasu Bay**															
Informative and warning signs	3	3	3	4	3	3	3	3	3	3	3	3	3	4	1	5	4	4	4	4	3	3	4	4	3	4	4	3	3	4	1	4
Restaurants	3	2	4	3	5	5	4	3	2	3	1	2	2	3	1	5	2	2	4	3	5	5	4	3	2	3	1	2	2	3	1	5
Product sales points/Buffets	3	3	5	5	5	5	5	2	2	5	2	5	3	2	4	2	2	2	4	3	5	5	4	3	2	3	1	2	2	3	1	5
Trash cans	2	2	3	2	3	3	3	3	3	3	2	3	3	3	1	3	2	2	3	2	4	3	4	4	2	3	2	2	2	2	2	3
Toilets	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4
Picnic tables	5	5	3	2	4	4	5	5	5	5	5	4	3	5	4	2	5	5	3	2	4	4	5	5	5	5	5	4	3	5	4	2
Bench and other rest elements	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	4	4	4	4	5	5	4	5	5	4	4	5	4	4
Fountains	3	3	2	2	1	3	3	3	1	4	3	2	1	4	2	4	3	3	2	2	1	3	3	3	1	4	3	2	1	4	2	4
Footpaths	3	3	3	3	3	3	2	3	3	3	3	3	3	2	1	2	3	3	3	3	3	3	2	3	3	3	3	3	3	2	1	3
Stairs	2	2	3	3	3	3	2	2	3	4	1	1	2	2	1	5	2	2	3	3	3	3	2	2	3	3	2	2	2	2	1	5
Parking lots	5	5	4	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	4	5
Directional signs	2	2	5	4	5	5	5	4	4	5	2	4	3	2	1	5	2	2	5	4	5	5	5	4	4	5	2	4	3	2	1	5
Vehicle roads	2	2	2	2	1	2	3	3	1	4	2	2	1	3	1	4	2	2	2	2	1	2	3	3	1	4	2	2	1	3	1	4
Showers	3	3	3	3	4	3	3	3	2	3	2	2	2	2	2	4	5	5	3	3	4	4	3	3	5	5	4	4	4	5	1	4
Dressing cabins	4	4	3	4	5	4	5	5	3	4	3	4	3	4	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Children's playgrounds	4	4	3	4	5	4	5	5	3	4	3	4	3	4	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean Score	3,07	3,00	3,29	3,25	3,38	3,50	3,50	3,50	2,75	4,00	2,63	2,88	2,50	3,00	1,63	4,25	3,14	3,14	3,36	3,07	3,57	3,71	3,71	3,57	3,07	3,93	3,00	3,00	2,71	3,43	1,93	4,07

The scores received by the superstructures and outdoor facilities located on the main axis, providing access to all bays of the National Park, are presented in Table 5 using a 5-point Likert scale. It was found that the superstructure and outdoor facilities on the main axis were positioned very well (mean: 5.00), and there was great attention to size/ratio balance (mean: 5.00) in the designs. Nevertheless, it was observed that the designs lacked consideration for individuals with disabilities (mean: 1.75).

Table 5. Evaluation of the superstructure and outdoor facilities on the main axis on a 5-point Likert scale according to design criteria

	Main Axle															
	Design Criterion NO															
Outdoor facilities	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Entrance unit/Box Office	3	3	5	5	5	5	5	5	4	5	2	5	4	3	4	5
Walking Path and Limiting Elements	5	5	4	4	3	3	3	5	5	5	4	3	4	4	1	3
Landscape viewing terraces	4	4	4	4	5	3	5	5	4	5	2	5	4	4	1	5
Bus stops	5	5	4	4	5	5	5	5	5	5	4	4	4	5	1	4
Mean Score	4,25	4,25	4,25	4,25	4,50	4,00	4,50	5,00	4,50	5,00	3,00	4,25	4,00	4,00	1,75	4,25

(0=not at all, 1=very inadequate, 2=insufficient, 3=partially sufficient, 4=sufficient, 5=very sufficient)
(1- Use of natural materials, 2- Being in harmony with nature, 3- Use of durable materials, 4- Being well-groomed/clean, 5- Being functional, 6- To be safe, 7- Being ergonomic, 8- Size/ratio balance, 9- Material compatibility 10- Good location, 11- Compatibility with the identity of the national park and the region, 12- Be detectable,, 13- Being aesthetic, 14- Compatibility with other equipment, 15- Uses for disabled people, 16- Adequacy - meeting the need)

The total score and success percentage received by each superstructures and outdoor facilities in each working location are presented in Table 6. Additionally, in Table 6, the total score and success percentage received by each superstructures and outdoor facilities in terms of design criteria throughout the National Park, and the total score and success percentage received from all outdoor facilities in each bay are presented.

Table 6. Score distributions of superstructure and outdoor facilities

Facilities	**IÇMELER BAY**		**AYDINLIK BAY**		**KAVAKLIBURUN BAY**		**KARASU BAY**		**MAİN AXLE**		**ALL LOCATIONS**	
(Code)	**T.S.**	**S.P.**	**T.S.**	**S.P.**	**T.S.**	**S.P.**	**T.S.**	**S.P.**	**T.S.**	**S.P.**	**T.S.**	**S.P.**
A	52	%65	50	%62,5	50	%62,5	56	%70	-	-	208	%65
B	49	%61,25	48	%60	48	%60	47	%58,75	-	-	192	%60
C	61	%76,25	58	%72,5	58	%72,5	47	%58,75	-	-	224	%70
D	38	%47,5	42	%52,5	42	%52,5	42	%52,5	-	-	164	%51,25
E	44	%55	48	%60	50	%62,5	49	%61,25	-	-	191	%59,68
F	63	%78,75	63	%78,75	66	%82,5	66	%82,5	-	-	258	%80,625
G	69	%86,25	69	%86,25	-	0	69	%86,25	-	-	207	%86,25
H	59	%73,75	40	%50	41	%51,25	41	%51,25	-	-	181	%56,56
I	38	%47,5	46	%57,5	43	%53,75	44	%55	-	-	171	%53,43
J	72	%90	0	0	0	0	0	0	-	-	72	%90
K	44	%55	37	%46,25	39	%48,75	40	%50	-	-	160	%50
L	78	%97,5	78	%97,5	78	%97,5	78	%97,5	-	-	312	%97,5
M	58	%72,5	58	%72,5	58	%72,5	58	%72,5	-	-	232	%72,5
N	59	%73,75	40	%50	35	%43,75	35	%43,75	-	-	169	%52,81
O	44	%55	55	%68,75	44	%55	62	%77,5	-	-	205	%64,06
P	60	%75	50	%62,5	61	%76,25	-	-	-	-	121	%71,25
R	-	-	-	-	-	-	-	-	68	%85	36	%85
S	-	-	-	-	-	-	-	-	61	%76,25	31	%76,25
T	-	-	-	-	-	-	-	-	64	%80	36	%80
U	-	-	-	-	-	-	-	-	70	%87,5	31	%87,5
%	888	%55,5	732	%50,8	713	%49,5	734	%50,9	263	%82,1	3330	%57,76

(0-30% unsuccessful, 31-45% inadequate, 46-60% partially successful, 61-85% successful, 86-100% very successful) (T.P. Total Score, B.Y. Success Percentage)
(A-Informative and warning signs, B-Restaurants, C-Product sales points/Buffets, D-Trash cans, E-Toilets, F-Picnic tables, G-Banks and other recreational elements, H-Fountains, I-Pathways roads, J-Stairs, K-Car parks, L-Directional signs, M-Vehicle roads, N-Showers, O-Dressing cabins, P-Children's Playgrounds, R-Entrance unit/Tollbooth, S-Walking Path and Limiting Elements, T-View observation terraces, U-Bus Stops)

In accordance with the assessments, the initial three superstructures and outdoor facilities, exhibiting highly successful designs (86-100%) throughout the National Park, comprise directional signs (97.5%), stairs (90%), and bus stops (87.5%). Conversely, the concluding three superstructures and outdoor

facilities, identified as partially successful across the National Park, encompass car parks (50%), garbage bins (51.25%), and footpaths (53.43%). Notably, based on the evaluations, superstructures and outdoor facilities in the National Park were deemed unsuccessful (0-30% unsuccessful) or inadequate (31-45% inadequate) in terms of design criteria.

Upon scrutinizing the success percentages of the study locations, it is evident that the total success percentage of superstructures and outdoor facilities along the main axis, providing access to all bays of the National Park, is the highest at 82.1%, while Kavaklıburun Bay registers the lowest total success percentage at 49.5%.

Summing up all location success percentages, the superstructures and outdoor facilities within the Dilek Peninsula Büyük Menderes Delta National Park were noted to be partially successful, achieving an overall success rate of 57.76%

4. Conclusion and Suggestions

National parks are among the most important natural areas that are protected due to their natural and cultural values and also meet the recreational needs of the public. One of the most important purposes of recreational activities carried out in national parks is for visitors to get away from the cultural landscape and get to know natural areas, understand nature, and feel the integrity of nature. In this context, decisions on activities to be carried out in national parks and recreation area plans should be made based on scientific foundations.

In addition, the designs of superstructures and outdoor facilities in recreation areas in national parks should be compatible with the cultural identity and natural structure of the national park, durable, in sufficient numbers, and have aesthetic and functional functions. In this context, the designs of superstructures and outdoor facilities in national parks cannot be expected to have the same design features as other superstructures and outdoor facilities used in open and green areas in cities. The main concern in terms of design in national parks should be to prevent the natural landscape image from evolving into a cultural landscape.

In this study, the design success of of superstructures and outdoor facilities within the recreation areas of Dilek Peninsula Büyük Menderes Delta National Park was assessed through the examination of 16 design criteria. Upon evaluating the findings derived from field studies, it was determined that the designs of of superstructures and outdoor facilities utilized in the National Park achieved a partial success rate of 57.76%.

It has been observed that most of the parking areas situated at the entrance of each bay in the National Park lack regularity, suffer from poor visibility, and are not in harmony with the natural surroundings. The influx of heavy vehicle traffic at the National Park causes insufficient parking space. As a consequence, vehicles often resort to parking along the roadsides and even encroach into the picnic areas. Additionally, in designing parking lots within protected areas, it is essential to prioritize ecological and conservation-oriented approaches over accommodating visitor numbers. The size of parking areas should be determined exclusively by taking into account public transportation and emergency vehicle entrances (ambulance, fire brigade, etc.). Additionally, parking solutions for visitors outside the National Park area should be implemented.

Four bays, designated as Kalamaki Bays, situated in the Dilek Peninsula section of the National Park, experience high levels of utilization, particularly in the summer season. Within the National Park, where the recreational carrying capacity is disregarded, and no visitor management tools are employed, the National Park gates are closed, and visitor reception is suspended on weekends, coinciding with the unavailability of parking areas and roadsides. Confronted with intensified usage, in addition to the inherent physical characteristics of the area, the superstructure facilities and equipment elements suffer from inadequacy in terms of quantity, making the control, maintenance, and cleaning of the area challenging.

One of the primary challenges arising from the dense visitor masses is the issue of solid waste. On crowded days, garbage is indiscriminately discarded as bins reach full capacity. Leaking water from

these waste containers not only contaminates the ground but also attracts wild animals to the vicinity. While foraging through garbage cans to meet their nutritional needs, garbage bins may inadvertently topple or wild animals become trapped inside the bins, resulting in potential injury or even fatality.

A design proposal for garbage bins has been developed and illustrated in Figure 5. In this design suggestion, the trash can lid is opened by pulling it forward and the garbage is placed inside this lid. In this way, wild animals cannot enter the trash can. The accumulated garbage can be emptied by unlocking the discharge door located on the side of the trash can. Impregnated pine was selected as the primary material for the main body in this design.

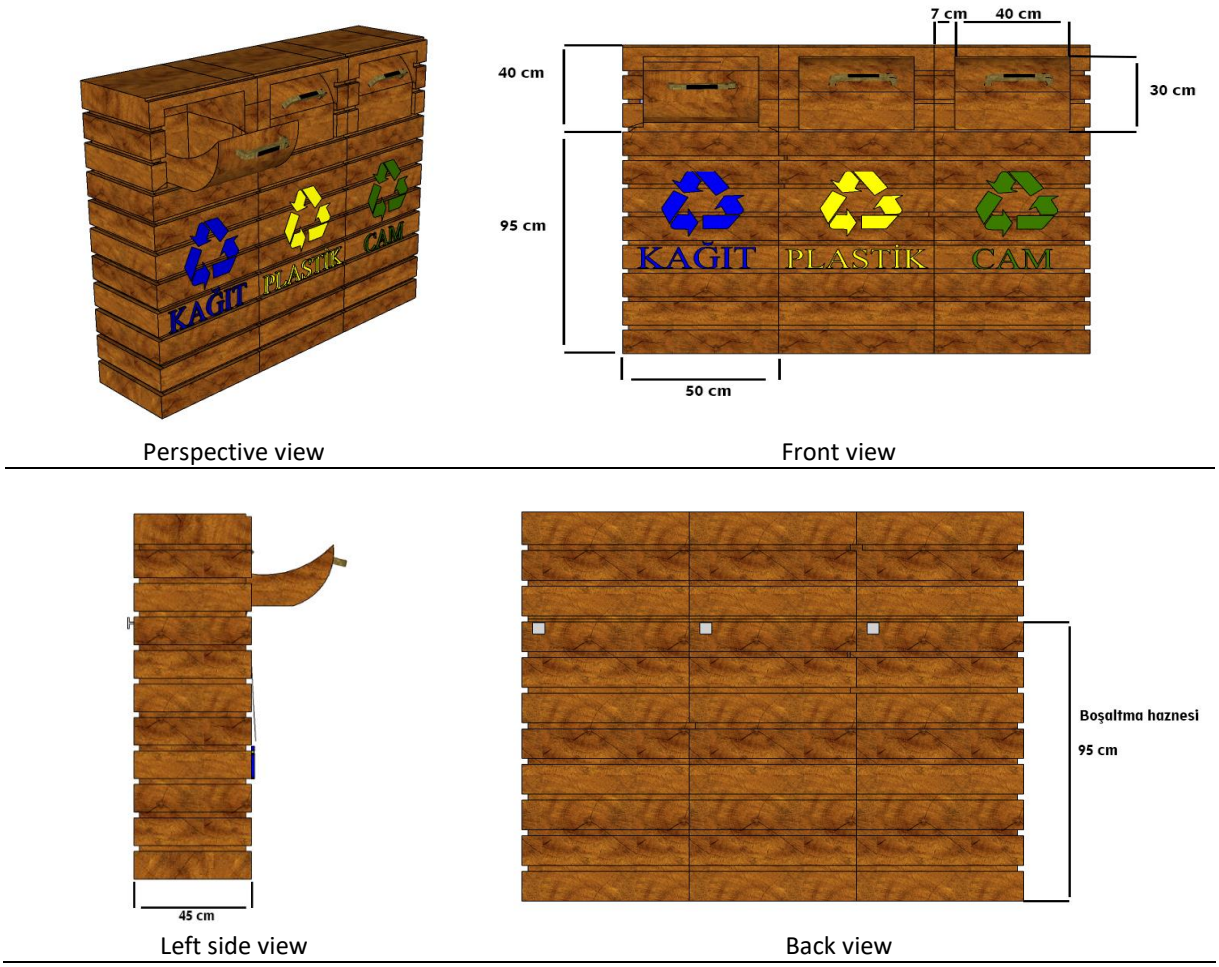
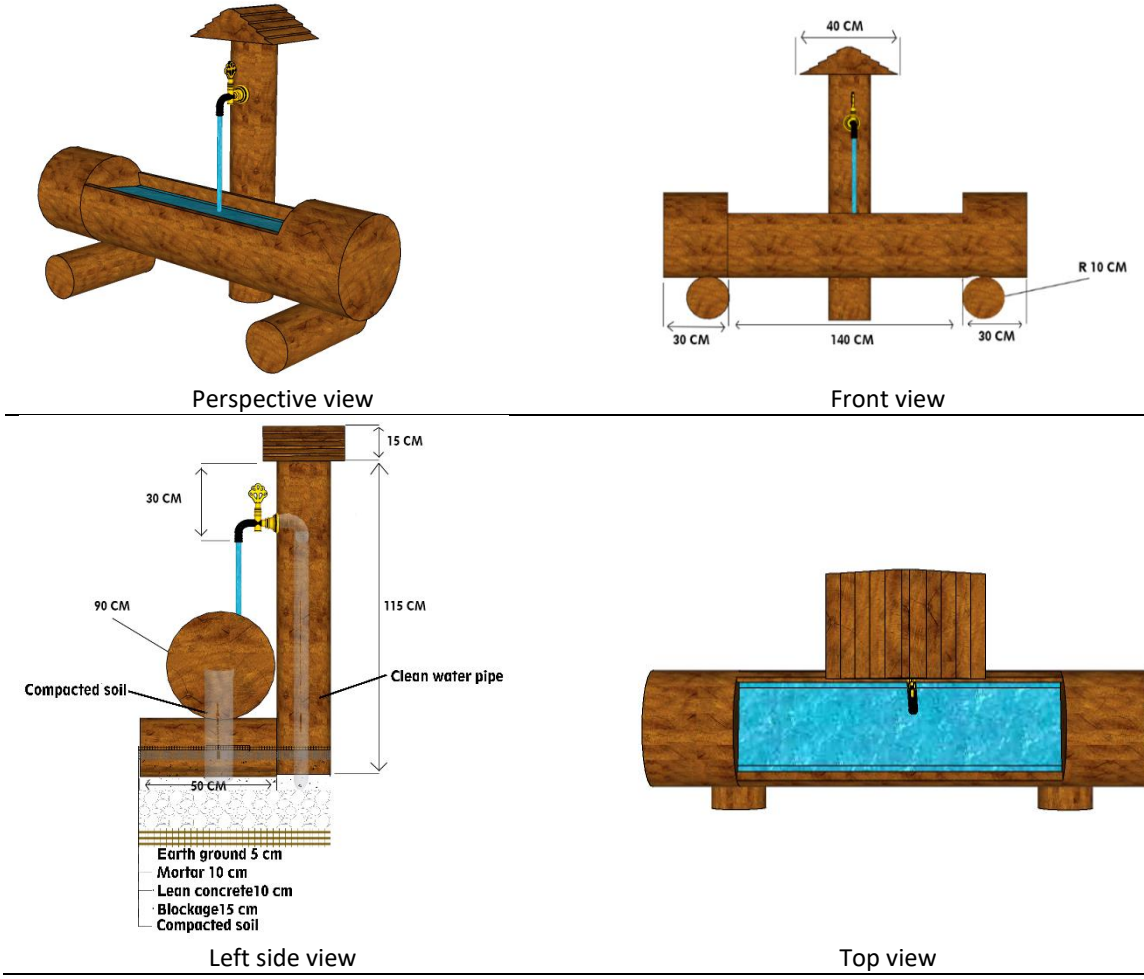


Figure 5. Trash can design (Eşlik & Göktuğ, 2023b)

The most preferred bay among the Kalamaki Bays is İçmeler Bay, due to its proximity to the entrance gate and possession of the only beach and shallow sea among the bays. İçmeler Bay has recently undergone reorganization through landscaping projects, resulting in the renewal of the majority of superstructure facilities and equipment elements. The newly installed picnic tables, restaurants, and buffets have been identified as well-maintained and functional. However, an observation reveals a lack of integration with the natural landscape image, and the quantities and numbers exceed those stipulated in the long-term development plan of the National Park and the technical specifications of the recreation areas. Similarly, it has been determined that too many pedestrian paths have been created in the area beyond the needs, and sand and gravel brought from outside in designing these paths have damaged the lower vegetation and natural texture. Floral designs were incorporated around these paths with exotic plants that are not part of the natural vegetation of the national park. This situation has been observed to negatively impact the natural landscape image of İçmeler Bay. Furthermore, an excessive number of picnic tables has compromised the wild and untouched appearance of the area, making it resemble an ordinary recreation space. In national parks protected

for their natural qualities, the design of superstructure facilities and equipment elements should not compromise the natural texture, flora, and fauna, and should prioritize aesthetic concerns.

It is crucial to acknowledge that the perception of aesthetic appearance in national parks significantly differs from that in open and green urban areas. Therefore, the chosen materials for designs must be durable and harmonize with nature. Although the fountains designed in İçmeler Bay are constructed from metal, a durable material, they appear incongruent with nature. The fountains in other bays exhibit partial compatibility with nature but suffer from poor maintenance, low functionality, and aesthetic appeal. As an alternative to these fountains, a design utilizing natural wood material is presented in Figure 6. In this fountain design, the interior of an impregnated pine tree is carved, housing a clean water pipe that allows water to flow into the fountain. The reservoir, through which the water flows, retains water up to a certain level. When the water reaches the discharge pipe's level, it is released. This designed fountain effectively caters to wildlife's water needs by accumulating water in its reservoir up to a specified level.



Perspective view | Front view

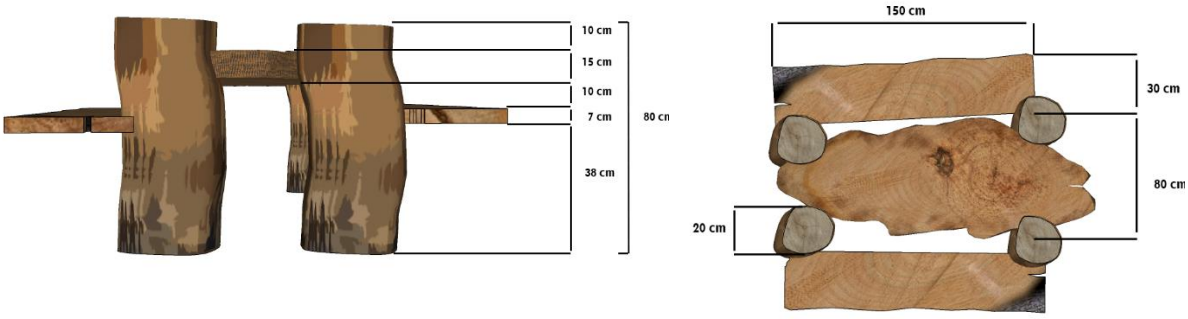
Left side view | Top view

Figure 6. Fountain design (Eşlik & Göktuğ, 2023b)

During the observations, two distinct picnic table designs were identified in Içmeler Bay. However, these designs lack visual coherence with each other, and it was observed that the newly added picnic tables obstruct the view and do not aesthetically adhere to principles such as balance, form, and ratio/proportion. Conversely, picnic table designs in other bays were found to be conventional, exhibiting signs of neglect and damage. As an alternative to these benches, a bench design utilizing natural wood material is presented in Figure 7.

Solid fir material with its natural form intact was employed for the legs, seat, and upper part of the bench. During the assembly of this bench, grooves were created in the areas where components were fixed together, ensuring a seamless fit without the use of any screws.

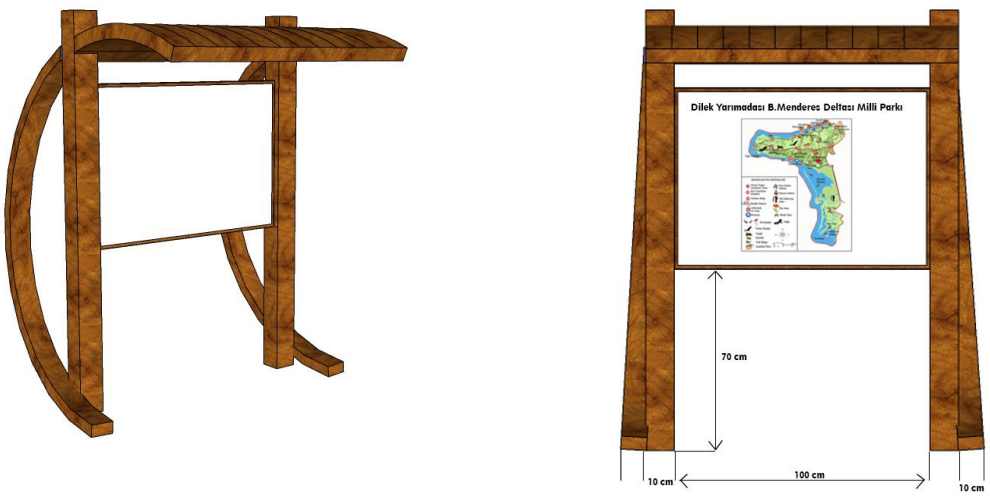
Perspective view | Perspective view



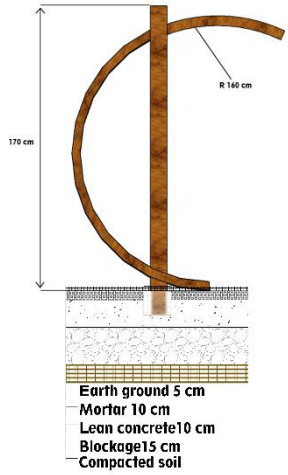
Left side view | Top view

Figure 7. Picnic table design (Eşlik & Göktuğ, 2023b)

One of the essential elements in national parks includes information boards and warning signs. Information boards play a crucial role in explaining the natural and cultural wealth of the National Park, offering insights into recreational activities, and thereby providing visitors with valuable information. Warning signs are pivotal for visually communicating visitor rules, designated areas, and behaviors, emphasizing situations that require visitor sensitivity. Therefore, it is imperative that these panels and signs are visually striking, appropriately positioned, and easily readable. During the inspections, it was observed that many of these elements had lost their functionality due to faded and unreadable inscriptions. An alternative design has been developed, incorporating a roof system to mitigate the impact of adverse weather conditions on informative and warning signs used in the National Park, as presented in Figure 8. The design utilizes impregnated pine for the construction of the sign's poles and roof, with mica serving as the protective material for the written content on the sign.



Perspective view



Front view

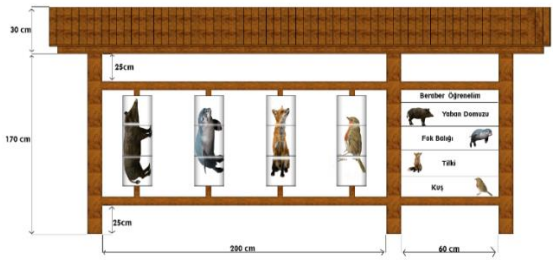
Left side view

Top view

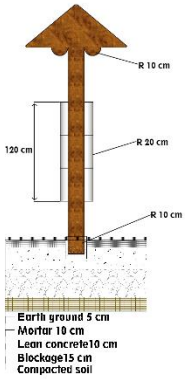
Figure 8. Informative sign sample design (Eşlik & Göktuğ, 2023b)

As a result of the evaluations conducted on the design criteria of the children's playgrounds in the National Park, it can be concluded that it achieved a success rate of 71.25%, indicating a commendable success. Nevertheless, children's play elements in the National Park exhibit similar features and functions as those found in urban areas. Instead of conventional children's play elements in national parks, there is an opportunity to incorporate educational designs where children can learn various aspects of the national park, such as flora and fauna, through play. To illustrate this concept, a game element was designed in which the image of a wild animal native to the National Park is completed when pieces are rotated and aligned, as depicted in Figure 9. The main frame and roof of the design utilize impregnated pine wood, circular PVC is employed in the rotation mechanism, and mica material serves as a protector on the informative game board.

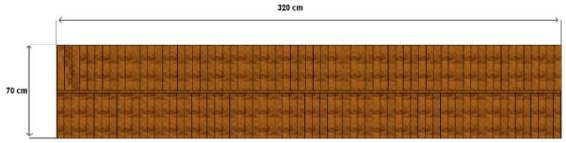
Perspective view



Front view



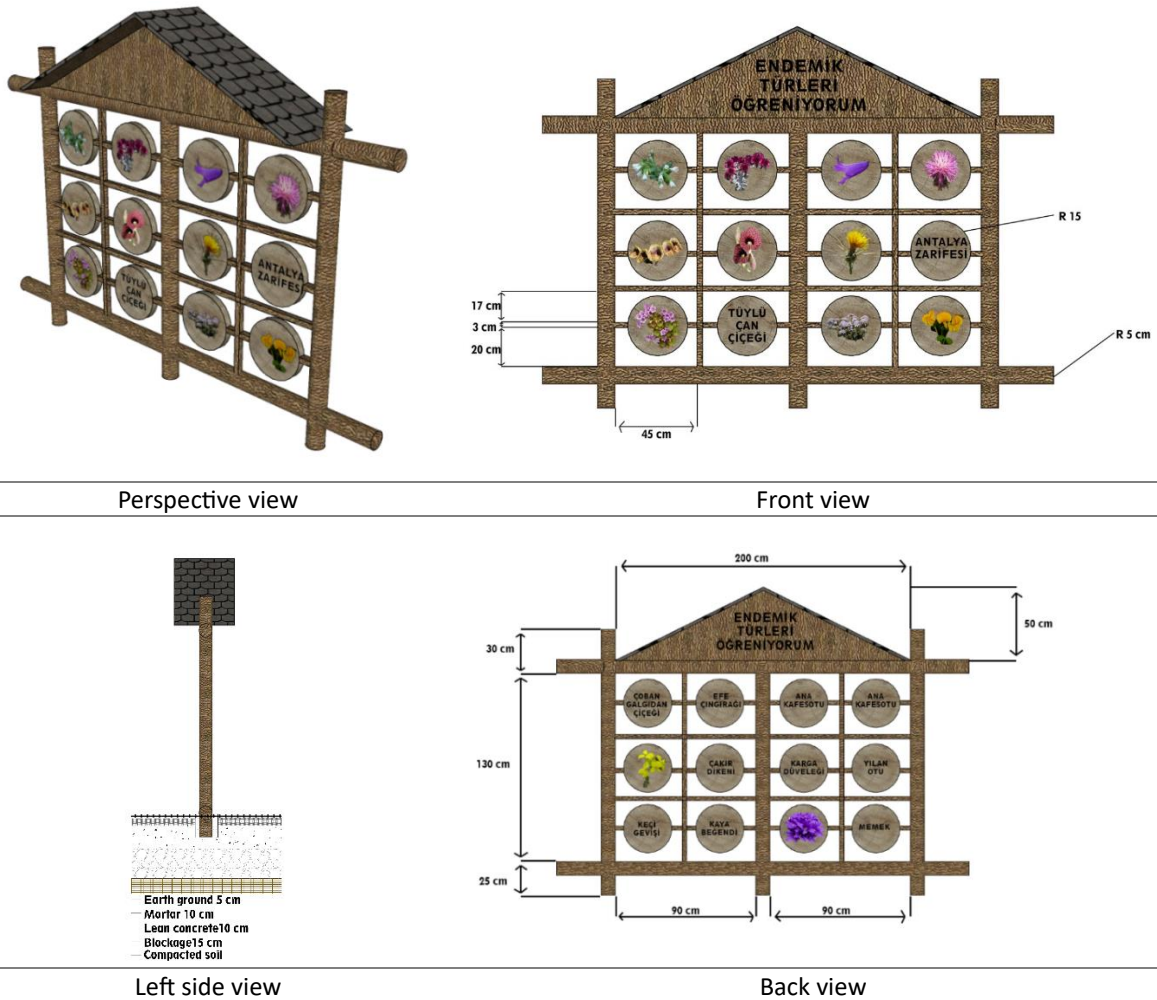
Left side view



Top view

Figure 9. Design of a fauna activity game called" Beraber Öğrenelim" (Eşlik & Göktuğ, 2023b)

In the design depicted in Figure 10, panels featuring pictures and names of endemic species in the National Park are mounted on a rotating mechanism. The objective is to provide an enjoyable learning experience for children, allowing them to simultaneously have fun and gain knowledge about significant plant species in the National Park. The main frame of the design is constructed using untreated oak wood, ensuring durability. A sand membrane is employed for the roof due to its high resistance, and a steel material is used in the mechanism facilitating the rotation of the panels.

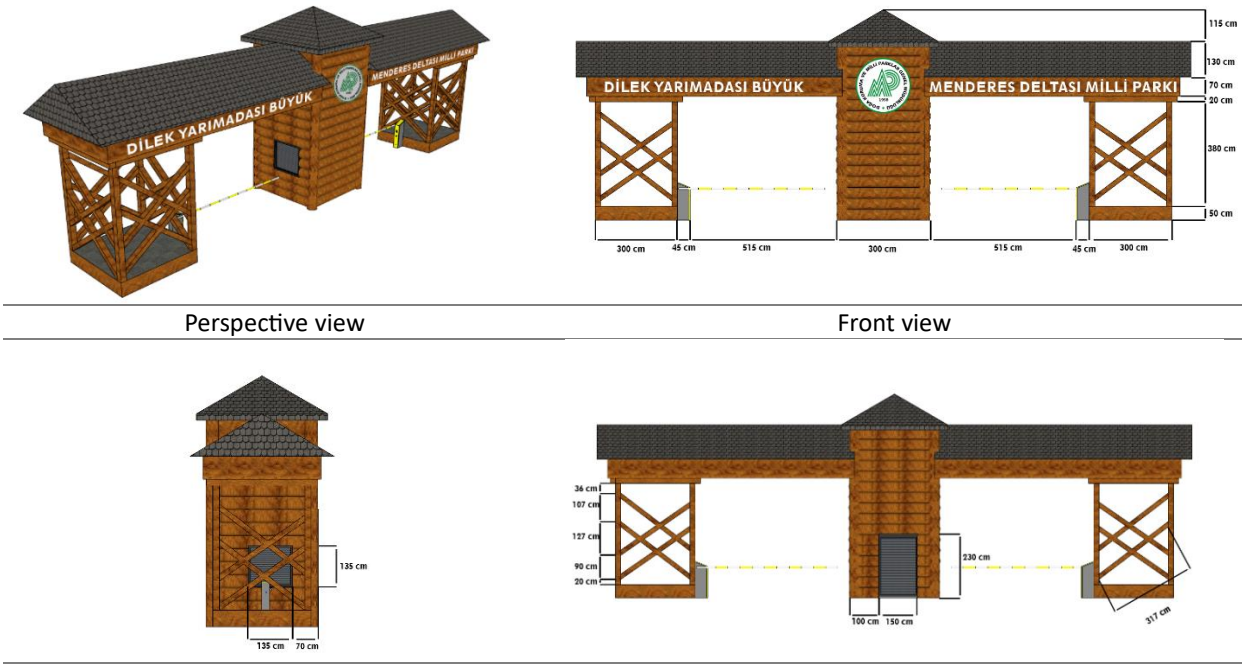


Perspective view | Front view

Left side view | Back view

Figure 10. Plant activity game design called "Endemik Türleri Öğreniyorum" (Eşlik & Göktuğ, 2023b)

The entrance gates of national parks serve as crucial elements symbolizing the park, shaping visitors' initial impressions. Consequently, these gates are expected to feature natural or nature-inspired designs that effectively express the core values of the national park. In the conducted evaluations, the entrance gates and toll booths at the Dilek Peninsula were found to have an 85% success rate concerning design criteria, classifying them as 'successful.' However, they garnered average to below-average scores in terms of the design criteria related to the 'use of natural materials,' 'reflection of the national park's identity,' and 'harmony with nature.' As a response, an alternative design proposal has been developed for the entrance gate and toll booths (Figure 11). This design encompasses both entrance and exit directions, with the ticket booth strategically placed at the center. The toll booth and main frame are crafted from impregnated pine trees, while a highly durable sandy membrane material is employed for the roof.



Perspective view | Front view

Left side view | Back view

Figure 11. Entrance unit and toll booth design (Eşlik & Göktuğ, 2023b)

The subsequent recommendations have been offered for the design of superstructure facilities and equipment within the National Park:

Firstly, the pedestrian path originating from the administrative building at the National Park's entrance, leading to İçmeler Bay, could be extended to Karasu Bay, the final bay designated for recreational activities, utilizing the space allocated for vehicular traffic.

Upon scrutiny, it was discerned that superstructure facilities and equipment in all bays lacked consideration for the utilization by individuals with disabilities. There is a pressing need for designs that prioritize accessibility for disabled individuals. Consequently, it is imperative to ensure that forthcoming designs adhere to universal design principles, accommodating the diverse needs of the entire societal spectrum (Belir, 2021).

In conclusion, when formulating designs for the superstructure facilities and equipment within the Dilek Peninsula Büyük Menderes Delta National Park, meticulous attention should be given to soliciting input from expert groups and users. The resultant designs should embody the National Park's identity, satisfying functional, aesthetic, and universal design criteria. It is anticipated that such an approach will elevate its standing, both nationally and internationally.

Acknowledgements and Information Note

The article adhered to national and international research and publication ethics. Ethics committee approval was not necessary for the study.

Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to the article.

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Assessment of Ecological Landscape Design: A Case Study Applying LEED Certification Criteria to BTU Mimar Sinan Campus

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Abstract

Ecological design is an approach that is applied in campus areas. This study aims to determine the LEED certificate points achievable through proposed ecological landscape designs for campus areas. The v3-2009 version of the LEED certificate was used in the study. In this study, national and international articles, LEED scoring system was first examined. Within the scope of the information obtained, the point value of the study area was calculated for its current form based on the LEED certification system. New ecological landscape design study was proposed for the area and re-scoring was performed within the scope of this proposed project. After the total score that campus would receive from the LEED certificate and the score obtained from each category were determined. Through the ecological campus planning approach developed in this study, the campus's certificate score increased from 10 to the 'Silver certificate' level, totalling 50 points.

Keywords: *Planting design, ecological design, energy and water efficiency, green certification, LEED.*

Ekolojik Peyzaj Tasarımının Değerlendirilmesi: LEED Sertifikasyon Kriterlerinin BTÜ Mimar Sinan Yerleşkesine Uygulandığı Bir Örnek Olay Çalışması

Öz

Ekolojik tasarım kampüs alanlarında uygulanan bir yaklaşımdır. Bu çalışma, kampüs alanları için önerilen ekolojik peyzaj tasarımlarıyla elde edilebilecek LEED sertifika puanlarının belirlenmesini amaçlamaktadır. Çalışmada LEED sertifikasının v3-2009 versiyonu kullanılmıştır. Bu çalışmada ilk olarak ulusal ve uluslararası makaleler, LEED puanlama sistemi vb. çalışmalar incelenmiştir. Daha sonra elde edilen bilgiler kapsamında çalışma alanının LEED sertifikasyon sistemi esas alınarak mevcut haliyle puan değeri hesaplandı. Daha sonra alana yönelik yeni ekolojik peyzaj tasarım çalışması önerilmiş ve önerilen bu proje kapsamında yeniden puanlama yapılmıştır. Daha sonra kampüsün LEED sertifikasından alacağı toplam puan ve her kategoriden alınacak puan belirlendi. Bu çalışmada geliştirilen ekolojik kampüs planlama yaklaşımı sayesinde kampüsün sertifika puanı 10'dan 'Gümüş sertifika' düzeyine çıkarak 50 puana yükseldi.

Anahtar kelimeler: *Bitkisel tasarım, ekolojik tasarım, enerji ve su verimliliği, yeşil sertifika, LEED.*

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1. Introduction

Along with the global decrease in biological capacity, many threats such as global warming and a decrease in arable land, potable water and natural energy resources are occurring (Obata, Agostinho, Almeida & Giannetti, 2019). To minimise these effects, different professional disciplines have come together and developed solutions. One of these solution proposals is the use of ecological approaches. Ecological design is a concept that requires working with an interdisciplinary approach to support social, cultural, economic and technological processes, especially ecological processes while designing a vital environment that can be sustained without disturbing the natural balance despite nature in the natural environment (Ünal, 2014). The ecological design approach is applied in the building and its immediate surroundings, green areas, hospital structures and many other areas. Another application area of the ecological design approach is campus buildings. Ecological campuses focus on 'environmental sustainability', the 'ecological cycle' and being 'healthy' (Gomez & Derr, 2021). For example, Konya Food and Agriculture University has designed a green roof that can be described as ecological, also called "Green Pot" (Arat & Kaçar, 2020). In addition to the substantive connotations of 'energy conservation' and 'resource recycling', sustainable campuses integrate the common awareness of the community by breaking down barriers. For example, there are many ecological practices at Taiwan University. These ecological applications are such as seperation of garbage, recycling of resources and use of leaf litter as fertilizer by turning it into compost and expanding the use of solar energy (Yang, 2021).

Sustainability is often associated with ecology. However, the concept of sustainability has a broader perspective such as economy, politics and social issues in addition to ecology (Schiederig, Tietze & Herstatt, 2012). The concept of sustainability has been on the agenda of the world since the 1970s. Since the Stockholm Declaration in 1972, studies on sustainability have started and university institutions have been involved in studies in this direction since 1990 (Saygın & Ulusoy, 2011). This has led to the design of university campuses taking into account the principle of sustainability. The main purpose of sustainable design in campus areas is to mitigate the consumption of basic resources such as energy, water, and raw materials (Patel & Patel, 2012). Energy-efficient, water-efficient, waste-efficient and climate-efficient designs can be developed with ecological and sustainable design approaches for campus areas. There are some green certification systems within the supervision of all these approaches.

Numerous green certification systems worldwide evaluate green area, buildings and their nearby environments, thereby demonstrating how ecologically sound these designs are (Süzer, 2015). Leadership in Energy and Environmental Design (LEED) rating systems and the Building Research Establishment Environmental Assessment Method (BREEAM) are the world's leading certification systems (Erbıyık, Çatal, Durukan, Topaloğlu & Ünver, 2021). Other certification systems include the Green Standard for Energy and Environmental Design (G-SEED, South Korea), Green Star (Australia) and the Comprehensive Assessment System for Built Environment Efficiency (CASBEE, Japan) (Caymaz & Başkaya, 2022; Erbıyık et al., 2021). Another certificate system is the SİTES certificate, which evaluates green areas (Sustainable Sites Initiative, 2014; SITES, 2023). For example, the SITES Silver-certified Minneapolis Convention Center Plaza is the first SITES project in Minnesota, and the first SITES-certified project at a convention center (SITES, 2023). Certifications serve an important role in providing information between stakeholders through simplified communication, minimising environmental impacts, completing sustainability assessment tools and introducing sustainability aspects early in the planning process (Süzer, 2015).

LEED is the most popular and widely used green building rating system worldwide. The LEED green building certification system was developed in 1998 by the United States Green Building Council (USGBC), a consensus-based nonprofit organisation (Uğur & Leblebici, 2018). The LEED certificate evaluates projects using different versions according to the nature of the area to be designed. Categories such as new constructions, schools, homes, commercial interiors and neighbourhood development are included under this certification system. The evaluation criteria and rating schemes of each category are different (Atasoy, 2020). However, in general, the evaluation criteria are

examined in six categories. These categories are sustainable areas (SS), water efficiency (WE), energy performance (EA), materials and resources (MR), indoor environmental quality (IEQ) and innovative design (INNO) (Cidell, 2009). Projects that score 40–49 points after the evaluation are entitled to receive a certificate, while projects with 50–59 receive a silver certificate, those with 60–79 points receive a gold certificate and those with 80–110 points receive a platinum certificate (Gurgun, Polat, G., & Bayhan, 2016). LEED NC, v.3 was used within the scope of the present study and consists of five main categories. These categories include sustainable areas, WE, energy and atmosphere, MR and IEQ. Various criteria must be fulfilled under each relevant category, with specific points being awarded to each. The final score of the evaluated building is determined by summing the points earned. The higher the number of points earned, the higher the level of certification achieved. The possible scores that can be obtained from these five main categories correspond to a total of 100 points. There are two additional categories, innovation and regional priority, which can provide 10 bonus points to projects (Atasoy, 2020).

In this research, Bursa Teknik University (BTU) Mimar Sinan Campus located in Bursa province, which is under pressure with the urban texture of the western, south and northern parts, but still preserves its green texture, was determined as the study area. Many applications have been carried out within the scope of a sustainable campus in Mimar Sinan Campus. The present study aimed to evaluate how many points would be obtained if it was assumed that the LEED certificate was created with the discipline of landscape architecture in mind. In this context first stage, literature research was conducted. Two stages the current certificate point value of BTU Mimar Sinan Campus was determined by considering the v3-LEED 2009 version. Then, a new ecological landscape design proposal was developed for the area while considering these data and the headings in the LEED certification. Final stage, the scores obtained from all ecological applications were revealed and it was determined which certificate could be obtained with these applications. There are many studies in the literature evaluating ecological campuses. Many of these studies were evaluated by the Green Metric system. However, in these studies, only the current state of the campus and its score were determined. This study is unique in that it evaluates campuses according to the LEED certification system and develops a new ecological design proposal for the area. This study is important in terms of evaluating the campuses according to a new certification system other than the Green Metric certificate and showing the low scores obtained due to the LEED certificate being created with more architecture in mind. In addition, the outcomes of this study are valuable as they reveal that landscape should be considered as an important factor in the evaluation of university campuses in the future versions of the LEED certificate. The methods and outputs of this study set an example for the development of an ecological campus model in accordance with international standards in campuses in Türkiye and other developing countries.

2. Material and Method

2.1. Study Area

The study area was Bursa Technical University (BTU) Mimar Sinan Campus, which is located within the provincial borders of Bursa, with an area of 211,257 m^2 (Figure 1). In the western part of the area, there is Safety Street, with Eflak Street in the southern part, Ankara Yolu Street in the northern part and Hacivat Stream in the eastern part.

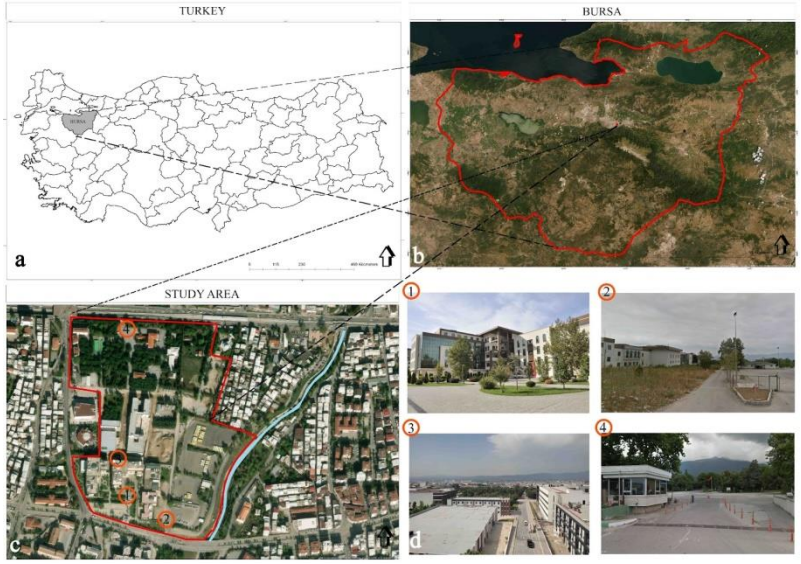

Figure 1. Location of BTU Mimar Sinan Campus in Türkiye (a, b) (Google Earth, 2022), the points where images 1–4 were taken (c) (Google Earth, 2022) and images of the study area (d) (Photograph: Onur AKSOY, 2022)

2.1.1. Data collection

In the study area, elevation, aspect and slope mapping was conducted by considering the Türkiye digital elevation model (DEM) data. The study area is located at an altitude range of 136–228 m asl. As a result, plant species selections for campus plant design were made according to the known altitude values. Slope analysis was also performed using DEM data and it was observed that the slope of the area varied between 7 and 10%. Aspect analysis was conducted using the same data. In this manner, suitable plant species were selected while considering these aspects and the desire to reduce the energy consumption of buildings. The soil structure of the campus area is colluvial, moderately eroded and consists of Class II soils (TSA, 2022). All topographic data in the study area is important in terms of guiding the designs in the campus areas where ecological landscape design will be conducted. In addition, a map showing the soil condition of the area was also created. In the plant design project to be proposed for the area, plant species selection was made in accordance with the soil type. When the water present in the area was examined, it was noted that Hacivat Stream is located on the eastern border of the area.

2.1. Method

The ecological landscape design project and evaluation study, which was conducted on BTU Mimar Sinan Campus while considering the LEED certificate, consisted of four stages (Figure 2). In the first stage, national and international literature data on the subject, applied project examples and landscape studies of all sizes were examined. In addition, various books, articles, herbarium surveys and notes and photographs taken during field studies on natural plants of Bursa were also examined at this stage. In the second stage, the current certificate point value of BTU Mimar Sinan Campus was determined by considering the v3-LEED 2009 version. The reason for using the v3-2009 version of the LEED certificate is that the company that provides the LEED certificate in Türkiye was called and received the opinion that it was appropriate to use this version. Company officials use this version in the evaluation of campuses in Türkiye. When determining the score values, the criteria determined by Council UGB (2009) and Haselbach (2010), Gurgun et al. (2016), Erbıyık et al. (2021) were considered. In addition to these criteria, natural data (i.e., topography, slope, aspect, elevation, soil, water, flora and climate) and structural data (transportation and existing structures) in BTU Mimar Sinan Campus were also examined.

Then, a new ecological landscape design proposal was developed for the area while considering these data and the headings in the LEED certification scoring criteria. At this stage, structural and plant suggestions related to ecological landscape design proposed for the area were put forward. In

the third stage, BTU Mimar Sinan Campus was then re-scored with the created ecological landscape design. The reason for using the v3-2009 version of the LEED certification in this study is that this version is more suitable for the ecological landscape design of campus areas. In addition, to evaluate the study area, applications in the structural category that were not under the jurisdiction of landscape architecture (but in the 'Necessary' category) in the LEED certificate were scored assuming that they already exist. During the final stage, the scores obtained from all ecological applications were revealed and it was determined which certificate could be obtained with these applications.

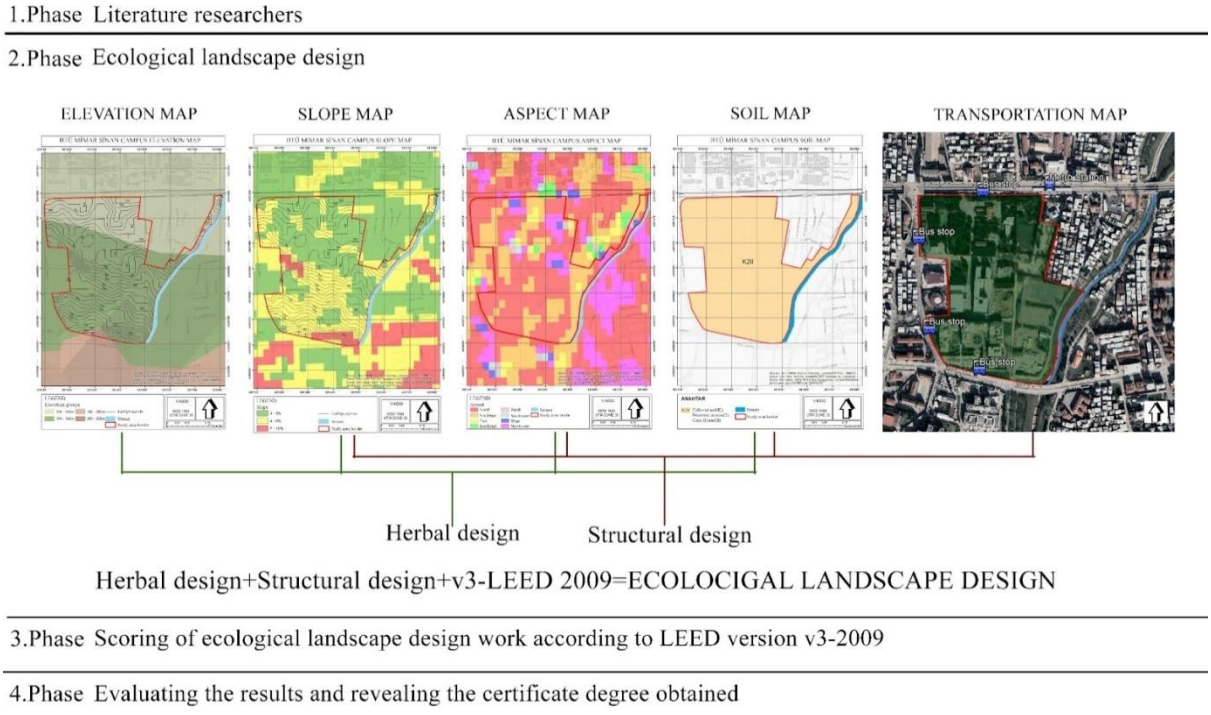

Figure 2. Study workflow chart (Aksoy, 2022)

3. Results and Discussion

3.1. The LEED Score of BTU Mimar Sinan Campus Before Ecological Landscape Design

Considering the 6 categories (sustainable areas, water efficiency, energy performance, materials and resources, indoor environmental quality, and innovative design) included in the v3-LEED 2009 version by Council UGB (2009) and the titles under these categories, the current score value has been determined. In determining and evaluating all these score values, interviews and technical reports held at BTU Construction Works Department were taken into account. In line with the examinations made in the study area, it was determined that the current LEED value of the area is 10 points. A breakdown of point values is presented as follows: Site selection (1 point); Brownfield redevelopment (1 point); Public transportation access (6 points); Innovative wastewater technologies (2 points). It was determined that BTU Mimar Sinan Campus could not obtain any certificate from the LEED certification system based on this point value. This point value of Mimar Sinan Campus is due to the fact that ecological approaches are not taken into account in building and landscape planning. Mimar Sinan Campus received a low score from the LEED certificate due to the lack of bicycle paths, inadequate bicycle parking areas, and lack of ecological design approaches regarding rainwater, waste, and energy efficiency. Figure 3 shows the parking areas, floors, roofs and open green area system before the ecological landscape design at Mimar Sinan Campus.

Figure 3. The situation of BTU Mimar Sinan Campus (Google Earth, 2022) before the ecological landscape design (Photograph: Onur AKSOY, 2023)

3.2. Ecological Landscape Design at BTU Mimar Sinan Campus

The BTU Mimar Sinan Campus ecological landscape design, which was performed while considering the natural and structural area analyses and the seven main titles in the v3-LEED 2009 version, is presented in Figure 4. This design work was conducted with structural and plant solutions that reflect the ecological characteristics of the area. Within the scope of structural design, suggestions for applications such as parking lots, bicycle paths, water collection areas, flooring and urban reinforcement elements were developed. Within the scope of planting design, natural plant use, rain gardens, rooftop and vertical gardens, wind shielding, drought-resistant grass use and biolamb were proposed. Applications were also proposed for the field.

Figure 4. The situation of BTU Mimar Sinan Campus after the ecological landscape design (Aksoy, 2022)

3.2.1. Sustainable sites

The sustainable sites category was evaluated out of 26 points (Table 1). The score value of the area before the ecological landscape design was 8 points. While 4 points of this value were obtained via

planting design applications, 7 of these points (Figure 12) were obtained due to the location of the area and structural applications. With the ecological landscape design proposed for BTU Mimar Sinan Campus, 19 points were obtained from the title of 'Sustainable Areas'.

Table 1. Point values obtained from the sustainable areas category and its sub-headings before and after the ecological design

v3-LEED 2009 Categories		**Category weights**	**Point value before design**	**Point value after design**
Sustainable Sites		26 points	8 points	19 points
Prereq 1	Construction Activity Pollution Prevention			
Credit 1	Site Selection	1	1	1
Credit 2	Development Density and Community Connectivity	5		
Credit 3	Brownfield Redevelopment	1	1	1
Credit 4.1	Public Transportation Access	6	6	6
Credit 4.2	Bicycle Storage and Changing Rooms	1		1
Credit 4.3	Low-Emitting and Fuel-Efficient Vehicles	3		3
Credit 4.4	Parking Capacity	2		2
Credit 5.1	Protect or Restore Habitat	1		1
Credit 5.2	Maximise Open Space	1		1
Credit 6.1	Quantity Control	1		1
Credit 6.2	Quality Control	1		
Credit 7.1	Non-roof	1		1
Credit 7.2	Heat Island Effect—Roof	1		1
Credit 8	Light Pollution Reduction	1		

In this category, the first structural application made within the scope of ecological landscape design was to minimise the number of parking lots in the area. The parking areas designed in the area have been designed while considering the parking regulations of Türkiye (2018) (see Annex 1). The working area is 211.257 m^2. In Annex 1 of the parking regulations, one parking lot is recommended for an area of 200 m^2 for university buildings. According to this article, a parking area for at least 1,057 people is needed in the study area. In the newly proposed ecological landscape design, an outdoor parking lot for 269 people, a parking lot for 53 hybrid vehicles, an indoor parking lot for 150 people and 555 parking lots should be provided in an area outside the campus, if required. Overall, 53 of these parking areas are reserved as shared parking areas. Additionally, a 310-person bicycle parking lot has been proposed for the study area. Shower cabins are also recommended in the immediate vicinity of the bicycle parking lots if there is space in the building.

Under this category, planting applications made within the scope of ecological landscape design are also included. Within the scope of ecological landscape design, the amount of green space in the study area has been increased by creating rooftop gardens (Figure 5), rain gardens, xeriscape gardens and natural plant areas. Except for the existing trees in the study area, a new planting design has been proposed for the entire area. With the new ecological design approach, 98,511 m^2 (approximately 58.07% of the area) of open green area was created. Among these open green areas, the area covered by the rooftop gardens is 24,168 m^2. The area covered by the buildings in this area is 46,821 m^2. Succulent plant species indigenous to Bursa were proposed for 51.61% of the roof area.

Figure 5. Recommended green roof application before and after the work area (Aksoy, 2022)

Apart from the ecological landscape design, due to the current location of the area, a point value was obtained from the sustainable areas category based on examinations made of the area according to the soil map of Türkiye II Class land (TSA). According to the results of the Google Earth program and measurements made in the field, Hacivat Stream is located in an area approximately 70 m from the buildings. In the 'Red Book of plants of Türkiye ', Ekim et al. (2000) assigned 1 point value from the title of 'field development' under this category since there were no living creatures from the threatened or endangered categories. Additionally, according to the 1996 zoning plan for the area, it has been used as a primary and high school education area as well as a public space from 2003–2006. Today, the area is used as a public space. Within the scope of this data, the area was not previously polluted and is not currently polluted. It is also considered that it is in a class of agricultural land; thus, 1 point was obtained from the title of 'brownfield redevelopment'. Due to the location of the area, the final point value obtained from the sustainable areas category originated from the 'Public transport access' heading. In line with the measurements made at BTU Mimar Sinan Campus, the existing north entrance is 150 m away from the metro station. In addition, the bus stops on Eflak Street and Safety Street are 30 m away from the campus. Thus, it achieved 6 points under the title of 'public transportation access' under the sustainable areas category.

3.2.2. Water efficiency

The current point value of this category before the ecological landscape design was 2 points (Table 2). This point value was obtained due to the existing water-saving faucets in the building. After the ecological landscape design was applied, the point value of this category increased to 6 points (Figure 12). These scores were obtained through planting design applications. In this context, the first planting application recommended for the area is rain gardens.

Table 2. Point values obtained from the water efficiency category and its sub-headings before and after the ecological design

v3-LEED 2009 Categories		Category weights	Point value before design	Point value after design
Water Efficiency		10 points	2 points	6 points
Prereq 1	Water Use Reduction—20% Reduction			
Credit 1	Water Efficient Landscaping	2–4		4
Credit 2	Innovative Wastewater Technologies	2	2	2
Credit 3	Water Use Reduction	2–4		

Many rain gardens (Figure 6) have been proposed for the area within the scope of the study. These applications are generally applied in the middle refuge, parking lot and areas where the slope decreases. While designing the rain gardens, the selected species were chosen according to the requirements of the zones. Water-loving plant species were used in the first zone, moderately water-

loving plants were used in the second zone and drought-resistant plant species were used in the outer zone. Additionally, natural species that can best adapt to the ecology of the area were selected. The plant species used in the rain garden are presented in Table 3. These species were selected from the natural species of Bursa flora while considering the study conducted by Uncapher & Erskine (2012).

Table 3. Natural plant species recommended for the rain gardens of BTU Mimar Sinan Campus

Trees	Bushes	Herbaceous species
Acer campestre	*Erica arborea*	*Bellis perennis*
Celtis australis	*Salix cinerea*	*Carex pendula*
Populus alba	*Vaccinium myrtillus*	*Iris orientalis*
Ulmus glabra	*Viburnum opulus*	*Primula vulgaris*

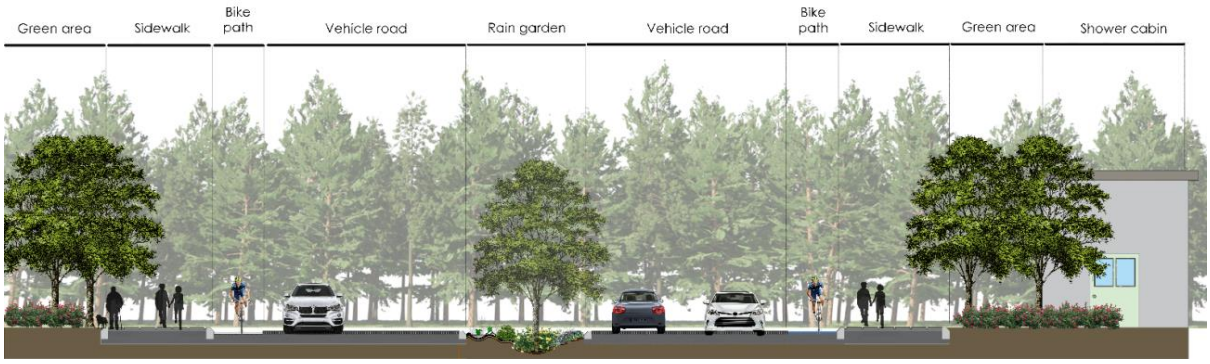

Figure 6. Rain gardens proposed for the medians of BTU Mimar Sinan Campus (Aksoy, 2022)

The second planting application recommended for the area is xeriscape gardens. According to Hilaire et al. (2008), with the correct application of xeriscaping, savings of up to 76% can be achieved in terms of outdoor water consumption. Additionally, drought-resistant plant species were used in the proposed water towers (Figure 7). The plant species used in xeriscape applications are listed in Table 4. These include plant species listed by Davis (1965–85), which were used in xeriscape applications by Williams (2013) and belong to the natural flora of Bursa.

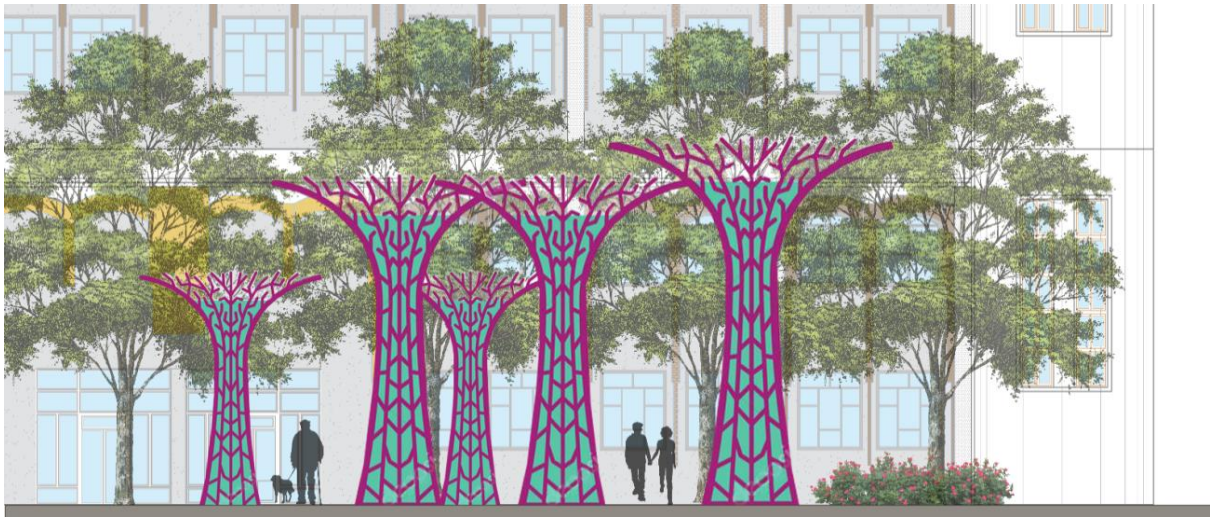

Figure 7. Proposed water collection towers in front of E block at BTU Mimar Sinan Campus (Aksoy, 2022)

Table 4. Natural plant species recommended for xeriscaping at BTU Mimar Sinan Campus

Trees	Bushes	Herbaceous species
Cercis siliquastrum	*Pyracantha coccinea*	*Achillea millefolium*
Fraxinus ornus	*Arbutus unedo*	*Cistus laurifolius*
Malus sylvestris	*Genista lydia*	*İberis spruneri*
Tilia argentea	*Vitex agnus castus*	*Salvia argentea*

Natural plant species were used in all planting practices recommended in the study area (except the use of plants that produce their own energy and plants that shine throughout their life cycles). Overall, a 42.121 m^2 grass area is proposed for the study site. Within the scope of ecological plant design, the grass mixture proposed for the area was created by considering the species naturally found in the region and low water consumption. Finally, passive rainwater harvesting system area of 4,712 m3 was proposed. The proposed water collection area (Figure 8) is designed to meet the irrigation water needs of outdoor plants. The passive rainwater harvesting system requires no additional pump power and no complex filtration systems (Kucukkaya, Kelesoglu, Gunaydin, Kilic & Unver, 2021).

Figure 8. Recommended compost and water collection area (Aksoy, 2022)

3.2.3. Energy and atmosphere

Before the ecological landscape design was made in the area, no points were obtained from the energy and atmosphere category. However, the score for this area increased to 17 (Table 5) with the vertical garden and roof gardens recommended in the ecological landscape design. While 17 points of this value were obtained with vegetative applications (Figure 12).

Table 5. Point values obtained from the energy and atmosphere category and its sub-headings before and after the ecological design

v3-LEED Categories		Category weights	Point value before design	Point value after design
Energy and Atmosphere		**35 points**	**0 points**	**17 points**
Prereq 1	Fundamental Commissioning of Building Energy Systems			
Prereq 2	Minimum Energy Performance			
Prereq 3	Fundamental Refrigerant Management			
Credit 1	Optimise Energy Performance	1–19		17
Credit 2	On-Site Renewable Energy	1–7		
Credit 3	Enhanced Commissioning	2		
Credit 4	Enhanced Refrigerant Management	2		
Credit 5	Measurement and Verification	3		
Credit 6	Green Power	2		

Windbreak, vertical garden and roof gardens have been proposed to save energy in the area. Vertical gardens on the north-northwest and south-southwest façade (i.e., the dominant wind directions of BTU Mimar Sinan Campus), rooftop gardens on the upper parts of the buildings and vegetative screening on the building facades have been proposed. *Hedera helix* was used as the plant species in vertical gardens. The specific leaf area (SLA) of the species is c. 200 $cm^2\ g^{-1}$ in shade, but closer to 100 $cm^2\ g^{-1}$ in sun. Typical leaf characteristics are: lamina area c. 50 cm^2; lamina volume c. 1.4 cm^3; foliar

water content is relatively high at c. 230 g H_2O 100 g^{-1} leaf dry mass (65–70% wet mass), although declining from juvenile to mature plants (Metcalfe, 2005). Considering the studies of Aşkın (2014) and Esin (2001) with all of these applications, it was predicted that 40% energy savings could be achieved. Thus, 17 points were obtained from this topic.

3.2.4. Materials and resources

In this category, the site has no current LEED score (Table 6). Materials were separated and stored with the recycling bins recommended for outdoor environments within the scope of LEED. In addition, the reinforcement elements used were recycled and procured from local materials. After these studies, the point value of the area was increased to 4 points (Figure 12).

Table 6. Point values obtained for the materials and resources category and its sub-headings before and after the ecological design

v3-LEED Categories		**Category weights**	**Point value before design**	**Point value after design**
Materials and Resources		14 points	0 points	4 points
Prereq 1	Storage and Collection of Recyclables			
Credit 1.1	Maintain Existing Walls, Floors and Roof	1–3		
Credit 1.2	Maintain 50% of Interior Non-Structural Elements	1		
Credit 2	Construction Waste Management	1–2		
Credit 3	Material Reuse	1–2		
Credit 4	Recycled Content	1–2		
Credit 5	Regional Materials	1–2		2
Credit 6	Rapidly Renewable Materials	1		1
Credit 7	Certified Wood	1		1

Except for 8 buildings in the Mimar Sinan Campus, which is the study area, only the concept design of 18 buildings is available. The materials to be used before the construction of these buildings have not been determined. However, the most important feature of the LEED certificate that distinguishes it from other certification systems is that it applies to the certification system before construction, after construction and during the construction phase. However, architectural applications were not included in the scope of the study. When the booklet in the LEED v3-2009 version is examined, it is stated that Regional Material Use is equivalent to the SITES v2 credit or component (USGBC, 2023). From this point of view, we can also think of this title as outdoor flooring. This suggests that the existing impermeable floors planned to be built in the area in the future will be removed and the use of regional materials will be used instead. In this context, it is recommended to use regional materials in the outdoor floor coverings planned to be built in the area in the future. In addition, it is recommended to replace the existing impermeable flooring materials with regional materials. The flooring materials recommended for the study area are naturally found in the area (e.g., Gemlik diabase, Uludağ granite, travertine and marble materials). Floors created using these materials are designed to provide an underground water supply. In addition, a distance map of the mines (Figure 9) from which the material used in the area was extracted was created in the ArcGIS environment. When the topographic thresholds are not considered, it is evident that the furthest mine supply distance for granite material is between 60–70 km, while the closest mine is Gemlik diabase for marble material. As a result, a value of 2 points was obtained for this title. The building materials of all reinforcement elements used in the area have been designed by considering recyclable and naturally site-specific materials. Within the study area, outdoor wood items include bamboo flooring, garbage cans made of linen, pergolas made of wood and geotextiles, seating units made of wood and stone materials, and lighting units constructed of wooden materials. These materials are rapidly renewable. In this manner, recycling which is an important component of ecological landscape design has been implemented in campus areas.

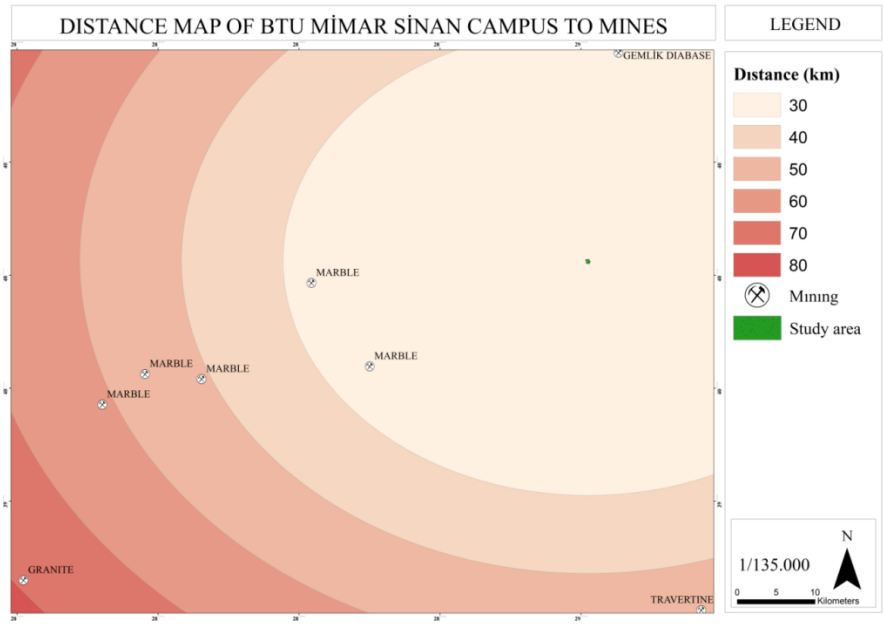

Figure 9. Distance map of the campus to mines (Aksoy, 2024)

The recommended wood materials were obtained from companies certified by the Forest Stewardship Council (FSC) in accordance with their principles and criteria. In this context, 1 point was obtained from this title. A compost processing facility (Figure 7) is proposed for the southeast of the area. By using the proposed compost processing facility, tree, branch, leaf, kitchen and grass residues can be converted into compost. This compost is planned for use as organic fertiliser for plants.

3.2.5. Indoor environmental quality (IEQ)

The IEQ category includes strategies for improving indoor air quality and accessing natural daylight and views while also improving acoustics (Council UGB, 2009; Haselbach, 2010). However, since the applications under this category cover architectural applications, the point value could not be obtained (Figure 12).

3.2.6. Innovation and design

In the examinations conducted at the BTU Mimar Sinan Campus, it was observed that there is currently no study in the field that can be considered innovative. The following aspects can be described as innovative in the ecological landscape design proposed under LEED: self-watering soil (Karagöz & Yücel, 2020), plant species that produce their own energy (Murray et al., 2016), plants that glow at night (Patel & Ashwini, 2022) and biolamb (Horvath & Tóth, 2005). With these applications, the score for this category was increased to 4 points (Table 7).

Table 7. Point values obtained for the ınnovation and design category and its sub headings before and after the ecological design

v3-LEED Categories		Category weights	Point value before design
Innovation and Design Process		**6 points**	**4 points**
Credit 1.1	Innovation in Design: Specific Title	1	1
Credit 1.2	Innovation in Design: Specific Title	1	1
Credit 1.3	Innovation in Design: Specific Title	1	1
Credit 1.4	Innovation in Design: Specific Title	1	1
Credit 1.5	Innovation in Design: Specific Title	1	
Credit 2	LEED Accredited Professional	1	

The first application that can be considered innovative in the study area is the application of 'biolamb' (Figure 10). Since the study area in Yıldırım District is close to an industrial zone, the air quality is low. The 'biolamb' (Horvath & Tóth, 2005) proposal is an ecological application that has been used for trial purposes in the campus area. These devices clean polluted air with algae growing within them and have been used in an attempt to improve air quality in the campus area.

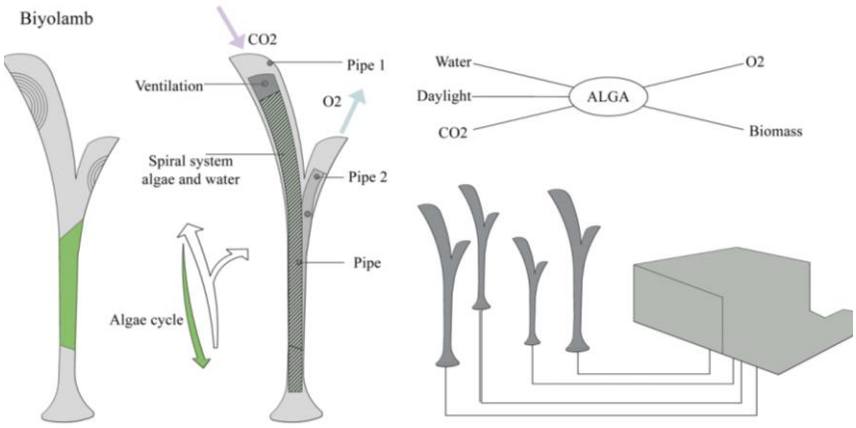

Figure 10. Working principle of the biolamb application proposed for the BTU Mimar Sinan Campus (Horvath &Tóth, 2005)

Another application is the use of plants that produce their own energy. This type of system, which works by using the energy stored in soil which contains nutrients and microorganisms secreted by plants during their growth (Murray et al., 2016)—was placed in certain parts of the study area for trial purposes. Compost material created from branches, bark, leaves and grass waste in the gardens will be constantly supplied to these areas. In this manner, the continuity of nutrients in the soil will be ensured. Plants that glow throughout their lifetime (Patel & Ashwini, 2022) are suggested for entrances and heavily used areas for trial purposes. The last application that can be considered innovative within the scope of ecological landscape design in the area is the 'self-irrigating soil' application. This new soil mixture can draw water from the air and distribute it to the plants. This soil mixture can expand the arable land map and reduce agricultural water use. In this method, highly moisture-absorbing gels (Figure 11) are used to draw water from the atmosphere to the soil. When the soil reaches a certain temperature, the gels release water to be given to the plants (Demitri et al., 2013). In a similar study, Karagöz & Yücel (2020) tested this method on Euonymus japonicus 'Aureomarginatus'. In this study, the authors attempted to reduce the amount of water consumption by using super-absorbent polymers. As a result of the study, water use was reduced by 45%, while labour costs were reduced by 48%. This study was applied to four parcels for trial purposes in the field.

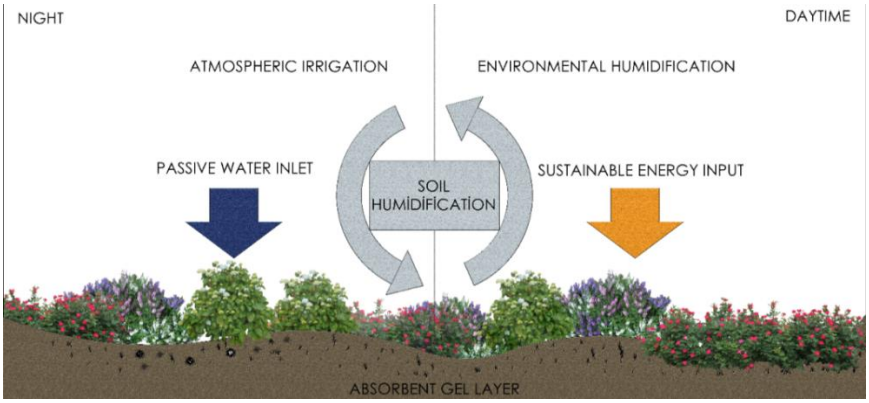

Figure 11. 'Self-irrigating soil' proposed for BTU Mimar Sinan Campus (Aksoy, 2022)

3.2.7. Regional priority

No point value could be obtained for this category within ecological landscape design. This is due to the inability of the design to meet the appropriate spatial criteria and the fact that the LEED certificate was created while considering areas within the borders of the USA.

3.3. Scoring BTU Mimar Sinan Campus After Ecological Landscape Design According To the LEED Scoring System

Although the score value for BTU Mimar Sinan Campus before the ecological landscape design was 10, a total of 50 points were obtained from the LEED certification when the ecological landscape design based on the natural and structural area was analyzed and v3-LEED (2009 version) was applied. This point value corresponds to a 'Silver Certificate' from the LEED certification.

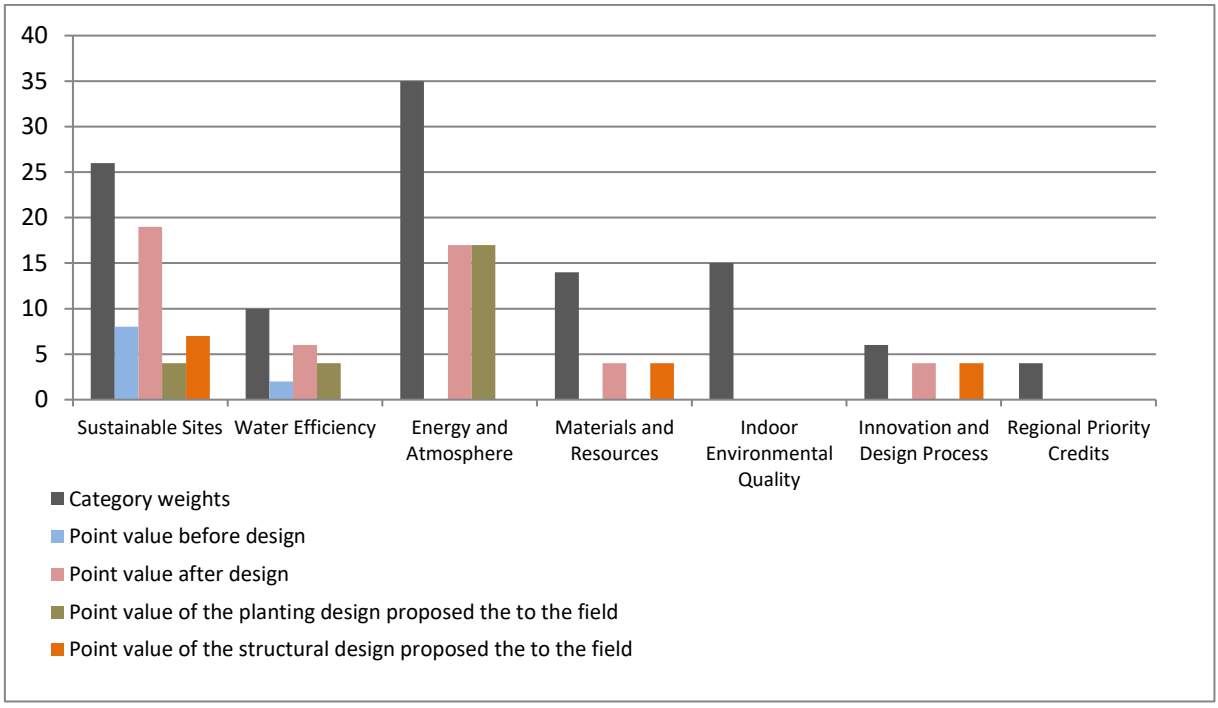

Figure 12. Point values for seven main titles in v3-LEED (2009 version) at BTU Mimar Sinan Campus. Values obtained before and after the ecological design and from the structural and planting applications in the designs (Aksoy, 2024)

As a result of the study carried out at BTU Mimar Sinan Campus by taking into account the v3-LEED (2009 version), structural and natural data in the area, it was determined that the study could receive a Silver Certificate. These score values were obtained with ecological landscape design applications made in the area. In the study area, applications were made in many categories such as water, energy, transportation, close environment, waste and materials. Similar applications to these applications were made at the Eisenhower Memorial. The Eisenhower Memorial is a conservation area in Washington, Columbia, USA. The area has obtained a Gold certificate in LEED certification. Many applications have been made in the area, such as the use of alternative transportation vehicles, reducing the parking capacity, increasing open green areas, rainwater management applications, green roofing, energy-efficient designs and regional flooring materials and the use of certified wood (USGBC, 2023). Other studies were obtained at the gold-certified University of Hawaii UHH Student Srvcs, the gold-certified Warszawa Business Garden, the gold-certified University of Hawaii WO Library, the platinum-certified BG Wroclaw Building 7 and the silver-certified Inonu University Student Life Center in Türkiye (USGBC, 2023). All these practices are important in ecological and sustainable design studies on campuses.

With the ecological practices to be carried out on the campuses; Many benefits are provided, such as saving water and energy, reducing the urban heat island effect, combating disasters, increasing biodiversity and creating a healthy and livable environment. According to a study by Song (2022),

planted rooftop gardens can absorb 15 to 90% of available rainwater and rain gardens can reduce runoff by 25–69%. According to studies conducted by Erken (2021) and Wolf (2004), the use of natural plant material in the landscape protects existing natural vegetation while preserving water and enhancing its quality.

The energy problem concerns the campus areas as well as the whole world. In this context, while planning university campuses, design proposals that provide minimum energy savings should be made. This makes the energy title in many certification certificate systems such as LEED, BREEAM, SITES, Green Metric an important tool for campus and other areas. However, structural material is not the only alternative for energy saving in LEED certification. Energy savings can be achieved in plant material. According to Kern, Antoniolli, Wander, Mancio, & González (2016), among 21 certified LEED buildings, the results for 18 show savings of only 1% below the expected value, rather than the 27% promised at the certification stage. Another study investigated the energy performance of 100 LEED buildings and concluded that these buildings use 28 to 35% more energy on average than non-certified buildings (Kern et al., 2016). According to Panagopoulos (2008), urban tree planting can provide a 25% reduction in net cooling and heating energy use in urban landscapes. According to Aboelata & Sodoudi (2019), trees and vegetation can reduce indoor energy consumption by increasing outdoor thermal performance and reducing urban heat islands. Also, urban trees can reduce energy use from air conditioning by 20%. Regarding energy reduction, lawns lower the outdoor air temperature and therefore reduce the energy demand of buildings by 0.2–0.5%. In this study, the authors attempted to save energy by using plant material that is not in the energy and atmosphere title of the LEED certificate. The cost of plant material is low when compared to other structural applications and its efficiency is high in terms of energy saving. According to a study by Feng & Hewage (2014), covering a building envelope with green vegetation (e.g., a green roof or vertical garden) is considered a sustainable practice in terms of energy savings. According to studies conducted by Aşkın (2014) and Esin (2001), heating and cooling cost savings of 20–40% can be achieved with herbal applications in campus areas. According to Feng and Hewage (2014), by planting plants in urban areas, a 25% reduction in cooling and heating energy use can be achieved in urban areas.

Many of the university's environmental sustainability actions are limited in scope and focus mostly on reducing resource consumption, waste generation and carbon emissions, rather than rethinking existing processes and reorienting sustainability strategies (Mendoza, Gallego-Schmid & Azapagic, 2019). Recycling of solid waste is important in terms of reducing the negative effects on the environment (Saygın & Ulusoy, 2011). In this context, solid waste and plant residues are recycled in university campuses and suitable solid wastes are reused as reinforcement elements (El Ouaqoudi et al., 2015) while plant material is used as compost (Mendoza et al., 2019). In addition, studies have proven that there are some benefits such as water purification, reduction of traffic noise, Urban Heat Island (UHI) reduction and recycling of waste materials, thanks to the permeable flooring material (Guan et al., 2021).

LEED certification also conducts auditing studies on ecological and sustainable transportation practices for university campuses. Ecological campus practices such as shared vehicle use, increasing hybrid vehicle use, bicycle access, increasing public transportation access and increasing parking areas are important in campus sustainability. For example, WSU Riverpoint Biomedical Campus has obtained a silver certificate by applying for many of the above-mentioned titles (USGBC, 2023). Finally, reducing the UHI effect by increasing open green spaces on university campuses, reducing CO_2 emissions (Zhang et al., 2014) and providing habitat areas for wildlife. For example, Whirlpool Downtown Campus has obtained a platinum certificate for campus sustainability with many applications such as green roofs, increasing open green spaces and preventing light pollution (USGBC, 2023).

All applications made within the scope of LEED certification are important for the sustainability of the campus and its immediate surroundings. Because, within the scope of green certification studies, it can be ensured that the balance of protection and use, the development of an effective system to

cope with the problems occurring on a global scale, the evaluation of the campus and its immediate surroundings according to a certain classification, and the supervision of planning, design and management by expert and academic committees. There are some limitations in the scope of the study. For example, it could be possible to evaluate the area according to the SİTES certificate, but the SİTES certificate only evaluates green areas. Within the scope of this study, the building and the green area were evaluated together in the area. Another limitation in the LEED certificate is that almost all of the applications recommended in the energy and atmosphere category include structural applications. In the study, although not in the LEED certificate, point values were obtained by considering planting practices in the title of optimizing energy use. In this context, the use of plant materials should be increased, especially in areas where open green areas such as campus areas are considered together. Another limitation of the LEED certificate is the 'education' title in the Greenmetric certificate in campus areas. As a result, landscape planning, design and management issues for different versions of the LEED certificate, which evaluates campus areas, should be rethought by considering the academy and sustainable campus studies.

4. Conclusion and Suggestions

In the BTU Mimar Sinan Campus, an ecological landscape design study was conducted for the area while considering the v3-LEED (2009 version). Although the current point value for the area was 10 before the design study was conducted, this value was increased to 50 with the ecological landscape design study. This score corresponds to the 'Silver Certificate' of the LEED certification. Overall, 30 points of this score were realised through planting applications. Considering this score, it was concluded that the ecological landscape characteristics of the area can be increased with the proposed planting design. A score of 11 was obtained through the proposed structural applications, which have a lower score output than the outdoor herbal applications. This score was obtained from areas such as irrigation, waste, energy and transportation. The reason for not obtaining a higher score than the LEED certificate is that the certificate was created with the architectural infrastructure in mind. Since it is an architectural certificate, no points could be obtained by improving indoor air quality. As a result, the BTU Mimar Sinan Campus could not receive any certificate in its current form; however, with the proposed ecological landscape design, it could obtain a 'Silver Certificate' by achieving 50 points in the LEED certification system. An important step can be taken in terms of cost and sustainability by encouraging the use of the structural and plant applications of landscape architecture in this certificate system, which can be achieved by investing a large amount of labour and money in architecture.

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

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Symbiotic Synergy: Exploring Waterfront Architecture Theory, Rural Areas, and Environmental Harmony

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Abstract

This research explores the complex interplay between theories of waterfront architecture, rural landscapes, and equilibrium in the environment. The simultaneous presence of constructed urban areas and natural environments holds significant significance in a time characterized by swift urbanization. This project aims to investigate architectural strategies that facilitate a balanced and mutually beneficial relationship between human settlements and the natural environment, specifically focusing on rural waterfront locations. By thoroughly examining case studies and theoretical frameworks, this study aims to identify novel design strategies that effectively integrate with the environment and simultaneously meet the community's demands. This research contributes to understanding how architectural interventions may effectively integrate with and enhance the natural environment in rural waterfront areas. It achieves this through a multidisciplinary approach incorporating architecture, environment, and socio-cultural dynamics perspectives. The findings of this study have the potential to guide future design approaches, promoting the development of landscapes that are environmentally sustainable and culturally dynamic. The study's ultimate ambition is to create landscapes in which waterfront architecture demonstrates respect for environmental processes and actively nurtures them. This approach aims to result in the development of resilient and prosperous rural communities.

Keywords: *Waterfront architecture theory, rural areas, environmental harmony.*

Simbiyotik Sinerji: Kıyı Mimarisi Teorisini, Kırsal Alanları ve Çevresel Uyumu Keşfetmek

Öz

Bu araştırma, kıyı mimarisi teorileri, kırsal manzaralar ve çevresel denge arasındaki karmaşık etkileşimi araştırıyor. Hızlı kentleşmenin yaşandığı bir dönemde, inşa edilmiş kentsel alanların ve doğal çevrelerin bir arada bulunması büyük önem taşımaktadır. Bu çalışma, özellikle kırsal kıyı konumlarına odaklanarak, insan yerleşimleri ile doğal çevre arasında dengeli ve karşılıklı yarar sağlayan bir ilişkiyi kolaylaştıran mimari stratejileri araştırmayı amaçlamaktadır. Bu çalışma, vaka çalışmalarını ve teorik çerçeveleri kapsamlı bir şekilde inceleyerek, çevreyle etkili bir şekilde bütünleşen ve aynı anda topluluğun taleplerini karşılayan yeni tasarım stratejilerini belirlemeyi amaçlamaktadır. Bu araştırma, mimari müdahalelerin kırsal kıyı alanlarındaki doğal çevreyle nasıl etkili bir şekilde bütünleşebileceğini ve onu geliştirebileceğini anlamaya katkıda bulunmayı hedeflemektedir. Bunu mimarlık, çevre ve sosyo-kültürel dinamikler perspektiflerini birleştiren multidisipliner bir yaklaşımla başarmayı amaçlamaktadır. Bu çalışmanın bulguları, çevresel olarak sürdürülebilir ve kültürel açıdan dinamik peyzajların gelişimini teşvik ederek gelecekteki tasarım yaklaşımlarına rehberlik etme potansiyeline sahiptir. Çalışmanın nihai amacı, kıyı mimarisinin çevresel süreçlere saygı gösterdiği ve onları aktif olarak beslediği peyzajlar yaratmaktaki uygun yaklaşımları tespit etmektir. Bu yaklaşım, dirençli ve müreffeh kırsal toplulukların gelişmesine yol açmayı amaçlamaktadır.

Anahtar kelimeler: *Kıyı mimarisi teorisi, kırsal alanlar, çevresel uyum.*

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1. Introduction

In a time marked by rapid urbanization and environmental challenges, it is increasingly important to balance natural ecosystems, rural communities, and architectural design. Waterfronts stand as focal points for sustainable development initiatives with their potential to bridge urban and rural landscapes. This study delves into the intricate interplay between waterfront architecture theory, rural environments, and environmental harmony, aiming to illuminate pathways toward holistic development that respects both nature and local communities.

The study builds upon a rich body of literature spanning multiple disciplines, including architecture, ecology, sociology, and environmental science. Key works by Cialdea & Pompei (2022), Girard et al. (2014), Hall & Stern (2014), Hoyle (1999), Jun (2023), and Üzümcüoğlu & Polay (2022) provide foundational insights into waterfront development, rural dynamics, and environmental sustainability. The study seeks to synthesize diverse perspectives and theories to inform its interdisciplinary approach, drawing from these sources.

Despite the breadth of existing literature, there remains a notable gap in understanding how contemporary waterfront design theories can effectively promote sustainability and community well-being in rural areas. While some studies have explored urban waterfront development, rural contexts present unique challenges and opportunities that require tailored solutions. This study aims to address this gap by investigating the specific dynamics of rural waterfront development and its implications for environmental harmony.

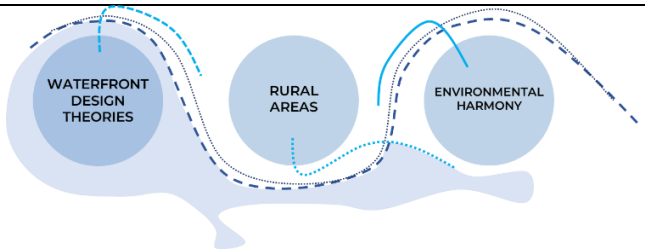
The study adopts an interdisciplinary approach, employing diverse methodological tools such as site-specific case studies. Its primary aim is to explore the synergies that emerge when waterfront architecture theory is integrated into rural landscapes. To achieve this aim, the study also sets objectives to assess the current state of rural waterfront developments and examine the impact of design theories on environmental sustainability. Through empirical data and conceptual frameworks, the study seeks to provide a comprehensive understanding of the complex relationship between waterfront design, rural environments, and community well-being (Table 1).

By shedding light on the intricate dynamics of rural waterfront development, this study holds significant implications for relevant literature. It contributes to advancing knowledge in fields such as architecture, ecology, and sociology by offering insights into sustainable development practices in rural areas. Moreover, the study's findings and recommendations have the potential to inform policy-making and practice, inspiring innovative approaches to waterfront development that prioritize environmental harmony and community resilience. Ultimately, this research seeks to foster synergy between the built environment and the natural world, benefiting both rural communities and the broader ecosystem.

Table 1. Analytical framework of the study (Author)

INTRODUCTION		
Context of the Study and Relevant Literature	The Gap of the Study	Structure of the Study, Aim and Method and the Impact of This Study

↓

LITERATURE REVIEW		
Waterfront Design Theories	Rural Areas	Environmental Harmony
• *Identifying Symbiotic Synergy with waterfront design, rural areas, and environmental harmony* • *Developing a conceptual framework based on the literature findings*		
		

↓

CASE SELECTION
• *Selecting relevant case studies that represent a diverse range of waterfront projects from different geographical locations* • *Considering factors such as size, cultural context, and success metrics*

↓

METHODOLOGY
• Outlining the methodology for analyzing case studies • Specifying the criteria for evaluating the success of each waterfront project

↓

Data Collection	**Data Analysis**
Gathering data on each case study, including architectural plans, economic impact, and any available post-implementation assessments	Applying a systematic approach to analyze the data Applying symbiotic framework principles identified in the literature review

↓

Integration of Literature and Case Findings
Integrating the findings from the literature review with the results obtained from the case studies

↓

SYNTHESIS AND DISCUSSION
• *Synthesizing the case study findings and literature review to identify overarching trends, challenges, and critical success factors in contemporary waterfront design* • *Discussing the implications of the findings* • *Addressing how successful waterfront projects align with or diverge from theoretical frameworks*

↓

CONCLUSION	
Summarizing the essential findings and their significance	
Recommendations	**Limitations and Future Research**
• *Providing practical suggestions based on the findings* • *Offering insights for architects, designers, policymakers, and other stakeholders involved in waterfront development in rural settings*	• *Acknowledging the limitations of the study, such as constraints in case selection or data availability* • *Proposing directions for future research to further enhance understanding in this field*

1.1. Waterfront Design Principles

Indicators of waterfront design are specific characteristics or elements that are assessed to evaluate the quality, effectiveness, and sustainability of a waterfront development or design. These indicators help measure the success of a project in achieving its goals, whether they are related to aesthetics, functionality, environmental sustainability, or community well-being. The selection of indicators may

vary depending on the project's objectives and context. However, common indicators employed to evaluate waterfront design often encompass environmental sustainability (Avni & Fischler, 2019; Bonney et al., 2023; Chen & Ma, 2023; Doka et al., 2022; Kathijotes, 2013). Environmental sustainability includes monitoring the cleanliness and health of the water in and around the waterfront area. Besides, it is related to assessing the presence and diversity of aquatic and terrestrial species in the area. It is also relevant to measuring the success of efforts to restore or enhance natural habitats and evaluating how well the design manages rainwater runoff and prevents pollution. One of the most essential common indicators is related to accessibility and connectivity (Guvenbas & Polay, 2020; Hoyle, 1999; Moore, 2016; Schreurs et al., 2023). Assessing the ease and safety of walking in the area, evaluating the availability of bike paths and facilities, measuring access to public transit options, and examining how well the waterfront connects with adjacent neighborhoods and attractions are significant aspects of the waterfront qualities. Another standard indicator is aesthetics and urban design efficiency (Üzümcüoğlu & Polay, 2022; Al Ansari, 2009; Avni & Teschner, 2019; Dal Cin et al., 2021; Hu et al., 2023). Assessing the visual appeal of the waterfront area, evaluating the quality and appropriateness of buildings and structures, and examining the presence and quality of public art installations and landscaping are significant for the image quality of waterfronts. The standards also include cultural and historical preservation (Toomey et al., 2021; Dova et al., 2022; Fernandes et al., 2017). Evaluating efforts to protect and showcase cultural and historical assets and assessing the presence and success of cultural events and festivals in the area are essential for the waterfront's unique identity. Community engagement and well-being are also primary indicators of the waterfront designs (Dova et al., 2022; Green, 2023; Hoyle, 1999; Zakirzianova, 2021). Measuring the extent to which residents and stakeholders were involved in the design process, assessing the availability of recreational activities, such as parks, playgrounds, and sports facilities, and evaluating the perception and actual safety of the waterfront area is essential for the waterfront adequacy of its users. Economic impact is a significant indicator of funding for continuous improvement of the waterfronts (Borggren & Ström, 2014; Kathijotes, 2013; Schreurs et al., 2023; Situmorang et al., 2023). Assessing the impact on local businesses and tourism and measuring the number of jobs created as a result of waterfront development is necessary to understand the situation and suggest the proper improvement opportunities. The other indicator is resilience and adaptation (Jun, 2023; Ahern, 2011; Garcia, 2021; Niedziółka et al., 2021; Theodora & Spanogianni, 2022). Assessing measures in place to mitigate flood risks and evaluating strategies to adapt to climate change, such as sea-level rise are necessary for changing requirements of contemporary urban and rural spaces. Sustainability metrics are also significant (Ahern, 2011; Bonney et al., 2023; Garcia, 2021). Assessing the energy efficiency of buildings and infrastructure, evaluating strategies for waste reduction and recycling, and measuring the presence of green spaces, green roofs, and sustainable landscaping are required for today's evolving needs of urban and rural settlements. Another essential indicator is public health (Brückner et al., 2022; Chen & Ma, 2023). Assessing the air quality in the area and evaluating the availability of fresh and healthy food options is necessary for community well-being. Waterfront resilience is also a significant indicator. Measuring strategies to prevent shoreline erosion and evaluating the presence of natural buffer zones like wetlands and dunes is necessary for potential global threats of climate change and disasters.

The indicators chosen for assessing waterfront design are tailored to the project's goals, geographical setting, and the priorities of stakeholders involved. Typically, a thorough assessment incorporates a blend of these indicators to offer a well-rounded evaluation of the effectiveness of the waterfront design.

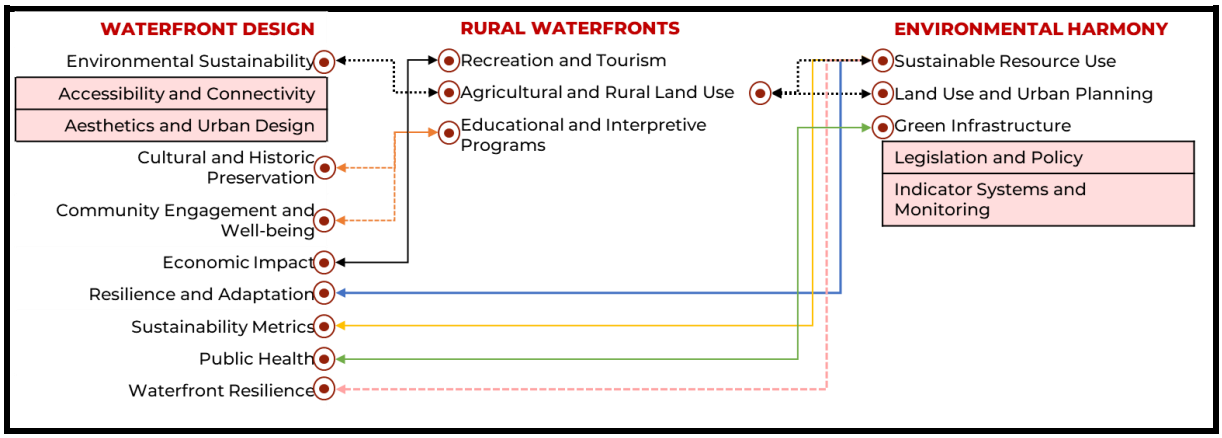
1.2. Symbiotic Synergy with Waterfront Design, Rural Areas, and Environmental Harmony

Indicators of rural waterfronts are specific criteria or characteristics that are used to assess the quality, sustainability, and functionality of waterfront areas in rural settings. These indicators help evaluate how well a rural waterfront development or design meets its objectives, which can vary depending on the project's goals and context. Several common indicators used to assess rural waterfronts include recreation and tourism (Chen & Ma, 2023; Onen, 2007; Sousa et al., 2016). Assessing the availability of recreational activities, such as boating, fishing, hiking, and camping, and

measuring the attractiveness of the rural waterfront for tourists and the economic benefits derived from tourism are necessary for visitors' satisfaction. The other indicator of rural settlements includes agricultural and rural land use adequacy (Shi et al., 2022; Feng & Ma, 2018; Mao & Wenyan, 2021). Evaluating agricultural practices in the rural waterfront area with a focus on sustainability and environmental stewardship and assessing efforts to preserve and promote the cultural and historical significance of agriculture in the region can be necessary for relevant settlements. Besides, educational and interpretive programs are also essential for the adequacy of rural settlements (Md Yassin et al., 2010). Evaluating educational programs and signage that inform visitors about the local ecology and culture and assessing the presence of interpretive trails and exhibits that enhance visitors' understanding of the rural waterfront's significance is essential to increasing awareness of the community. The choice of indicators for assessing rural waterfronts will depend on the project's objectives, location, and the interests of stakeholders. A practical assessment often combines multiple indicators to provide a comprehensive view of the rural waterfront's overall health and sustainability.

Indicators of environmental harmony are specific criteria or measures used to assess how well a particular environment or development aligns with principles of sustainability, ecological balance, and the responsible management of natural resources. These indicators help evaluate whether a project or area is in harmony with its environment. Various common indicators of environmental harmony include the use of sustainable resources (Feng & Ma, 2018; Berman & Center for Coastal Resources Management, Virginia Institute of Marine Science, 2003). The responsible and efficient use of natural resources, such as water and energy, and the use of renewable energy sources, like solar and wind power, may be necessary for potential threats of climate crises and disasters. Another essential indicator of environmental concerns is land use and rural planning quality (Fumagalli et al., 2014). The promotion of compact, mixed-use development that reduces sprawl and efforts to protect and conserve natural habitats and open spaces may be a solution to the threats of uncontrolled rural growth. Green infrastructure has an essential place in environmental considerations (Kantartzis, 2015). The use of environmentally friendly building materials and practices and the promotion of eco-friendly modes of transportation, such as walking, biking, and public transit, are necessary for nature-friendly approaches. Legislation and policies need to be provided for relevant locations for high protection (Md Yassin et al., 2010). The existence and enforcement of laws and regulations that protect the environment and government policies that promote sustainable land use and development practices are required for continued success. Besides, indicator systems and monitoring are also essential for understanding the existing situation at relevant locations (Liang et al., 2020). The development and use of specific metrics to measure environmental performance and track progress are necessary for proper improvement suggestions for relevant locations. These indicators can vary depending on the specific context and goals of a project or area, but they collectively help gauge the extent to which environmental harmony is being achieved. Assessing these indicators allows for informed decision-making and the implementation of strategies to enhance sustainability and ecological balance.

In the course of the theoretical inquiry conducted thus far in this study, it has been explicated that several primary principles exist about waterfront design, rural environment, and environmental impact. However, these indicators can also be incorporated within each other to enhance the comprehensivity of shore areas. Figure 1 illustrates the integration of the highlighted indicators of the waterfront design, rural areas, and environmental harmony as a symbiotic model. The model comprises eight indicators, and it is implemented to assess specific case studies.



SYMBIOTIC PRINCIPLES OF WATERFRONT DESIGN, RURAL AREAS, AND ENVIRONMENTAL HARMONY

1. **ENVIRONMENTAL SUSTAINABILITY** (SUSTAINABLE RESOURCE USAGE, GREEN INFRASTRUCTURE, RESILIENCE AND ADAPTATION)
2. **CULTURAL AND HISTORIC PRESERVATION**
3. **ACCESSIBILITY AND CONNECTIVITY**
4. **AESTHETIC AND URBAN DESIGN** (RECREATION AND TOURISM, LAND USE AND URBAN PLANNING)
5. **PUBLIC HEALTH** (COMMUNITY ENGAGEMENT)
6. **ECONOMIC IMPACT** (ATTRACTIVITY)
7. **AWARENESS** (EDUCATIONAL AND INTERPRETIVE PROGRAMS)
8. **LEGISLATION AND POLICY IMPROVEMENT** (INDICATOR SYSTEM AND MONITORING)

Figure 1. Symbiotic indicators of waterfront design, rural areas, and environmental harmony (Author)

2. Material and Method

The study employed the following methodology to ensure a structured and thorough investigation:

1. Case Study Selection:
   - Objective: To encompass a diverse array of notable rural waterfront projects worldwide.
   - Criteria: Selection based on the attainment of prestigious accolades for excellence in rural waterfront design.
   - Scope: The study focused on rural areas situated across multiple continents, allowing for a manageable sample size while ensuring representativeness.
2. Documentary Analysis:
   - Objective: To gather detailed insights into each chosen case study, evaluating them based on established indicators of waterfront design, rural contexts, and environmental harmony.
   - Methodology: Conducted an exhaustive analysis involving the collection of project documentation, architectural blueprints, historical data, and available reports.
   - Coverage: Encompassed the entire lifecycle of the waterfront projects, from conceptualization and development to post-implementation phases.
3. Qualitative Analyses:
   - Objective: To extract meaningful insights from the amassed data for each case study.
   - Approach: Employed qualitative analyses to interpret findings and delve into the intricacies of individual projects.
4. Synthesis of Qualitative Findings:
   - Objective: To craft comprehensive narratives for each case study.
   - Methodology: Synthesized qualitative discoveries to underscore key success factors, obstacles encountered, and policy strategies aligned with theories of rural waterfront design.
5. Discussion of Synthesized Findings:

- Objective: To contextualize and discuss the synthesized findings within the realm of comprehensive rural waterfront development.
- Emphasis: Explored how the selected projects exemplified and translated theoretical frameworks into tangible real-world manifestations.

6. Acknowledgment of Methodological Limitations:
   - Objective: To address inherent limitations within the chosen research methodology.
   - Recognized constraints: Acknowledged the restricted sample size due to stringent selection criteria and geographical focus. Additionally, noted potential oversights of significant projects and variations in data availability among case studies.
7. Evaluation of Methodological Rigor:
   - Objective: To assess the reliability and validity of the research methodology.
   - Strengths highlighted: Emphasized the systematic approach in case selection, data collection, and analysis across a diverse spectrum of esteemed rural waterfront projects. Underlined the significance of acquired knowledge concerning current theoretical paradigms and practical implementations in rural waterfront architecture.

This systematic framework delineates the study's sequential progression, from case study selection to the evaluation of methodological robustness, ensuring a comprehensive and rigorous exploration of the subject matter.

3. Findings and Discussion

3.1. Findings

Rural waterfront projects exemplify theories of rural waterfront design, effectively turning theoretical concepts into captivating and functional real-world environments. A collection of case studies is presented within this area, each carefully chosen based on its outstanding typical approaches and global acclaim.

The selection of examples was mainly based on their practice approaches. A limitation has been implemented to ensure a manageable sample size due to the abundance of waterfront areas. Therefore, as a criterion for selection, the cities should be located on rural waterfronts across several continents. Furthermore, different facets of the waterfront were chosen, including those of historical significance, those well-protected, and those famous worldwide. Therefore, six waterfront locations from various countries were chosen for investigation based on the imposed limits. The waterfront locations mentioned include the Outer Banks in North Carolina, Paraty in Rio de Janeiro, the Amalfi Coast in Italy, Djenne in Mali, the Inle Lake in Myanmar, and Warrnambool in Victoria (Figure 2).

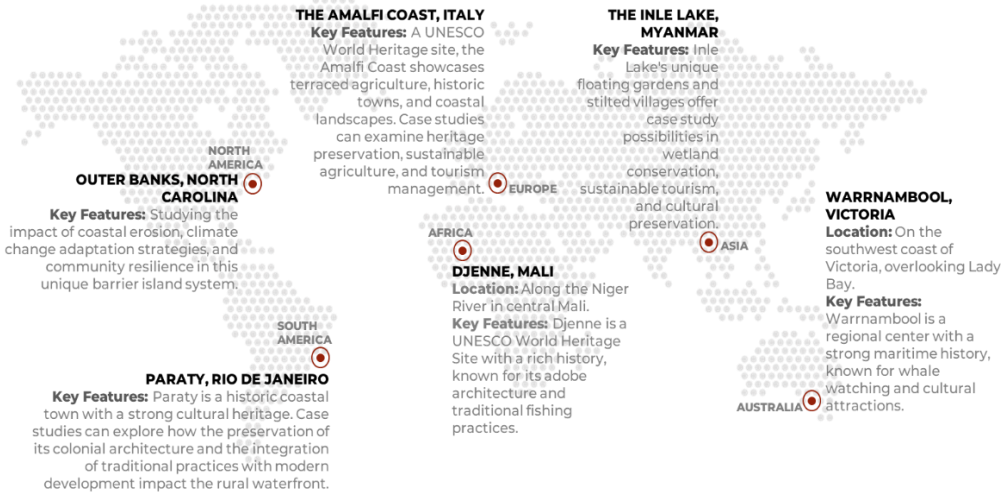
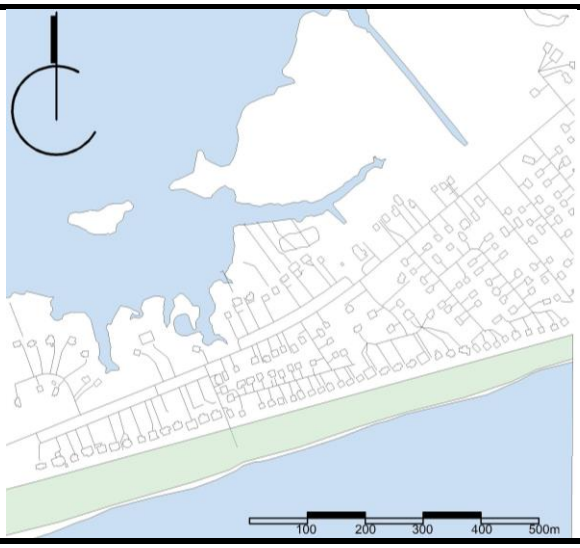


Figure 2. Location of the chosen cases (Author's archive)

3.1.1. Case 1. Outer banks in North Carolina

The evaluation of the Outer banks in North Carolina (Table 2) according to the principles of symbiotic indicators

Table 2. Information on outer banks in North Carolina



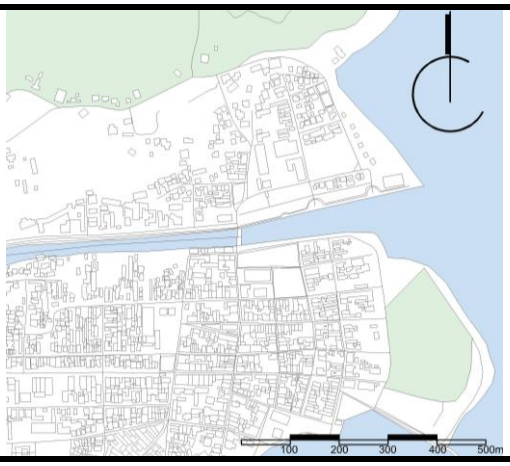
Name of the Waterfront	Outer banks in North Carolina
Feature	Studying the impact of coastal erosion, climate change adaptation strategies, and community resilience in this unique barrier island system.
SYMBIOTIC INDICATORS	**EVALUATION OF THE CASE AREA**
1. ENVIRONMENTAL SUSTAINABILITY **2. CULTURAL AND HISTORIC PRESERVATION** **3. ACCESSIBILITY AND CONNECTIVITY** **4. AESTHETIC AND URBAN DESIGN** **5. PUBLIC HEALTH** **6. ECONOMIC IMPACT** **7. AWARENESS** **8. LEGISLATION AND POLICY IMPROVEMENT**	**1.** The Outer Banks exhibit a commendable commitment to environmental sustainability. From preserving critical ecosystems to implementing sustainable tourism practices and climate resilience measures, the region demonstrates a proactive approach to minimizing its environmental footprint and protecting its natural resources (Edgell & McCormick, 2011). **2.** Cultural and historic preservation are integral to the Outer Banks' identity. The region effectively integrates its rich cultural heritage into waterfront development while maintaining historical sites like the Wright Brothers National Memorial and Roanoke Island Festival Park. By incorporating these elements into its planning, the Outer Banks ensures that its cultural legacy remains a vibrant part of its communities and visitor experiences (Edgell & McCormick, 2011). **3.** Accessibility and connectivity are crucial aspects of the Outer Banks' appeal, particularly given its status as a tourist destination. While the evaluation provided focuses more on environmental aspects, initiatives such as visitor education programs and sustainable tourism practices indirectly enhance accessibility and connectivity by promoting responsible visitation and minimizing environmental impacts on the region's infrastructure (Clifford, 2022). **4.** The Outer Banks boasts a unique aesthetic characterized by its pristine beaches, maritime forests, and historic landmarks. While the evaluation does not extensively cover specific details regarding urban design, the region's integration of cultural heritage into waterfront development suggests a commitment to maintaining a visually appealing and historically rich environment that enhances the area's overall aesthetic quality (Team of Carolina Designs Realty, n. d.). **5.** Public health considerations, such as water quality management and environmental stewardship, are paramount in the Outer Banks' approach to sustainability. Regulations and stormwater runoff controls maintain water quality in coastal areas, safeguarding public health by ensuring clean bathing waters and protecting estuarine environments from contamination (Edgell & McCormick, 2011). **6.** While not explicitly addressed in the evaluation, it is evident that the Outer Banks' commitment to environmental friendliness has significant economic implications. Sustainable tourism practices, cultural heritage integration, and efforts to protect natural resources not only preserve the region's appeal to visitors but also support local economies reliant on tourism and outdoor recreation (Edgell & McCormick, 2011). **7.** The Outer Banks demonstrate a proactive approach to raising awareness about environmental issues through public education and outreach programs. Educational institutions, nature centers, and local organizations play a crucial role in informing residents and visitors about coastal ecology, wildlife conservation, and sustainable practices, fostering a culture of environmental stewardship and awareness within the community (Edgell & McCormick, 2011). **8.** While specific legislative or policy initiatives are not detailed in the evaluation, the Outer Banks' commitment to environmental friendliness suggests a supportive regulatory framework conducive to sustainability. Efforts to address sea-level rise, storm surge risks, and water quality management likely involve collaboration between local government entities, conservation organizations, and community stakeholders to implement effective policies and regulations aimed at protecting the region's natural resources and cultural heritage (Edgell & McCormick, 2011).

In summary, The Outer Banks of North Carolina showcases a robust commitment to environmental sustainability and cultural preservation through various initiatives. From the protection of critical ecosystems to the integration of historical sites into waterfront development, the region emphasizes responsible tourism practices, community engagement, and climate resilience measures. Efforts to maintain water quality, raise public awareness, and foster a sense of environmental stewardship contribute to the area's charm and economic vitality. While specific legislative actions are not outlined, the region's proactive approach to addressing environmental challenges reflects a collaborative effort among stakeholders to uphold its unique natural beauty and cultural heritage for future generations.

3.1.2. Case 2. Paraty in Rio de Janeiro

The evaluation of the Paraty in Rio de Janeiro (Table 3) according to the principles of symbiotic indicators

Table 3. Information on paraty in Rio de Janeiro



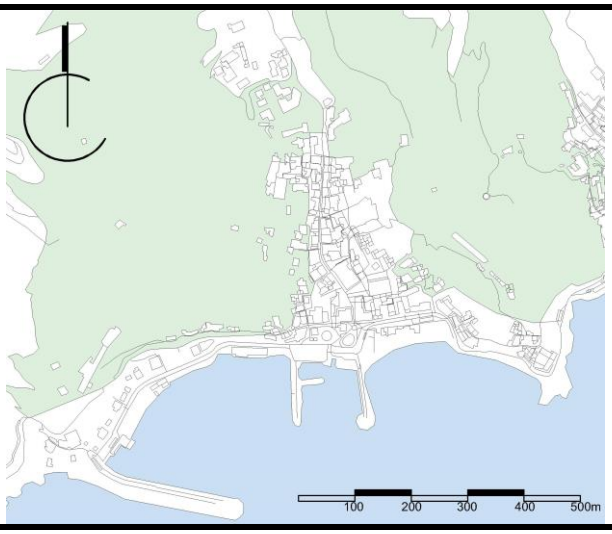
Name of the Waterfront	Paraty in Rio de Janeiro
Feature	Paraty is a historic coastal town with a strong cultural heritage. Case studies can explore how the preservation of its colonial architecture and the integration of traditional practices with modern development impact the rural waterfront.
SYMBIOTIC INDICATORS	**EVALUATION OF THE CASE AREA**
1. ENVIRONMENTAL SUSTAINABILITY **2. CULTURAL AND HISTORIC PRESERVATION** **3. ACCESSIBILITY AND CONNECTIVITY** **4. AESTHETIC AND URBAN DESIGN** **5. PUBLIC HEALTH** **6. ECONOMIC IMPACT** **7. AWARENESS** **8. LEGISLATION AND POLICY IMPROVEMENT**	**1.** Paraty demonstrates a commendable commitment to environmental sustainability, particularly through initiatives focused on ecosystem preservation and biodiversity conservation. Efforts to protect the Atlantic Rainforest and combat deforestation showcase a proactive approach to safeguarding natural resources (Gallo et al., 2016). **2.** The town effectively integrates its cultural heritage into waterfront development, preserving its historic center with colonial architecture. This integration contributes to cultural preservation and enhances the town's appeal to heritage tourism (Padilha, 2016). **3.** While not extensively covered in the evaluation, efforts to promote sustainable tourism and preserve the historic town center indirectly contribute to enhancing accessibility and connectivity by maintaining the town's cultural and historical attractions (Padilha, 2016). **4.** Paraty's well-preserved colonial architecture and integration of cultural heritage into waterfront planning contribute to its aesthetic appeal and urban design. However, challenges related to waste management and overcrowding during peak tourist seasons may impact the overall aesthetic quality of the town (Padilha, 2016). **5.** Efforts to improve water quality management, particularly through sewage treatment initiatives, contribute to safeguarding public health and preserving marine ecosystems. However, further improvements are needed to address pollution in the bay and protect public health (Gallo et al., 2016). **6.** Sustainable tourism practices and cultural heritage integration support the local economy by attracting visitors interested in Paraty's natural beauty and historical significance. However, challenges such as waste management and overcrowding during peak tourist seasons may affect the overall economic impact of tourism on the town (Padilha, 2016). **7.** While environmental education programs and outreach initiatives exist, further efforts are needed to raise residents' and tourists' awareness of conservation and sustainable practices. Increased awareness can foster a culture of environmental stewardship and support ongoing conservation efforts (Gustavo Carvalhaes et al., 2018). **8.** Ongoing challenges related to sustainable tourism, water quality, and climate resilience highlight the need for improved legislation and policy measures. Regulatory frameworks addressing waste management, sustainable fishing practices, and renewable energy adoption are essential for achieving long-term environmental sustainability in Paraty (Gustavo Carvalhaes et al., 2018).

Paraty, nestled in the state of Rio de Janeiro, Brazil, showcases positive indicators of environmentally friendly waterfront practices with notable strengths in ecosystem preservation, cultural heritage integration, and community engagement. Efforts to protect the nearby Atlantic Rainforest and preserve the town's colonial architecture contribute to its environmental sustainability and appeal to heritage tourism. Challenges persist in areas such as sustainable tourism management, water quality, and climate resilience, necessitating continued attention and policy improvements. Despite these challenges, Paraty's commitment to preserving its natural and cultural treasures positions it as a picturesque coastal town with significant potential for sustainable development and environmental stewardship.

3.1.3. Case 3. The Amalfi Coast in Italy

The evaluation of the Amalfi Coast in Italy (Table 4) according to the principles of symbiotic indicators

Table 4. Information on the Amalfi Coast in Italy



Name of the Waterfront	the Amalfi Coast in Italy
Feature	A UNESCO World Heritage site, the Amalfi Coast showcases terraced agriculture, historic towns, and coastal landscapes. Case studies can examine heritage preservation, sustainable agriculture, and tourism management.
SYMBIOTIC INDICATORS	**EVALUATION OF THE CASE AREA**
1. ENVIRONMENTAL SUSTAINABILITY **2. CULTURAL AND HISTORIC PRESERVATION** **3. ACCESSIBILITY AND CONNECTIVITY** **4. AESTHETIC AND URBAN DESIGN** **5. PUBLIC HEALTH** **6. ECONOMIC IMPACT** **7. AWARENESS** **8. LEGISLATION AND POLICY IMPROVEMENT**	**1.** While the Amalfi Coast benefits from broader conservation efforts, the lack of specific protected areas within the coastal region poses challenges. Efforts to address sustainable tourism, water quality management, and biodiversity conservation are crucial for enhancing its environmental sustainability (Volpicelli, 2021). **2.** The seamless integration of cultural heritage into waterfront development reflects a strong commitment to preserving the region's historic towns and buildings, contributing to its overall charm and visitor experience (Volpicelli, 2021; Petti et al., 2018). **3.** Accessibility and connectivity are not extensively covered in the evaluation. However, the integration of cultural heritage with waterfront development indirectly enhances accessibility by maintaining the region's historical and cultural attractions (Volpicelli, 2021). **4.** The Amalfi Coast's integration of cultural heritage with urban design contributes to its aesthetic appeal. It forms the heart of waterfront development and enhances the overall visitor experience (Volpicelli, 2021). **5.** Challenges related to sewage and wastewater management highlight concerns for public health, especially in older towns with limited infrastructure. Initiatives to improve water quality are essential for protecting both marine ecosystems and public health (Petti et al., 2018). **6.** While not extensively addressed, tourism's economic pressure can impact sustainable fishing practices and conservation efforts. Managing sustainable tourism is crucial to balancing economic benefits with environmental sustainability (Volpicelli, 2021). **7.** Environmental education programs and initiatives exist, but further efforts are required to raise residents' and visitors' awareness about conservation and sustainable practices. Increased awareness can foster a culture of environmental stewardship and support ongoing conservation efforts (Volpicelli, 2021). **8.** Ongoing challenges such as sustainable tourism management and climate resilience highlight the need for improved legislation and policy measures. Regulatory frameworks addressing these challenges are essential for achieving long-term environmental sustainability in the region (Petti et al., 2018) .

The evaluation of the Amalfi Coast reveals a mix of strengths and challenges in its pursuit of environmentally friendly waterfront practices. While the region showcases seamless integration of cultural heritage into urban design and active community engagement in environmental initiatives, challenges such as managing sustainable tourism, improving water quality, and addressing climate resilience persist. Efforts to protect marine ecosystems and promote sustainable fishing practices are hindered by economic pressures from tourism. Despite ongoing conservation efforts and environmental education programs, further attention to raising awareness and implementing effective legislation is necessary to ensure the long-term environmental sustainability of this iconic coastal region.

3.1.4. Case 4. Djenne in Mali

The evaluation of Djenne in Mali (Table 5) according to the principles of symbiotic indicators

Table 5. Information on Djenne in Mali

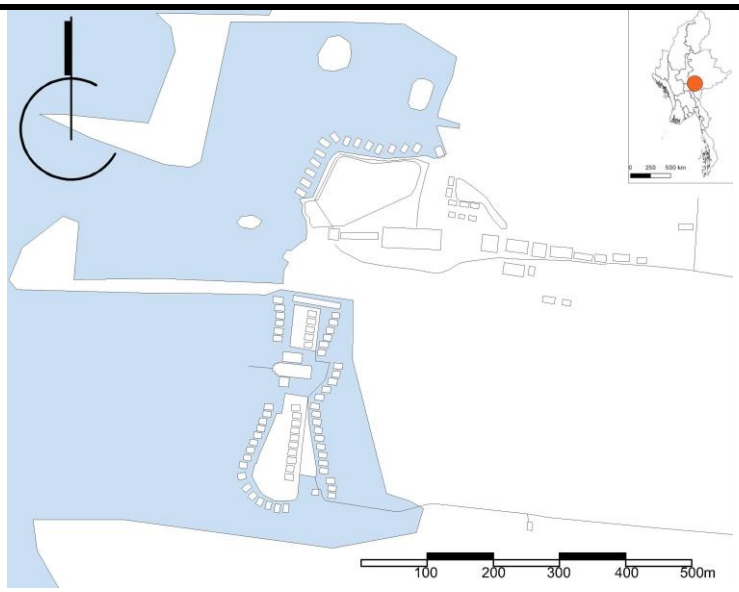
Name of the Waterfront	Djenne in Mali
Feature	Location: Along the Niger River in central Mali. Key Features: Djenne is a UNESCO World Heritage Site with a rich history, known for its adobe architecture and traditional fishing practices.
SYMBIOTIC INDICATORS	**EVALUATION OF THE CASE AREA**
1. ENVIRONMENTAL SUSTAINABILITY **2. CULTURAL AND HISTORIC PRESERVATION** **3. ACCESSIBILITY AND CONNECTIVITY** **4. AESTHETIC AND URBAN DESIGN** **5. PUBLIC HEALTH** **6. ECONOMIC IMPACT** **7. AWARENESS** **8. LEGISLATION AND POLICY IMPROVEMENT**	**1.** Djenne demonstrates environmental sustainability through traditional land and water management practices despite the absence of specific protected areas. However, challenges such as waste management and pollution require careful attention to ensure the preservation of fragile ecosystems (Wedum et al., 1996). **2.** Djenne's rich cultural heritage, including its historic adobe architecture and Great Mosque, is seamlessly integrated into waterfront development. This attracts heritage tourism and contributes to the town's unique identity (Arnoldi, 2014; Sacko, 2021). **3.** Accessibility and connectivity are not extensively covered in the evaluation. However, the town's historic significance and cultural attractions likely contribute to its accessibility and connectivity within the region (UNESCO Office in Beijing, 2023). **4.** The historic adobe architecture and UNESCO-listed Great Mosque contribute to Djenne's aesthetic appeal and urban design, forming an integral part of waterfront planning and development (Sacko, 2021; UNESCO Office in Beijing, 2023). **5.** While not extensively addressed, maintaining water quality in the Niger River is essential for public health and agricultural activities in Djenne. Challenges related to pollution and sedimentation require attention to safeguard community well-being (Maiga, 2017). **6.** Although the economic impact is not extensively discussed, Djenne's cultural heritage likely supports local livelihoods through heritage tourism and traditional economic activities such as fishing and agriculture (UNESCO Office in Beijing, 2023). **7.** Environmental education initiatives are crucial for raising residents' awareness of conservation and sustainability. Greater emphasis on education regarding water and land management can further enhance environmental awareness in the community (Arnoldi, 2014). **8.** The evaluation does not extensively cover legislative or policy measures. However, investment in infrastructure resilience and renewable energy initiatives can contribute to long-term sustainability (Arnoldi, 2014).

Overall, Djenne's unique blend of traditional practices, community engagement, and cultural heritage provides a solid foundation for achieving environmentally friendly waterfront practices despite environmental challenges. However, ongoing efforts and investment are needed to address issues such as waste management, infrastructure resilience, and pollution to ensure the long-term sustainability of the town's riverside context.

3.1.5. Case 5. the Inle Lake in Myanmar

The evaluation of the Inle Lake in Myanmar (Table 6) according to the principles of symbiotic indicators

Table 6. Information on the Inle Lake in Myanmar



Partial map of the Inle Lake in Myanmar

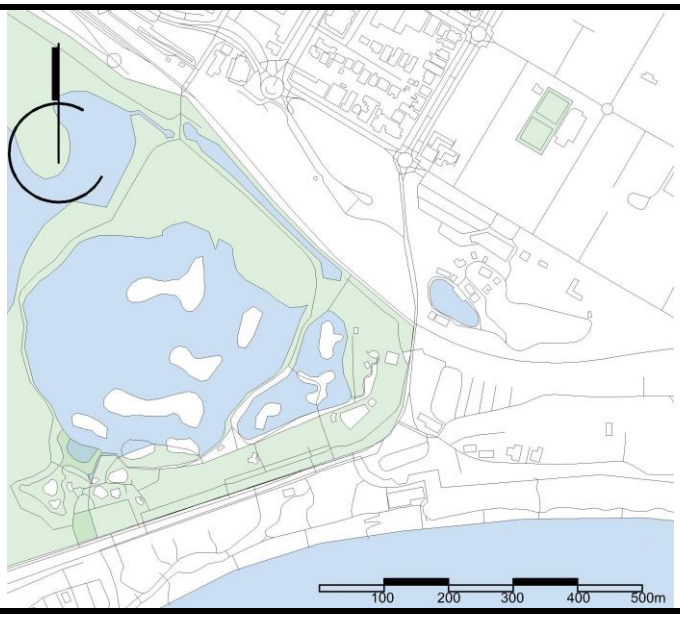
Name of the Waterfront	the Inle Lake in Myanmar
Feature	Inle Lake's unique floating gardens and stilted villages offer case study possibilities in wetland conservation, sustainable tourism, and cultural preservation.
SYMBIOTIC INDICATORS	**EVALUATION OF THE CASE AREA**
1. ENVIRONMENTAL SUSTAINABILITY **2. CULTURAL AND HISTORIC PRESERVATION** **3. ACCESSIBILITY AND CONNECTIVITY** **4. AESTHETIC AND URBAN DESIGN** **5. PUBLIC HEALTH** **6. ECONOMIC IMPACT** **7. AWARENESS** **8. LEGISLATION AND POLICY IMPROVEMENT**	**1.** Inle Lake demonstrates strong environmental sustainability efforts through the designation of the Inle Lake Wetland Sanctuary and conservation projects focusing on protecting unique species. However, challenges such as water pollution from tourism and agricultural runoff require ongoing attention (Ingelmo, 2013). **2.** The integration of cultural heritage, including stilted villages and traditional fishing practices, into waterfront development showcases a commitment to cultural preservation. Heritage tourism is encouraged, contributing to the local economy while preserving traditional ways of life (Ingelmo, 2013). **3.** The evaluation does not extensively cover accessibility and connectivity. However, Inle Lake's unique cultural and scenic attractions likely contribute to its accessibility and connectivity within the region (Yadanar, 2020). **4.** The unique architectural features of stilted villages and floating gardens contribute to Inle Lake's aesthetic appeal and urban design, forming an integral part of waterfront planning and development (Yadanar, 2020). **5.** Concerns about water quality due to increased tourism and agricultural runoff highlight potential public health risks. Initiatives to improve wastewater management are essential for safeguarding public health and protecting the lake's delicate ecosystem (Karki et al., 2018). **6.** Heritage tourism and traditional economic activities, such as fishing, contribute to the local economy. However, challenges such as water pollution and unsustainable tourism practices may impact the area's long-term economic sustainability (Ingelmo, 2013). **7.** Environmental education programs play a crucial role in raising awareness about conservation among residents and visitors, fostering a sense of responsibility for protecting the lake's ecosystem and cultural heritage (Naing Oo et al., 2010; Re et al., 2021). **8.** Given the environmental sensitivity of the area, exploring renewable energy options and implementing policies to regulate tourism and protect water quality is essential for ensuring the long-term sustainability of Inle Lake. Continued investment in flood control measures and infrastructure resilience is also necessary to enhance climate resilience (Re et al., 2021).

In summary, Inle Lake exhibits positive indicators of environmentally friendly waterfront practices, including strong community engagement, cultural preservation, and biodiversity conservation. However, ongoing challenges such as water pollution and sustainable tourism management require concerted efforts and policy improvements to ensure the lake's long-term environmental sustainability in Myanmar.

3.1.6. Case 6. Warrnambool in Victoria

The evaluation of Warrnambool in Victoria (Table 7) according to the principles of symbiotic indicators

Table 7. Information on Warrnambool in Victoria



Name of the Waterfront	Warrnambool in Victoria
Feature	Location: On the southwest coast of Victoria, overlooking Lady Bay. Key Features: Warrnambool is a regional center with a strong maritime history, known for whale watching and cultural attractions.
SYMBIOTIC INDICATORS	**EVALUATION OF THE CASE AREA**
1. ENVIRONMENTAL SUSTAINABILITY **2. CULTURAL AND HISTORIC PRESERVATION** **3. ACCESSIBILITY AND CONNECTIVITY** **4. AESTHETIC AND URBAN DESIGN** **5. PUBLIC HEALTH** **6. ECONOMIC IMPACT** **7. AWARENESS** **8. LEGISLATION AND POLICY IMPROVEMENT**	**1.** Warrnambool demonstrates strong environmental sustainability efforts through the presence of protected natural areas, conservation projects, and initiatives to maintain water quality. These efforts contribute to the preservation of unique coastal ecosystems and native flora and fauna (Versace et al., 2013). **2.** The integration of cultural heritage, including maritime history and indigenous heritage, into waterfront development reflects a commitment to cultural preservation. This integration enriches the visitor experience and promotes cultural heritage awareness (Versace et al., 2013). **3.** Warrnambool's vibrant community and cultural attractions likely contribute to its accessibility and connectivity within the region. The area is the most accessible population center in the region (Taylor & Susilawati, 2012). **4.** Warrnambool's integration of cultural heritage into waterfront planning enhances its aesthetic appeal and urban design, enriches the visitor experience, and promotes cultural preservation (Versace et al., 2013). **5.** Efforts to maintain water quality in coastal areas are essential for safeguarding public health and the health of Warrnambool's coastal environments. Initiatives focus on reducing pollution and maintaining clean bathing waters, contributing to public health and well-being (Versace et al., 2013). **6.** Sustainable tourism practices and cultural heritage integration support the local economy by attracting visitors interested in Warrnambool's natural beauty and cultural heritage. These initiatives contribute to economic sustainability while preserving the environment and cultural identity (Versace et al., 2013). **7.** Environmental education programs offered by local organizations and schools play a crucial role in raising residents' and visitors' awareness about conservation and sustainable practices. These programs promote environmental stewardship and encourage responsible behavior (Versace et al., 2013). **8.** While not extensively covered, ongoing attention to sustainable tourism management, climate resilience, and renewable energy adoption indicates a proactive approach to environmental policy and regulation. Continued investment in these areas will be critical for ensuring the long-term environmental sustainability of Warrnambool's rural waterfront area in Victoria, Australia (Versace et al., 2013).

In summary, Warrnambool exhibits several positive indicators of environmentally friendly waterfront practices, including community engagement, cultural heritage integration, and efforts to protect biodiversity. Ongoing attention to sustainable tourism management, climate resilience, and renewable energy adoption will be critical for ensuring the long-term environmental sustainability of this rural waterfront area in Victoria, Australia.

3.2. Discussion

The findings of this study shed light on the intricate relationship between waterfront architecture theory, rural areas, and environmental harmony across diverse case study locations. Through theoretical analysis and empirical evidence, we have uncovered significant insights that hold relevance for both academia and practical application. Theoretical underpinnings from architecture and urban planning have provided a foundation for understanding the importance of thoughtful design in rural waterfront areas (Üzümcüoğlu & Polay, 2022; Yıldırım & Banoğlu, 2022; Akın & Demir, 2021). Architectural theories emphasize principles of aesthetics, functionality, and sustainability. Our study reinforces the notion that these principles can be successfully integrated into rural waterfront development to achieve ecological, cultural, and economic sustainability (Akın & Demir, 2021; Yıldırım & Banoğlu, 2022). The concept of ecological resilience, borrowed from environmental science, has been instrumental in guiding waterfront development (Chen & Ma, 2023; Doka et al., 2022; Fumagalli et al., 2014; Liang et al., 2020).

Case studies such as the Murray-Darling Basin in Australia illustrate the significance of resilient design to mitigate environmental risks. The adaptive capacity of rural waterfront areas can be enhanced through measures like elevated infrastructure, sustainable land use practices, and habitat preservation. Sociology and anthropology theories have informed our understanding of community engagement and cultural preservation. Rural waterfront development is not merely about aesthetics but also about fostering a sense of belonging and identity. Case studies in Mali and Myanmar highlight the pivotal role of local communities in preserving cultural heritage and sustaining ecosystems.

The case studies encompassed a wide range of geographic contexts, from the remote rural waterfronts of Mali to the picturesque coastal areas of Italy and Australia. This diversity allowed for a nuanced examination of the impact of geographic factors on waterfront design and environmental outcomes. The cases of Inle Lake in Myanmar and the Amalfi Coast in Italy underscore the importance of sustainable tourism practices in protecting fragile ecosystems. Visitor management and environmental education initiatives have shown promise in balancing tourism-driven economic growth with environmental preservation. Mali's Djenne and Myanmar's Inle Lake offer valuable insights into the power of traditional knowledge and community stewardship. These cases emphasize the need to recognize and leverage indigenous practices in environmental management, which often go hand in hand with cultural preservation. Coastal areas such as the Amalfi Coast and Warrnambool are grappling with climate change impacts. Theoretical insights on resilience have practical applications in these regions, where elevated buildings, erosion control measures, and adaptive infrastructure are becoming critical to long-term sustainability. While these case studies exemplify environmentally friendly rural waterfront development, they also reveal persistent challenges. Water quality management, pollution control, and renewable energy adoption are areas where further progress is required to achieve holistic sustainability. The empirical findings from our case studies emphasize the importance of holistic, interdisciplinary approaches to rural waterfront development. Incorporating architectural, environmental, sociocultural, and economic considerations is imperative. Sustainable tourism management, community engagement, and climate-resilient infrastructure are actionable strategies that can guide waterfront projects.

The symbiotic synergy between waterfront architecture theory, rural areas, and environmental harmony is not just a theoretical construct but a practical reality demonstrated by the case studies examined. The theoretical foundations from architecture, environmental science, sociology, and anthropology converge to offer valuable insights for sustainable waterfront development. By

adopting the principles and lessons learned from these case studies, policymakers, planners, and communities can aspire to create rural waterfronts that harmonize with nature, culture, and the well-being of all inhabitants.

4. Conclusion and Suggestions

The exploration of rural waterfront areas through case studies has provided insights into how theoretical indicators intersect with practical outcomes. These findings offer valuable guidance for future research and practical applications aimed at achieving environmentally friendly waterfront development.

Environmental Sustainability: The case studies demonstrated the importance of protected natural areas, conservation efforts, and water quality management in promoting environmental sustainability. Researchers and stakeholders should prioritize interdisciplinary collaboration and longitudinal studies to monitor the effectiveness of sustainability practices over time.

Cultural and Historic Preservation: Integrating cultural heritage into waterfront development emerged as a critical aspect of preserving local identity and promoting tourism. To ensure the preservation of cultural heritage while fostering economic growth, stakeholders must prioritize community engagement and sustainable tourism management.

Accessibility and Connectivity: While the case studies did not extensively cover accessibility and connectivity in rural waterfront areas, the importance of these cannot be overlooked. Future research should explore how enhancing accessibility and connectivity can improve economic opportunities and community well-being.

Aesthetic and Urban Design: The integration of cultural heritage into waterfront planning contributed to the aesthetic appeal and urban design of the case study areas. To create visually appealing and culturally rich waterfront environments, stakeholders should prioritize cultural preservation in urban design plans.

Public Health: Efforts to maintain water quality and mitigate pollution are essential for safeguarding public health in coastal areas. Stakeholders should invest in infrastructure and regulatory measures to address water quality concerns and protect the health of residents and visitors.

Economic Impact: Sustainable tourism practices emerged as a significant driver of economic growth in rural waterfront areas. To maximize economic benefits while minimizing environmental impact, stakeholders should prioritize sustainable tourism management and community engagement.

Awareness: Environmental education programs played a crucial role in raising awareness about conservation and sustainable practices among residents and visitors. Stakeholders should continue to invest in education and outreach initiatives to foster environmental stewardship and promote responsible behavior.

Legislation and Policy Improvement: The case studies highlighted the need for robust legislation and policy frameworks to support sustainable waterfront development. Stakeholders should advocate for policies that prioritize environmental sustainability, cultural preservation, and community well-being while addressing challenges such as climate resilience and renewable energy adoption.

One limitation of the study lies in the scope of the case studies conducted. While the selected cases offer valuable insights into rural waterfront development, they may need to fully represent the diverse range of contexts and challenges present in such areas globally.

Additionally, the study's focus on theoretical indicators may only capture some relevant factors influencing waterfront development, such as socioeconomic disparities, political contexts, and indigenous perspectives. Therefore, future research should aim to incorporate a broader range of case studies and factors to provide a more comprehensive understanding of sustainable rural waterfront development practices. In summary, the case study results underscored the interconnectedness of theoretical indicators and practical outcomes in rural waterfront development.

By addressing environmental sustainability, cultural preservation, accessibility, public health, economic impact, awareness, and legislation, researchers and stakeholders can work collaboratively to create environmentally friendly waterfront areas that benefit communities and ecosystems alike.

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Determining the Efficiency of Rapid Damage Assessment Studies after the 6 February Kahramanmaraş Earthquakes

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Abstract

Referred to as "the disaster of the century", Kahramanmaraş earthquakes have exposed the significant seismic vulnerability of many buildings in Türkiye. The February 6, Kahramanmaraş earthquakes, which are the focus of this study, had a very wide impact area, and high intensity, and the limited number of expert teams, resulted in insufficient damage assessment studies. This study aims to examine the suitability of the RYTEİE method for application in Türkiye and to assess the parameters of the method used during the February 6, Kahramanmaraş earthquakes. Data obtained from damage assessment studies revealed critical issues, such as improper establishment of the relationship between buildings and the ground, non-compliance with relevant regulations, and a lack of adequate inspection. Accordingly, the necessity of interdisciplinary cooperation for all structures was emphasized in the study. Considering the earthquakes that cause loss of life and property, this study aims to contribute to the literature.

Keywords: *Kahramanmaraş earthquakes, damage assessment, RYTEIE method, assessment form.*

6 Şubat Kahramanmaraş Depremlerinden Sonra Hızlı Hasar Tespit Çalışmalarının Etkinliklerinin Belirlenmesi

Öz

"Yüzyılın felaketi" olarak adlandırılan Kahramanmaraş depremleri, Türkiye'deki birçok yapının önemli sismik zayıflığını ortaya koymuştur. Çalışmanın merkezinde olan 6 Şubat Kahramanmaraş depremlerinin etki alanının çok geniş olması, şiddetinin büyük olması ve uzman ekip sayısının az olması hasar tespit çalışmalarının yetersiz kalmasına sebep olmuştur. Çalışma kapsamında RYTEİE yönteminin Türkiye için kullanılmasının uygunluğunun incelenmesi ve 6 Şubat Kahramanmaraş depremlerinde kullanılmış olan yöntemin parametrelerinin değerlendirilmesi amaçlanmıştır. Hasar değerlendirme çalışmalarından elde edilen veriler, binalar ile zemin arasındaki ilişkinin uygunsuz bir şekilde kurulması, ilgili yönetmeliklere uyulmaması ve yeterli denetimin yapılmaması gibi kritik sorunları ortaya koymaktadır. Buna bağlı olarak, çalışmada tüm yapılar için disiplinler arası işbirliğinin yapılması gerekliliği vurgulanmıştır. Can ve mal kayıplarına yol açan depremler düşünüldüğünde bu çalışmayla literatüre katkı sağlanması hedeflenmiştir.

***Anahtar Kelimeler**: Kahramanmaraş depremleri, hasar tespiti, RYTEIE yöntemi, değerlendirme formu.*

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1. Introduction

Historically, Türkiye has been one of the countries most affected by earthquakes that carry a high risk of loss of life and property. As can be seen in the earthquake map prepared by the Turkish Earthquake Research Department under the Disaster and Emergency Management Presidency of the Ministry of Internal Affairs, the majority of the country's population lives under earthquake risk (Figure 1). It is seen that the country's land is located on active fault lines, as well as the lack of implementation of earthquake-resistant building design, plays an important role in the high loss of life and property due to earthquakes in the country. A total of 116,720 buildings were severely damaged due to the earthquake on 27 of December 1939, which hit Erzincan with a magnitude of 7.9, while the number of deaths reached 32,968. Another earthquake hit Kocaeli / Gölcük on 17th August 1999 with a magnitude of 7.8 and caused severe damage to 73,342 buildings and 17,480 people died (Taş, 2003).

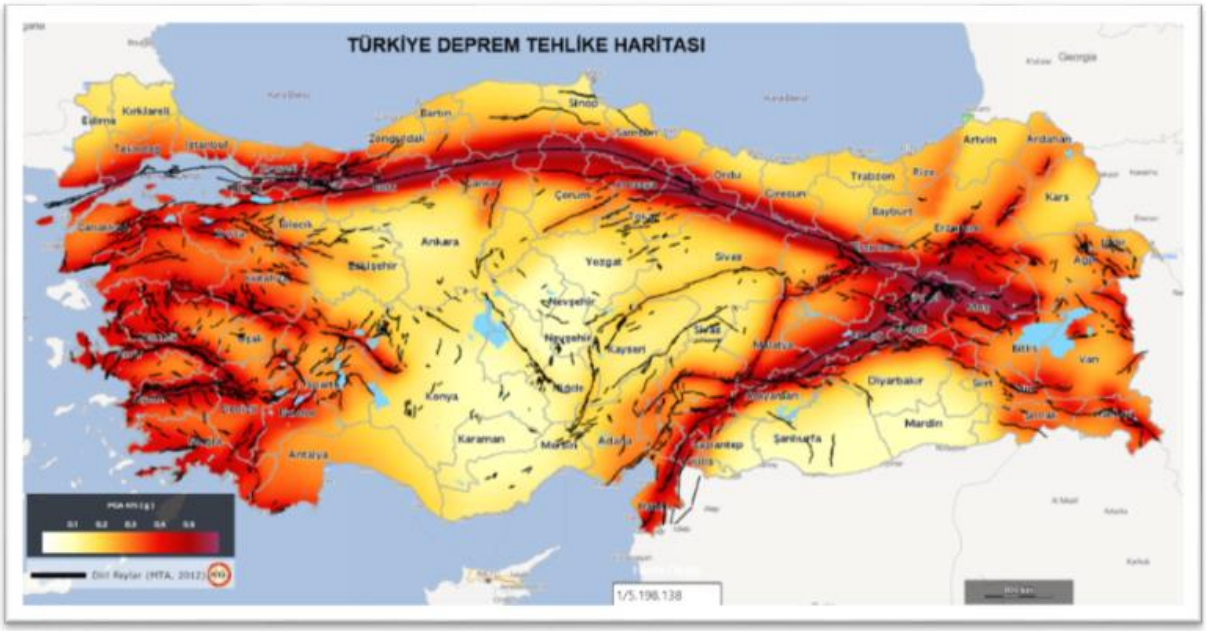

Figure 1. Türkiye earthquake zones map (AFAD, 2024)

The first of the two earthquakes detected by the Disaster and Emergency Management Presidency (AFAD) systems of the Ministry of Internal Affairs of the Republic of Türkiye and the Richter scale on 06.02.2023 occurred in Pazarcık district of Kahramanmaraş province at 04:17 Türkiye time with a magnitude of 7.7 Mw, while the second one was measured at 13:24 in Elbistan district of Kahramanmaraş province with a magnitude of 7.6 Mw (AFAD, 2023). The seismic tremor of this earthquake was sensed in the provinces of Kilis, Gaziantep, Adıyaman, Hatay, Malatya, Osmaniye, Şanlıurfa, Adana, Elazığ and Diyarbakır, and more than 50,000 people lost their lives in this earthquake (TRT, 2023). All this taken together, the Kahramanmaraş/Pazarcık and Elbistan earthquakes highlighted the importance of the rapid detection of existing buildings after earthquakes in Türkiye for the prevention of the safety of life and property.

Türkiye suffered a lot of damage due to the lack of practice in the construction phase, the severity of the earthquake, deficit of knowledge and education, use of improper and poor quality materials, and inappropriate construction techniques. Many of the country's people have been affected by earthquakes in one way or another (Özkul & Gülgeç, 2022).

Structural damage occurs in buildings due to the earthquake effect, therefore, in order to ensure people's life safety, the area must be evacuated as soon as possible, damage assessment studies must be carried out quickly in the buildings by experts, and usable buildings must be identified. This detection process, called "Post-Earthquake Emergency Damage Detection" in buildings, aims to examine buildings with structural damage and to ensure the life safety of people affected by the earthquake while the tremors continue (Yüksel, 2008).

There are many rapid damage detection methods used today to detect damages caused by earthquakes, while studies are still ongoing to make damage detection faster. The main rapid screening methods used in the world and in Türkiye include the Canadian Seismic Screening Method, the Japanese Seismic Index Method, the FEMA-154 Rapid Visual Screening (Gülgeç, 2019) Method, the Indian Rapid Visual Screening Method, the New Zealand Standard and the P25 method developed with the "Zero Loss of Life Project". Türkiye, on the other hand, uses a method called "Simplified Methods That Can Be Used to Determine the Regional Earthquake Risk Distribution of Buildings" which is explained in detail in ANNEX-A of the “Principles for Identification of Risky Structures (RYTEİE)”. All methods described above are generally similar in that, while the base score of the building is calculated based on the load-bearing system type of the building and the earthquake risk of the region in which it is located, the defects on the structure determine the negativity scores, which have been subtracted from the base score to calculate the final the performance score of the building. The performance score obtained as a result of the evaluation determines the risk ranking of the buildings, and with this ranking, the risk level of the building is decided according to the current limit values (Demirbaş, Şahin & Durucan, 2021).

The parameters of the rapid scanning methods used in the World are generally the number of floors and load-bearing system type of the building, soft floor / short column effect, planning irregularities, adjacent order situation, heavy overhangs, etc. In the light of observational on-site examinations, these parameters are classified by giving a score to each defect, and the obtained data are evaluated by writing them on forms (Demirbaş et al., 2021).

Since the rapid detection method to be used after an earthquake will significantly reduce the loss of life and property, it is of great importance to apply the correct method. The aim of the study is to determine the suitability of the method "Principles on Identification of Risky Structures (RYTEİE)" described in ANNEX-A that is applied within the scope of Law No. 6306 in Türkiye, as a rapid damage detection method in the Kahramanmaraş earthquakes of 6 February 2023 and to identify the parameters that cause severe damage.

2. Material and Method

In the qualitative research, buildings in Malatya and Adıyaman provinces with severe damage due to the earthquakes on 6th February 2023 were evaluated with the rapid damage detection method. The samples were selected among 30 cases that have been assessed about court decisions for the second time by the experts who were appointed by the court as arbitrators. The researcher examined the analysis and performed an additional analysis with the rapid damage detection using the RYTEİE method, while the structural and non-structural defect types were examined in detail.

The variables used in the rapid damage detection assessment performed with the RYTEİE method are classified as; the type of carrier system in the buildings, the number of floors of the building, the age of the construction, soft floor and short column effect, irregularities in the plan, vertical irregularity, type of the ground, the slope of the ground, heavy overhangs, seismicity, dilatation, usage of the building. The types of damage were analyzed according to these variables, and the damage caused in each building was evaluated according to the RYTEİE method with field inspections.

2.1. Damage detection method according to the principles regarding the detection of risky structures (RYTEİE) regulation

RYTEIE Method is a damage detection method in which the Principles for Identification of Risky Buildings are prepared in order to prevent possible loss of life and property in earthquakes in Türkiye. This method, which was issued in accordance with the Regulation on the Implementation of the Law No. 6306 on the Transformation of Areas Under Disaster Risk, which came into force in 2012, makes risk assessment according to the region where existing buildings are located (6306 Sayılı Afet Riski Altındaki Alanların Dönüştürülmesi Hakkında Kanun, 2012).

The "final damage assessment report" is given in form in the annex of the Damage Assessment Circular issued in accordance with the Law on the Organization and Duties of Disaster and Emergency

Management Presidency (Afet ve Acil Durum Yönetimi Başkanlığı/AFAD) (AFAD, 2014). Information to help fill out the damage assessment form is included in the attachment of the form.

The context of the attachment to the damage assessment form prepared by AFAD includes information such as the order status of the building (adjacent or separate), Numbering of the building, roof geometry, type of the buildings' structural system, information about the damaged floor of the building, useage purpose of the building (AFAD, 2014).

As the first step, observation has been focused on the elements such as change in structure shape, slips on the ground or deteriorations in the carrier system in order to determine whether the building is severely damaged or not, while dtermination process is terminated if the building is severly damaged to prevent any accident due to any aftershock, etc. If observational detection cannot be made from outside, the damage conditions at the detected points are classified as A, B, C, D types and recorded in the damage assessment forms, after checking the factors starting from the bottom floor of the building to the damaged floors. They are marked as undamaged, slightly damaged, moderately damaged or heavily damaged (AFAD, 2014).

2.1.1. Damage detection stages of the RYTEİE method

According to the RYTEİE damage detection method, the limits of external and internal inspection steps in reinforced concrete structures have been determined. Damage detection in buildings is evaluated according to the parameters in the examination steps given in Figure 2 and Figure 3. When the structures examined from the outside are considered to be heavily damaged, the inspection is terminated and the internal inspection is not carried out. In buildings that are not considered to be heavily damaged, the internal inspection step is started and the evaluation is made by starting from the lower floors of the building and examining it up to the damaged floors (İlki, Demir, Cömert & Halıcı, 2019).

External inspection steps;

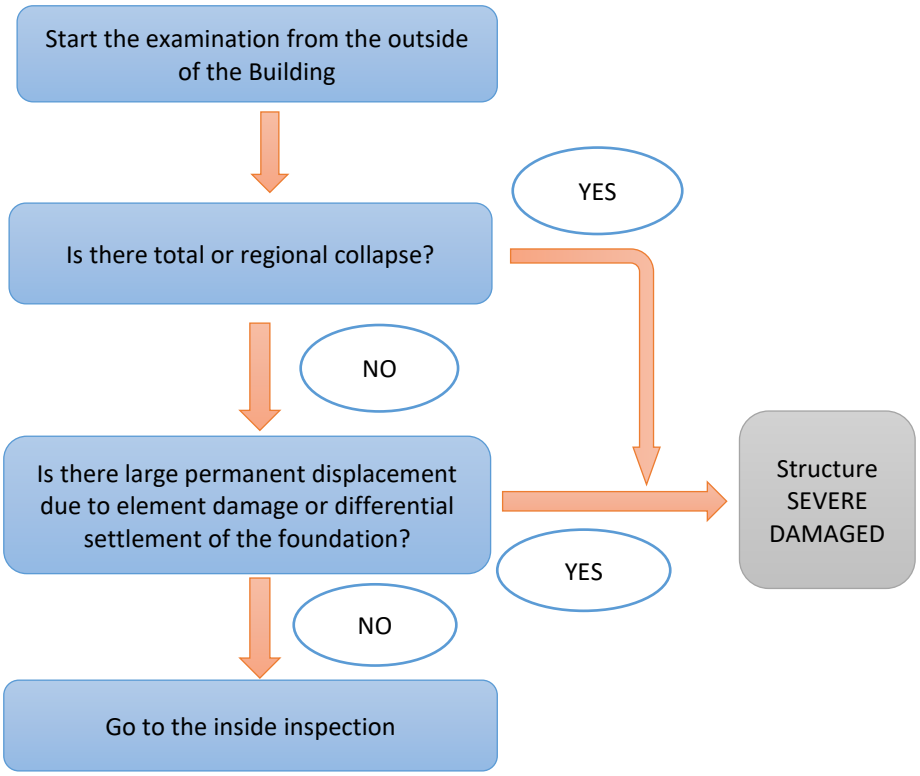

Figure 2. Schematic sequencing of external review steps (İlki et al., 2019)

Internal inspection steps;

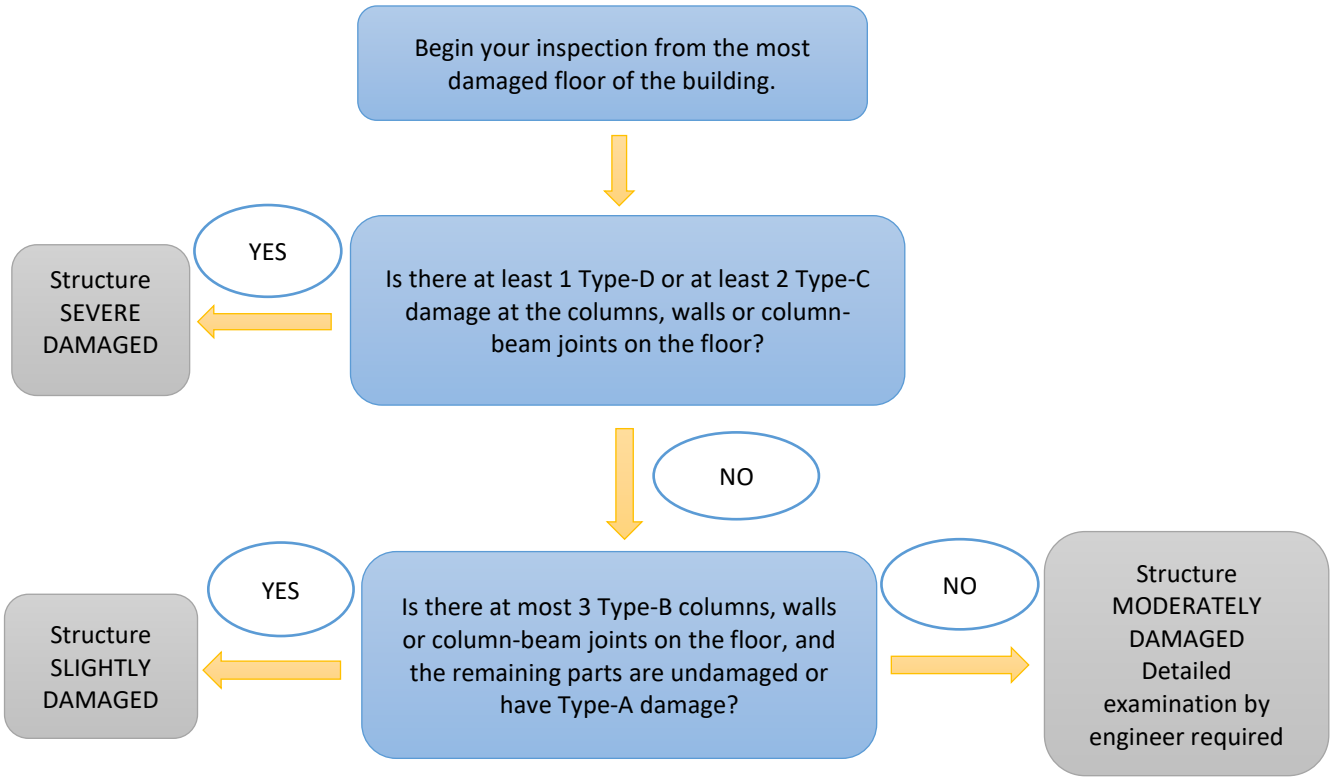

Figure 3. Schematic sequencing of internal review steps (İlki et al., 2019)

In post-earthquake damage assessment studies, by following the instructions of the method in question and determining the damage types according to the observations made on the buildings from outside and inside, the teams in charge finalize their determinations about the buildings by giving codes to the buildings as undamaged, slightly damaged, moderately damaged, heavily damaged and urgently demolished.

2.1.2. External inspection of reinforced concrete structures

1. Investigation step: Regional or complete collapse

If a complete or regional collapse has been observed in the building, the structure is determined as severely damaged the process is terminated and no other stages are examined.

2. Inspection step: Checking permanent horizontal displacement between floors

The following step includes examination for permanent displacements in the floors and the relative drift ratio must be determined. If this ratio is greater than 0.01, the building is classified as severely damaged and the process is terminated.

3. Inspection step: Checking the rotation of the building from ground collapse

At this stage, movements in the ground and foundations and their effects on the structure are evaluated. If there is a proper fit without rotation, the examination continues, however, if a bending of more than 3rd degree is detected, the examination is terminated (Figure 4). If the rotation amount is less than 1 degree, it is determined as minor damage, whereas a bending between 1 and 3 degrees is classified as moderate damage where the examination has been continued (Kaplan, 2018). Settlement and collapse damages on the ground that occur in buildings due to the effect of ground movement and liquefaction are shown in Figure-4.

2.1.3. Internal inspection of reinforced concrete structures

If the structure is not classified as severly damaged after the external observation, experts are allowed to enter the building to examine the horizontal and vertical load-bearing elements of the damaged building, starting from the lowest floors to the most damaged floors. If there are different levels of damage to the load-bearing elements of the building on different floors, the most severely damaged floor is chosen to classify the damage rates on the floors. In reinforced concrete structures, damage to the infill walls is not taken into account, even if the damage is very advanced or severe. On the other hand, the damage to the load-bearing elements of the structure; bending, shear cracks, the width of these cracks, and crushing in the concrete are important and should be taken into account (Kaplan, 2018).

• If there are no cracks or pressure damage in the load-bearing elements of the structure, the element is classified as "**NO DAMAGE**",

• If there are bending or shear cracks not wider than 0.5 mm without any pressure damage, the element is classified as "**SLIGHTLY DAMAGED**",

• If there are bending cracks wider than 0.5 mm, shear cracks between 0.5 mm and 2 mm, or crushing in the concrete shell (cover, concrete cover), the element is classified as "**MODERATELY DAMAGED**",

• If the width of the shear crack is between 2 and 10 mm or if there is peeling (the width of the bending crack is not important), the element is classified as "**SEVERELY DAMAGED**"

• If the width of the shear crack is more than 10 mm or if there is buckling of longitudinal reinforcement or crushing of the core concrete (the width of the flexural crack is not important), the element is considered as "**VERY SEVERE DAMAGED**". If there is damage at the column-beam joints that is more serious than the damage seen in the columns, these are considered as column damage. Damage types, classification and dimensions of load-bearing elements are given in Table 1 (Kaplan, 2018).

2.1.4. Damage types, classes and criteria of load-bearing elements

Table 1. Classification of damage types (Karataş, 2023)

DAMAGE TYPE	DAMAGE CLASS	Flexural Crack Width	Shear Crack Width	Pressure Damage
O Type Damage	*No Damage*	-	-	-
A Type Damage	*Slight Damage*	$w \leq 0.5$ mm	$w \leq 0.5$ mm	-
B Type Damage	*Moderate Damage*	$w > 0.5$ mm	$0.5 \text{ mm} < w \leq 2$ mm	Crushed Shell
C Type Damage	*Severe Damage*	-	$2 \text{ mm} < w < 10$ mm	Crusting; Spalled Shell
D Type Damage	*Very Severe Damage*	-	$w \geq 10$ mm	Reinforcement Buckling, Core Crushing

Damages that may occur on load-bearing structural elements in reinforced concrete structures;

a. Bending cracks in load-bearing structural elements in areas subject to tensile stress,

b. Shear cracks occurring in load-bearing structural elements under the influence of shear force,

c. Along with pressure damage on load-bearing structural elements, damages such as shell crushing, shedding, reinforcement buckling and core crushing may occur. In reinforced concrete systems, the widths of the cracks that will occur in the load-bearing structural elements are measured, while bending and shear cracks are evaluated where the crack is widest. Moreover, the plaster surface

should be excavated and it should be checked whether the concrete crack continues in the carrier elements.

• **Shell Crushing**: The concrete layer outside the stirrup is called the Shell, while Shell crushing is defined as crushes occurring in the concrete outside the stirrup (Figure 5).

• **Shell Casting**: It is the pouring of concrete outside the stirrup (Figure 5).

• **Reinforcement Buckling**: These are bucklings in longitudinal reinforcements, stirrups or horizontal reinforcements within the load-bearing structural element (Figure 5).

• **Core Crushing**: The concrete and/or concrete layer inside the stirrup is called the core. Core crushing is defined as the crushing of the concrete inside the stirrup (Figure 5) (Kaplan, 2018).

According to the internal damage inspection, the damage of the building has been classified as "SEVER DAMAGED" when at least 1 of the column, beam, curtain or column-beam connection areas on the floor is in D Type or at least 2 of them are in C Type damage classes. The damage of the building is classified as "SLIGHTLY DAMAGED" if at most 3 of the column, beam, curtain or column-beam connection areas on the floor are in B Type damage classes whereas all the remaining parts are undamaged or in type A damage class. If any of these two conditions are not met, the building is classified as "MODERATELY DAMAGED" and a detailed investigation by engineers is required (Kaplan, 2018).

3. Results and Discussion

Within the scope of this study, the RYTEİE method was suitable and appropriate to be used as a rapid damage assessment in buildings with severe damage after the 6th February earthquakes in Malatya and Adıyaman provinces. We were able to detect and identify the structural and non-structural fault types such as damages caused by the ground (Figure 4.), carrier system errors in buildings (Figure 5.), workmanship and application errors (Figure 6.), manufacturing errors (Figure 7.), short column effect (Figure 8.), weak column strong beam effect (Figure 9.), the soft layer effect (Figure 10.), in the severely damaged buildings, showing that the loss of life and property in earthquakes was mainly due to buildings that are not earthquake-resistant rather than the severity of the earthquake.

3.1. Causes of Structural Damage

The observed parameters used in practice were associated with the damage status of the buildings, whose damage level was determined through rapid damage assessment studies after the Kahramanmaraş earthquakes, while the damage assessment method used in Türkiye will play an active role in creating the risky building stock.

The types of structural damage that occurred on buildings due to the intensity of the Kahramanmaraş earthquakes were explained using field examples under the heading of structural damage causes, and it was evaluated that the collapse or damage of the structure depends on many factors. With the combination of more than one factor, the buildings were damaged in different ways, and the damage conditions and causes in the buildings were evaluated by field investigations using the RYTEIE method. As a result of observation-based field research, these damages were evaluated as defects arising from the construction phase and design.

Defects during construction; Damages caused by the ground, carrier system errors, workmanship errors, use of poor quality materials and lack of inspection, while design errors were determined as lack of technical knowledge and experience. On the other hand, building damage causes were identified as structural damage during the construction phase, damages caused by the ground, carrier system errors during the construction phase, workmanship errors, manufacturing errors and design errors caused by the construction phase; short column, weak column-strong beam and soft storey effect.

3.1.1. Structural Damages Under Construction

In the research performed in Malatya and Adıyaman provinces after the earthquakes, it was observed that damages occurred for different reasons as a result of errors during the construction phase. The types and causes of damage resulting from the construction phase can be explained as described below.

3.1.1.1 Damages caused by the ground

During the evaluation based on the rapid damage assessment method used in Türkiye, the damages caused by ground liquefaction were observed in the Gölbaşı district of Adıyaman province. During an earthquake, a situation called "soil liquefaction" occurs in the ground of the structure when the sand content is high and is additionally influenced by the groundwater. While this situation causes loss of bearing capacity on the buildings, it is observed as ground settling, tilting or collapse, which are considered structural damages in the buildings. The foundation soil of the buildings loses its bearing capacity due to the effect of liquefaction. Thus, structures in such areas where ground liquefaction occurs tend to sink, tilt or topple over (Alpaslan, 2013). After the 6 February 2023 Kahramanmaraş earthquakes collapses and bearing capacity losses in the structures and roads in the Gölbaşı district of Adıyaman were observed due to the ground movements and liquefaction on the ground (Figure 4). The structures, having settlements and bendings as a result of liquefaction on the ground, were evaluated as severely damaged due to type D damages according to the RYTEIE method.

(a) (b) (c)

Figure 4. Ground-related damages (a) (b) Settlement on the ground (loss of bearing capacity), (c) Collapses on the ground – Adıyaman / Gölbaşı; (Karataş, 2023)

3.1.1.2. Damages caused by carrier system errors during construction

The main purpose of determining the damage to buildings after an earthquake is to ensure the safety of life and property. For this reason, buildings that are not suitable for immediate use in damage assessment studies are marked and the use of these buildings is completely or partially restricted. If the building is damaged, they are classified according to the method used as undamaged, slightly damaged, moderately damaged, severely damaged and urgently demolished, based on the observational results of the technical teams during field studies.

In reinforced concrete structures, earthquakes apply very large forces to the column-beam joints, which are the elements of the load-bearing system, and structural damage occurs as a result of the strain on these joints. During field studies in the selected region, it was observed that severe damage occurred at the column-beam joints in many buildings (Figure 5).

Deficiencies in transverse reinforcement

In order to prevent buckling of longitudinal reinforcement in reinforced concrete structures, installing transverse reinforcement in accordance with the regulations increases the durability of the core concrete under pressure. In the field studies, the reinforced concrete buildings in the earthquake zone

were severely damaged as a result of the crushing and crusting of the core concrete, which has been categorized as C and D type damages according to the evaluation criteria explained in the RYTEIE method (Figure 5).

(a) (b) (c)

Figure 5. Structural damage types (a), (b) core crushing, shell crushing, shell crushing, reinforcement buckling, (c) insufficient transverse reinforcement - Malatya; (Karataş, 2023)

3.1.1.3. Workmanship and application errors

Design errors originating from the construction phase is another type of error observed in reinforced concrete structures in the earthquake zone. Field studies carried out after the Kahramanmaraş earthquakes showed that both the damage to the carrier system and workmanship and application errors might result in severe damage to the structure during an earthquake. An example of a severely damaged building can be seen in Figure 6/c, where column-beam axes do not meet each other and give rise to severe damage. On the other hand, some buildings were identified as reinforced concrete mixed structures with separations in the load-bearing elements in these structures (Figure 6/b). Since partition walls in reinforced concrete structures do not have a load-bearing function, damage to the walls caused by earthquakes is not taken into account in detection studies and is stated as non-structural damage (Figure 6/a).

(a) (b) (c)

Figure 6. Structural/non-structural damages and construction errors (a) wall crack (non-structural damage in reinforced concrete structures), (b) separation of load-bearing elements (structural damage), (c) design error (structural damage) – Adıyaman; (Karataş, 2023)

3.1.1.4. Manufacture defects

Even if the load-bearing system of the building is designed in accordance with the regulations, concrete spills in columns and beams due to mistakes made during on-site application cause damage to the load-bearing system. Damages resulting from manufacturing errors in the load-bearing structural system of the observed building, in addition to the effect of the earthquake load, caused the rusting iron concrete to crack and the structure to be severely damaged due to not leaving enough cover on the columns (Figure 7).

Figure 7. Damages resulting from manufacturing errors - Malatya (Karataş, 2023)

3.1.2. Structural Damages Due to Design

Severe damage resulting from design errors has been identified in several buildings that has been affected by the 6 February 2023 Kahramanmaraş earthquakes, and some examples are explained in the following section below.

3.1.2.1. Short colon effect

During the design phase, horizontal windows planned on the exterior walls for illumination and ventilation purposes in the basement and ground floors play an important role in the formation of the short column effect. Other reasons for the formation of short columns include gradual foundations made to suit the land structure, mezzanine floor solutions, and different floor alignments in adjacent buildings due to the slope of the land. It has been observed that column damage on the lower floors of such buildings is higher than on the ground floors, as a result of the earthquake effect not distributing the load from the ground to the beams. Examples of the short colon effect giving rise to different types of severe damage in buildings can be seen Figure 8.

Figure 8. Short colon effect damages – Malatya (Karataş, 2023)

3.1.2.2. Weak column strong beam effect

Columns and beams in the load-bearing system of the building should be strictly dimensioned according to the regulations. In the load-bearing system of reinforced concrete structures, the column-beam dimensions should have a harmonious relationship in order to transfer the load to the ground appropriately. In order to create wide space in rooms, columns were constructed thinner and/or weaker than beams, which cause serious damage in the columns due to loss of bearing capacity during earthquakes. It has been observed that weak column gives rise to damages in the load-bearing system of the building resulting in severe damaged structure as seen in Figure 9.

Figure 9. Weak column and strong beam damage - Malatya (Karataş, 2023)

3.1.2.3. Soft floor effect

Especially reinforced concrete structures are expected to be resistant to earthquake loads, however, the ground floors are sometimes planned as workspaces for commercial with a greater height than the other floors, resulting in a soft floor. “Soft floor” is defined as the situation when shear walls on the upper floors do not continue on the ground floor, the height is more compared to the upper floors and the stiffness is less than the upper floors. This situation caused structural irregularities in the building and damage to the structure against the earthquake load (Figure 10.).

Figure 10. Soft Floor Effect Damage - Malatya (Karataş, 2023)

Although challenges have been experienced in building teams to work in damage assessment due to the size of the coverage area of the Kahramanmaraş earthquakes, which were called the disaster of the century, approximately 8,000 technical personnel took place in these rapid assessment teams. Damage assessment not only determines the damages to the structures caused by the earthquake but also can contribute to taking precautions in the reconstruction of the region and carrying out new projects more safely. The Kahramanmaraş earthquakes have once again demonstrated the importance of carrying out damage assessment studies quickly and accurately to create an earthquake-resistant building stock at the beginning of the post-disaster recovery process (Aydoğdu Gürbüz & Aslan, 2023).

Literature shows that analyzes made with rapid damage detection methods used in different earthquakes have detected the same types of damage in buildings. Elyiğit & Ekinci (2023) discussed damage detection in reinforced concrete buildings after the earthquake as structural and non-structural damages, while they explained the cause and effect relationships of the damage caused by the earthquake on buildings, the types of damage and what needs to be done for earthquake-resistant building designs. Authors suggested that safe buildings should be built to ensure the safety of life and property and emphasized that bioharmological buildings should be designed to build safe and durable buildings (Elyiğit & Ekinci, 2023). On the other hand, Yüksel (2008) examined the most common causes of structural damage while classifying damages in buildings and explained the principles of emergency damage detection and usability. As a result of his research, it was emphasized that the team should be experienced and trained and the organization should be well-organized to inspect damaged buildings quickly after the earthquake (Yüksel, 2008).

In his study, Taş (2003) examined the population density brought about by industrialization in big cities and the awareness of earthquake risk in settlements, revealed the damages that may occur and explained the planning that should be done before and after the earthquake. He stated that the negative consequences on the buildings resulting from the destructive effect of the earthquake were not only due to the lack of construction of the building but also to the inadequacy of urban planning and implementation. He stated that it is important for many institutions to share work in order to be prepared for possible earthquake disasters, and emphasized that institutions, organizations and non-governmental organizations should be informed, and organized and the framework of work-sharing should be drawn before a natural disaster (Taş, 2003).

In his study, Solak (2022) conducted research on earthquake-resistant building design in education and evaluated whether civil engineering and architecture students used their knowledge in the design phase and examined their success status and projects. According to the findings of his study, he determined that the students who were successful in these courses designed their projects by taking the earthquake risk into consideration. Therefore, it has been emphasized that these courses should be compulsorily included in the education curriculum in order to raise earthquake awareness among students of both departments for Türkiye, which is in the earthquake zone (Solak, 2022).

In a study examining the rapid assessment method in reinforced concrete buildings, Demirbaş et al. (2021) determined the risk distribution in 130 buildings determined to be heavily damaged after the Elazığ-Sivrice earthquake (2020) by using two different methods, the simplified method presented in the Principles for Identification of Risky Buildings and the Canadian Seismic Scanning Method. The results of these two methods were compared, and findings showed that both methods give outcomes that are not compatible and it was concluded that improvements are needed to eliminate the deficiencies of the existing methods (Demirbaş et al., 2021).

Çatal (2019) compared different damage assessment forms designed to reveal the damage status of buildings affected by the earthquake. While comparing the forms used in different countries and Türkiye, he realized that the damaged parts of the building in the USA are evaluated based on the criteria in ATC-38 and ATC-20 forms including information about the age of the building, its area, whether it is built on sloping land, plan irregularities and torsional irregularities. The UN-Balkan form used in the Balkan countries includes the identity information of the structure, load-bearing system information, degree of damage and ground information, and the form indicates whether the structure requires urgent intervention. He examined the damage assessment forms prepared by AFAD in Türkiye

and determined that the common features of these forms are the information of the person making the determination and the identity information of the damaged structure, as well as whether it can be used immediately. As a result of his study, he states that using the damage assessment forms ensure consistent detection since the forms are used by trained technical personnel who focus on the spesific points questioned in the forms and identify the level of damage in similar structures (Çatal, 2019).

Özkul & Gülgeç (2022) conducted a study on a reinforced concrete frame type school building with predetermined earthquake performance and measured the earthquake performance using four different methods and a revised rapid evaluation method, and compared the results of each method and examined its shortcomings and advantages. Rapid damage detection methods were evaluated according to the application time, reliability, ease of application and number of parameters used, and at the end of the study, it was emphasized that the appropriate approach should be the selection of the appropriate method for the building group to be examined (Özkul & Gülgeç, 2022).

According to Özkul & Gülgeç (2022), FEMA 154 Seismic Scanning Method is a simple method that can be applied easily such that it determines the structural risk score of the building via the structural system of the building, the building material and the seismic activity of the region in which it is located. Area scanning can be done easily due to the short application time, however, the limited evaluation parameters decrease the reliability of the method. Moreover, the Canadian Seismic Scanning Method is a simple method that can be performed in a short time, but the method needs to be adapted when used in different countries because it is based on the regulations in different years prepared in Canada, thus it is not reliable and suitable to apply in Türkiye due to the low-risk level in the parameters. On the other hand, The Japanese Seismic Index Method is a 3-stage evaluation method with high reliability due to the evaluation parameters that are more comprehensive than other methods and also fast and easy to use (Özkul & Gülgeç, 2022).

As a result of the study, the RYTEİE Method, currently implemented in Türkiye, has been evaluated as a more applicable method compared to the damage assessment methods used in other countries. In Türkiye, the use of the RYTEİE method in observational assessments of buildings, which are mostly constructed with reinforced concrete and masonry systems, is based on existing defects. Therefore, it is considered an appropriate method for obtaining reliable results. However, it is crucial that the team conducting the damage assessment consists of expert technical personnel and that the team determines a damage level similar to the same damage level on the buildings, ensuring consistency in the assessment. Following the Kahramanmaraş earthquakes, it was observed that the damage statuses of buildings, determined through rapid damage assessment studies, were consistent with the parameters used in practice. Based on the data obtained from the study, it is believed that the RYTEİE method will play an effective role in determining the existing stock of risky buildings in Türkiye.

Türkiye is among the countries with high earthquake risk due to its territory being on active fault lines. As a result of the rupture of the Eastern Anatolian Fault line on February 6, 2023, earthquakes of 7.7 Mw and 7.6 Mw magnitude occurred in Pazarcık and Elbistan districts of Kahramanmaraş province and went down in the country's history as the disaster of the century. While these earthquakes caused many people to lose their lives, it was once again revealed that the earthquake is too important an issue to be ignored, as it caused great destruction in a wide area covering 11 provinces.

4. Conclusion

With this study, the causes of damage to buildings in the February 6, 2023, Kahramanmaraş earthquakes in Malatya and Adıyaman provinces were evaluated using the parameters of the RYTEİE rapid detection method. The use of the RYTEIE method, which can be applied easily and is reliable, in observational determinations on structures built according to reinforced concrete and masonry systems in Türkiye, facilitates the work of those who make the evaluation which is based on existing defects. Since the team that will assess the damage of buildings consists of technical staff who are experts in this field, RYTEİE can be applied with high reliability and consistency in damage assessment.

Within the scope of the study, the most common defects determined during the damage assessment reports prepared with the RYTEİE method after the Kahramanmaraş earthquakes were stated as

irregular planning, soft floors, low material quality and poor evaluation of the ground quality in site selection. The experienced earthquakes have shown that although there are reasons such as not establishing the relationship of the buildings with the ground correctly, not complying with the relevant regulations and lack of inspection, the harmony of the load-bearing system and architectural design in all buildings in the country located in the earthquake zone reveals the need for interdisciplinary cooperation.

It is thought that eliminating the control deficiencies in legislation and practices, learning to live with earthquakes as a society by becoming aware of the need to live with earthquakes and constructing suitable buildings will significantly reduce the occurrence of earthquake damages.

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Author Contribution and Conflict of Interest

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

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Cognitive Mapping and Space Syntax Analysis of Universal Design Principles: The Case of the Üsküdar Barrier-Free Life Center

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Abstract

The purpose of this research was to examine universal design concepts and principles. Within the scope of the research, the spatial and structural features of the Istanbul-Üsküdar Barrier-Free Life Center were examined. The space syntax analysis method was applied in order to access the numerical data of the syntactic analysis of the space, and cognitive mapping analysis was performed in order to reflect the spaces formed in the minds of individuals in the cognitive maps of the space on the drawings. The participants and the sample were selected among individuals who use this place via the random sampling method. As a result of this research, the design features of a space used by disabled and non-disabled individuals, design criteria, syntagmatic features of the space, and cognitive features of the space were determined, and inferences that can serve as examples for the spaces to be built in the future were presented.

Keywords: *Design for all, inclusive design, universal design, accessibility, architecture.*

Evrensel Tasarım İlkelerinin Bilişsel ve Dizimsel Analizi: Üsküdar Engelsiz Yaşam Merkezi Örneği

Öz

Bu araştırmanın amacı, evrensel tasarım kavramları ve ilkeleri incelenerek Üsküdar Engelsiz Yaşam Merkezi örneği üzerinden açıklanmaya çalışılacaktır. Araştırma kapsamında Üsküdar Engelsiz Yaşam Merkezi yapısal, mekânsal ve iç mekân özellikleri incelemektir. Bu araştırmada uygulanan yöntem mekânın dizimsel analizinin sayısal verilerine ulaşabilmek için mekân dizim analizi (space syntax) ve mekânın bilişsel haritalarında bireylerin zihinlerinde oluşan mekânların çizime yansıtılması amacıyla bilişsel haritalama analizi (cogntive mapping analysis) yapılmıştır. Araştırmanın evrenini Üsküdar Yaşam Merkezi ve örneklemi ise bu mekânı kullanan (engelli veya engelsiz) bireyler arasından rastgele örnekleme yöntemiyle seçilmiştir. Bu araştırma sonucunda engelli ve engelsiz bireylerin kullandıkları bir mekânın tasarım özellikleri, tasarım kriterleri, mekânın dizimsel özellikleri ve mekânın bilişsel özellikleri tespit edilerek gelecekte yapılacak olan mekânlar için örnek teşkil edebilecek çıkarımlar ortaya koymaktadır.

Anahtar kelimeler: *Herkes için tasarım, kapsayıcı tasarım, evrensel tasarım, erişilebilirlik, mimari.*

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1. Introduction

"Universal design" is defined as a design approach that enables all products and environments to be used by many people, regardless of age, skill, and situation. In addition, universal design covers different fields, from product design to architecture and urban design, from simple systems that provide environmental control to complex information technologies (Dostoglu et al., 2009). Universal design (Goldsmith, 2007), individual differences (Mayer & Rose, 2000), creating inclusive environments (Steinfeld & Maisel, 2012), ergonomics, and universal design (Olguntürk & Demirkan, 2009). Universal design principles (Mustaqium, 2012; Boduroğlu, 2014), principles and models (Null, 2013), themes for wearable (Tomberg et al., 2015), street design (Ahmed & Sungur Ergenoglu, 2016), urban spaces (Meşhur, 2016), old city open space elements (Widiastuti & Harsritanto, 2018), ergonomic investigation of working environment (Aylin et al., 2019), urban public spaces (Meşhur & Yılmaz Çakmak, 2018), historical environment (Tutal & Topcu, 2018), interior architecture education (Usal & Evcil, 2019), re-design of schoolyard (Al Şensoy & Sarı, 2019), park planning (Seçme & Küçük, 2020), interior design (Grimley & Smith, 2021), library interior spaces (Bekar, 2021), impact of the pandemic on the principles of "universal design" (Ensarioğlu, 2020), accessibility and universal design of university spaces (Hilmioğlu & Seçer Kariptaş, 2022), universal design, barrier-free design and technology (Burkut, 2023), universal design approach in universities (Bulut & Halaç, 2023), public space (Süvari, 2023), architectural education (Bakar & Şimşek, 2023) museum (Sayar & Arat, 2024), commercial buildings (İşanç & Yılmaz, 2024), museums' historic buildings (Filová et al., 2022), universal design and barrier-free design with bibliometric analysis (Burkut, 2023), public playground (Moore et al., 2023), urban green space (Selanon & Chuangchai, 2024), online education (Yang et al., 2024), universal design for learning in the classroom (Hall et al., 2024), biophilic design pattern and universal design (Elsafty, 2024) and universal design for the workplace (Doussard et al., 2024).

As seen in Figure 1, the seven principles of universal design are (CEUD, 2024); 1) Equitable Use: The design is useful and welcoming to people with various abilities. 2) Flexibility in Use: The design accommodates a spectrum of individual preferences and abilities. 3) Simple and intuitive use: The design is easy to understand for people of various backgrounds, cultures, and skills. 4) Perceptible Information: The design incorporates the necessary information that is understandable by people of various cognitive abilities. 5) Tolerance for Error: The design minimizes hazards and consequences, intentional and not. 6) Low Physical Effort: The design is efficient and comfortable, with minimal fatigue. 7) Size and Space for Approach and Use: The design is approachable for people of various body sizes, postures, and mobility (NLC, 2022). Table 1 lists the current literature on universal design.

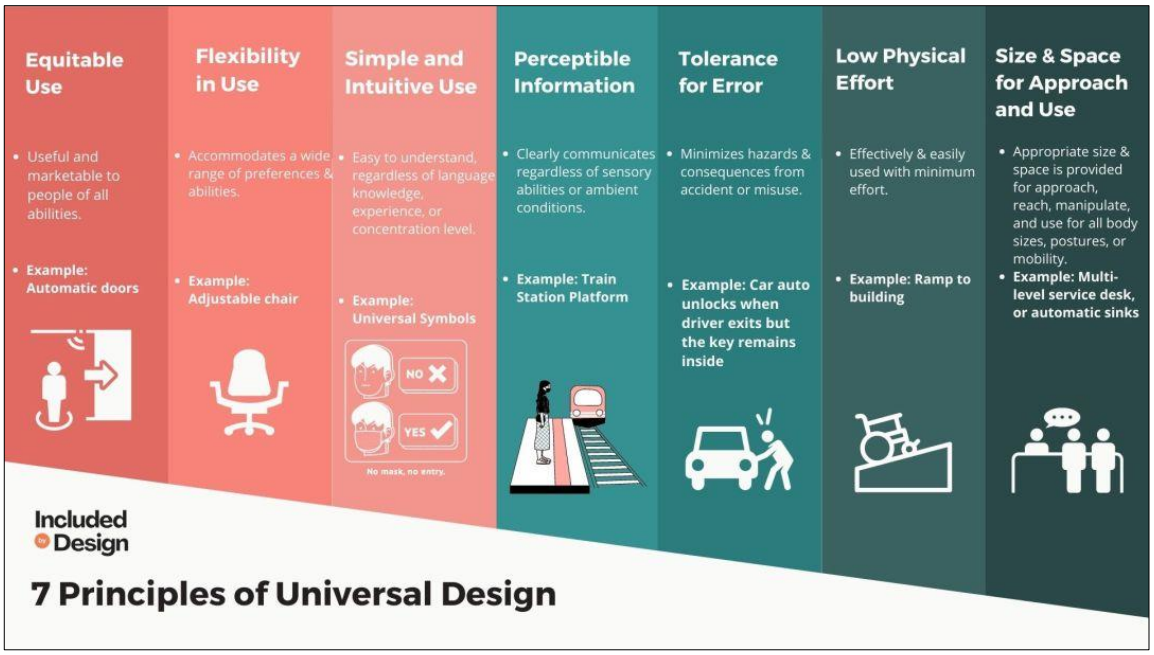

Figure 1. 7 Principles of universal design (CEUD, 2024)

Table 1. Publications on **"**Universal Design" in chronological order over the last five years in Web of Science Core Collection Database (WOS, 2024).

Author(s)	Year	Publication Titles	Publishers
Yang et al.,	2024	**"Universal Design** in Online Education: A Systematic Review"	Distance Education
Selanon & Chuangchai	2024	"Improving Accessibility to Urban Greenspaces for People with Disabilities: A Modified **Universal Design** Approach"	Journal of Planning Literature
Ielegems & Vanrie	2023	"The Cost of **Universal Design** for Public Buildings: Exploring a Realistic, Context-Dependent Research Approach"	Archnet-IJAR: International Journal of Architectural Research
Arsenault P.,	2023	**"Universal Design** Incorporating Architectural Linear Drains Designing Buildings and Spaces for All People, with or without Disabilities "	Architectural Record
Hurst et al.,	2023	**"Universal Design** in Playground Environments: A Place-Based Evaluation of Amenities, Use, and Physical Activity"	Landscape Journal
Īle & Bergmane	2023	"Development Patterns of **Universal Design** in Residential Courtyards in the Jugla Neighbourhood"	Landscape Architecture and Art
Yeşiltepe & Demirkan	2023	"Reflection of Empathic Design Process On Interior Architecture Students' **Universal Design** Solutions"	METU Journal of the Faculty of Architecture
Watchorn et al.,	2023	"Evaluating **Universal Design** of Built Environments: an Empirical Study of Stakeholder Practice and Perceptions"	Journal of Housing and the Built Environment
Filová et al.,	2022	**"Universal Design** Principles Applied in Museums' Historic Buildings"	Prostor: znanstveni časopis za arhitekturu i urbanizam
Duman & Asilsoy	2022	"Developing an Evidence-Based Framework of **Universal Design** in the Context of Sustainable Urban Planning in Northern Nicosia"	Sustainability
Moore et al.,	2022	"A National Study of Playground Professionals **Universal Design** Implementation Practices "	Landscape Research
Usal & Evcil	2019	**"Universal Design** in Interior Architecture Education: The Case of Store Design"	ICONARP International Journal of Architecture and Planning
Al Şensoy & Sarı	2019	"Re-Design of Schoolyard for Effective Development of Child From a **Universal Design** Perspective"	Megaron
Meşhur & Yılmaz Çakmak	2018	**"Universal design** in urban public spaces: the case of Zafer Pedestrian Zone/Konya-Turkey"	ICONARP International Journal of Architecture and Planning

Barrier-free design forms the basis of concepts such as "accessible design, adaptable design, design for everyone, universal design, and means creating an environment that will enable each individual in society to live at an equal level of prosperity" (Heiss et al., 2010). A barrier-free design-built

environment allows people with disabilities to move safely and freely and use facilities within the built environment. The purpose of barrier-free design is to create an environment that encourages autonomous functioning so that people can go about their daily lives without help. Some of the publications available in the literature on barrier-free design; and free-life barrier center (Demirci, 2020; Ozalp, 2022; ASHB, 2023). Furthermore, development, services, and applications for barrier-free living centers continue in Türkiye's municipalities of Kayseri, Konya, Gaziantep, and Gebze. Some municipalities in Istanbul have barrier-free living centers. To give an example: Beşiktaş, Çekmeköy, Gaziosmanpaşa, Tuzla, and Pendik Municipality in Istanbul (Beşiktaş, 2023; Çekmeköy, 2023; Gaziosmanpaşa, 2023; Pendik, 2023; Tuzla, 2023). But within the scope of this research, only the Üsküdar Barrier Free-Life Center is focused on (Usküdar, 2023).

2. Methodology

This section provides information about the methodologies applied in the paper. In this article, the Üsküdar Barrier-Free Living Center is examined syntactically and cognitively in terms of universal design criteria using two methods.

1) Space Syntax Methodology:

DepthmapX-0.8.0 and Syntax 2D 1.3 are the software packages utilized in space syntax analysis. Both software packages were used in this study's space syntax analysis. First, the architectural project, floor plans, sections, and facade obtained from the Municipality of Üsküdar were examined. The architectural floor plans were created in the AutoCAD 2018 application in dxf format. Following that, space syntax studies were carried out using the software packages DepthmapX-0.8.0 and Syntax 2D 1.3.B. Data from connection, integration, and intelligibility analyses were displayed visually and numerically.

In the first step, a space syntax analysis was conducted to examine the interaction of space organization and social structure at the Üsküdar Barrier-Free Living Center and to provide quantitative data. The space syntax methodology explores the relationships between spatial organization and a range of social, economic, and environmental phenomena. These phenomena include movement patterns, awareness, and interaction; land use intensity, land use mix, and land value; urban growth and social differentiation; security and crime distribution, etc. Space syntax symposiums are organized to discuss the method, theory, and research with all researchers. It aims to bring together academics, practitioners, and students working on space syntax and related approaches to share knowledge, discuss theoretical and methodological advances as well as practical applications, and find directions for further collaborations. In June 2024, the Space Syntax Symposium will be held in Cyprus (SSS14, 2024). Symposium themes are architecture and complex buildings, spatial cognition, methodological developments, history and urban morphology, evidence based design, teaching and pedagogy, urban design and planning, urban economics and land use, space and society. These themes show that space syntax methodology is used in many fields of science.

Also, numerous research studies in the literature use the space syntax method. Some of the studies using the space sequence method are as follows; urban design (Karimi, 2012), Also, the reference sources of the space syntax method are as follows (Koohsari et al., 2014; Karimi, 2018; Van Nes & Yamu, 2021; Ergün et al., 2022; Arslan & Ergener, 2023). In additionally, some references regarding the space syntax method are as follows: (Oliynyk & Troshkina, 2023; Karimi, 2023; Garau et al., 2024; Yang et al., 2024; Fan et al., 2024; Wu et al., 2024; Behzadfar & Mazarei, 2024; Laouar et al., 2024; Zhang et al., 2024; Lee, 2024; Haghlesan, 2024; Şahin Körmeçli, 2024; Molaei et al., 2024; Günaydın & Selçuk, 2024; Mounia & Foued, 2024; Cao & Li, 2024). Table 2 lists the current literature on space syntax in the Web of Science Core Collection Database.

Table 1. Current articles on "space syntax" that can be accessed through the Web of Science Core Collection Database (WOS, 2024).

Author(s)	Year	Publication Titles	Publishers
Peponis, J.	2024	"**Space syntax** and design"	Environment and Planning B: Urban Analytics and City Science
Qanazi et al.,	2024	"Exploring Urban Service Location Suitability: Mapping Social Behavior Dynamics with **Space Syntax** Theory"	Land
Laouar et al.,	2024	"Do urban renewal programs make suburbs safer? A fine-grained GIS and **space syntax** study of an urban renewal project in the city of Toulouse"	Journal of Urban Design
Günaydın & Selçuk	2024	"How urban growth influences the spatial characteristics of cities: Empirical research in Malatya/Türkiye based on **space syntax**"	Geo Journal
Safizadeh et al.,	2024	"Integrating **space syntax** and CPTED in assessing outdoor physical activity"	Geographical Research
Lee	2024	"Public Memory, Architectural Language, and Its Configurational Relationship in the Memorial Museum: A Case Study of the War Memorial of Korea Using **Space Syntax** and Movement Tracking"	Buildings
Fan et al.,	2024	"Using a **Space Syntax** Approach to Enhance Pedestrians' Accessibility and Safety in the Historic City of George Town, Penang"	Urban Science
Liu & Wang	2024	"Study on the classification of villages in Jilin Province based on **space syntax** and machine learning"	Architectural Science Review
Zhang et al.,	2024	"Analysis of Cross-Generational Co-Living Space Configuration in Residential Communities—Case Study in China and Italy Based on **Space Syntax**"	Buildings
Wu et al.,	2024	"Integrating restorative perception into urban street planning: A framework using street view images, deep learning, and **space syntax**"	Cities
Istiani et al.,	2023	"Investigating the spatial network of playgrounds during covid-19 based on a **space syntax** analysis case study: 10 playgrounds in Delft, the Netherlands"	Cogent Social Sciences
Keles et al.,	2023	"Accessibility analysis of public buildings with graph theory and the **space syntax** method: government houses"	Journal of Asian Architecture and Building Engineering
Lyu et al.,	2023	"Unveiling the potential of **space syntax** approach for revitalizing historic urban areas: A case study of Yushan Historic District, China"	Frontiers of Architectural Research
Körmecli	2023	"Evaluating Accessibility of Street Network in Neighborhood by **Space Syntax** Method: The Case of Çankırı"	ICONARP International Journal of Architecture and Planning
Mohamed & van der Laag Yamu	2024	"**Space syntax** has come of age: A bibliometric review from 1976 to 2023"	Journal of Planning Literature

2) Cognitive Mapping Methodology:

In the second step, the cognitive mapping methodology was applied in the field research. A variety of studies in the literature have employed the cognitive mapping method examples of references (Alinam, 2017; Jang & Kim, 2019; Wu et al., 2020). In addition, current research in cognitive mapping studies are as follows; individual differences (Ishikawa, 2023), wayfinding decision (Bock et al., 2024), suburban (Zheng et al., 2022); landmark and configurationally representations (Chiang et al., 2023); legibility (Ghods et al., 2023); spatial schemas (Farzanfar et al., 2023); urban (Mijani et al., 2023); bibliometrics and visual analysis (Qu et al., 2023); urban spaces (Tchertov, 2024).

In this research, the users of the space were interviewed and asked to draw cognitive maps of the space in their minds, and cognitive mapping analysis was performed on these drawings. Participants were asked to draw on white A4 paper with a pencil. This exercise took an average of 20 minutes. Participants were asked to draw the places they remembered in the space (entrance, garden, workshops, corridors, etc.). Participation in the survey was entirely voluntary. No identifying information or personal data was requested in the survey. In addition, the answers of the participating individuals were kept completely confidential and evaluated only by the researchers. Interviews with volunteer participants in the field study were conducted with the knowledge and accompaniment of the director, managers, and teachers of the Center for Life without Disabilities, and all kinds of abuses were avoided. Inclusion criteria for volunteers: adult educators or administrators over the age of eighteen who wanted to draw voluntarily; adult users were included. Table 3 lists the current literature on cognitive mapping in the Web of Science Core Collection Database.

Table 2. Current articles on "cognitive mapping" that can be accessed through the Web of Science Core Collection Database (WOS, 2024).

Author(s)	Year	Publication Titles	Publishers
Zanon et al.,	2024	"Relations between supply chain performance and circular economy implementation: A fuzzy **cognitive map**-based analysis for sustainable development"	Business Strategy & Development
Polykretis & Danielescu	2024	"Mapless mobile robot navigation at the edge using self-supervised **cognitive map** learners"	Frontiers in Robotics and AI
Sarmiento et al.,	2024	"Fuzzy **cognitive mapping** in participatory research and decision making: a practice review"	Archives of Public Health
Dan-Rakedzon et al.,	2024	"A framework for understanding the human experience of nature through **cognitive mapping**"	Conservation Biology
Zhan et al.,	2024	"**Cognitive mapping** of indoor environments: constructing an indoor navigation network from crowd sourced indoor route descriptions"	Cartography and Geographic Information Science
Banerjee	2024	**Cognitive mapping** as a research method: The childhood city"	The Routledge Handbook of Urban Design Research Methods
Peer et al.,	2023	"The format of the **cognitive map** depends on the structure of the environment"	Journal of Experimental Psychology: General
Stein	2022	"De-imaging New York: **cognitive mapping** and the city symphony"	GeoJournal
McNaughton & Saksena	2022	"Route selection with a **cognitive map**"	Neuron

3. Üsküdar Barrier-Free Life Center Location

Üsküdar, which is at the center of Istanbul's historical, cultural, educational, and social life, is home to many different layers due to its location. The coexistence of these layers creates a rich texture. Üsküdar Accessible Life Center, which was examined within the scope of this research, is located between Büyük Çamlıca and Küçük Çamlıca Grove, next to Bulgurlu, Libadiye Junction (Figure 2). Due to its location, it is close to transportation networks such as bridges, highways, Marmaray, metro, and metrobuses and easy to access. It is also in a very central location with its proximity to monuments such as Çamlıca Tower (Figure 2) and Çamlıca Mosque. Çamlık Park is located on the west side of the Üsküdar Barrier-Free Living Center (Figure 3). The entrance of the center is designed on a flat level without stairs for the disabled, elderly, children, and their relatives. It consists of 5 floors, 4 thousand square meters of construction area, a barrier-free park, a barrier-free living garden, a hobby garden for the disabled, and an outdoor parking lot for 50 vehicles (Figure 3).

The Üsküdar Barrier-Free Life Center was planned in consultation with disabled citizens, academicians, and trained experts (Üsküdar, 2023). This building was designed as a completely "barrier-free" building, considering all disability groups (Üsküdar, 2023). Üsküdar Barrier-Free Living Center is used as a special living space for socialization, education, treatment, and support for disabled citizens and their relatives. This center is designed to facilitate the lives of its users with its surroundings, garden, entrance, and interior spaces. Üsküdar Barrier-Free Living Center received the "Turkey Accessibility Award" in 2020 (Savaş, 2021).

Figure 2. Üsküdar Barrier-Free Life Center and Çamlıca Tower (Burkut, 2024)

Figure 3. Üsküdar Barrier-Free Life Center (X, 2024)

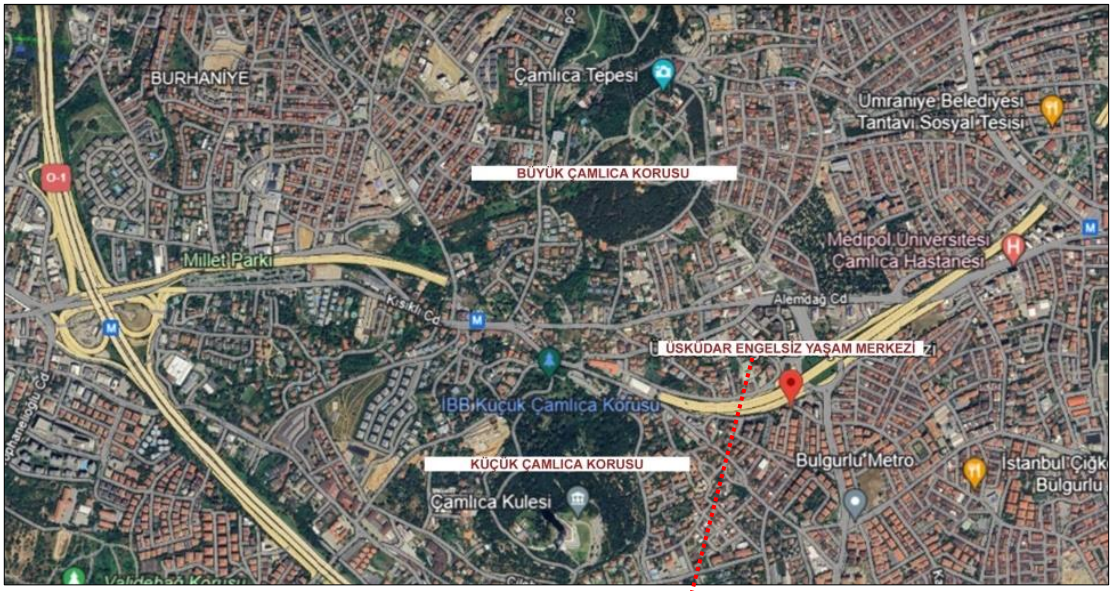

Figure 4. Location in Istanbul (Created by authors)

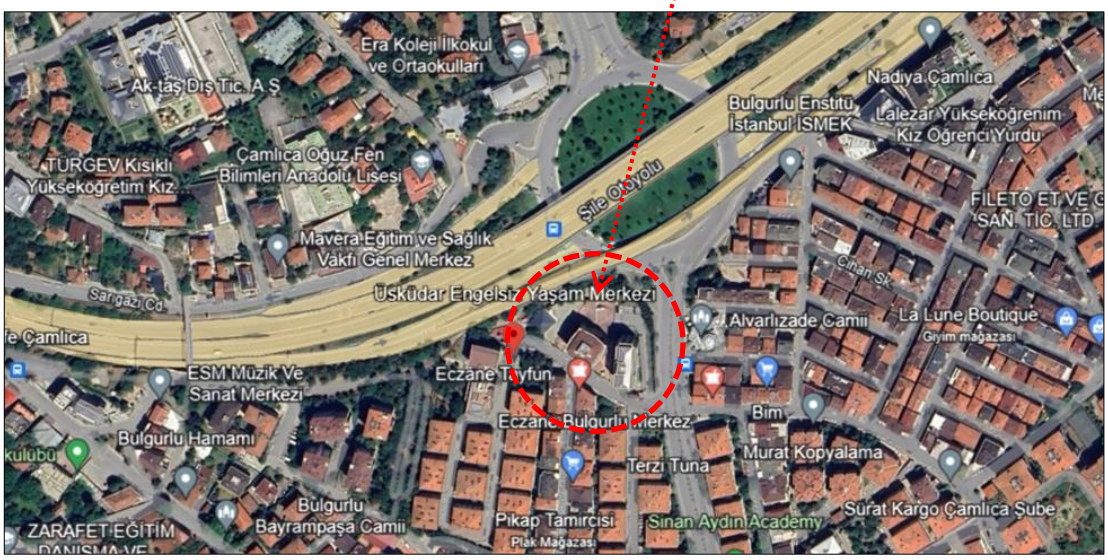

Figure 5. Üsküdar Barrier-Free Life Center Location in Üsküdar (Created by authors)

3.1. Üsküdar Barrier-Free Life Center Spatial Features

Üsküdar Barrier-Free Life Center consists of 5 floors, 4 thousand square meters of construction area, a barrier-free park, a barrier-free living garden, a hobby garden for the disabled, and an outdoor parking lot for 50 vehicles. There is an accessible building entrance and yellow wayfinding floor sign for users (Figure 6). In addition, there are places that serve and educate people with disabilities in Üsküdar Barrier-Free Life Center; there are two pools for men and women according to the disability status of disabled people. Many services, such as hydrotherapy (water therapy), sensory integration therapy, space therapy, physiotherapy, hypnotherapy, speech and language therapy, and techno therapy, are provided. In addition, individual and group education, a pedagogue service, a psychologist service, and a sociology service are provided for individuals requiring special education. In 10 special patient care rooms in the Barrier-Free Life Center, services are provided to disabled people who are bedridden at home. Concert, theater, cinema, conference, and seminar services are provided in the multi-purpose 100-person barrier-free conference hall. Individuals with disabilities are engaged in production by receiving training in computer, filography, calligraphy, handicrafts, music, and art workshops.

Figure 6. Building entrance accessible for users and yellow wayfinding floor sign (image by authors)

In addition, floor layout plan and floor information boards are available on each floor and in the elevator in a location that users can easily see (Figure 7). Also, group education, physiotherapy, psychological counseling, pedagogy, speech and language therapy, sensory integration therapy, space therapy, hydrotherapy (water therapy), technotherapy, sports rehabilitation, creative drama, philography, wood painting, folklore, rhythm, music, and sound, concert studies, image, marbling art, textile, computer, wood burning and etching, calligraphy, Alzheimer's school hobby center, daycare rooms, home health service, and hairdresser service (Uskudar, 2023). The relationship of the building with the environment brings the garden and the green together. The location of the building is designed to maximize daylight, with classrooms and workshops on the east-west façade. There is no elevation difference or stairs at the entrance, making it easier for users to access the space. It is designed as an animal-friendly building that establishes a relationship with the environment with the hobby garden for disabled people and cat houses in the garden (Figure 8, Figure 9).

Figure 7. Floor layout plan (left), floor information board (right) (image by authors)

Figure 8. Facade (image by authors)

Figure 9. Outdoor playground and outdoor seating (image by authors)

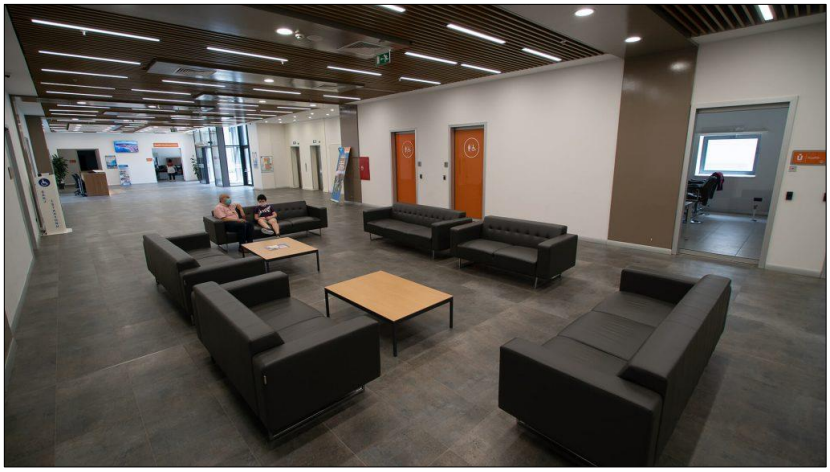

Figure 10. Interior space (Usküdar, 2023)

Figure 11. Wc (image by authors)

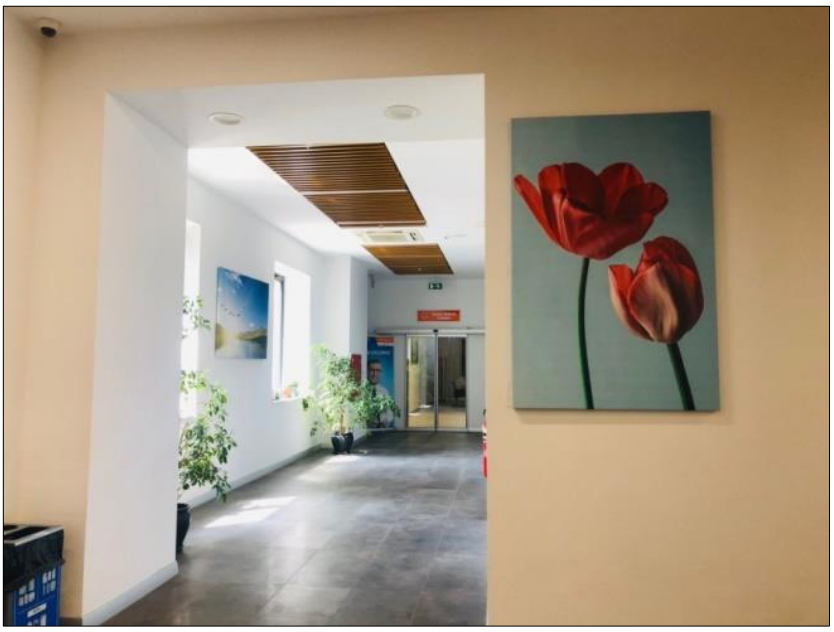

Figure 12. Interior design (image by authors)

The Barrier-Free Living Center floor layout plans on each floor provide detailed information to users about the spaces they want to access. In addition, male and female WCs and washbasins on each floor are specially designed for disabled and wheelchair users (Figure 10). Touchscreen doors provide hygiene by opening untouched. This also makes life easier for disabled individuals Light colors were preferred on the walls in the interior design of the Üsküdar Barrier-Free Living Center. It is quite bright, and daylight is let in in the best way (Figure 11). The paintings preferred on the walls consist of nature and flower themes (Figure 12). The light colors preferred in the interior make it look quite spacious, bright, and wide.

3.2. Participants

On a white A4 sheet of paper, participants were instructed to sketch with a pencil. On average, this activity took 20 minutes. They were requested to draw with a pencil on A4 white paper the places they remembered in the space (entry, garden, workshops, corridors, etc.) (Figure 13). The survey's participation was entirely voluntary. The questionnaire requested no identifying information or personal information. Additionally, the responses provided by the participants were kept totally private and were only examined by the researchers. Such abuses were prevented since interviews were performed with the awareness of the Center for Life without Disabilities' director, managers, and teachers (Figure 13). Interviews with voluntary participants were conducted in the presence of management and teachers. Exclusion Criteria for Volunteers; children, the elderly, and users with disabilities in the eyes, hands, arms and fingers were not included in the study. Inclusion Criteria for Volunteers; Adult educators or administrators over the age of eighteen who want to draw voluntarily, adult users were included.

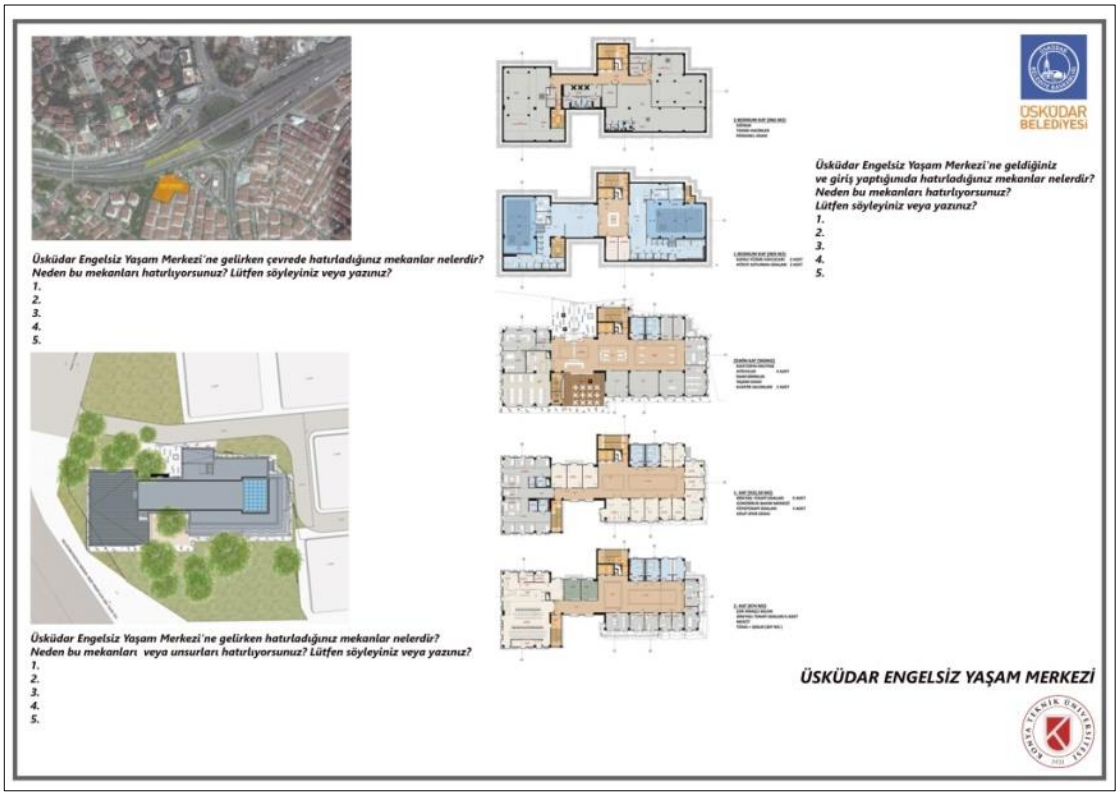

Figure 13. Sketch for cognitive map drawing (creating by authors)

4. Results and Discussion

In this section, the results are analyzed in two steps. The first is the results of the cognitive map of the spaces drawn and verbally remembered by the participants. The second is the results of the space syntax analysis of the space with the DepthMap X program.

4.1. Results of Cognitive Analysis (Cognitive Mapping)

The results of the cognitive mapping analysis are presented in this section. Volunteer participants were questioned briefly and instructed to draw on letterheads for the cognitive map drawings. One of these letterheads was blank, while the other included the site plan and floor plans for the participant to memorize and note.

Table 4 shows the numerical data of the cognitive map drawings. The percentage of administrator/trainer interior a drawing was quite high and the percentage of outside drawings was low when these drawings were analyzed (Table 4). Compared to indoor drawings, the percentage of outdoor drawings by administrators and trainers is slightly greater. One may argue that the increasing popularity of outdoor playgrounds, camellias, and hobby gardens is the cause of this. There were very few user/visitor plan drawings. Facade drawings in staff and employee drawings are a little bit higher than those in other places. The reason for this is that users think that the facade design is remarkable.

Table 4 Spaces drawn on cognitive maps

Spaces Drawn on Cognitive Maps	Employee / Staff	Users / Visitors	Administrator / Instructor
Garden	**53,1**	**74,6**	**62,3**
Waiting and Rest	**82,5**	**65,8**	**57,9**
Pool / Sports area	**35,78**	**65,7**	**72,3**
Therapy rooms	**64,2**	**76,4**	**65,9**

4.2. Results of Syntactic Analysis (Space Syntax)

The floor plans of the architectural project were prepared in the AutoCAD 2018 program in dxf. format. In DepthmapX-0.8.0 and Syntax 2D 1.3.B software programs, connectivity, integration, and intelligibility analysis of visual and numerical data were revealed. Figure 10 shows axial lines in the connectivity analysis. The fact that these lines are blue indicates that the depth value of the space is high, and the fact that they are red indicates that the connectivity value is high. Accordingly, the connectivity value of the central area where waiting, resting, and exhibition areas are located is quite high (Figure 14). Figure 15 shows the graph of the intelligibility analysis. The fact that this curve approaches 45 degrees and the R-value is close to 1 indicates that the intelligibility of the space is strong. According to the analysis, the R-value is R=0.829107 (Figure 15). According to Figure 16 space syntax analysis results attribute summary and minimum, average and maximum numerical data.

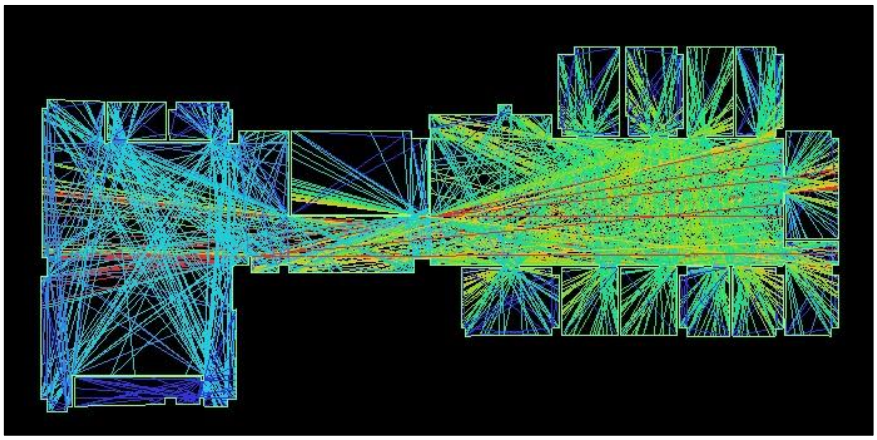

Figure 14. Connectivity analysis (analyzed and visualized by the Authors)

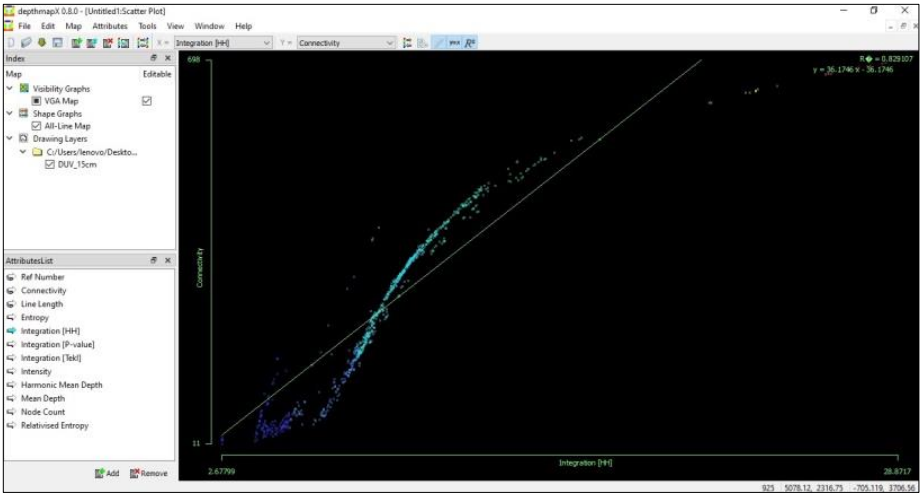

Figure 15. Intelligibility (analyzed and visualized by the Authors)

Attribute Summary

	Attribute	Minimum	Average	Max
1	Connectivity	14	286.543	621
2	Line Length	179.041	1795.41	5282.19
3	Entropy	1.01051	1.47135	1.86907
4	Integration [HH]	2.66426	8.4685	18.917
5	Integration [P-value]	2.66426	8.4685	18.917
6	Integration [Tekl]	0.783315	0.910911	1.04308
7	Intensity	0.547052	1.68625	2.87446
8	Harmonic Mean Depth	47.5794	130.951	350.108
9	Mean Depth	1.3872	2.02163	3.74921
10	Node Count	954	954	954
11	Relativised Entropy	1.11202	1.53576	2.82958

Figure 16. Space syntax analysis findings (analyzed and visualized by the Authors**)**

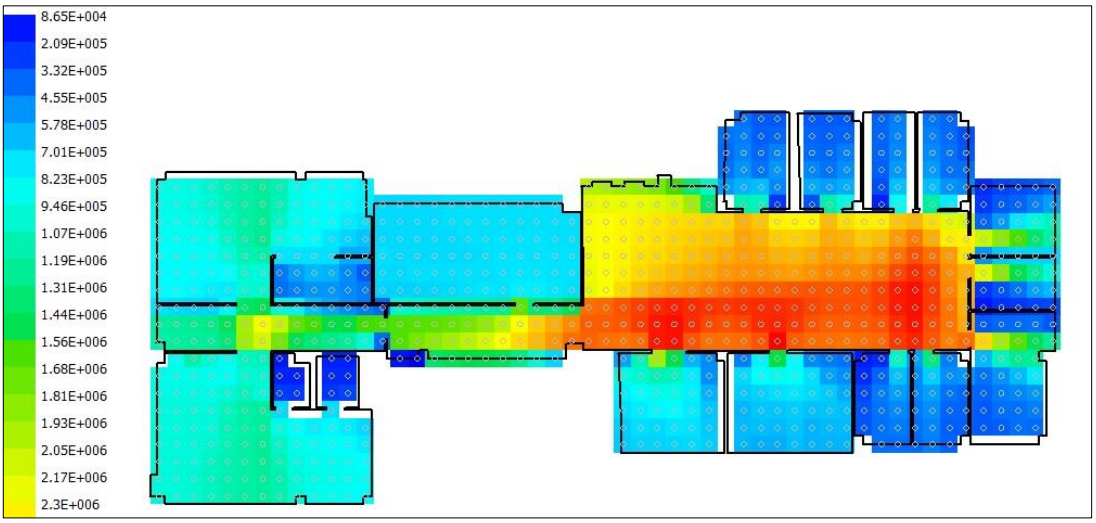

Figure 17. Space syntax analysis in Syntax2D software (analyzed and visualized by the Authors)

Syntax2D software was used to do space sequence analysis. As a result, waiting, listening, and exhibition areas are positioned in locations with the highest connectedness and integration values. These areas are highlighted in red. The color shift from red to yellow, turquoise blue, and dark blue reflects the space's circulation density (Figure 17). In other words, the psychologist, pedagogue, and therapy rooms are the shallowest environments. The locations of the pool and gymnasiums are in areas with low connectivity value. The organization of the space provides accessible solutions for disabled individuals and their families; equal use; the presence of guidance and information boards in the use of the spaces; and the accuracy of the information.

5. Conclusion and Suggestions

The Üsküdar Barrier-Free Living Center was analyzed cognitively and syntactically in terms of universal design principles in this study. In the first step, a space syntax analysis was performed to evaluate and give numerical data on the relationship between space organization and social structure at the Üsküdar Barrier-Free Living Center. In the second step, users of the space were interviewed and instructed to create mental cognitive maps of the space, which were then analyzed using cognitive mapping software. The research findings are intended to shed light on new research in terms of universal design standards, contribute to the field of barrier-free design, and offer an example for new barrier-free living centers to be developed. During the field research phase, Üsküdar Barrier-Free Living Center participants openly indicated their pleasure with the services provided by the center. Users of the facility and their families urged that similar services be provided for the disabled throughout Üsküdar's various towns and neighborhoods. This service is expected to be replicated by other municipalities in Istanbul as a model initiative. The fact that services and training are provided for free is seen positively.

In addition, the availability of free shuttle service facilitates access to the center. During the time when disabled individuals receive services, it is desired to create a training, seminar, waiting area, or sports area for mothers and caregivers. While the presence of an indoor playground gives satisfaction to the users, they expressed the demand that the playground should be larger and the play materials should be increased. Creating a sports and gymnastics (sportive rehabilitation) area for special children. For users with more than one child, it is expected to create a suitable environment for children during the waiting process and to create an indoor-outdoor play and activity area for children of different age groups. The services provided by the Üsküdar Barrier-Free Life Center were thanked again. It is aimed at contributing to the future design of centers for administrators, managers, educators, parents, academicians, researchers, and interested parties, as well as the individuals and their relatives who will use these centers. The space can be said to meet many basic needs, such as education, socialization, learning, personal care, the need for exercise and play with its green areas and parks, repairing disabled cars, barbers, and therapies, learning while socializing with family participation, and turning leisure time into an opportunity. As a result, all sociological, psychological, and pedagogical components of accessible and barrier-free environments must be approached from an interdisciplinary standpoint. In the future, new designs can be available to users with the assistance of municipalities and local governments in designing and constructing new barrier-free access to all (elderly, disabled, children, etc.) spaces.

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Author Contribution and Conflict of Interest Declaration Information

1st Author % 60, 2nd Author % 40 contributed. There is no conflict of interest

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Evaluation of the Condition of Antakya (Antioch) Urban Site after the Kahramanmaraş Earthquake

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Abstract

Throughout history, many cultural heritage buildings worldwide have been severely damaged by earthquakes and even faced the risk of destruction. On February 6, 2023, two earthquakes with a magnitude of 7.7, centered in Pazarcık and 7.6 in Elbistan, occurred in Kahramanmaraş Province. This study examines the registered buildings in the Antakya urban conservation area after these earthquakes. Within the scope of the study, 250 registered buildings in the area were examined, and their post-earthquake conditions were determined. The city of Antakya is a unique city that has been home to many civilizations due to its location in the historical process it has undergone; it has been kneaded with various religious, ethnic, and cultural richness of these civilizations and reflects the cultural diversity and layeredness created by history. For this reason, it is thought that it is very important to determine the post-earthquake conditions of these buildings, which have an important place in the city's identity.

Keywords: *Antakya (Antioch), Kahramanmaraş earthquakes, urban site, historical building, damage degree.*

Antakya Kentsel Sit Alanının Kahramanmaraş Depremi Sonrasındaki Durumunun Değerlendirilmesi

Öz

Tarih boyunca, dünyanın dört bir yanında bulunan kültürel miras niteliğindeki pek çok yapı, depremlerde ciddi bir şekilde hasar almış, hatta yıkım riskiyle karşı karşıya kalmıştır. 6 Şubat 2023 tarihinde Kahramanmaraş İli, Pazarcık merkezli 7.7 ve Elbistan merkezli 7.6 büyüklüğünde iki deprem meydana gelmiştir. Bu çalışma söz konusu depremler neticesinde, Antakya kentsel sit alanı içerisinde yer alan tescilli yapıların incelenmesini konu edinmektedir. Çalışma kapsamında alanda yer alan iki yüz elli adet tescilli yapı incelenmiş ve deprem sonrası durumları tespit edilmiştir. Antakya kenti, geçirdiği tarihsel süreç içerisinde bulunduğu konum itibariyle birçok medeniyete ev sahipliği yapmış, bu medeniyetlerin çeşitli dini, etnik, kültürel zenginlikleriyle yoğrulmuş, tarihin oluşturduğu kültürel çeşitliliği ve katmanlılığı yansıtan özgün bir kenttir. Bu sebeple kentte bulunan ve kentin kimliğinde önemli bir yeri olan bu yapıların deprem sonrası durumlarının tespitinin oldukça önemli olduğu düşünülmektedir.

Anahtar kelimeler: *Antakya, Kahramanmaraş depremleri, kentsel sit, tarihi yapı, hasar derecesi.*

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1. Introduction

Anatolia has been under the influence of earthquakes since ancient times. When we look at the geological structure of Türkiye, it is completely under the influence of the Alpine orogenic belt. Faulting and epirogenic movements started in our country with the Alpine orogenesis, which intensified at the end of the Oligocene and the beginning of the Miocene. During this period, the areas with hard characteristic structures collapsed under pressure by being torn apart by faults. Afterward, new fault lines were formed, and old faults were rejuvenated simultaneously. In the same period, with tension in the west and compression in the East of Anatolia, North and West Anatolia shifted westwards along the fault lines (Atalay, 1989). Based on current data, our country has three important fault zones. The first is the North Anatolian Fault Zone, the second is the East Anatolian, and the third is the West Anatolian Fault Zone (Figure 1). Fault lines, formed by fractures in the earth, trigger destructive earthquakes in Anatolia every period. Since the early ages until today, many destructive earthquakes have occurred, and these earthquakes have caused thousands of people to lose their lives.

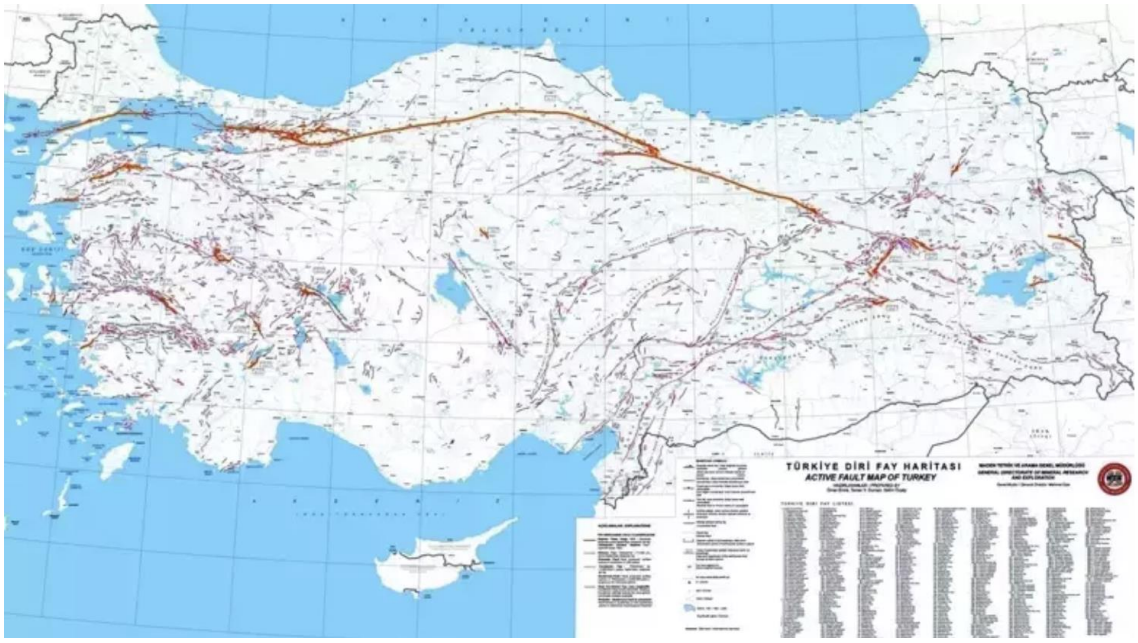


Figure 1. Türkiye Fault Zone Map (TMMOB Chamber of Geological Engineers, 2012)

On February 6, 2023, two earthquakes of magnitude 7.7 and 7.6 occurred at 04.17 and 13.24 Turkish time, with epicenters in Pazarcık and Elbistan districts of Kahramanmaraş. On February 20, 2023, an earthquake with a magnitude of 6.4 occurred at 20.04, with the epicenter in Yayladağı, Hatay. These earthquakes caused major destruction in 11 provinces, particularly Kahramanmaraş, Hatay, and Adıyaman (AFAD, 2023; T.C. Cumhurbaşkanlığı Strateji ve Bütçe Başkanlığı, 2023). In these cities, the earthquake's most important and destructive impact after human losses was on cultural heritage sites. Four World Heritage Sites, 3715 protected sites, and 7987 registered immovable cultural assets are in the provinces affected by the earthquake. In addition, many buildings, urban, rural, archaeological sites, and intangible cultural heritage items in the mentioned areas have also been affected by the earthquake. In the region with a multilayered and rich cultural heritage, some monumental buildings and civil architecture examples that were severely damaged were partially or destroyed (ICOMOS Türkiye Milli Komitesi, 2023).

There are various studies on the effects of earthquakes on historic cities. Guidoboni & Ferrari (2000) examined the effects of earthquakes on historic cities through the example of Italy. Finkel & Ambraseys (1997) examined the effects of the Marmara Sea earthquake of 1894 on historic buildings in and around Istanbul. Abdessemed-Foufa & Benouar (2010) examined the effects and damages of the Algeria earthquake of 1716, and Solares & Arroyo (2004) examined the effects of the 1755 earthquake on Spain. Various studies have also been conducted due to the Kahramanmaraş and Antakya earthquakes. Kocaman (2023) evaluated the effects of the Kahramanmaraş earthquake on historical masonry mosques and minarets through Adıyaman Ulu Mosque. Varnacı Uzun & Somuncu (2023)

evaluated Antakya's urban cultural heritage after the earthquakes and photographed approximately eight buildings damaged in the earthquake. Sezgin & Karagöz (2023), on the other hand, investigated the impact of Kahramanmaraş earthquakes on accommodation establishments in the region. Aktemur & Ünlükaplan (2024), conducted a SWOT analysis of Antakya Zenginler Neighbourhood streets and examined the impact of the 6 February 2023 Kahramamnmaraş earthquake on Antakya urban identity through a sample neighbourhood. Soyluk & Köse (2024) evaluated disaster risk reduction plans in historical areas and the 6 February 2023 Kahramanmaraş earthquakes through the example of Antakya Kurtuluş Street.

This study discusses the city of Antakya, one of the cities most severely affected by these earthquakes. With its 2300 years of history, Antakya, which is the intersection point of many important events in history and carries a great value with every abstract-concrete part it has added to its urban memory in this process, has suffered great losses in terms of cultural and architectural heritage as a result of these earthquakes. Many historical buildings belonging to Antakya's rich cultural heritage were destroyed or severely damaged. This study analyzed 250 monumental or civil architecture works in Antakya Urban Conservation Area (Figure 2).

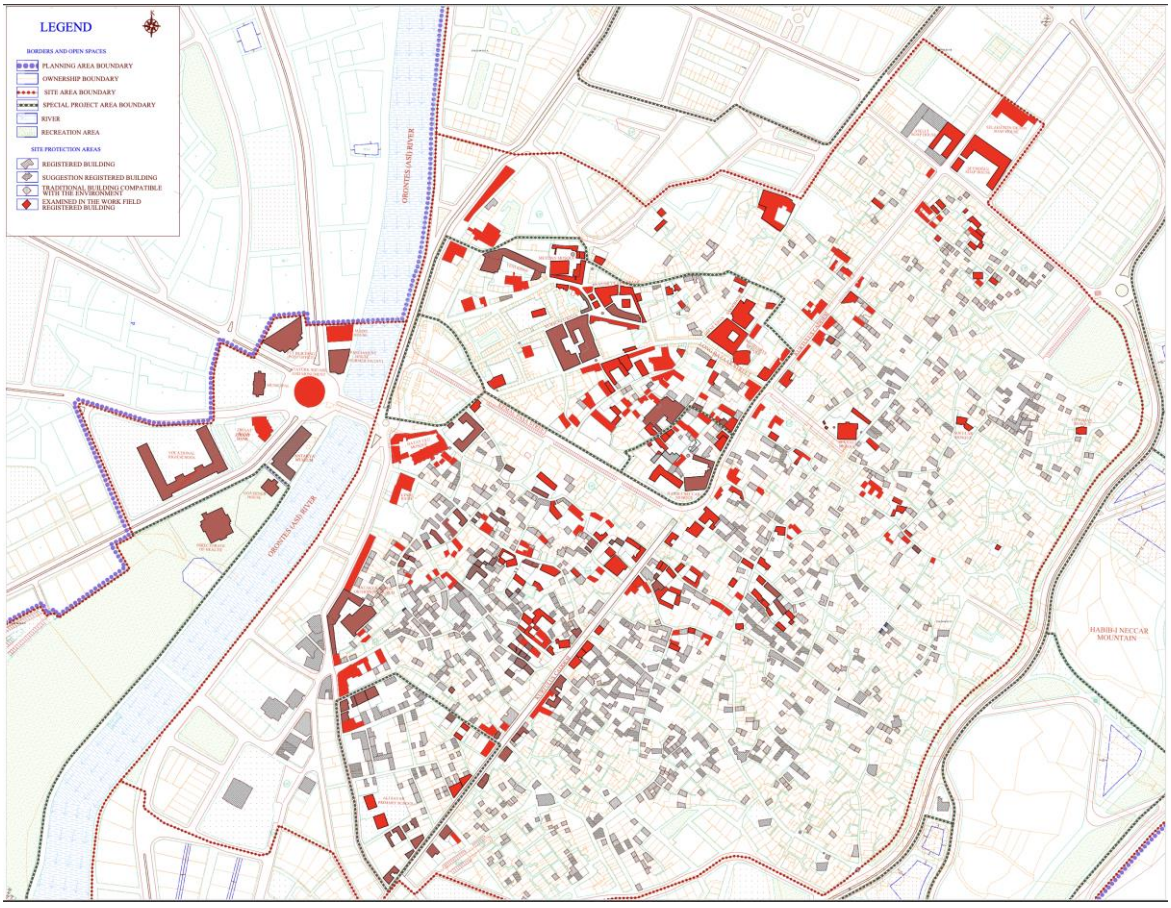


Figure 2. Structures analyzed in the field (drawn by the Authors)

2. Material and Method

2.1. Damage Assesment

Protecting and revitalizing the urban memory left behind after the earthquake was decisive in conducting a study on this city. In this direction, first of all, a literature review and archival research were conducted on the location and boundaries of the area, its importance, historical development process, cultural and natural assets, and the area's natural, physical, social and economic structure. The latest Conservation Zoning Plans for Antakya (Antioch) Urban Conservation Site were accessed (Archieve of A Proje Architectural Office), the building inventory list was prepared, and data/information about the architectural characteristics of the buildings were collected. Then, a field study was conducted between September 8-11, 2023 to determine the condition of the registered

buildings in the Antakya Urban Conservation Area after the February 6 earthquakes. The structures identified in the field were photographed according to the inventory number, and the damage status was noted. Simultaneously, the study was carried out by taking the necessary notes on the map and zoning plan. Some deficiencies in the zoning plans, inconsistencies between the zoning plan and some building addresses on Google Maps, the fact that the streets were lost due to the magnitude of the destruction and turned into a large empty land, and the difficulty of access to the building due to the debris are the main factors limiting the study. Due to these factors, some buildings on the inventory list could not be identified. Since there was no access to the courtyard of some buildings consisting of two or more buildings in the courtyard, the part of the buildings facing the street could be identified, but the other parts could not be reached. After the fieldwork, the notes taken in the field were transferred to digital media (CAD/EXEL/WORD). In this process, maps, photographs, and Google Earth street views were used to clarify the structures, and a new inventory list was created. In this context, new maps related to damage assessment were created.

Post-earthquake damage assessment is one of the most important preliminary stages in determining restoration strategies. Post-earthquake damage assessment and evaluation of structures' usability are important in earthquake-affected countries such as Italy, Japan, and Türkiye. In Italy, the process after the 1570-74 Ferrara earthquakes, 1661 Tuscany earthquake, 1781 Faenza earthquake, 1887 Liguria earthquake, 1968 Belice, 1976 Friuli, 1980 Irpinia and 1984 Abruzzo earthquakes is important in terms of damage assessment methods and evaluation methods (Goretti & Di Pasquale, 2002). In Italy, after the 1997 Umbria-Marche and 1998 Pollino earthquakes, an action plan was initiated to bring order to damage and safety assessment. Various forms were issued for damage assessment. The I Level form, prepared after the 1983 Parma and 1990 S. Lucia earthquakes, analyzed the damage in 6 levels from A2 to F (Table 1).

Table 1. Masonry bearing walls damage classification (I Level GNDT- Ministry of Labour, Civil Protection- form) (Goretti & Dİ Pasquale, 2002)

Level	Severity	Description
A	None	No visible damage
B	Slight	Any crack up to 1 mm
C	Medium	Cracks up to 4 mm when types 1,5,6; up to 2 mm when types 2,3,7; up to 1 mm when types 4, 8 or 9.
D	Heavy	Cracks up to 10 mm when types 1,5,6; up to 5 mm when types 2,3,7; up to 1 mm when types 4, 8 or 9.
E	Very heavy	Cracks and damages higher than D.
F	Destruction	

The 1997 Umbria- Marche earthquake damage classification is characterized by simplicity, immediate comprehensibility, and continuity with previous damage classifications. The damage levels have been reduced to three for easy analysis but with more detailed descriptions. They are grouped into damage to structural elements and damage to non-structural elements. In this forms, the components (vertical structures, horizontal structures, stairs and pre-existing damage) are evaluated with damages levels; very heavy/collopase, medium/heavy and null/slight (Goretti & Di Pasquale, 2002)

After the 1999 earthquakes that hit northwestern Türkiye (Aydan et al., 2000), the Government of the Republic of Türkiye changed its policy on state aid to earthquake victims whose houses were destroyed and damaged during seismic events. The new regulation pointed to compulsory state insurance of structures. As a result, the Turkish Catastrophe Insurance Pool (TCIP) was established in 2000 to administer compulsory earthquake insurance. In 2002, TCIP commissioned researchers to develop a consistent, fast, easy-to-implement damage assessment method that could be utilized after an earthquake. Accordingly, a methodology (Table 2) that fulfills the basic characteristics expected from a reliable damage assessment algorithm was developed for reinforced concrete and masonry structures, Türkiye's two most common building systems (Boduroğlu et al., 2013; Ilki et al., 2013). During the development of the methodology, various guidelines for post-earthquake damage

assessment in different countries were used (Baggio et al. 2007; Grünthal, 1998; FEMA 306 1998; Japan and Building Disaster Prevention Association (JBDPA) 2015).

Table 2. The revised version of TCIP Damage Assessment System (Revised by the Authors)

Level	Name	Definition
0	Undamaged Building	Where there is no earthquake damage in vertical and horizontal load-bearing structural members
1	Slightly damaged Building	The vertical and horizontal members that form the structural system of the building suffered limited damages in such a way that the damaged members either do not entail any repair or require relatively simple repair relatively simple repair applicators
2	Moderately damaged Building	Due to damages in the vertical and horizontal structural membes, the performanca and capacity of the structure can be decrased to a certain degree in comparison to that of pre-earthquake condition
3	Heavily damaged Building	The damages in the structural members can reach to severe levels. In addition, many of the non-structural members of the building are substantially damaged. The building may have lost a signicant amount of its pre-eartquake performance and capacity.
4	Building to be urgently demolished	The building where a partial collapse has occured in at least one storey, or the building exhibiting easily observable residual displacements are classified in this category. The existing condition of this buildings poses danger to the safety of life and property.
5	Collaped Building	The structural system lost its integrity and the building lost its integrity and the building is collaped partially or comltely. The vertical and horizontal load bearing capacity of the building is entirely eliminated.

The damage assessment of the buildings examined in this study was made based on these studies, however; since the study was conducted in September, some of the buildings that needed to be urgently demolished were demolished, and therefore, no examination was made under the title of "building to be urgently demolished". The investigations were evaluated according to the criteria 0 (undamaged building), 1 (slightly damaged building), 2 (moderately damaged building), 3 (heavily damaged building) and 4 (collapsed building).

2.2. The City of Antakya and the Urban Conservation Area

Antakya is a cosmopolitan city where many civilizations, empires, and states established sovereignty and bequeathed their cultures. Since it has a rich cultural heritage from the Hellenistic period to the present day, it is a city known and important worldwide (Arıman, 2002). Antakya, which was one of the three major metropolises of the world in the past and received the title of "Queen of the East", sets an example to the world today with its cultural structure, lifestyle, and tolerance (Ömeroğlu, 2006).

Playing an important role in the spread of the Christian religion, being an important center for the exchange of information between Constantinople and the East, and being a base of preparation and operations in the military expeditions of the emperors to the East are among the factors that increased the importance of Antakya throughout its history. Due to its strategic location, the city constantly fought foreign invasions (Bakır, 2022). A while after the establishment of Christianity in the city, Islamic conquests took place, and Islam began to spread in the region. Two different beliefs prevailed in the city before Christianity. One of these beliefs was Paganism, and the other was Judaism (Bahadır, 2013). The cultural blend of the city has deepened even more with the experience of the three Abrahamic religions and other religions.

The city was built between the Asi (Orontes) River and the western slope of the Habibi Naccar (Silpius) Mountains. A city wall surrounded it until two centuries ago, but now there are only some ruins on the Silpius Mountains (Figure 3) (Çelebi & Günaltay, 1982).

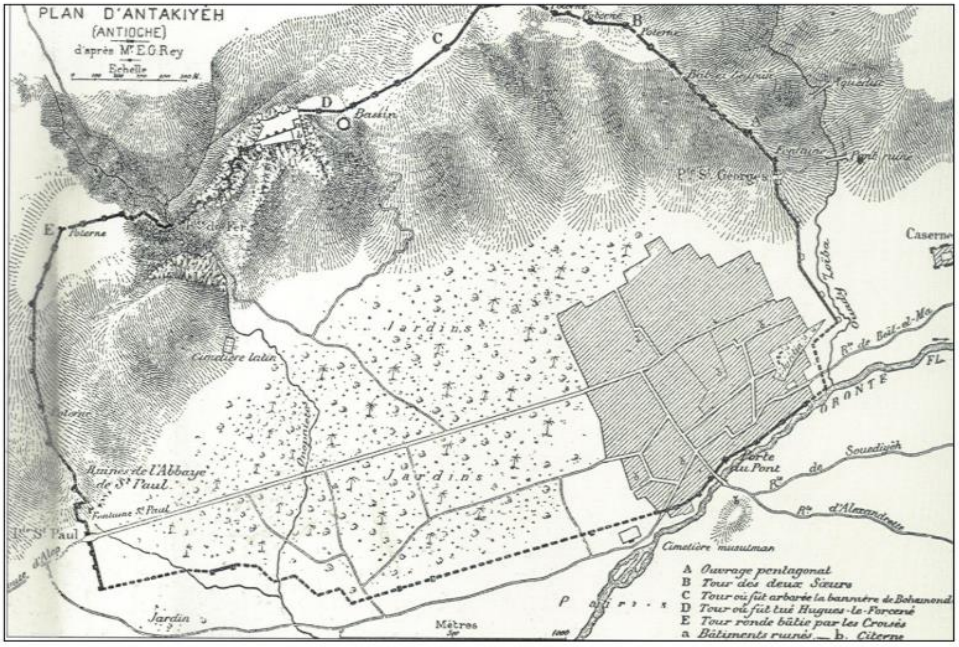


Figure 3. The expansion area of Antakya, bounded by the city walls surrounding the city and the Asi River (Güzer, 2007; Demir, 1996)

The grid plan scheme, a characteristic feature of Hellenistic period cities, was also applied in Antakya, and the Agora in the city was located around the Great Mosque (Demir, 1996; Güzer, 2007). The most important reconstruction activity of the Roman Period was the construction of the 2956 m long "Colonnaded Street" (Herod Street) (Downey, 1961). The city was severely damaged during the Persian invasion in 256 AD. Although rebuilt afterward, the city form was largely destroyed by successive earthquakes and subsequent fires in the early 6th century (Maas, 2000).

Antakya was remodeled according to the characteristics of an Islamic city during the Ottoman Period. The courtyard typology and introverted architecture dominated the grid plan (Güzer, 2007). Antakya's road texture did not emerge due to certain planning or depending on an order. The road texture, which developed spontaneously depending on the needs, existing texture, and topographical structure, shows an intricate, winding, and organic structure. The walls of buildings or courtyards limit the streets. The streets are narrow, and dead-end streets are frequently encountered (Ömeroğlu, 2006; Temiz, 2002).

Due to the successive earthquakes and wars in 1615, 1822, and 1872, Antakya turned into ruins, and the city became a town due to the decrease in population. The earthquake of 1872 caused the heaviest damage to the city, and the city walls surrounding the city were almost destroyed. The bridge over the Asi River cracked, and 2/3 of the city was destroyed. After this date, the walls surrounding the city were considered as proof of the original size of the city (Güzer, 2007). Until the end of the 19th century, while the city was within the city walls, a new settlement area was formed on the opposite bank of the Asi River. This area, known as "Muhacirin Osmaniye", later became known as "Yeni Mahalle". This area was rapidly built up due to the favorable topography. Completely new buildings were constructed here (Güzer, 2007).

When the city was under French rule, the historical Colonnaded Street was replaced by Kurtuluş Street and Kemal Paşa Street, which cut this street vertically. These streets form a linear axis. The grid plan scheme seen in the city at the beginning has lost its dominance in the central area and turned into an organic texture. The old city center, which continued its development around Ulucami Square at the end of Hürriyet Street until the 1940s, bears the architectural traces of the Ottoman Period (Figure 4) (Güzer, 2007).

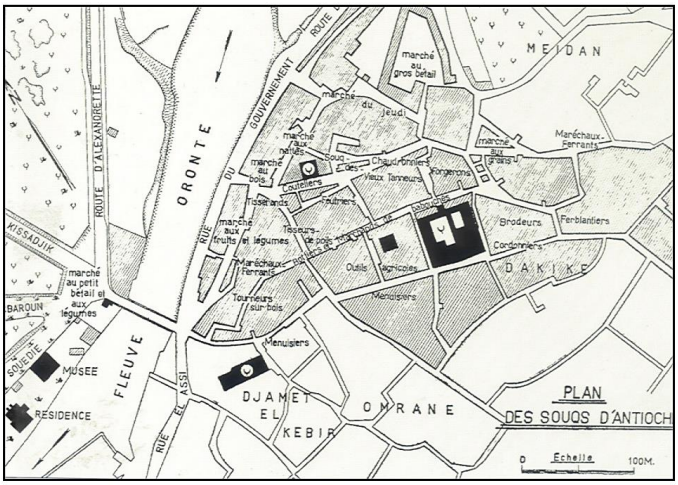


Figure 4. Plan of the city dated 1936. It is seen that Kurtuluş Street, the main axis of the city, has not yet been opened (Güzer, 2007; Demir, 1996)

The first zoning plan for Antakya, including Gazipaşa Street, was prepared in 1948, but this plan was not put into practice, and a new zoning plan was prepared in 1957 (Rifaioğlu, 2014). However, since the 1957 zoning plan brought an order that changed the urban texture and damaged the street-courtyard-house relationship, the traditional urban texture was negatively changed (Özalp, 2008). In 1975, 70 buildings to be protected were registered as " Monuments" and 132 houses were registered as "Civil Architecture Examples" by a board appointed by the General Directorate of Antiquities and Museums of the Ministry of Culture. In addition, archaeological, urban, and natural site boundaries were determined. A new zoning plan was prepared in 1978 based on the decision that necessary measures should be taken for the artifacts identified and deemed necessary to be protected and that plan decisions should serve this purpose (Demir, 1996; Ömeroğlu, 2006; Güzelmansur et al., 2007). However, this plan was not successful in protecting the city's historical texture, and a new zoning plan was put into effect in 1987. This plan defined 1st and 3rd Degree Archaeological Sites, Natural Sites, and Urban Sites (Rifaioğlu, 2014). The city, which many civilizations have shaped, the area to the East of the Asi River passing through it, where historical events and cultures were formed, was defined according to the Hatay-Antakya Site Conservation Zoning Plan Implementation Regulation. Kurtuluş Street and most of Old Antakya are located within the boundaries of the urban conservation area. The Antakya Historic Site, the development activities within the site boundaries, and the "Antakya Site Boundaries" were finalized with the board decision numbered 638 in 1990 (Ömeroğlu, 2006; Kocaoğlu, 2016).

The neighborhoods in Antakya urban site are as follows: Akbaba, Barbaros, Biniciler, Dutdibi, Fevzipaşa (part of it), Gazipaşa, Güllübahçe, İplikpazarı, Kuyulu, Kantara, Kocaabdi, Kardeşler (part of it), Meydan (part of it), Orhanlı (part of it), Sofular, Şehitler, Şirince (part of it), Şeyhali, Ulucami, Yenicami and Zenginler (Figure 5). The location of the urban conservation area in the center provides easy access. Kurtuluş Street, which has existed since the city's foundation, is still a very important axis for the city and is one of the most important transport axes of Antakya throughout history. The area has many building types such as temples, inns, baths, traditional houses, and traditional bazaars. This historical texture formed by monumental and civil buildings has formed the silhouette of Antakya city (Ömeroğlu, 2006).

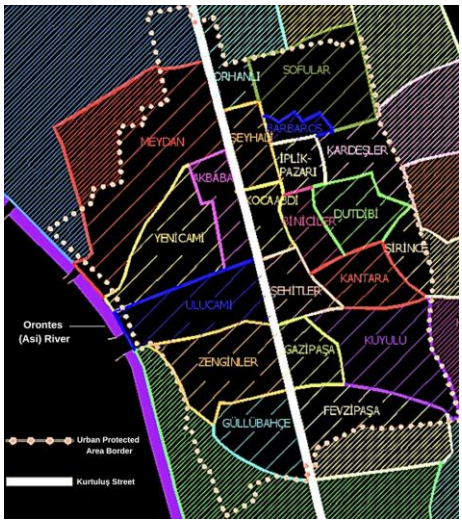


Figure 5. Antakya Urban Conservation Site (Ömeroğlu, 2006)

When the distribution of Antakya cultural heritage buildings in the city center is examined, it is seen that most of these buildings are located east of the Asi River, between Kurtuluş Street and Hürriyet Street (Figure 6) (Dal & Kaymaz, 2021). Old Antakya, located between the Asi River and Habib-i Neccar Mountain, is also the city's oldest settlement. For this reason, most buildings with historical and cultural value are in this area. Old neighborhoods (Zenginler Quarter, Yeni Cami Quarter) are in Old Antakya. In these neighborhoods, traditionally narrow streets and Antakya houses are concentrated. Habibi Neccar Mosque and Ulu Mosque (Figure 7), Sarımiye Mosque, Amntakya Orthodox Church (Figure 8), Antakya Catholic Church, and Antakya Jewish Synagogue are the religious buildings in this area (Sargın & Dinç, 2017). Apart from the Ottoman period buildings such as Kurşunlu Han (Figure 9), Defne Han, Cindi Bath, there are also Republican period buildings such as the Hatay Parliament Building (Figure 9), Hatay Governorship, PTT building.

Figure 6. Kurtuluş Street, Hürriyet Street and Gazipaşa Street (Kocaoğlu, 2016)

Figure 7. Habibi Neccar Mosque (left) (Fikriyat, 2023), Antakya Ulu (Grand) Mosque (right) (Antakya Metropolitan Municipality, 2015)

Figure 8. Greek Orthodox Church of Antioch (Church of St Piyer and St Paul) (Kültür Portali, 2014)

Figure 9. Hatay Historical Parliament Building (left) (Fırat Üniversitesi İletişim Fakültesi Uygulama Gazetesi, 2022) and Uzun Bazaar and the entrance to Kurşunlu Han (right) (ASE İnşaat Mutfak Turizm, 2022)

3. Findings and Discussion

Antakya is geographically located in the Amik Plain on the southwestern flank of the point where the Asi River meets Habib Neccar Mountain. In addition to being located on the northern end of the Jordan Rift Valley, an active fault line, it is also located in a region where different tectonic movements are felt. Some of the earthquakes in the city in the historical process were mild, and some were quite destructive (Bakır, 2022). The last of these catastrophic earthquakes occurred on February 6, 2023. Hatay was one of the cities most affected by the February 6 earthquakes, in which many buildings collapsed, and more than 50 thousand lives were lost.

As a result of the examination of the inventories prepared after the zoning plans and the last Conservation Plan approved in 2009 (Archieve of A Proje Architectural Office), it was determined that there are 462 registered buildings in total within the Antakya Urban Site (Hatay Valiliği, 2011). The majority of these buildings are traditional Antakya houses. After the houses, the dominant building type is mosques. Among these building types, in addition to traditional houses, mosques, churches, synagogues, inns, baths, and tombs, there are also soap-making structures (sabunhane) unique to Antakya. These buildings are among the important groups that enrich the urban conservation area.

Based on the inventory list and the Conservation Zoning Plan, 250 registered buildings were inspected for damage. Of the buildings examined, 44 are examples of Group 1 (monumental buildings), and 206 are examples of Group 2 (civil architecture). Of the 44 monumental buildings, 19 are mosques, 5 are masjids, 2 are churches, 3 are tombs, 4 are baths, 4 are inns, 5 are soap houses, 1 is a Bedesten, 1 is a synagogue. Of the 206 civil architecture buildings, 13 are commercial, 22 are residential+commercial, 158 are residential, 1 is an Atatürk Monument and square, and 12 are buildings with different functions (Hatay Parliament Building, Post Office Building, Municipality Building, dispensary, Primary School, Police Station etc.) (Figure 10).

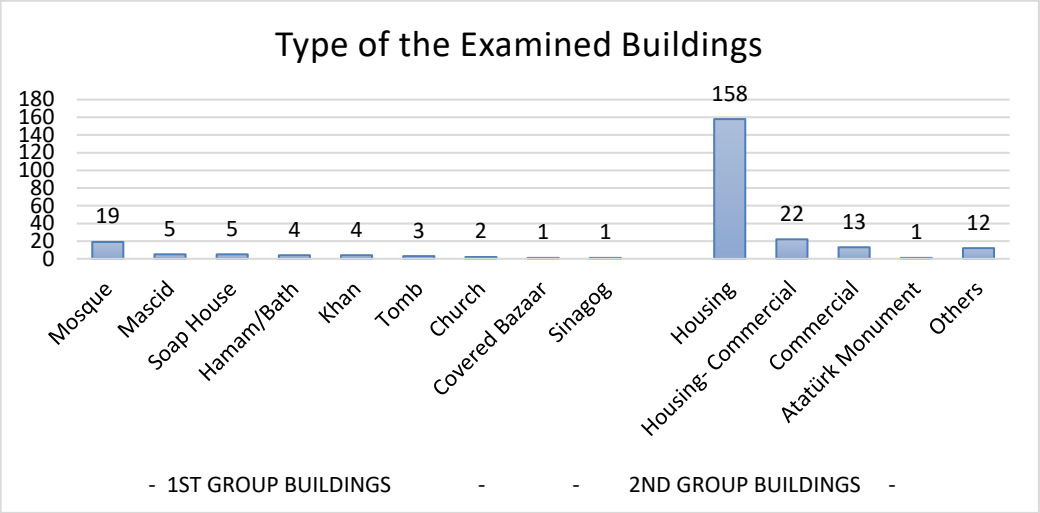


Figure 10. Building groups analysed in the field

Figure 11 and Figure 12 shown the damage level distrubution due building types. From the 44 monumental buildings examined, 3 were undamaged, 7 were slightly damaged, 3 were moderately damaged, 16 were heavily damaged, and 15 were demolished (Table 3). Regarding the civil architecture works, 19 buildings were undamaged, 19 were slightly damaged, 13 were moderately damaged, 39 were heavily damaged, and 116 were demolished (Table 4). Out of 250 buildings, 131 buildings were completely demolished (Figure 13). Most of the remaining structures are heavily and moderately damaged.

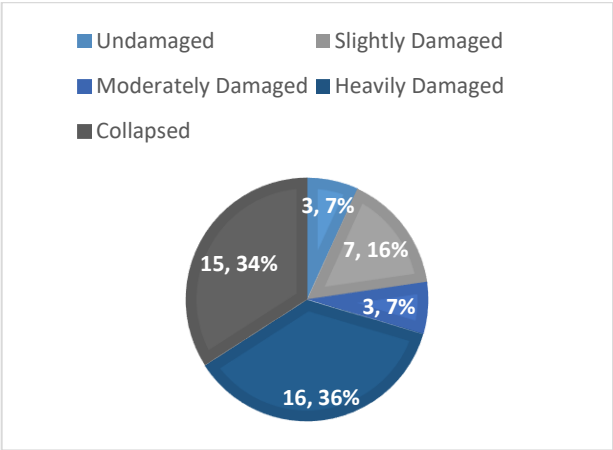


Figure 11. 1st Group damage level

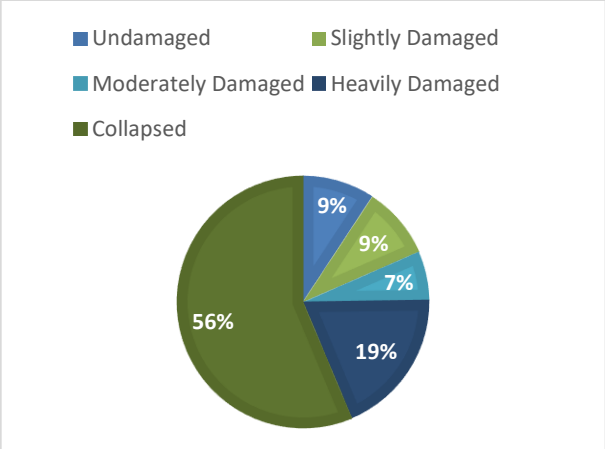


Figure 12. 2nd Group damage level

Table 3. The damage degree of the 1st group buildings (monuments) (Prepared by the authors)

NO:	TYPE OF BUILDING	INVENTORY NUMBER	EXPLANATION	DAMAGE LEVEL
1	MOSQUE	B11	Hatay Ulu Mosque	4
2	TOMB	B12	Şeyhoğlu Tomb	4
3	HAMAM/BATH	B13	Cindi Hamam/Bath	3
4	CHURCH	B15	Church	4
5	COVERED BAZAAR	B16	Covered Bazaar	3
6	MOSQUE	B21	Habib-İ Neccar Mosque	3
7	HAMAM/BATH	B31	Yeni Hamam/Bath	4
8	MOSQUE	B45	Mahremiye Mosque	4
9	KHAN	B47	Defne Khan	3
10	HAMAM/BATH	B48	Saka Hamam/Bath	3
11	MASJID	B49	Rıfat Ağa Masjid	1
12	MOSQUE	B52	Zülfikar Mosque	4
13	MASJID	B53	Debruz Masjid	2
14	MASJID	B54	Ali Çavuş Masjid	1
15	MOSQUE	B59	Yeni Mosque	4
16	SOAP HOUSE	B71	Old Soap House	1
17	MOSQUE	B72	Semerciler Mosque	4
18	KHAN	B73	Kurşunlu Khan	3
19	KHAN	B75	Tütün Khan-Kuyumcular Khan	3
20	MOSQUE	B79	Meydan Mosque	4
21	KHAN	B81	Yeni Khan	4
22	MOSQUE	B82	Ahmediye Mosque	3
23	MOSQUE	B83	İhsaniye Mosque	4
24	HAMAM/BATH	B84	Meydan Hamam/Bath	4
25	MOSQUE	B87	Selvili Mosque	2
26	SOAP HOUSE	B88	Kuseyri Soap House	4
27	SOAP HOUSE	B96	Aselci Soap House	3
28	SOAP HOUSE	B97	Sabun Soap House	4
29	SOAP HOUSE	B98	Savon Soap House	1
30	TOMB	B99	Hıdır Tomb	1
31	MOSQUE	B101	Orhanlı Mosque	3
32	MOSQUE	B105	Şeyh Muhammed Mosque	3
33	MOSQUE	B111	Osmanlı Mosque	3
34	MOSQUE	B112	Sofular Mosque	1
35	MOSQUE	B113	Şeyhali Mosque	3
36	TOMB	B118	Şıh Abdurrahman Tomb	2
37	MOSQUE	B120	Deveci Bekiroğlu Mosque	3
38	MOSQUE	B122	Kürtfakih Mosque	3
39	MASCID	B124	Uçtum Masjid	0
40	MOSQUE	B148	Nakipoğlu Mosque	4
41	MOSQUE	B156	Sarımiye Mosque	3
42	SINAGOG	B171	Konut Sınagog	0
43	MASJID	B183	Hünkar Masjid	1
44	CHURCH	B203	Türk Katolik Church	0

Table 4. Damage degree of the 2nd group buildings (houses and commercial buildings)

NO:	TYPE OF BUILDING	INVENTORY NUMBER	EXPLANATION	DAMAGE LEVEL
1	MONUMENT	B1	Atatürk Square and Monument	0
2	PARLIAMENT HOUSE	B2	Parliemant House (Former Hatay)	4
3	PUBLIC	B3	Mado House	4
4	PUBLIC	B4	PTT Building (Post Office)	3
5	PUBLIC	B5	Municipal	3
6	BANK	B6	T.C. Ziraat Bank	4
7	MUSEUM	B7	Antakya Museum	1
8	PUBLIC	B8	Governer House	2
9	HEALTH SERVICE	B9	Directorat of Health	3
10	SCHOOL	B10	Vocational High School	3
11	COMMERCIAL	B14	Commercial next to Orthodox Church	4
12	HOUSING	B17	Housing	4
13	HOUSING	B18	Housing	4
14	HOUSING	B19	Ramize Karabay House	1
15	HOUSING	B20	House	1
16	HOUSING	B22	Ülkü Ocakları Building	1
17	HOUSING	B23	Housing	1
18	HOUSING	B24	Housing	1
19	HOUSING	B25	Housing	3
20	HOUSING	B26	Housing	2
21	HOUSING	B27	Housing	0
22	HOUSING	B28	Housing	3
23	HOUSING	B29	Housing	4
24	HOUSING	B30	Housing	4
25	HOUSING	B32	Housing	3
26	HOUSING	B33	Housing	4
27	HOUSING-COMMERCIAL	B34	Housing-Commercial	1
28	HOUSING-COMMERCIAL	B35	Housing-Commercial	4
29	COMMERCIAL	B36	Commercial	4
30	HOUSING	B37	Housing	4
31	HOUSING	B38	Housing	2
32	HOUSING	B39	Housing	4
33	HOUSING-COMMERCIAL	B40	Housing-Commercial	4
34	HOUSING	B41	Housing	3
35	HOUSING	B42	Housing	4
36	HOUSING	B43	Housing	3
37	HOUSING	B44	Housing	1
38	HOUSING	B46	Uludağ House	4
39	HOUSING	B50	House-Fountain	1
40	HOUSING	B51	Chemistry House	3
41	HOUSING	B55	Housing	4
42	HOUSING	B56	Sedat Adali House	4
43	HOUSING	B57	Housing	4
44	HOUSING	B58	Housing	4
45	HOUSING	B60	Housing	4
46	HOUSING	B61	Housing	4
47	HOUSING	B62	Housing	4
48	HOUSING-COMMERCIAL	B63	Housing-Commercial	4
49	COMMERCIAL	B64	Commercial	4
50	HOUSING-COMMERCIAL	B65	Housing-Commercial	1
51	HOUSING	B66	Housing	4

Table 4. Damage degree of the 2nd group buildings (houses and commercial buildings) (continued)

52	HOUSING-COMMERCIAL	B67	Housing-Commercial	**4**
53	HOUSING	B68	Kuseyri House	**0**
54	HOUSING-COMMERCIAL	B69	Housing-Commercial	**3**
55	COMMERCIAL	B70	Commercial	**1**
56	COMMERCIAL	B74	Commercial	**1**
57	COMMERCIAL	B76	Commercial	**3**
58	COMMERCIAL	B77	Commercial	**3**
59	COMMERCIAL	B78	Commercial next to Meydan Mosque	**1**
60	COMMERCIAL	B80	Commercial	**4**
61	COMMERCIAL	B85	Sultan Sofrası	**4**
62	COMMERCIAL	B86	Hotel-Commercial	**4**
63	HOUSING	B89	Housing	**4**
64	HOUSING	B90	Housing	**4**
65	HOUSING	B91	Housing	**4**
66	HOUSING	B92	Housing	**4**
67	HOUSING	B93	Housing	**4**
68	HOUSING	B94	Housing	**3**
69	HOUSING	B95	Bekir Çelik House	**4**
70	HOUSING	B100	Housing	**4**
71	HOUSING	B102	Housing	**4**
72	HOUSING	B103	Housing	**3**
73	HOUSING	B104	House-Fountain	**4**
74	HOUSING	B106	Housing	**4**
75	HOUSING	B107	Housing	**4**
76	HOUSING-COMMERCIAL	B108	Housing-Commercial	**4**
77	HOUSING	B109	Housing	**4**
78	HOUSING	B110	Housing	**4**
79	COMMERCIAL	B114	Commercial	**4**
80	HOUSING-COMMERCIAL	B115	Housing-Commercial	**4**
81	HOUSING	B116	Housing	**4**
82	HOUSING	B117	Housing	**4**
83	HOUSING	B119	Housing	**4**
84	HOUSING	B121	Housing	**4**
85	HOUSING	B123	Housing	**4**
86	HOUSING	B125	Housing	**4**
87	HOUSING	B126	Housing	**4**
88	HOUSING	B127	Housing	**4**
89	HOUSING	B128	Housing	**0**
90	HOUSING	B129	Housing	**0**
91	HOUSING	B130	Housing	**3**
92	HOUSING	B131	Housing	**3**
93	HOUSING	B132	Yigitbaş House	**0**
94	HOUSING	B133	Housing	**4**
95	HOUSING	B134	Housing	**3**
96	HOUSING	B135	Housing	**4**
97	HOUSING	B136	Housing	**1**
98	HOUSING	B137	Housing	**3**
99	HOUSING-COMMERCIAL	B138	Housing-Commercial	**3**
100	HOUSING-COMMERCIAL	B139	Housing-Commercial	**4**
101	HOUSING	B140	Housing	**4**
102	HOUSING-COMMERCIAL	B141	Housing-Commercial	**2**
103	HOUSING	B142	Housing	**4**
104	HOUSING	B143	Housing	**2**
105	HEALTH SERVICE	B144	Trahom War Dispancary	**2**

Table 4. Damage degree of the 2nd group buildings (houses and commercial buildings) (continued)

106	HOUSING	B145	Housing	1
107	HOUSING	B146	Housing	4
108	HOUSING	B147	Housing	1
109	HOUSING	B149	Housing	4
110	HOUSING	B150	Housing	4
111	HOUSING	B151	Housing	4
112	HOUSING	B152	Housing	3
113	HOUSING	B153	Housing	4
114	HOUSING	B154	Housing	3
115	HOUSING	B155	Housing	2
116	HOUSING	B157	Housing	3
117	HOUSING	B158	Housing	0
118	HOUSING	B159	Housing	0
119	HOUSING	B160	Housing	0
120	HOUSING	B161	Housing	3
121	HOUSING	B162	Housing	3
122	HOUSING	B163	Alexi K. House	3
123	HOUSING	B164	Fethiye G. House	3
124	HOUSING	B165	Housing	3
125	HOUSING	B166	Housing	3
126	HOUSING-COMMERCIAL	B167	Housing-Commercial	0
127	HOUSING-COMMERCIAL	B168	Housing-Commercial	0
128	HOUSING-COMMERCIAL	B169	Housing-Commercial	2
129	HOUSING	B170	Housing	0
130	HOUSING	B172	Housing	0
131	HOUSING-COMMERCIAL	B173	Housing-Commercial	2
132	HOUSING-COMMERCIAL	B174	Housing-Commercial	2
133	HOUSING	B175	Housing	4
134	HOUSING	B176	Housing	1
135	HOUSING-COMMERCIAL	B177	Caffehouse-Housing	3
136	HOUSING	B178	Housing	2
137	HOUSING	B179	Housing	4
138	HOUSING-COMMERCIAL	B180	Housing-Commercial	2
139	HOUSING	B181	Housing	4
140	HOUSING	B182	Housing	4
141	HOUSING	B184	Housing	4
142	HOUSING	B185	Bedriye Küçük House	0
143	HOUSING	B186	Housing	4
144	HOUSING	B187	Housing	4
145	HOUSING	B188	Housing	4
146	HOUSING	B189	Housing	4
147	HOUSING	B190	Housing	4
148	HOUSING	B191	Housing	4
149	HOUSING	B192	Nuriye Kumru House	4
150	HOUSING	B193	Kemal Bilgin House	4
151	HOUSING	B194	Housing	4
152	HOUSING-COMMERCIAL	B195	Housing-Commercial	3
153	HOUSING	B196	Housing	4
154	HOUSING	B197	Housing	4
155	HOUSING	B198	Housing	4
156	HOUSING	B199	Housing	4
157	HOUSING	B200	Housing	4
158	HOUSING	B201	Housing	4
159	HOUSING	B202	Housing	0

Table 4. Damage degree of the 2nd group buildings (houses and commercial buildings) (continued)

160	HOUSING	B204	Housing	4
161	HOUSING	B205	Housing	3
162	HOUSING	B206	Housing	4
163	HOUSING	B207	Housing	4
164	HOUSING	B208	Housing	4
165	HOUSING	B209	Housing	4
166	HOUSING	B210	Housing	4
167	HOUSING	B211	Housing	4
168	HOUSING	B212	Housing	4
169	HOUSING	B213	Housing	4
170	HOUSING	B214	Housing	4
171	HOUSING	B215	Housing	4
172	HOUSING	B216	Housing	3
173	HOUSING	B217	Housing	3
174	HOUSING	B218	Abdul Keberiti House	4
175	HOUSING	B219	Housing	4
176	HOUSING	B220	Housing	4
177	HOUSING	B221	Housing	4
178	HOUSING	B222	Housing	4
179	HOUSING	B223	Housing	4
180	HOUSING	B224	Housing	4
181	HOUSING	B225	Housing	4
182	HOUSING	B226	Housing	4
183	HOUSING	B227	Housing	4
184	HOUSING	B228	Housing	4
185	HOUSING	B229	Housing	1
186	HOUSING	B230	Housing	4
187	HOUSING	B231	Housing	0
188	HOUSING	B232	Housing	2
189	HOUSING	B233	Housing	0
190	COMMERCIAL	B234	Commericial	0
191	HOUSING	B235	Housing	3
192	HOUSING	B236	Housing	3
193	SCHOOL	B237	Ali Sayar Primary School	0
194	HOUSING	B238	Housing	3
195	HOUSING-COMMERCIAL	B239	Housing-Commercial	3
196	HOUSING	B240	Housing	4
197	HOUSING	B241	Housing	4
198	PUBLIC	B242	Police Station	4
199	HOUSING-COMMERCIAL	B243	Housing-Commercial	4
200	HOUSING	B244	Housing	4
201	HOUSING	B245	Housing	1
202	HOUSING	B246	Housing	3
203	HOUSING	B247	Housing	4
204	HOUSING	B248	Housing	4
205	HOUSING	B249	Housing	4
206	HOUSING	B250	Housing	4

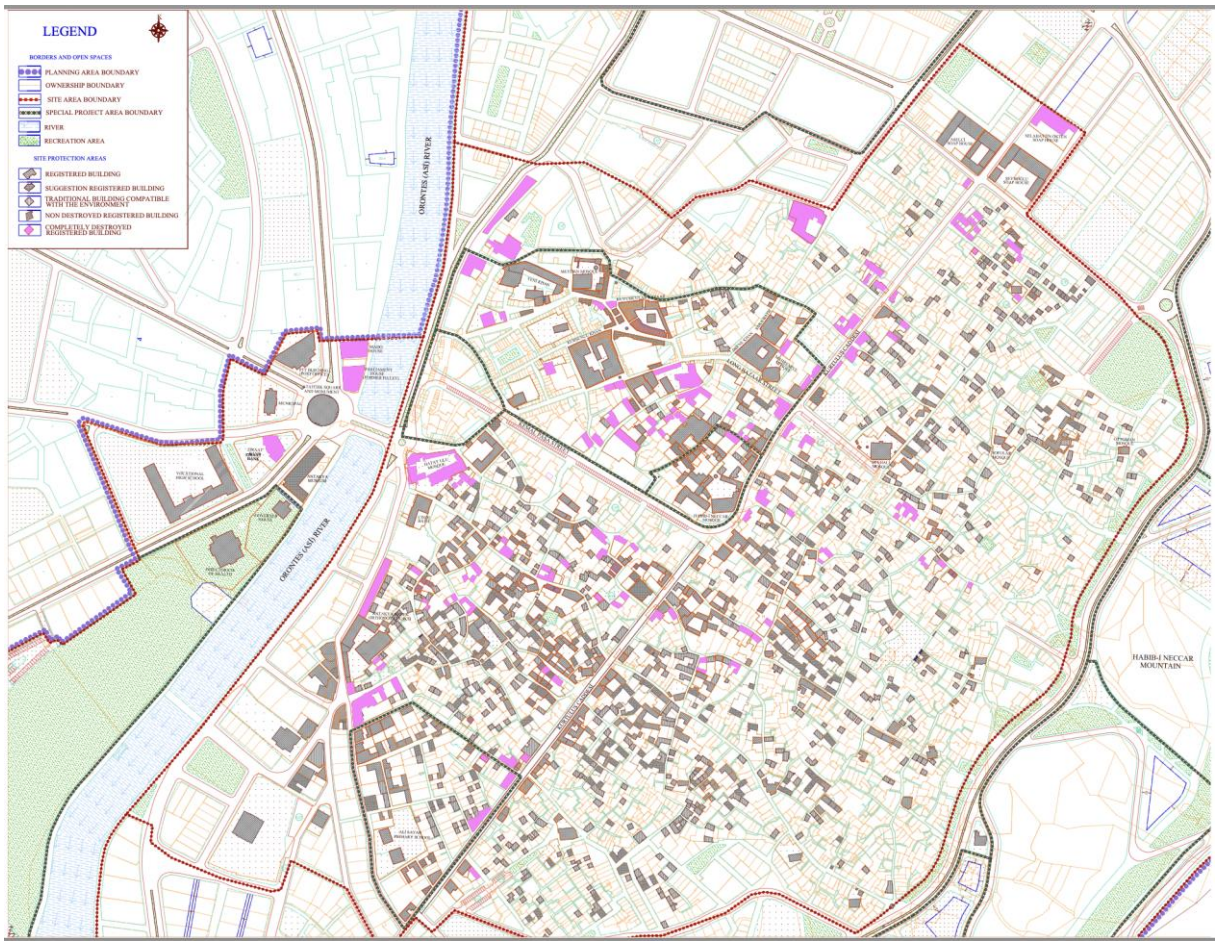


Figure 13. Collapsed Buildings (drawn by the Authors)

The destruction of many monumental buildings (Figure 14) is thought to have serious implications for urban identity and people's perception of the city. Although the magnitude of the destruction may be attributed to the intensity of the earthquake, it is obvious that other factors should also be emphasized. The multilayered structure of the city, especially within the urban conservation area, the alluvial soil structure in the East of the Asi River, and even the fact that the river bed was wider in the past and that the water decreased in time and the construction of buildings near the river bed can be counted among the factors that increased the severity of the destruction. The Great Mosque of Hatay, one of the important gathering places of the city, was destroyed, while the Habibi Neccar Mosque was heavily damaged (Figure 15). Habibi Neccar Mosque is one of the symbolic structures of the city, with a group of buildings around it. The mosque has a very important place in the city's history as it is considered the first mosque built within the borders of today's Türkiye.

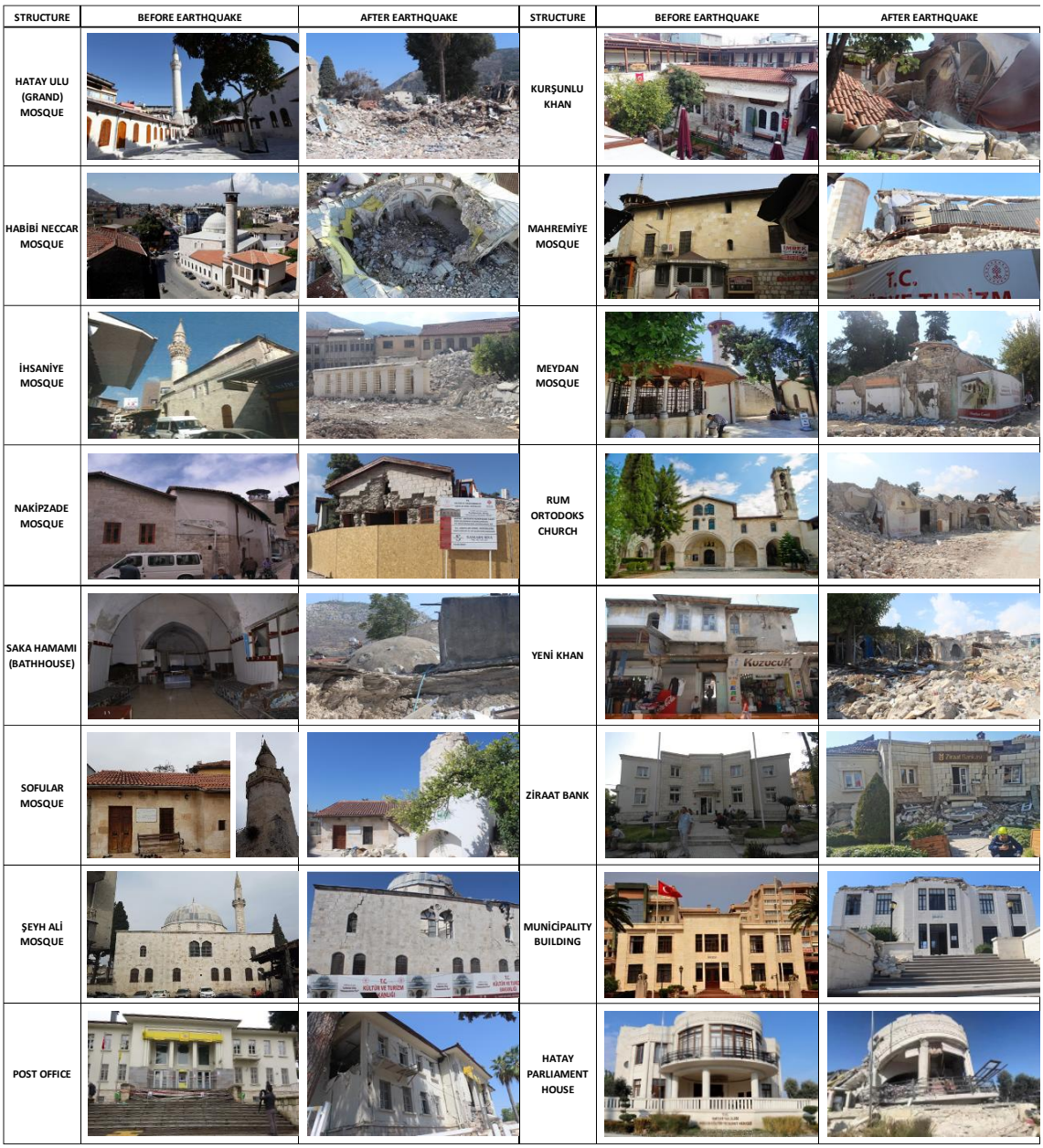


Figure 14. Post-earthquake condition of monumental buildings in the area (Taken by Authors, 2019 & 2023)

Figure 15. Habibi Neccar Mosque and its surrounding (Arkeofili, 2023)

Similarly, the Greek Orthodox Church (Church of St. Piyer and St. Paul) is a very important place for Christians and was heavily damaged after the earthquake. Buildings with residential-commercial functions located on Kurtuluş Street, one of the city's most important streets, were also significantly damaged (Figure 16). Antakya traditional houses with courtyard typology bounded by streets were also severely affected by the earthquake (Figure 17).

Figure 16. Kurtuluş Street before and after the earthquake (taken by the Authors, 2023)

Figure 17. Traditional house examples within the urban conservation area (taken by the Authors, 2023)

According to the research of Aktemur & Ünlükaplan (2024), most of the urban image elements such as the UNESCO Gastronomy House, Expo House, Sermaye Mosque, and the Catholic Church in Zenginler Neighbourhood, one of the oldest settlements of Antakya, were destroyed or heavily damaged. Cindi Hamam, Nakip Mosque, and Kurtuluş Hamam on Türk Yurdu Street are also among the buildings that were severely damaged. In addition, it is seen that the historical texture has also been lost with the destruction of the elements that form the boundaries of the neighborhood, the roads lost with the demolished buildings, and the images that serve as edges (Aktemur & Ünlükaplan, 2024).

Within the scope of the study conducted by Göçer (2024), the structural behavior of Antakya High School, which is an educational structure, due to the effects of Kahramanmaras earthquakes was evaluated by the data obtained by on-site observation. Three different branches of the building were

evaluated in terms of damages following the rating as 0 (no damage), 1 (rarely), 2 (moderate), and 3 (high). While one of the units with the same architectural characteristics collapsed due to the earthquake, the other unit survived with secere damage. The reasons for this can be defined as the inhomogenius mixture of the mortar used as binding material, the use of wall components in the form of rubble stones of different sizes, and irregularities in the wall knitting system (Göçer, 2024). These findings briefly summarise the reasons for the problems in the 250 structures examined.

One of the important architectural components damaged in the area is domes. Masonry domes, which are curved and spherical building components, have been widely used as upper covering elements in large interior spaces of historical buildings such as mosques, churches, mausoleums, baths, and palaces (Grillanda et. al., 2019; Pavlovic et al., 2016). These structures are weak elements against earthquakes due to their very low tensile strength. As stated by Bayraktar et al. (2022), heavy damage and collapse of masonry domes have occurred in the past due to disasters such as earthquakes. Of the 19 mosques analyzed, four are masonry domed and fourteen have wooden roofs (hipped, gable, pitched, flat, etc.). The Great Mosque of Hatay has a vaulted and wooden roof. Among the domed ones, the domes of 3 of them have collapsed and one of them is heavily damaged. Hatay Great Mosque was also completely demolished. Two of the ones with wooden roofs were demolished, three of them were heavily damaged, two of them were moderately damaged, and seven of them were slightly damaged (Figure 18a-b).

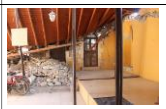
	Name of Building	Dome/Wooden roof (hipped, pitched, gable, flat)	Post-earthquake Situation	Pre-earthquake Situation	Damage Level of the Dome	Minaret	Photo of Minaret	Damage Level of the Minaret
1	Hatay Ulu Mosque	Wooden, Vault			Collapsed	✓		Collapsed
2	Habib-i Neccar Mosque	Dome			Collapsed	✓		Collapsed
3	Mahremiye Mosque	Wooden			heavily damaged	✓		heavily damaged (only base part standing)
4	Zülfikar Mosque	Wooden			heavily damaged	a ezanlık (small minaret)		Slightly damaged
5	Yeni Mosque	Dome			Collapsed	✓		Collapsed
6	Semerciler Mosque	Wooden			Collapsed	✓		heavily damaged
7	Ahmediye Mosque	Wooden			Slightly damaged	✓		heavily damaged (only base part standing, the base part was also dismantled for new construction)
8	Meydan Mosque	Wooden			Collapsed	✓		heavily damaged (only base part standing)
9	İhsaniye Mosque	Dome			Collapsed	✓		Collapsed

Figure 18a. Dome and minaret damage assessment in the mosques inspected (by Authors)

	Name of Building	Dome/Wooden roof (hipped, pitched, gable, flat)	Post-earthquake Situation	Pre-earthquake Situation	Damage Level of the Dome	Minaret	Photo of Minaret	Damage Level of the Minaret
10	Selvili Mosque	Wooden			Slightly damaged	a ezanlık (small minaret)		Collapsed
11	Orhanlı Mosque	Wooden			heavily damaged	✓		heavily damaged (only base part standing)
12	Şeyh Muhammed Mosque	Wooden			Slightly damaged	✓		heavily damaged (only base part standing)
13	Osmanlı Mosque	Wooden (it is wooden in original, later a reinforced concrete slab constructed)			Slightly damaged	✓		Collapsed
14	Sofular Mosque	Wooden			Slightly damaged	✓		heavily damaged (only base part standing)
15	Şeyhali Mosque	Dome			heavily damaged	✓		heavily damaged (only base part standing)
16	Deveci Bekiroğlu Mosque	Wooden			Slightly damaged	✓		Slightly damaged
17	Kürtfakih Mosque	Wooden			Slightly damaged	✓		Collapsed
18	Nakipoğlu Mosque	Wooden			Moderately damaged	✓		Collapsed
19	Sarımiye Mosque	Wooden			Moderately damaged	✓		heavily damaged (only base part standing)

Figure 18b. Dome and minaret damage assessment in the mosques inspected (by authors)

It has been determined that one of the building components affected by earthquakes is minarets, which generally have a long and thin architectural design. Minarets, due to their slender structure, are more susceptible to natural disasters such as wind and earthquakes compared to other architectural elements (Ercan et. al., 2017). The behavior of minarets during earthquakes has attracted the attention of many researchers and many studies have been conducted to understand the occurrence of these damages and to predict their behavior in earthquake scenarios. Doğangün et al. (2007) stated that minarets are mostly damaged in the cone/spire *(külah),* upper part of the minaret body, cylindirical or polygonal bady, and transition segment under the earthquake effect. Experimental and numerical studies have shown that there is no stress accumulation in the cone section of the minarets (Doğangün et al., 2008; Çakır et al., 2016). However, the maximum displacement occurs in this region, and the absence of a staircase in the upper body of the chancel causes the stiffness to decrease and the displacement to increase suddenly. Therefore, it can be said that the cone and body connection parts of some minarets do not have sufficient displacement stiffness and strength (Atmaca et al., 2020). Seventeen of the 19 mosques examined have minarets and two have ezanlık (small minaret).. Eight of the minarets have been demolished, nine of them are heavily damaged (only the pedestal part is standing), and two of them (one of which is a ezanlık) are slightly damaged (Figure 17a-b).

4. Conclusion and Suggestions

The issue of how and where new construction will occur in cities affected by the Kahramanmaraş earthquakes is very important. However, this issue must be considered more carefully, especially in historical city centers. It is a common practice to build post-earthquake disaster housing on the city's

outskirts and in areas with solid ground. This issue should inevitably be handled sensitively in the historical city centers affected by the earthquake, especially in the urban protected area of Antakya, and how the identity of Antakya city can be preserved, how these buildings can be revived, and in which building reconstruction is inevitable, should be addressed by experts in the field.

In order to preserve the multicultural and multilayered structure of Antakya, it is necessary to ensure that the region's people can live here and continue their economic activities. Since the area around the Asi River is a gathering area for Antakya's cultural heritage, such as the Habibi Neccar Mosque, churches, the Long Bazaar, cultural venues, and neighborhoods where traditional residences are gathered, it is important to preserve their relations with the old city in the plans to be made.

It is extremely important that post-earthquake restorations are carried out in a way to keep the social memory alive, to keep the places, focal points and old experiences alive in the memories. It is only possible to create and keep alive the urban identity of the region known as Old Antakya (Antioch) by revealing the production of a symbolic space and regaining the social memory of these places.

Within the scope of this study, archive and inventory studies, zoning plans, and conservation plan research were conducted, and the buildings in Antakya Urban Protected Area were listed. Subsequently, the post-earthquake conditions of the registered monumental and civil architecture examples were comprehensively revealed through field studies. This study, which records the city as a whole without focusing on the individual buildings and their reasons for being affected by the earthquake and the documentation necessary for processes such as restoration and reconstruction, presents the damage conditions of monumental buildings and civil architecture examples. The study's limitations include not being able to reach the buildings encountered in the fieldwork, not being able to approach them due to security risks, and the destruction of the elements (streets/avenues) necessary for the direction and location of the buildings. Nevertheless, the results obtained by examining 250 buildings in total and the experience of a large part of the conservation area both show the level of destruction of the earthquake effects in the historic city and constitute a reference for future studies such as conservation and site management.

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

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Transportation Decisions and Practices in Trabzon City and Their Impacts on the City Identity

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Abstract

The transportation of Trabzon is mainly provided by road. The negative impact of the roads, which started with the construction of the Black Sea Coastal Road, then passed through the historical castle and continued with the Tangent Road, which destroyed important areas, on the city has reached an even more destructive level with the construction of new roads today. As a result of all these, serious deterioration was experienced in the historical texture of the city on the one hand and the urban skyline on the other, and the identity values of the city began to disappear. This study is important in terms of revealing the extent of the effects of transportation decisions on the city identity on the city of Trabzon. In addition, the study is an example for cities that have or may have similar problems. In the study, transportation decisions, practices and results are handled in a multifaceted way through the concept of "relationship", which defines spatial integrity. As a result, it has been revealed that the consequences of the transportation decisions to be taken in the city on the whole city and the urban life should be discussed.

Keywords: *Identity, planning, spatial change, Trabzon, transportation.*

Trabzon Kentinin Ulaşım Kararları ve Uygulamalarının Kent Kimliğine Etkisi

Öz

Trabzon'un ulaşımı, ağırlıklı olarak karayolu üzerinden sağlanmaktadır. Öncelikle Karadeniz Sahil Yolu'nun inşasıyla başlayan ardından tarihi kale içinden geçen ve önemli alanları tahrip eden Tanjant Yolu ile devam eden yolların kente olumsuz etkisi günümüzde yeni yolların yapımıyla daha da yıkıcı boyuta ulaşmıştır. Tüm bunların sonucunda bir taraftan kentin tarihi dokusunda diğer tarafta kent siluetinde ciddi bozulmalar yaşanmış, kentin kimlik değerleri kaybolmaya başlamıştır. Bu çalışma, alınan ulaşım kararlarının kent kimliğine olan etkilerinin boyutunu Trabzon kenti üzerinde ortaya koyması açısından önemlidir. Ayrıca, çalışma benzer sorunlar yaşayan ya da yaşayabilecek kentler için örnek teşkil etmektedir. Çalışmada, ulaştırma kararları, uygulamaları ve sonuçları, mekânsal bütünlüğü tanımlayan "ilişki" kavramı üzerinden çok yönlü olarak ele alınmıştır. Sonuç olarak kentte dair alınacak ulaşım kararlarının kentin bütününe ve kentli yaşamına olacak sonuçlarının tartışılması gerektiği ortaya konmuştur.

Anahtar kelimeler: *Kimlik, planlama, mekansal değişim, Trabzon, ulaşım.*

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1. Introduction

Roads are influential elements in the urban texture and appearance (silhouette). They also play a significant role in connecting the urban spaces that form the spatial structure of cities (Besim & Polat, 2020). Lynch (1960) stated that roads are the most effective tools for organizing the whole, and he defined roads not only as physical spaces but also as urban spaces where social life flows. He defined roads as the most effective means by which the whole is organized, and as urban spaces where not only physical spaces but also social life flow. Therefore, roads are not only a result of transportation needs but they are also a subject of various disciplines.

From the past to the present, it can be observed that roads have taken on various roles. Serving as significant tools for interactions among different communities, roads have also been among the most valuable power of governors. The roads, which are important tools for the interaction of peoples in different geographies, have also been the most valuable assets of the monarchies. During the Roman period, roads were constructed with varying dimensions and purposes, often for military objectives. The Romans designed roads almost as monumental structures. On the other hand, the Phrygians built roads specifically for their chariots.

The Persian Royal Highway, built in the 5th century, has been one of the most important and remarkable of the Anatolian roads. This highway was built by the Persian King Darius primarily for communication purposes, was used as a military highway network by the Romans, and was used for intercontinental transportation on Silk Highway trips that served commercial and military purposes during the Byzantine period. Therefore, roads have not only served military purposes but also facilitated commercial and intercontinental communication, significant economic and strategic centers.

Trabzon is one of the cities that have hosted various civilizations. It has places which have identity. Trabzon, which was originally a city, directly connected to the sea and resting against green hills, has gradually lost this characteristic over time. Rapid urbanization, unplanned construction, and certain planning decisions have led to significant changes in the city. Especially new highway constructions for transportation, landfills, and demolitions have altered the texture of the city. The city has experienced losses in its spaces which have identity or discontinuities in the continuity between these spaces. This spatial fragmentation has manifested itself in disruptions in the city silhouette and the emergence of less identity environments that have lost their connection with the surroundings.

It is aimed to reveal the originality of the study by explaining the issues related to the previous studies on roads in the literature. When looking at the studies about “the roads”, it is seen that there are some studies that examine “the relationship between highway and urban morphology”. These include Kızıltepe (2014), Yılmaz (2015), Adıgüzel, Toroğlu & Kaya (2015), Ünlü Yücesoy & Özüduru (2018), Sakar & Ünlü (2019), Baytekin & Özüduru (2022), and Tiryaki & Kürkçüoğlu (2023). In addition to these studies, there are also studies that examine “the highway and urban relationship”. Examples include Surat & Yaman (2015), and Eren, Hacıoğlu & Polatoğlu (2021). Furthermore, there are also studies focusing on the impact of roads on the Trabzon city. These include Sağlam (1995), Çevik et al. (2008, 2010), Zorlu et al. (2010), Başman (2011), Sağır (2012), Bogenç, Bekçi & Bekiryazıcı (2019), Tarakçı Eren et al. (2018), Özlü & Dedeoğlu (2021), and Bayram & Yılmaz Yıldırım (2022). The original subject of the study is about the impact of new roads on the urban identity of Trabzon city through the "relationships" that constitute the spatial integrity.

In summary, roads encompass the scope of various disciplines such as urban planning, architecture, environmental science, sociology, and transportation engineering. Roads have a wide-ranging impact that includes aspects such as transportation, sustainability, accessibility, aesthetics, safety, as well as social and economic dimensions. In the study, firstly, the roads that influence the identity of Trabzon, spaces, which have identity, affected by these roads, and the city's planning decisions have been addressed. Subsequently, the study highlights the spatial fragmentations, weakening, disconnections, demolitions, and other consequences that have emerged in the identity areas of the city because of the construction of these roads. Then, spatial fragmentation, weakening and destruction in the identity areas of the city resulting from the construction of these roads were revealed.

1.1. Effective Old and New Roads in Trabzon Urban Identity

In the study, the effective primary roads in Trabzon's urban morphology are addressed as follows: 1st and 2nd Black Sea Coastal Highway, 1st Tangent Highway (Yavuz Selim Boulevard), and 2nd Tangent Highway (Kanuni Boulevard).

- 1st and 2nd Black Sea Coastal Roads: It is a section of 139 kilometers of the 542-kilometer highway that extends from Samsun to the Sarp Border Gate (Karataş, 2006). Firstly, the project was initially proposed in 1960 but was postponed due to various reasons. Secondly, it was planned as a two-lane highway in 1983, and its project was completed in 1987. However, due to the anticipation that the planned highway would not be able to accommodate the increasing traffic in a short time, it had to be transformed into a divided highway with 2 lanes in each direction (Yılmaz, 2015). In 1996, the Ministry of Transport and Infrastructure initiated the construction, and by 2006, a divided (dual) highway passing over land reclaimed from the sea, which runs through or immediately along the edges of cities, was opened for service (Turoğlu, 2005). However, the Black Sea Coast Highway, which was originally planned as a transit route for the city, has become one of the major influential arterial roads within the city. This situation has necessitated the construction of a 2nd Black Sea Coastal Highway. This project was expanded. It was designed as multilane rural Highways. The construction of the highway began in 2007 under the Ministry of Transport and Infrastructure, and the Trabzon section of highway was opened in 2018 (Republic of Turkey Ministry of Transport and Infrastructure, 2023).
- 1st Tangent Highway (Yavuz Selim Boulevard): Tangent Highway is an 11-kilometer highway extending from Uzunkum to Çömlekçi. It is heavily used by both vehicle traffic and pedestrians (Kadıoğlu, 2011). It was initially proposed in the Lambert Plan prepared by Jacques H. Lambert in 1938. This plan aimed to support the development of the city especially of the southern part. The plan includes the proposal to demolish some of the walls of the Zagnos Bridge and to cross the Tabakhane Valley with a second bridge. However, in the competition organized by İller Bank in 1968, unlike the Lambert Plan, another route passing through the south without damaging the historical structure/texture of the city was proposed (Sağlam, 1995). Nevertheless, due to high costs, the route was changed again in 1974. The first stage was completed in 1984. The second stage was started by the General Directorate of Highways in 2002 and opened in 2005 (Zorlu et al., 2010). The Tangent Highway is a two-lane and two way. and has a special importance because it passes through the city center and the urban protected area, which is the historical settlement area of the city.
- 2nd Tangent Highway (Kanuni Boulevard): Kanuni Boulevard is a 23-kilometer highway (JTAP, 2013). The sloping land structure of the city and the scarcity of settable land have led to the linear development of the city along the coast. This situation led to the inadequacy of the south connection roads and required the construction of Kanuni Boulevard (Sağır, 2012). The Kanuni Boulevard Project was initially included in plans as a corridor in 1989 and was proposed as an alternative transportation system in the east-west direction. It was revised in 2002 within the scope of the Southern Ring Highway Project (Beyazlı & Özlü, 2020), which would ease the burden of the coastal highway by shifting it to the south. Kanuni Boulevard is planned as an alternative to the Trabzon crossing of the Trabzon city center and the Black Sea Coastal Highway, and it is predicted that it will ensure the rapid flow of transit traffic (Yardımcı, 2021). The project was planned in 6 stages, and its construction that started in 2011 through a joint initiative of the General Directorate of Highways and the Municipality of Trabzon is ongoing (Özlü & Dedeoğlu Özkan, 2021). The highway is divided into 3 lanes in each direction (3+3 configuration) (İhlas Haber Ajansı, 2022).

Secondary vehicle and pedestrian paths/roads are Uzunsokak, Kahramanmaraş Street, Kunduracılar Street, and Erzurum Highway.

- Uzunsokak: Uzunsokak is an approximately 700-meter-long highway that starts from Atatürk Square, which is one of the most used squares of the city and extends to the historical core of Trabzon. There is Tangent Highway to the south and Kahramanmaraş Street to the north (Başman, 2011). One of the oldest streets in the city center of Trabzon (Albayrak, 1998; Gerçek 1990) is a commercial street. The street, which was used as a secondary vehicle highway until 2008, was later pedestrianized.

- Kahramanmaraş Street: Kahramanmaraş Street is a 2.5-kilometer-long street that starts from the Black Sea Coastal Highway and ends at Atatürk Square. It is bordered by Uzunsokak to the south and Kunduracılar Street to the north. It is one of the most significant and heavily used streets in Trabzon (Özkan, 2017). It was built by the Russians in 1916 as a second parallel street to Uzunsokak. The street was expanded with the Lambert Plan in 1938. Although the traffic flow direction of the street was changed in different periods until 2022, some of it was pedestrianized in 2022 (Bogenç, Bekçi & Bekiryazıcı, 2019; Tarakçı Eren, Düzenli & Akyol, 2018).

- Kunduracılar Street: Kunduracılar Street is a 450-meter-long street starting from Semerciler Street to today's port. It is connected to Iran transit highway by the Old Erzurum Highway to the south. This trade artery, which is in the center of Trabzon city, is a pedestrian-shopping area. This street is the Kemeraltı-Atatürk Area (Square Park) connection, which is a part of the historical and cultural heritage of Trabzon (Altınay & Bilgimöz, 2015). In 1985, the street was closed to traffic (Özkan, 2017). In the same year, an area of approximately 1,5 kilometers covering the main axle and the connection roads feeding the axle was designated as a protected area. In 2002, Protection-Renewal-Revitalization Study was conducted in cooperation with Trabzon Municipality and Karadeniz Technical University (Çevik et al., 2010; Çevik et al., 2008).

- Erzurum Street: Erzurum Street, which is part of the Iran Transit Highway, is a highway starting from Kunduracılar Street and extending to Rize in the east (Sipahi & Tavşan, 2019). The highway is bordered by Çömlekçi Neighborhood to the north and Fatih Park to the south. Erzurum Highway is one of the intermediate roads that come from the 'Silk Highway' route to the south of the Caspian Sea and extend to Tabriz and go to the coast of Trabzon through Erzurum. Thus, Erzurum Street has played a crucial role as a connection between land and sea, serving both military and commercial purposes (Aygün, 2005). Although the date of the first attempt at its construction is unknown, it is known that it was brought to the agenda by Sadullah Enveri Efendi in the 18th century, but it was not built in that period (Tozlu, 2002). Especially with the resurgence of Iranian trade in 1830, the construction of the highway gained importance (Issawi, 1971). Erzurum Street underwent a major change with the construction of the Tangent Highway, and many of the buildings on the highway were demolished (Zorlu, Aydıntan & Engin, 2010).

1.2. Urban Nodes and Districts Affected by Construction of New Roads

Trabzon has important urban nodes and districts affected by construction of new roads. Trabzon has important city focal points and regions that have been influenced by the construction of new roads. Particularly the areas of Kemerkaya, Güzelhisar, Çömlekçi, Moloz, Boztepe, Historical Castle, Tabakhane Valley, Zağnos Valley, Atatürk Square (Square Park), Atapark, and Fatih Park are significant areas that have undergone changes in terms of city identity due to the construction of new roads.

- Kemerkaya District: Kemerkaya District, one of the non-Muslim neighborhoods, was established in the Roman Period (Öztürk, 2016). It is bordered by İskender Pasha Neighborhood and Port district to the east, Çarşı Neighborhood and Kemeraltı district to the west, Black Sea to the north, and Cumhuriyet Neighborhood to the south. The district, which has formed the coastal character in the history of the city, has undergone a great change with the construction of the Black Sea Coastal Highway and coastal filling works.

- Güzelhisar District: The Güzelhisar district is in the İskender Pasha neighborhood of Trabzon. It is bordered to the east by the Port area, to the west by Çarşı District, to the north by the Black Sea, and to the south by the Black Sea Coastal Highway. In the 1930s and 40s, it hosted many events such as boat races, oil wrestling, and concerts (Doğan, 2016). Filling areas along the sea and 2nd Black Sea Coastal Highway, initiated in 2007, have changed its character seriously.

- Çömlekçi District: It is bordered by Sanayi Neighborhood in the east, İskender Paşa Neighborhood in the west, Black Sea in the north, and Tangent Highway in the south. The Çömlekçi district, one of the first Muslim neighborhoods of the city, is in the port area of Trabzon. It connects Trabzon to the east. Erzurum Street, once located in the region, used to cross the camel caravans coming from Iran and connect to the Black Sea in the past (Somel, 2011). Social life improved with the construction of the inter-district bus stop, coffee houses and the Coastal Cinema in this region in 1960s (Arslan, 2011). In the 1990s, with the establishment of the Eurasian (Russian) Market in the district, the area gained commercial function and operated as a commercial center until the 2000s (Aydın Öksüz, Seymen & Küçük Karakaş, 2018). With the relocation of the Eurasian (Russian) Market from here, the commercial function of the region has decreased. With the aim of creating a new physical and social image in cooperation with TOKİ and Trabzon Metropolitan Municipality, the Çömlekçi Urban Transformation Project was prepared. The project was initiated in the region as of 2009 (Anonymous, 2017).

- Moloz District: It is bordered to the east by Çarşı District, to the west by Pazarkapı District, and to the north by the Black Sea Coastal Highway. The Moloz experiences intense commercial activity. There are many commercial buildings, especially the Women's Market, which is an important commercial place of Trabzon. In the past, Moloz was located adjacent to the sea. Because of the filling area (Beyazlı & Aydemir, 2008) and the 2nd Black Sea Coastal Highway between 1967 and 2007, The Moloz area remains situated between the coastal roads. In 2020, the Moloz Recreation Area Project was developed and implemented in this area (Aydın, 2020).

- Boztepe District: Starting approximately 210 meters from the northern coastline of Trabzon, it is bounded by the Kuzgun Stream to the west and the Değirmendere Valleys to the east. This hill rises just behind the city center and the port. Due to its central location, it is the most important and strategic point of the city (Emir, 2016). It is in the historical Silk Highway route (Özsait, 1998). Boztepe also lies on the ancient highway routes coming from Gümüşhane and Bayburt, reaching Trabzon (Çiğdem, 2007). It is known that Boztepe, which dates to ancient times, was a place where "pagans who worship the sun" gathered at that time and was accepted as a sacred place (Üstün Demirkaya & Kırcı, 2020). With the construction of the first highway after the Russian occupation between 1916 and1918, settlement started in the region (Tarakçıoğlu, 1986). With the zoning plan implemented in 1989, the region was designated as a new development area. Boztepe has become one of the most densely populated settlements in Trabzon today (Yılmaz Aslantürk, 2019).

- Historical Castle District (Upper Castle, Middle Castle, Lower Castle): The Historical Castle District, starting from the sea coast and extending to the back hills of the city, was built on the ruins of the Byzantine Period. The Castle Area has hosted various civilizations, including the Byzantine and Roman periods (Üstün Demirkaya & Kırcı, 2020). The historical castle area, which is in the highest part of the city, started to form with the construction of the first castle in 2000 BC. It consists of three sections: Upper Castle, Middle Castle, and Lower Castle. The Upper Castle served as the city's acropolis as the southernmost part of the castle. Lower Castle stretches from the western side of Zağanos Tower to the sea. Middle Castle is an extension of Upper and the Inner Castles (Pural, 1995; Sürmen, 2015).

- Tabakhane Valley: It was named after the Tabakhane Bridge built in the Roman period. The valley, situated quite close to the city center, is also very close to residential and commercial areas. In the 1938 Lambert plan, it is known that the valley was initially designated as one of

the north-south air corridors. However, the concentration of slums in this area has caused the closure of the planned air corridor over time. In 2010, the Trabzon Metropolitan Municipality initiated the Tabakhane Valley Recreation Area Transformation Project, and demolition works began in 2014 and are still ongoing.

- Zagnos Valley: It was named after the Zagnos Bridge on it. The valley has been used as a settlement area for many years. It hosts various historical buildings (Güneroğlu & Pulatkan, 2021). Like the Tabakhane Valley, it was planned as one of the north-south air corridors in the Lambert plan in 1938. However, due to unplanned construction in the valley, the Trabzon Metropolitan Municipality initiated the Zagnos Valley Recreation Area Transformation Project in 2005. The project was completed in 2017 (Demiral, 2017).
- Atatürk Area (Square Park): It is bordered by İskele Street to the north, Atatürk Street to the south and west, and Square Mosque Street to the east. The area is surrounded by numerous commercial buildings and significant historical buildings such as the Old Municipality Building and İskender Pasha Mosque, etc. In the past, the historical city center, in the city walls, developed towards the east over time, and today Atatürk Area and its surroundings have become the city center. The square, which was used as a resting area for caravans in the 1900s, became the center of many events such as cinema, theater, concerts, lantern regiment and festive ceremonies after the 1920s. The Atatürk Area is still heavily used by the city residents for social, cultural, and political purposes today (Sancar & Acar, 2016). While the surrounding of the Atatürk Area was once an area where there were taxis, minibuses and bus stops, the area was partially pedestrianized by the Municipality of Trabzon in 2011 with the Square Park Transformation Project (Bayramoğlu & Yurdakul, 2019).
- Atapark: It is surrounded by İnönü Street in the north, 1st Tangent Highway (Yavuz Selim Boulevard) in the south, Şenol Güneş Street in the east, and Soğukçeşme Street in the west. Around the Atapark, there are buildings with different functions such as residential buildings, educational institutions, a theater building, the municipality building, and a shopping mall. Furthermore, within the Atapark, there is a public library, a children's playground, and player building. Until the late 1930s, Atapark functioned as a part of the Hatuniye Complex. However, in 1937, it was transformed into a park area (Yılmaz Yıldırım & Bayram, 2023). During the 1940s, the park was heavily utilized by the employees of the nearby Tobacco Factory as a recreational space. In the 1950s, the area became the gathering and dispersal point of people with the construction of a bus stop opposite Zağanos Tower (Tuluk & Düzenli, 2010, Doğan, 2016). Today, Atapark still serves as a significant open public space of city.
- Fatih Park: In the 1926 and 1938 city maps, Fatih (Aşıklar) Park was indicated as a cemetery area. In the 1926 survey, the section of the cemetery area bordered by Erzurum Avenue to the east and Taksim Street to the west was transformed into Fatih Park. Today, the park is in an area with heavy vehicle use and opposite the dense minibus stops under the Tangent Highway viaduct. It is an important public area of the city center as a park surrounded by trees with tea gardens, sculptures, cascaded pool, and seating equipment(Figure 1).

Figure 1. Effective highways, districts, focal points/nodes in Trabzon urban identity (Prepared by the Authors on Yandex Maps, Bölükbaşı, 2016)

2. Material and Method

Although the exact foundation date of Trabzon is unknown, it is known that it has a history dating back to 2000 BC. During the historical process, Trabzon, which has hosted many civilizations such as Miletus, Persians, Romans, Byzantines, Commenos, Genoese, Ottomans, Russians, and Turks, has had commercial importance as an important port city. The first borders of the city are the Inner Castle that provides high protection between today's Tabakhane and Zağnos Valleys (Aksoy, 2009). In the 13th century, the city center, protected by castle walls, began to expand west. Trabzon, which came under Ottoman domination in 1461, experienced significant changes in terms of commercial and structural aspects during this period. The spatial patterns of Ottoman cities began to be implemented in Trabzon as well. Commercial buildings such as bazaars, inn, and religious buildings such as mosques, cemeteries, and tombs were built in Trabzon (Özkan, Dedeoğlu & Akyol, 2017). During this period, with the opening of İnönü Street, the city started to develop towards the southwest (Çiçek, 2001) (Figure 2).

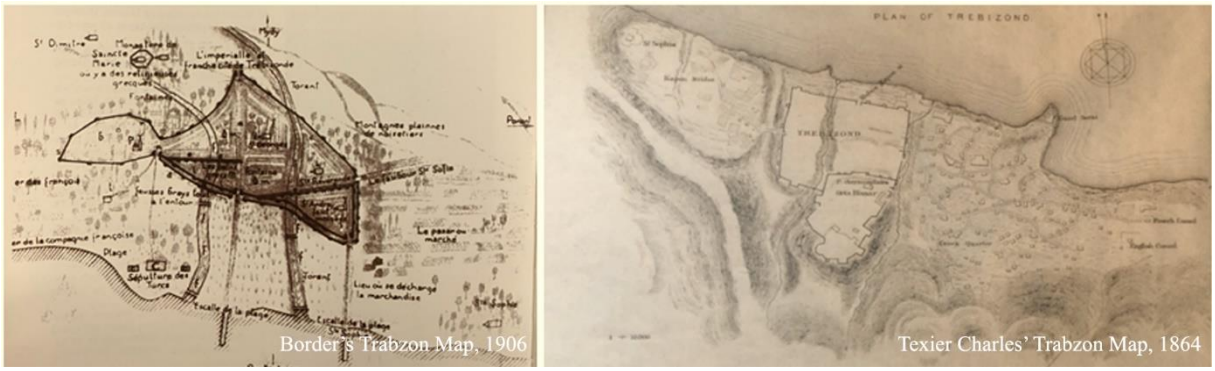

Figure 2. 1609 bordier Trabzon map (Bostan, 1997), 1864 Texier Charles Trabzon map (Texier, 2024)

The first initiatives regarding the mapping and cadaster of Trabzon emerged in 1909. However, these efforts were not realized. In 1924, a map of Trabzon was made during the Russian occupation (Başkaya, 2019). After the proclamation of the Republic, urban plans were made throughout Turkey within the scope of modernization efforts. Similar efforts were made for Trabzon, and in 1926, the municipality prepared a city map.

In 1930, the construction continued regardless of the city map (Başkaya, 2019). However, after the Municipal Law of 1930 and the Municipal Buildings and Roads Law of 1933 were enacted, it became mandatory for every city to have a map and a zoning plan.

In terms of urban planning, the "Trabzon's Artistic Works" report, prepared in 1937 by Sedat Çetintaş, a member of the Monuments Protection Society, marked a significant turning point, and a list of artifacts with historical and monumental value in Trabzon was created and their degree of protection was determined (Düzenli, 2010a; Düzenli, 2010b). Additionally, in 1937, the Lambert Plan, which aimed to preserve Trabzon's uniqueness and its connection to the sea, was put into effect. The Lambert Plan aimed to open parallel roads to existing ones to support the east-west development of the city and establish valleys as green corridors connecting settlements to the sea (Şen, 2000; Aysu, 1977; Gür, 2009). The plan also proposed the creation of a new city center (Atatürk Square) and connecting all roads to this center, making the Kahramanmaraş Street the city's main artery, organizing new roads to serve neighborhoods located to the south, establishing a new residential area in the west, creating cultural centers, preserving archaeological sites, and designing open spaces, parks, viewpoints, and terraces to allow the public to relate to the sea along the valleys (Aysu, 1981). Additionally, the plan suggested the establishment of a new harbor in Güzelhisar and the creation of an industrial zone that would be connected to Erzurum via the new port (Gerçek, 1987). However, the rapid urbanization and the focus on individual preservation of historical areas, instead of comprehensive protection, necessitated a revision of the Lambert Plan. The revised plan could not be finalized until 1941, and in 1951, it was decided to abolish the Lambert Plan (Zorlu et al., 2010) (Figure 3).

Figure 3. 1938 Lambert revised Trabzon plan (Aysu, 1981), 1967 Trabzon provincial analytical study (İller Bank, 1968)

In 1967-1968, a city planning competition for Trabzon was organized by the State Planning Organization (İller Bank), and a new zoning plan was created to be implemented in 1970 (Gür, 2009, Özen Turan, 2009). This plan was prepared in the collaboration with İrfan Bayhan, Hüseyin Kaptan, and Emre Aysu. In this plan, it was aimed to organize the "Tangent Highway" as the main artery, which would share the traffic load of the city, create a new development area in the south of the city, and pass without touching the ancient city (Şen, 2000, Aysu, 1977, Karadayı, 2000) (Figure 4).

Figure 4. 1970 Trabzon approved zoning plan (Aydemir, 1989)

Following the 1970 zoning plan, revision zoning plans were prepared in 1975, 1977, and 1984. The implementation process of the Tangent Highway project proposed in the 1970 zoning plan was suspended for various reasons (Sağlam, 1995).

In 1984, due to a court decision, the Tangent Highway project was revived, and construction began. However, unlike previous plans that aimed to pass the Tangent Highway without interfering with the ancient city, the highway in its current state intersects with the historical urban texture, with eight legs spanning over it, measuring 37.5 meters in width and 500 meters in length. Additionally, during the construction of the highway, the city walls and many historical buildings were demolished (Zorlu et al., 2010).

The Black Sea Coastal Highway, which started to be built in 1997 and completed in 2007, was implemented in an unplanned way and quickly to meet the transportation needs of the city. The Black Sea Coastal Highway was implemented by filling the sea along the narrow coastline with the idea that it was an economical and fast solution (Üçüncü, 2014). Especially the coastal districts of Trabzon such as Ganita, Kemerkaya, Rubble, Sotha, Faroz, Uzunkum beaches have undergone a significant transformation with the construction of the coastal highway (Uzunali & Acar, 2020). In subsequent years, due to the increased traffic density, there were discussions about expanding the existing coastal highway, and new landfill areas were created for this purpose.

In 1989, the existing plans were found to be inadequate, leading to the need for a revision of the zoning plan and the creation of additional zoning plans. Bülent Berksan prepared this zoning plan, in which the existing Tangent Highway was preserved as part of the transportation network, and a second Tangent Highway was proposed to establish a connection between the old city center, the port, and the new center. However, this proposal was not fully realized (Şen, 2000) (Figure 5).

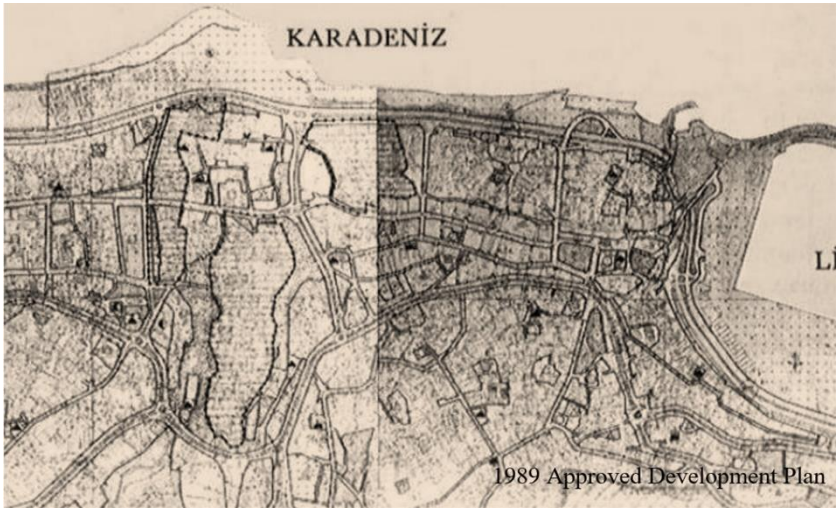

Figure 5. 1989 Trabzon approved zoning plan (Yeşiltepe, 2008)

In 2002, the zoning plan prepared by Rahmi Bıyık aimed to form the identity of the city center of Trabzon. Within the framework of this plan, it was aimed to plan the valley areas as natural recreation areas open to the public as a result of the natural structure of the city. For this purpose, Zagnos Valley Urban Transformation Project was implemented in 2005 and Tabakhane Valley Urban Transformation Project was implemented in 2007 (Akkaya, 2018). Furthermore, to revitalize the coastal area of the city and regulate the development along the coastline, a coastal plan for recreational purposes was developed as part of the New Coastal Highway Project. This plan involved decreasing building density as one moves southward from the coastal area. To facilitate the city's development to the south, the South Bypass Highway Project (Kanuni Boulevard) was integrated into this plan (Gür, 2016). In 2011, the Southern Ring Highway Project (Kanuni Boulevard), which is in question in the zoning plan, started to be built after the changes made in the proposed route and section (Beyazlı & Özlü, 2020). Today, while a significant portion has been completed, construction is still ongoing (Table 1), (Figure 6).

Figure 6. 2002 Trabzon revision zoning plan (Yeşiltepe, 2008)

Table 1. Decisions taken in the urban planning process of Trabzon

Decisions Taken in the Urban Planning Process of Trabzon	
Year	**Decisions**
1924-1926-1930	City Map Construction Tender-Completion-Shelving
1930-1933	Municipal Law-Municipal Building-Roads Law
1937	Sedat Çetintaş Detection and Reporting of Trabzon Artworks
1938	Lambert Plan: First Planning Experience
1975-1977-1984	Revised Zoning Plan
1987-1997-2007	Black Sea Coastal Highway Tender- Starting Construction Without Planning - Completion of the Construction of the Black Sea Coastal Highway
	Expanding the Coastal Highway, Increasing the Coastal Filling Areas
1989	Revision of the Zoning Plan by Bülent Berksan (Proposal for the 2nd Tangent Highway by Protecting the Tangent Highway)
2002	Zoning Plan Prepared by Rahmi Bıyık (Arrangement of Valley Areas and Coastal Plan for Recreational Purposes, Addition of Southern Ring Highway (Kanuni Boulevard)
2005	Zagnos Valley Urban Transformation Project
2007	Tabakhane Valley Urban Transformation Project
2011-2023	2nd Tangent Highway (Kanuni Boulevard) Construction

The study reveals the historical layering of the city from the past to the present through the city's planning decisions and practices. Roads that have contributed to changes in the city have been identified, and their effects on the city's identity. The city's identity indicators as texture, silhouette, and qualified areas have been discussed. These have been analyzed by visual analysis techniques. The visual analysis technique is to make the synthesis formed as a result of the analysis of the data visible and understandable (Aydınlı, 1986). The analysis of both historical and contemporary photographs in the study reveals the visual analysis technique in terms of making the photograph more understandable in the context of roads and spaces.

3. Findings and Discussion:

Spatial Fragmentations (Weakening and/or Severed Relationships)

The city of Trabzon has undergone significant changes due to both planned and unplanned highway constructions. It is possible to see these changes in the physical structure of the city as well as in the life of the city dweller. It is particularly observed that these changes have created spatial weaknesses, disconnections, and even demolitions in the identity-rich areas of the city. This transformation is discussed through the urban relationships, including the sea-city relationship, green-city relationship,

node-city relationship, district-city relationship, building-city relationship, and city- city dweller relationship.

- The Sea-City Relationship: The Black Sea Coastal Highway is one of the significant axes in Trabzon, and its construction has brought about various changes in the city's morphology. The city's transportation problem has been solved with the Black Sea Coastal Highway, but the construction of this highway has had a negative impact on the coastal character of the city. With the first phase of the Black Sea Coastal Highway, coastal areas like Moloz and Kemerkaya moved away from the sea, and with the second phase, they were entirely disconnected from the sea (Figure 7).

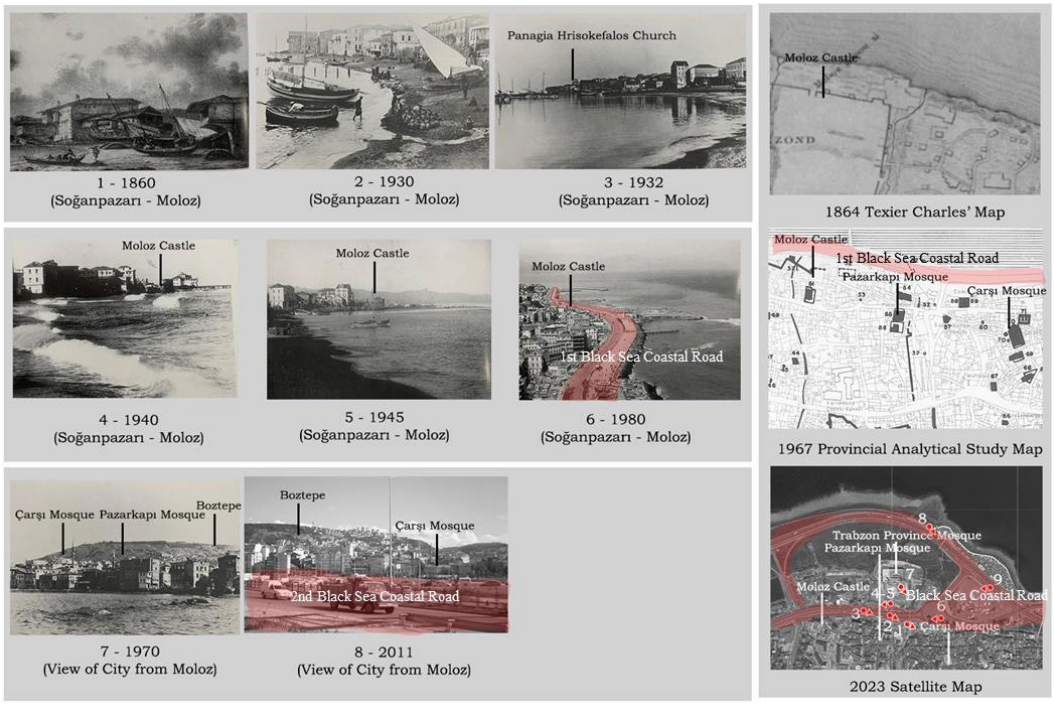

Figure 7. Moloz spatial change analysis (Bölükbaşı, 2006; Texier, 2024 ; İller Bank, 1968; GoogleMaps, 2023)

Although Ganita and Güzelhisar were not completely disconnected from the sea like other coastal areas, they have lost their original characters due to the landfill operations carried out during the construction of the Black Sea Coastal Highway. This transformation has also occurred in other coastal areas of the city, such as Çömlekçi and Ganita. The essential character of the city's quality areas, defined by their relationship with the sea, has been disrupted (Figure 8).

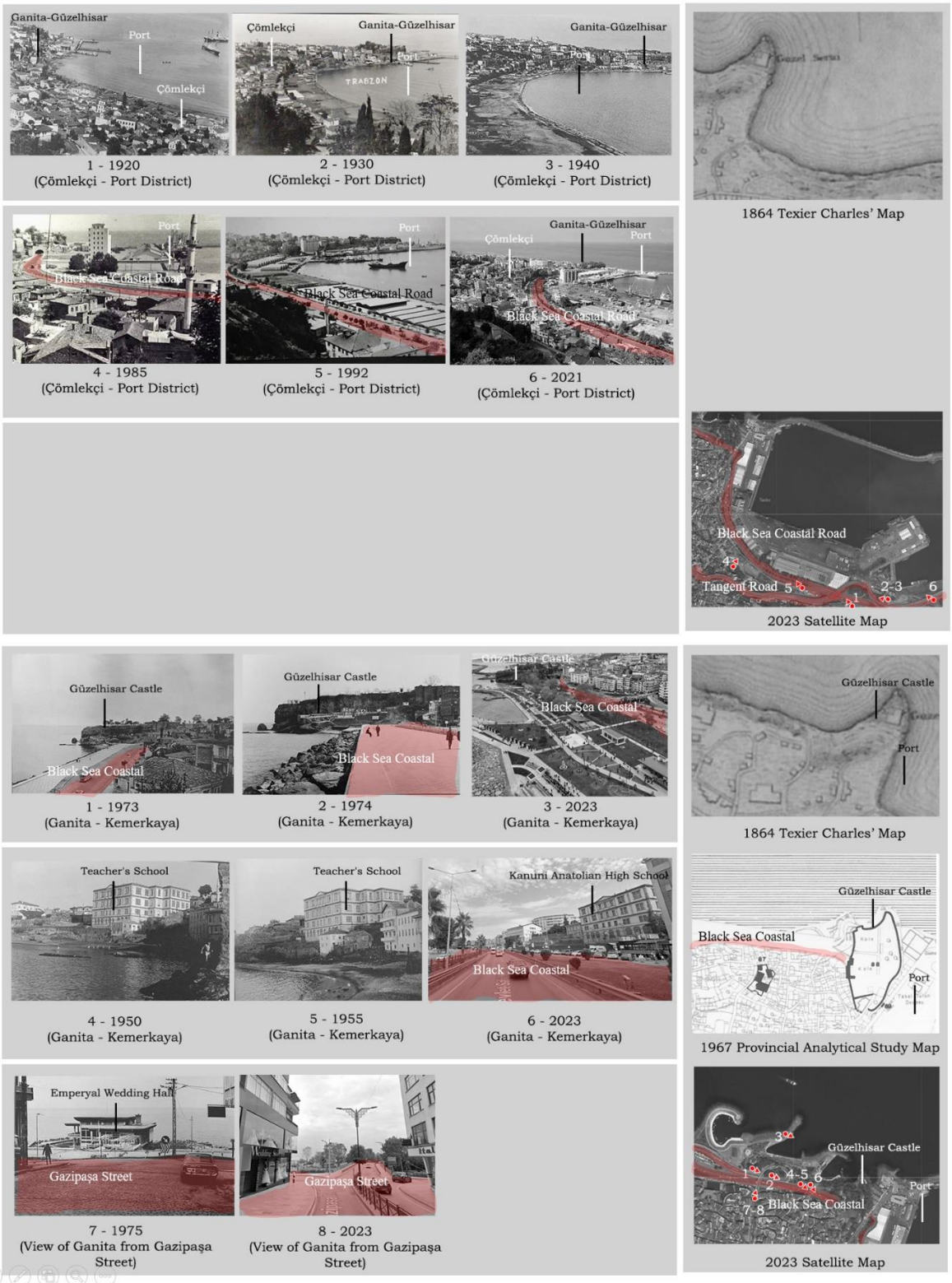

Figure 8. Çömlekçi – Port (Bölükbaşı, 2006; Texier, 2024 ; İller Bank, 1968; GoogleMaps, 2023) and Ganita – Kemerkaya (Bölükbaşı, 2006; Trabzon Büyükşehir Belediyesi, 2023; Texier, 2024 ; İller Bank, 1968; GoogleMaps, 2023) spatial change analysis

- Green-City Relationship: The significant green areas of the city, Atatürk Area and Atapark, have been isolated from the city and turned inward due to the construction of the Tangent Highway. Especially Atapark has surrounded roads and lost its active use by foot in some aspect. Although Zagnos and Tabakhane Valleys were planned as green corridors in the Lambert Plan, they have gradually been urbanized over time. The valley has been saved from the appearance of informal settlements through various regulations; however, today, the massive pillars of the

Tangent Highway pass through this area. As a result, there have been spatial fragmentations in the valley, and aesthetically, the valley has been disrupted. Boztepe, which had the characteristic of being a natural viewing terrace in the city, began to lose its green area quality as it became densely built-up, especially with the expansion of the highway network in the city. Subsequently, with the ongoing construction of the 2nd Tangent Highway (Kanuni Boulevard), there has been significant damage to the slopes covered with trees, where certain trees needed to be preserved, resulting in the loss of the green area appearance (Figure 9).

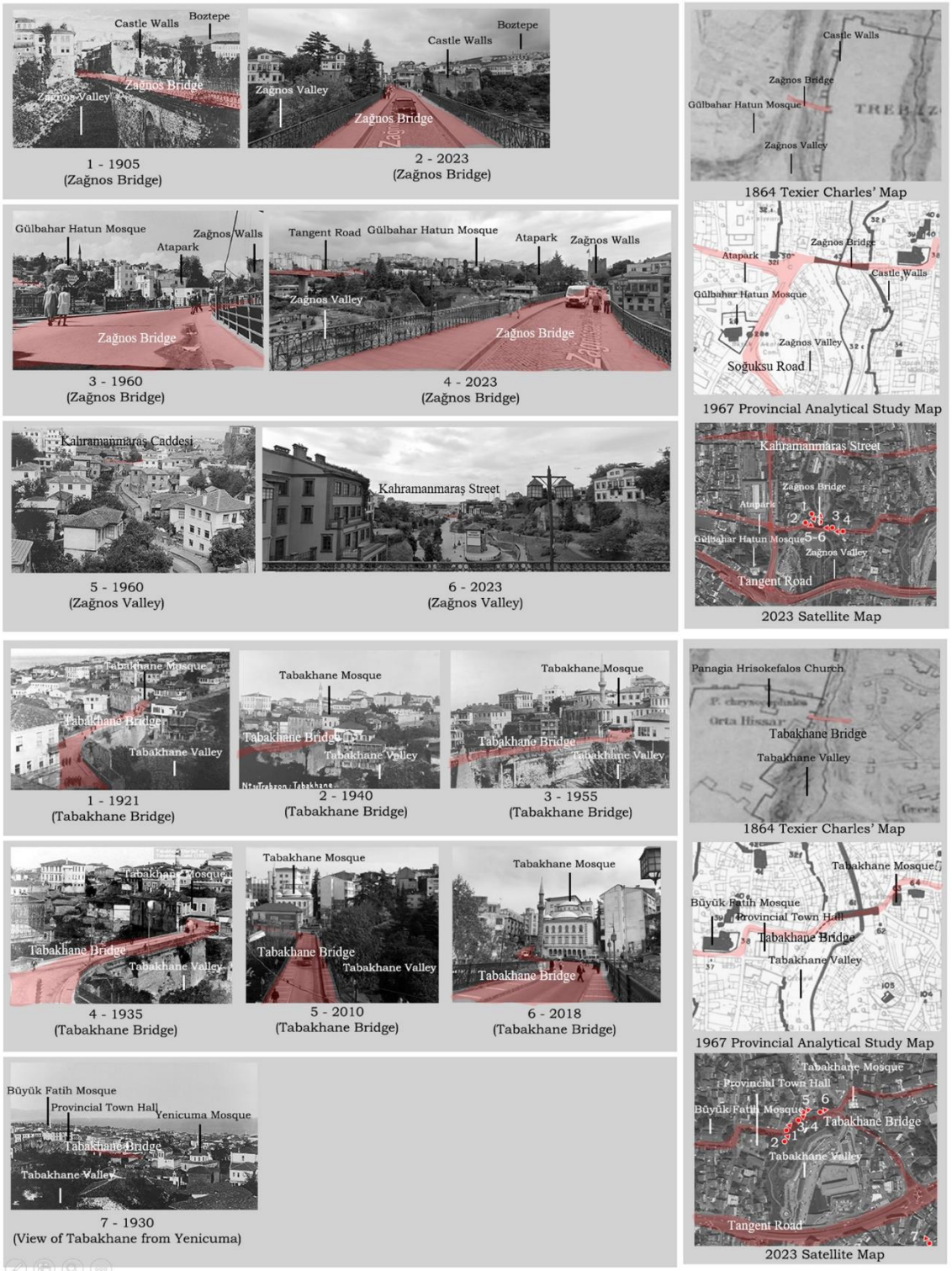

Figure 9. Zagnos valley (Bölükbaşı, 2006; Texier, 2024 ; İller Bank, 1968; GoogleMaps, 2023) and Tabakhane valley (Bölükbaşı, 2006; Bayram, 2018a; Texier, 2024 ; İller Bank, 1968; GoogleMaps, 2023) spatial change analysis

- Node-City Relationship: Atatürk Area, which has witnessed many important events in the city's history as the center of social life, has lost its connection with the southern part of the city due to the construction of the Tangent Highway. The holistic green texture and public space integrity that establishes the relationship between Fatih Park and Atatürk Area (Meydan Park), both significant public spaces in the city, have been eliminated. This has resulted in a decrease in the usage density of Fatih Park (Figure 10).

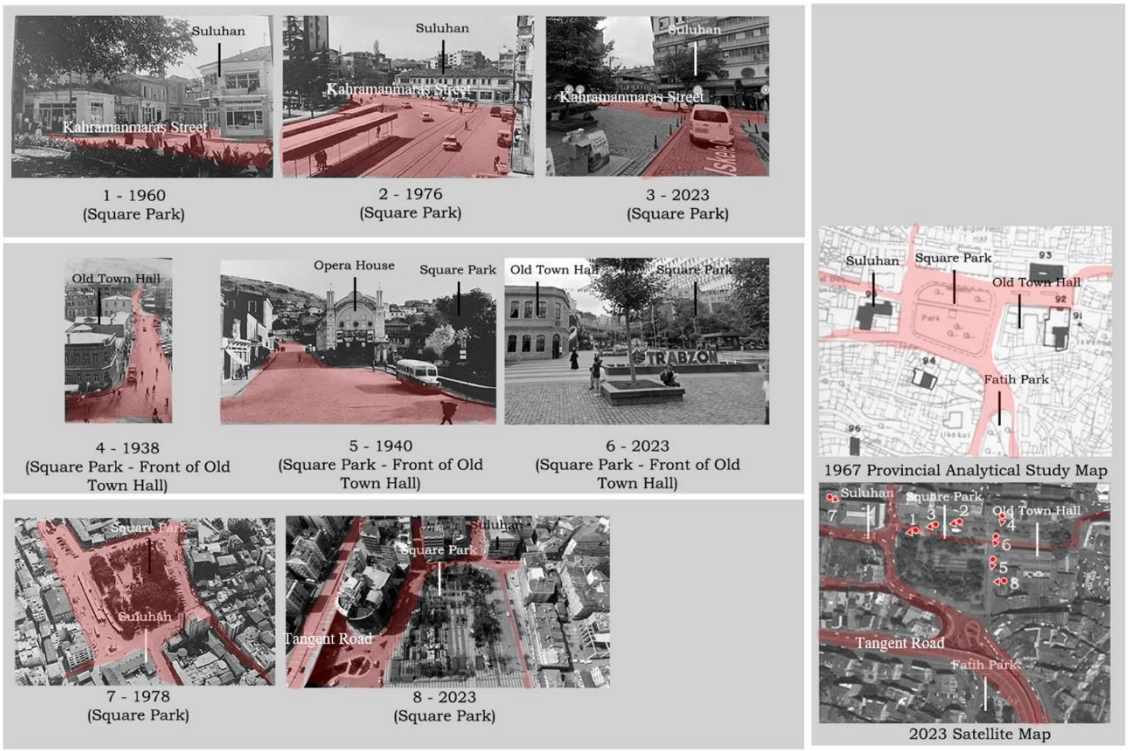

Figure 10. Atatürk area (Meydan Park) spatial change analysis (Bölükbaşı, 2006; İller Bank, 1968; GoogleMaps, 2023)

- District-City Relationship: The topography of the city, with hills rising from the seaside, has played a significant role in forming the urban morphology. However, with the construction of the roads, the city's topographical structure has become less legible both in city texture and city silhouette.

  These highway decisions that do not align with the topography also lead to spatial fragmentation. The permeability between regions has been interrupted by rigid highway boundaries. With the construction of the Tangent Highway, the Çömlekçi District has remained at a lower elevation under the highway. This situation has weakened the connection of the region with the southern areas of the city. A similar situation has occurred with the construction of the 2nd Tangent Highway (Kanuni Boulevard). In terms of vehicle connection, there are many intersections that provide north and south connection before the construction in the regions where the highway route passes, while only three huge intersections were built on the route with the construction of the 2nd Tangent Highway (Kanuni Boulevard). The decrease in the number of intersections weakened the connections of the sub-regions with each other. While there were many intersections that provided both north and south connections in the areas where the highway route passed, with the construction of the 2nd Tangent Highway (Kanuni Boulevard), only three massive intersections were built along the route. In terms of pedestrian connection, the upper level of the pedestrian from the lower level can only be reached by a step ranked one after the other such as stairs, pedestrian crossings, and overpasses. Although this situation is difficult in terms of pedestrian access, the highway constitutes an important threshold. In addition to vehicle access, stairs and overpasses have been built for pedestrians. In this case, it restricts the access of the districts

in the north and south of the highway to each other and negatively affects the relationship of the districts with the city (Figure 11).

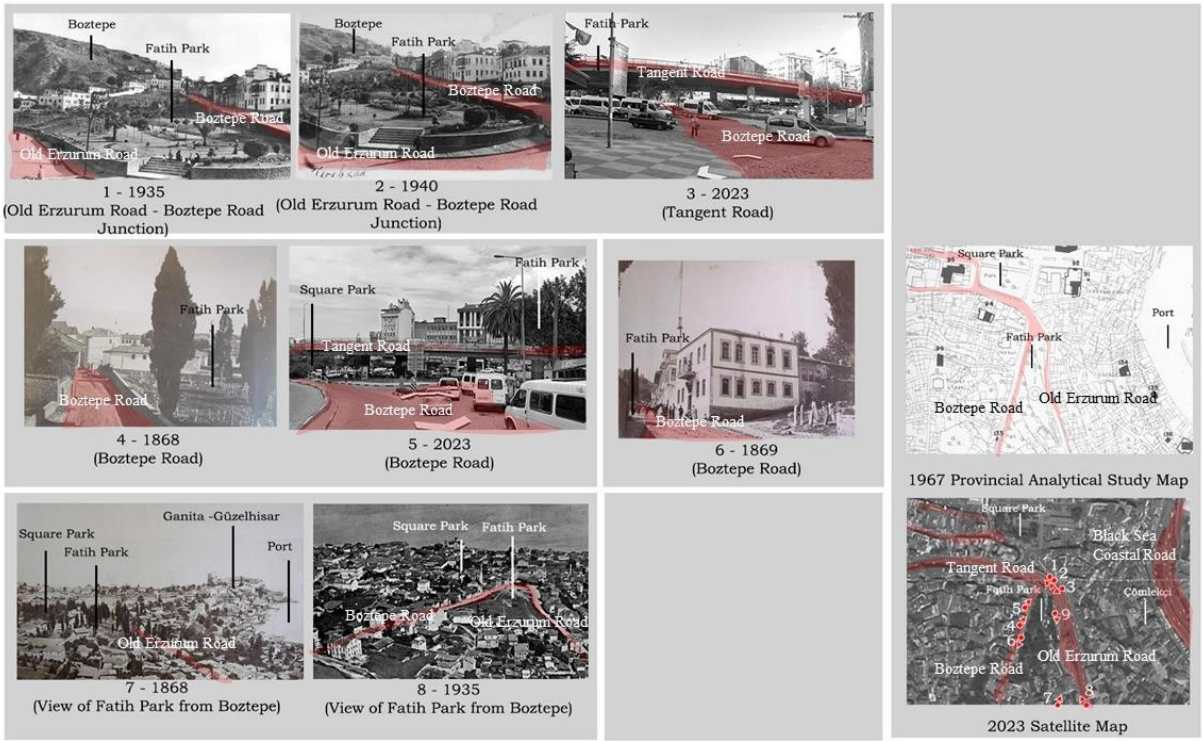

Figure 11. Fatih Park spatial change analysis (Bölükbaşı, 2006 ; İller Bank, 1968; GoogleMaps, 2023)

- Building-City Relationship: The construction of the Tangent Highway and the Black Sea Coastal Highway has also affected many historical buildings. Among these buildings, there are unique and significant building groups in terms of form, size, location, meaning, and symbolism. Among these buildings, Gülbahar Hatun Mosque, being located between the roads, has weakened its connection with the city center, especially to the east (Figure 12).

Figure 12. The weakening of the building-city relationship of Gülbahar Hatun Mosque (Bölükbaşı, 2006; Bayram, 2022)

Furthermore, historical buildings like Hamza Pasha Mosque and Musa Pasha Mosque were positioned below the highway level with the construction of the Tangent Highway, reducing their perceptibility from the highway (Figure 13).

Figure 13. On the Left Hamza Pasha Mosque (Bayram, 2018b) and on the Right Musa Pasha Mosque (Bayram, 2018b)

Many buildings, including the ongoing construction of Trabzon City Mosque in the Moloz region, which were built on the landfill areas created during the construction of the Black Sea Coastal Highway, have significantly altered the city's silhouette. Along with the city's topography, many religious structures like Çarşı Mosque and Müftü Mosque, which used to rise with their minarets, are no longer perceptible/legible in the city's silhouette.

Particularly, the Tangent Highway has cut through the historic city center, which is a conservation area, along with the Tabakhane and Zagnos Valleys. Historical buildings that coincided with the areas where the viaduct pillars in the valleys sit have been demolished. In addition, the historical buildings in the adjacent order on the Old Erzurum Highway route in the eastern part of the Tangent Highway were destroyed with the new highway, and only three of these buildings were left in the middle of the highway and tried to be protected. With the construction of the Tangent Highway, one of the city's oldest educational buildings, Gülbahar Hatun Primary School, was also demolished. With the filling works carried out during the construction of the Black Sea Coastal Highway, the last remains of the second oldest ancient port in the Moloz District were also destroyed (Üçüncü, 2014; Gerçek, 1987). The construction of the roads not only damaged the historical building-city relationship, but also weakened the relationship between the new constructions and the city. With the construction of the 2nd Tangent Highway (Kanuni Boulevard), elevation differences, high walls and viaducts have overshadowed the existing buildings (Figure 14).

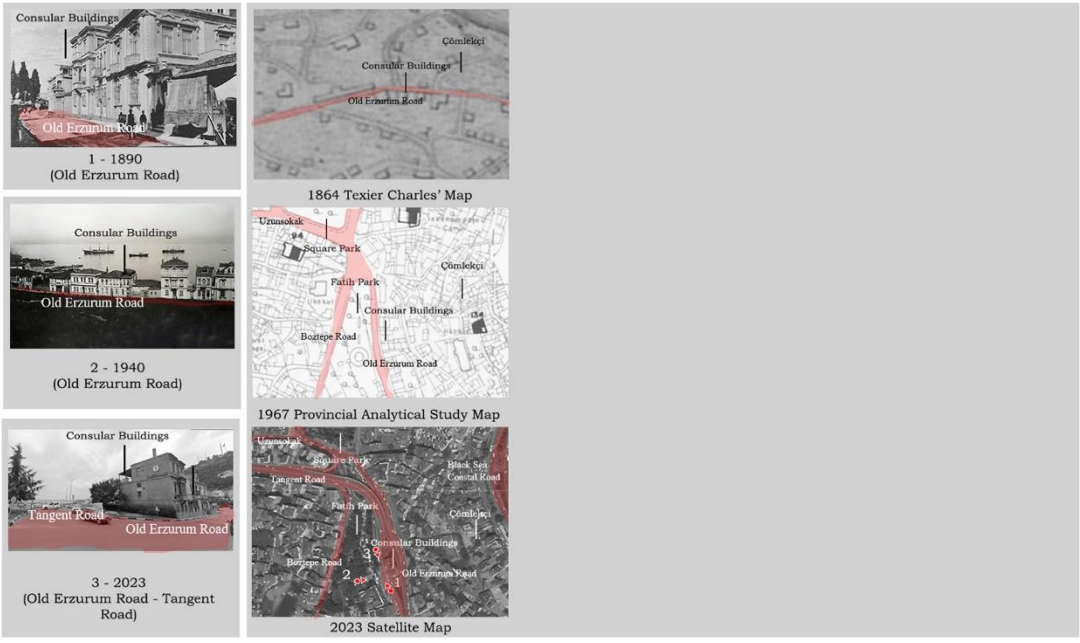

Figure 14. Erzurum highway (Bölükbaşı, 2006; Texier, 2024 ; İller Bank, 1968; GoogleMaps, 2023) and Atapark (Bölükbaşı, 2006; Tuluk, 2010; Bayram, 2020; Texier, 2024 ; İller Bank, 1968; GoogleMaps, 2023) spatial change analysis

- Sea-Dweller Relationship: The Black Sea Coastal Highway is mostly built on new filling areas. These areas are used for both transportation and recreational purposes. The use of these areas can only be made by crossing the highway. In fact, today, it is almost impossible for pedestrians to reach the sea without crossing the Black Sea Coastal Highway, which has become a significant urban threshold for pedestrians (Figure 15).

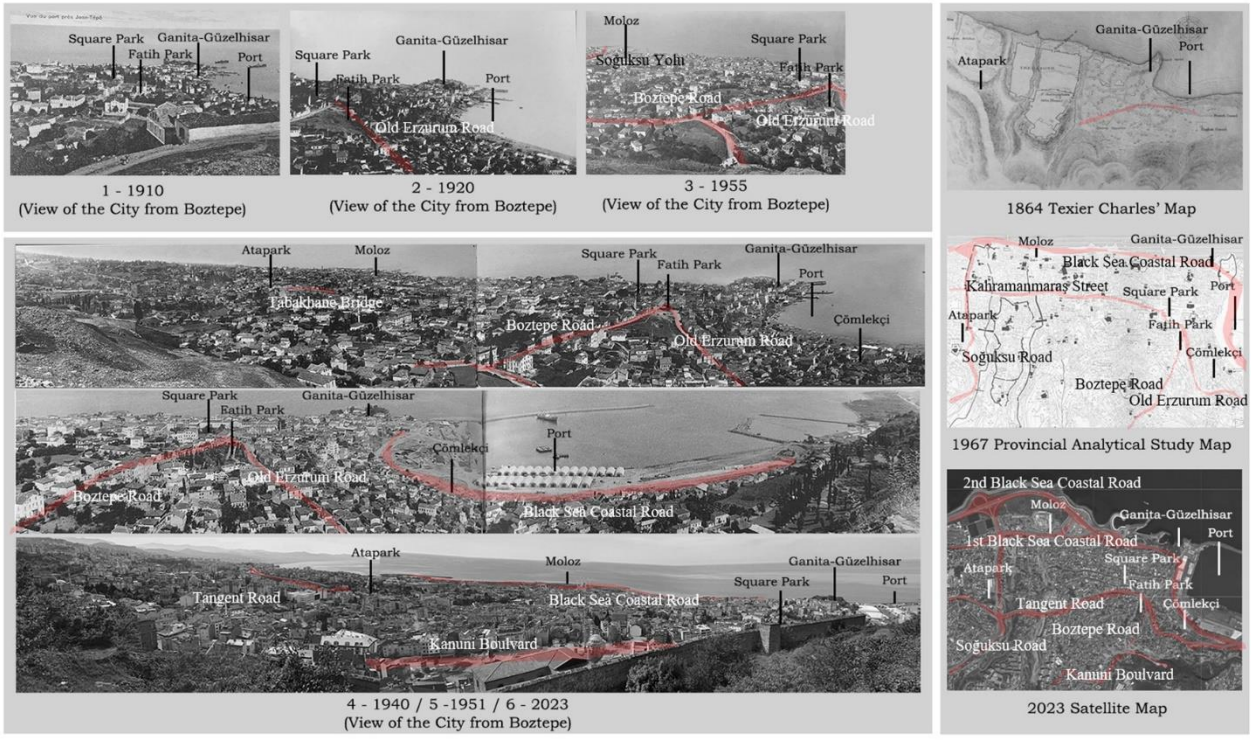

Figure 15. Trabzon spatial change analysis (Bölükbaşı, 2006; Texier, 2024 ; İller Bank, 1968; GoogleMaps, 2023)

4. Conclusion and Suggestions

Roads play a significant role in the formation of cities' physical structures and quality of life. It supports the growth of cities and the economic development of cities by enabling people and vehicles to move within and between cities. It supports the growth of cities and the economic development of urban areas by facilitating the movement of people and vehicles within and between cities. It is also an indicator of power for the government. For a design, roads not only determine the movement of vehicles and pedestrians within the city but also shape the overall flow of movement throughout the city. It also supports the social interaction of urban residents by creating important open public spaces of cities. As the main determinants of the city texture and silhouette, it is one of the important image elements of the city.

For all these reasons, roads have been an important tool of civilizations from past to present. Roads are a strong urban element that affects the physical, social, cultural structure and identity value of the city and it is an important field of study for architects, urban planners, and urban designers. However, today, new roads are planned and implemented only for the purpose of automobile-oriented transportation without considering their effects on the city identity and its citizens. In the current system, where vehicle-priority decisions are made in urban arrangements, it is tried to make area for pedestrians. In the current system, where vehicle-priority decisions are made in urban arrangements, it is tried to make room for pedestrians. Without considering the transportation alternatives provided by the topography of the cities, it is tried to give the city a form that it is not suitable for the city topography with planning decisions. As a result of these decisions, the construction of roads has led to demolitions in cities, and the relationship between the quality spaces of cities and the whole has started to weaken or be disconnected. In addition to spatial integrity, urban texture, and urban skyline that have begun to be deteriorated; green areas, historical buildings, and memory of city were also destroyed.

According to Lefebvre (2012), roads should be built in a certain order and new regulations should be able to integrate with the existing one without disturbing the space. Unfortunately, today, new transportation decisions ignore the existing system of cities. Alexander (1965) stated that the combination of city parts could not form the city because the connection of the parts with each other could not be established. Especially the inability to connect new roads to the existing system, in addition to fragmenting the city, has disrupted the relationship between spaces. Habraken (2000) emphasize that designers are not aware of the qualities that constitute the essence and content of the urban built environment. All these also reveal the reasons for the problem experienced with roads in the city of Trabzon. The main problem is not to take into consideration “relationship network/system of city” which composes the whole city or city identity.

As in many cities, in Trabzon, transportation stands out as an alternative. The port, which is one of the unique features of the city, is mainly used for maritime transportation. Unfortunately, new roads have started to become more destructive in Trabzon city. It carries the "historical coastal city" image of Trabzon, green rising slopes, and steep slopes even in its name, but these unique features of Trabzon City are rapidly disappeared. Both the construction of the Black Sea Coastal Highway with filling areas and the Tangent Highway and its connections, which pass through the historical castle, destroy important city identity-rich areas, ignore the historical texture and silhouette of the city. Viaducts have become the new image elements of the city. Unfortunately, the natural, structural, and social and cultural structure, that constitutes the identity of the city, is disappearing fast.

However, while many cities in the world are planned with the aim of making them safer and healthier with redesigned roads and living spaces, the city of Trabzon is crushed under the roads today. In the study, the destructions, divisions, and incompatibilities created by the roads in the city are clearly revealed. It was tried to emphasize the importance of the intervention to be made in terms of planning and design of the city and the importance of the urban identity and its impact on urban life. For this reason, Trabzon should give priority to creating human-oriented, natural environment and sustainable cities that are sensitive to the built environment in transportation decisions, which are an important determinant of cities and urban life in the planning processes of all cities. In addition, today, many

technological possibilities can be used in both construction and design. As a result, evaluating alternative transportation options and making arrangements that are sensitive to the natural, structural, and historical identities of the cities and that are suitable for the needs of the society will enable the cities to have a more livable, sustainable, and future-oriented structure.

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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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Architectural Promenade and MAXXI Museum

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Abstract

There exists disagreement over the content, purpose, and form of museums, which can be traced back to the Greek temples of antiquity. There is, however, consensus over how museums should be organized, display their art, and circulate their collection. Le Corbusier's concept of the promenade was defined to analyze the circulation setup of the MAXXI museum, which attracts attention with its design in contemporary museology. In this study, the components of the promenade setup for the MAXXI Museum were identified by analyzing photographic sequences taken from the perspective of a mobile observer. To bring out the current museum circulation design, the MAXXI Museum promenade layout was analyzed using spatial experiences, observations, syntactic analysis techniques, and semantic analysis. The purpose of the study is to shed light on how the circulation structure of modern spaces is changing through an analysis concept of a promenade. This brand-new museum area provides a spatial journey with surprises.

Keywords: *Promenade, circulation, museum, Le Corbusier, MAXXI Museum.*

Mimari Promenad ve MAXXI Müzesi

Öz

Eski Yunan tapınaklarına kadar uzanan müze tanımı, içeriği işlevselliği, formu ile tartışma konusu olurken eserlerin sergilenme biçimi, galerilerin formu ve müze sirkülasyonu tartışmaları da güncelliğini korumaktadır. Bu bağlamda, çağdaş müzecilikte tasarımıyla dikkat çeken MAXXI müzesinin sirkülasyon kurgusu Le Corbusier'in promenad kavramı tanımlanarak analiz edilmiştir. Bu çalışmada, MAXXI Müzesi promenad kurgusu, hareketli gözlemcinin gözünden fotoğrafik sekanslarla analiz edilmiş, promenadın öğeleri saptanmıştır. MAXXI Müzesi promenad kurgusu mekansal deneyimler, gözlemler, sentaktik analiz tekniği ve semantik irdelemeler kullanılarak günümüz müze sirkülasyon tasarımına ışık tutması için analiz edilmiştir. Çalışmada, Le Corbusier'in promenad kavramı ile günümüz çağdaş mekanının değişen sirkülasyon kurgusuna ışık tutmak amaçlanmıştır. Bu yeni müze mekanı, sürprizlerle mekânsal yolculuk sunmaktadır.

Anahtar Kelimeler: *Promenad, sirkülasyon, müze, Le Corbusier, MAXXI Müzesi.*

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1. Introduction

Museums are cultural establishments that educate the public through their exhibitions of art and preserve cultural heritage for upcoming generations. "In 1926, the International Museums Department; in 1947, "The International Council of Museums (ICOM) was established" (Gerçek, 1999). Since its founding, ICOM has revised its definition of a museum to reflect the evolving field of museology. The most recent museum definition, which ICOM discussed and voted on in Prague in 2022, is as follows:

"A museum is a not-for-profit, permanent institution in the service of society that researches, collects, conserves, interprets and exhibits tangible and intangible heritage. Open to the public, accessible and inclusive, museums foster diversity and sustainability. They operate and communicate ethically, professionally and with the participation of communities, offering varied experiences for education, enjoyment, reflection and knowledge sharing (ICOM, 2024)."

Contemporary Museums present the sanctuaries of museums, according to the meaning of the Greek Word Museion, the origin of the Word museum, just like the magnificent temples erected in antiquity, today's museum buildings are temples of our bourgeois enlightened cultural ideals (Uffelen, 2011).

There exists disagreement over the content, purpose, and form of museums, which can be traced back to the Greek temples of antiquity. There is, however, consensus over how museums should be organized, display their art, and circulate their collections. Gallery forms and circulation have been discussed in relation to museum architecture, as Taricat (2016) notes.

"The public opening of buildings to exhibit art was delayed until the eighteenth century. Thus, debates started about what kind of circulation would be best—whether it would be long galleries or connected rooms, useful warehouses, or cosy lounges. These are still contentious issues in today's contemporary museum setups.

The hallways ought to be interconnected and explain one another, much like a chain's rings do. It is necessary to arrange the works in chronological order, following the divisions that nature makes, if we acknowledge that there is an open book that will teach us the chronology of the previous centuries and that we read how the events in this book progressed. The way museums are organized chronologically makes them naturally turn into encyclopedias and educational institutions with a wealth of knowledge fit for a scholar. The museum had headings and paragraphs, just like a book, and its layout helped to categorize and divide" (Taricat, 2016).

Collections in modern museums comprise thematic exhibition layouts, more adaptable space setups, and circulation systems rather than being read cover to cover like a book.

The design of museums' circulation areas is important. Circulation the term is one of the keywords of the museum design. Le Corbusier stated that circulation is one of the important problems of architecture. Architectural promenade can be defined as a voyage with surprises in the space. Architectural promenades provide guests with a variety of unexpected and constantly shifting viewpoints. The promenade makes it possible to establish the relationship between the spaces. Promenade architectural is a concept developed by Le Corbusier. Why is promenade architecture important? "Promenade architecture is a concept which refers to designing of walkway or a promenade that combines architecture, urban planning and landscape elements. It can be designed to be used by pedestrians, cyclists or other forms of transport. It is a way to create a pleasant environment or atmosphere in a location as people enjoy their walk and appreciate the surroundings. It can also be used to connect different points of interest in a city such as parks, monuments and cultural sites. The overall purpose is to create a better quality of life and be source of pride and joy for the people who live and visit the area" (Moore, 2024).

2. Material and Method

The design of museums' circulation areas has changed significantly since the advent of modern architecture. Neo-classical, modern, and post-modern museum structures and circulation areas were discussed in this context as part of the study's scope. Le Corbusier's promenade concept was defined

to analyze the MAXXI museum's circulation setup, which is one of the most prominent structures in contemporary museology and draws attention due to its circulation design. The purpose of the study is to shed light on how the circulation structure of modern spaces is changing through an analysis of Le Corbusier's promenade concept—an architectural promenade that is defined as an incredible journey through space—conducted in the MAXXI museum.

As traditional representation models like orthographic plans and section planes would not be sufficient, the promenade setup, a method of creating an architectural space index, was used in this study to determine the perception of space created. The space setup was analyzed using photographic sequences acquired by the movement of the mobile observer.

A sequence of events that occur one after the other within a specific time frame, or a collection of images that together constitute a whole in a motion picture, is how Le Corbusier creates the architectural promenade.

In Villa Meyer, Le Corbusier draws the sequences that represent these successive viewpoints (Samuel, 2010). In a similar vein, Cullen (1961) employed movement-based serial sketches to capture the movement and temporal sequences of urban space. In his work, Manhattan Transcripts, Bernard Tschumi (1981), utilizes sequential sequences as a model of architectural representation within the fiction of movement and architecture. In this study, the components of the promenade setup designed by Zaha Hadid for the MAXXI Museum were identified by analyzing photographic sequences taken from the perspective of a mobile observer. Using syntactic analysis techniques, Clark & Pause (2005) looked at several structures and their circulation that garnered attention in the architectural literature.

To shed light on the contemporary museum circulation design, MAXXI Museum promenade layout was analyzed using spatial experiences, observations, syntactic analysis techniques, and semantic analysis.

3. Findings and Discussion

The design of museums' circulation areas is very important subject. Neo-classical, modern, and post-modern museum structures and circulation spaces were discussed in this context. Le Corbusier's concept of the promenade was defined to analyze the circulation setup of the MAXXI museum, which attracts attention with its design in contemporary museology. The components of the promenade setup designed by Zaha Hadid for the MAXXI Museum were identified by analyzing photographic sequences taken from the perspective of a mobile observer.

3.1. Circulation Design in Museum Architecture

“The origins of the oldest museum in Modern Europe date back to 1581. In that year Medici set up a gallery with pictures, statues and other precious things on the Uffuzi Museum. The Uffuzi Museumhas a U-shaped layout consisting of two long wings, to the east and the west” (Fossi, 2017) (Figure 1).

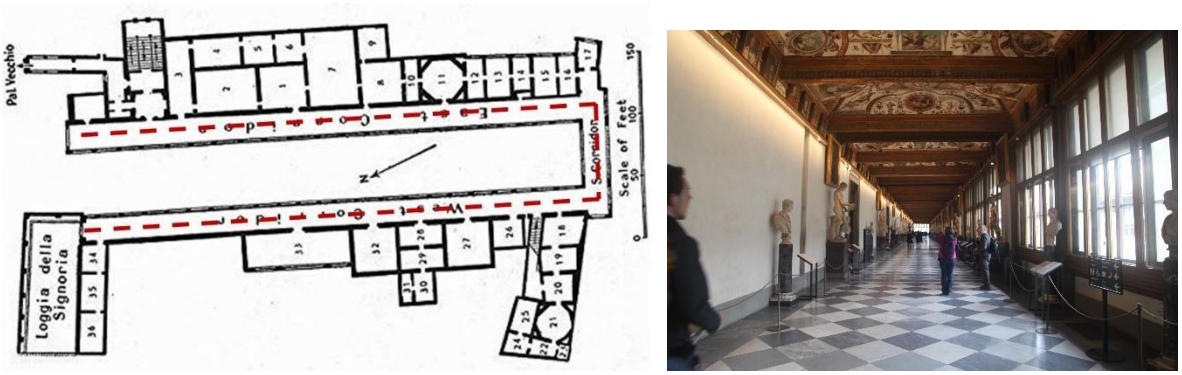

Figure 1. Uffuzi Museum linear circulation scheme (Alamy, 2024), Giorgio Vasari, Florence, photograph (Canbakal Ataoğlu, 2018)

Vasari created the galleries of the Uffizi Palace in Florence, which subsequently served as a model for museology and exhibition design (Artun, 2012).

The three principal museum typologies of the nineteenth century -the temple, the palace, and the exposition hall (Typified by the altes Museum in Berlin, the musee du Louvre and the Grand Palais, respectively) have given birth in the twentieth century museums (Lowry, 1996).

In the 19th century, museums began to be built in the capital cities of Europe. "There are many examples of the 19th-century museum. In Munich, the Glyptothek was designed by Leo von Klenze as a classical temple. Altes Museum, isolated in its urban setting and distinguished by an arcade and an unbroken series of galleries, expresses the cultural status of the city" (Marotta, 2012).

The challenge facing 19th-century museum architects was not only determining the right style but also structuring the museum's interior as a novel kind of ritual space (Duncan & Wallach, 2004). Altes Museum is a prototype for national, and international art museums (Artun, 2017). The layout of the Altes Museum's galleries is arranged around a rotunda in Figure 2, which shows a linear circulation scheme (Figure 2).

Altes Museum was arranged around two inner courtyards. Its center consisted of a large rotunda which Schinkel modelled on the Roman Pantheon (Steffens, 2016). Schinkel would preserve the world of classical perfection in his rotunda, designed to be the visitor's first encounter with the museum (Crimp, 1997). The dome not only served as a reception area and foyer leading into the different areas of the collection. Here, the sight of a beautiful and noble room must create an atmosphere of pleasure and the recognition of what this building holds", as Schinkel noted getting the visitor in the right mood was of such major importance to Schinkel that he devoted approximately a third of the floor's area of the museum to the rotunda and staircase in his plans (Steffens, 2016).

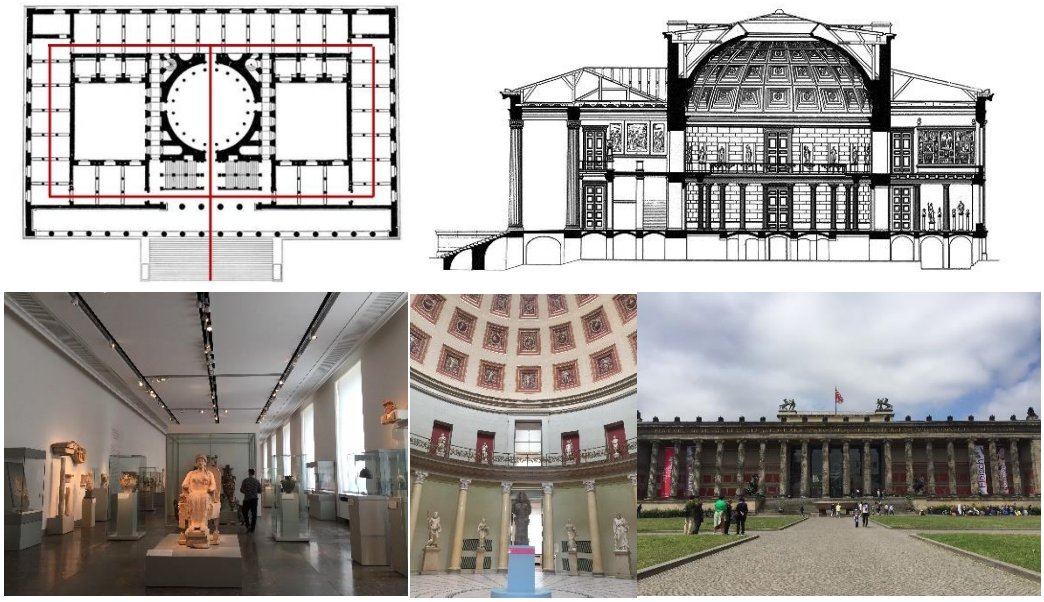

Figure 2. Altes Museum, Karl Friedrich Schinkel, Berlin, 1823-1930, plan, linear circulation scheme, section and rotunda (Archiweb, 2024); Altes Museum's exhibition space and façade, photographs (Canbakal Ataoğlu, 2018)

With the effect of Modern Architecture and Bauhaus; museum architecture started to move away from 19th-century neoclassic museum architecture. With the museum designs made by pioneers of modern architecture –like Le Corbusier, F.L. Wright, Mies van der Rohe, Louis Kahn- a new era started and museum architecture underwent a radical change in the 20th century (Canbakal Ataoğlu, 2016).

The introduction of new museum typologies in the 20th century has escalated discussion from a whisper in the 1930s and early 1940s, with the gridded open space of buildings such as MOMA and Mies's to full voice in1959, with the directed flow of Frank Lloyd Wright's Guggenheim. If the open spaces of MOMA and of museums by Mies represent Modernism's paradigm, Wright's spiral is its

antithesis. At the Guggenheim Wright respected the classical museum typology of a central dome and grand stair (transformed by him into a ramp) and at the same time revolutinized the relationship between art, architecture and the viewer. Like Le Corbusier in his Musee Mondial project, Wright emphasized movement as opposed to geometry (Newhouse, 1998).

In 1931, Le Corbusier, designed the museum with unlimited growth, in which galleries were arranged spiral-like on a single floor (Cohen, 2013). Le Corbusier developed the concept for the Museum of Unlimited Extension. The concept has its roots in his project for the *Mundaneum,* or World Museum, which he proposed as an ascending ramp in the form of a square spiral, resulting in a form that has been called a "helicoidal ziggurat (Christenson, 2016). There are only three versions of this type of Corbusian museum in the world: in Ahmedabad (1957), in Chandigarh (1965), and in Tokyo (1959) (Figure 3).

"The central area of the National Museum takes the form of a large hall, with a single post supporting its glass roof. The hall is extended by a ramp that provides access to the galleries. As one walks up, it gradually reveals the full extent of the vast space. The galleries, whose muffled atmosphere recalls the confines of an aquarium, are lit evenly by a complex system that regulates the amount of daylight that is admitted" (Architectural Moleskine, 2023) (Figure 4).

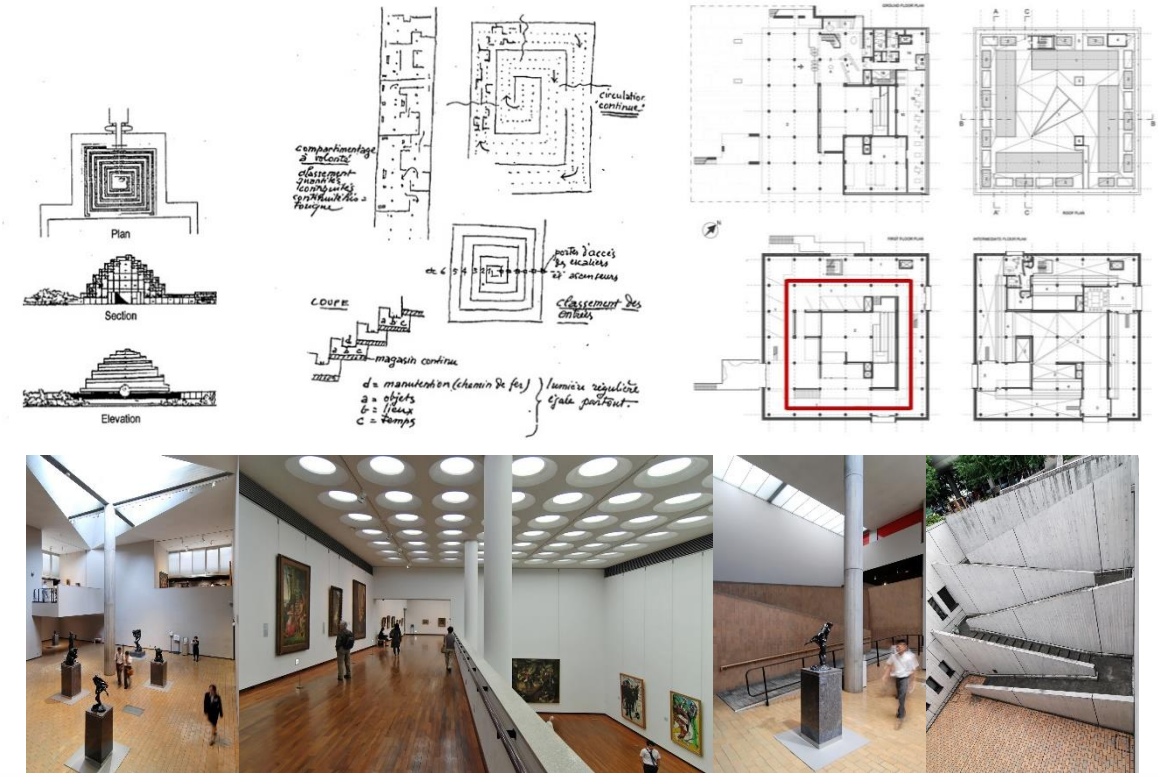

Figure 3. Museum of Unlimited Extension, scheme, (Architectural Moleskine, 2023); National Museum of Western Art, Le Corbusier, Tokyo, plan and photographs (Archiweb, 2023)

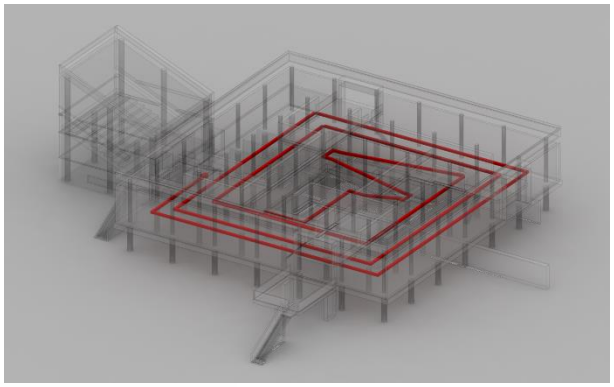

Figure 4. National Museum of Western Art, spiral circulation scheme (Architectural Moleskine, 2023)

In the 1960s, new trends in architecture led to the development of the museum as a kind of kinetic, dynamic machine. The introduction of a movable skeletal structure allowed flexibility of use, as in Renzo Piano and Richard Rogers' design for the Pompidou Centre in Paris. The external escalators and flexible space create a museum architecture liberated from its contents (Jodidio, 2011).

In 1988 the *Deconstructivist Architecture* exhibition was held at the Museum of Modern Art in New York and sparked new concerns about architectural composition. Leading architects in this period were Peter Eisenman, Frank Gehry, Zaha Hadid, Coop Himmelblau, Rem Koolhaas, Bernard Tschumi and Daniel Libeskind (Jodidio, 2011). In this period several architects each with their own distinct vocabulary have created what will be referred to here as the new museum (new in design as well as age) (Newhouse, 1998).

This change in direction is central to understanding museums in the '90s. The museum became a work of art and a theatrical space that was more important than even the works on display (Canbakal, 2002-2003).

"Like some futuristic work, the museum traces the defining lines of the city like an urban sculpture, an icon in the landscape of the public domain. Finally, Holl with his Kiasma Museum created a Le Corbusier-style promenade and fashioned the linear and spiral space into a design that speaks of the cultural and social blend of our time" (Jodidio, 2011).

The promenade, with its unexpected circulation structure, is viewed as a tool of spatial construction and narrative in the dominant structures of modern architecture and museums. A visitable contemporary artwork is what is meant to be understood by the MAXXI Museum (Arkitektuel, 2023). The MAXXI Museum served as the study's subject because of its promenade design, circulation system, and sculptured staircase, which together define the building's identity and flow of flexible spaces and galleries.

3.2. MAXXI Museum Circulation Diagram

The MAXXI 21st Century Contemporary Arts Museum, Zaha Hadid-designed, was situated in Rome's Flaminio neighborhood in 2009. The museum (29,000 m2) was built to revive the local economy in the former residential areas. The building has 21,200 m2 of interior space and 10,000 m2 of total exhibition space. The building is designed as two stories above ground in a flowing linear form, with its orientation towards the surrounding buildings and existing axes (Figure 5).

The object-oriented gallery space is rejected by the museum's architectural style. Hadid (2011): "The neutrality of many museums from the 20th century was created by modernist utopian space. It is now essential to contest this circumstance." Hadid's position challenges the white cube architecture that defines the museum gallery's discourse, which places the artwork at the center of the space. MAXXI is a work of art that should be seen because of its exhibition spaces, which flow into one another, its unique and remarkable circulation system, and its interior design, which skillfully uses materials like glass, concrete, and steel.

Figure 5. MAXXI Museum, Zaha Hadid, 2009, Rome, photograph (Hadid Architects, 2024)

Today's architects have made an effort to create interior spaces that are difficult to perceive through the use of orthographic tools like sections and plans, particularly in designs created after the 1980s. Particularly in circulation areas, this search and differentiation has become apparent. With their form, color, texture, and design, circulation areas and elements have come to represent the lifeblood, center of attention, and symbol of the structure (Canbakal Ataoğlu, 2009; 2014).

As Schittich (2013) describes below, circulation areas can define the characteristic features of a building:

"The purpose of circulation is to connect components and spaces in a horizontal and vertical direction. But its elements -corridors, stairs, elevators, ramps- should be much more than pure necessity. Spectacular lifts and escalators, interesting floor plan solutions or space-defining stair sculptures accentuate and characterise the paths through the building. Circulation areas can be designed as inviting spaces to spend time, in communication areas for spontaneous encounters and an exchange ideas, or as places offering a variety of spatial experiences on the way to somewhere else. This makes them a key criterion for successful design".

The way spaces connected by circulation are organized both influences and is influenced by the formation of circulation areas. Consequently, choosing the design of the circulation system essentially determines the building's spatial layout, particularly in complexly designed buildings (Ching, 2002). There are different types of circulation diagrams. According to Ching (2002), there are several categories for a building's circulation scheme: linear, radial, spiral, gridal, network, and mixed schemes. The MAXXI Museum uses a mixed scheme of network and linear circulation schemes, with multi-alternative circulation routes made up of flowing tracks, ramps, and sculpture-like stairs.

"The purpose of the MAXXI Museum's interior design is to create an energetic and engaging space where people can move around and use the transition areas. Zaha Hadid made an effort to maintain a segmented geometric order and a smooth transition between areas with various perspective points. Like life itself, the structure of this proposed system is chaotic rather than ordered (Arkitektuel, 2023). As seen in the diagram (Figure 6), a linear circulation scheme organizes the functions found in the L mass on the ground floor, including sales unit, galleries, multipurpose hall, entrance foyer, and mini cafeteria. Using Hadid's renowned fluid mass movement network circulation scheme, the museum's signature staircase encircles the atrium and creates a multi-alternative circulation setup. The ground floor's readable linear circulation scheme, complete with a sculptural staircase that beckons surprises, blends well with the building's mixed scheme and the unexpected first- and second-floor network scheme. Hadid (2011) explained how circulation becomes a network of intersecting nodes: "Vectors and circulation disrupt a simple mass." The general flow of the geometry is followed by both internal and external circulation. In the meeting and conference areas, vertical and inclined circulation elements were utilized."

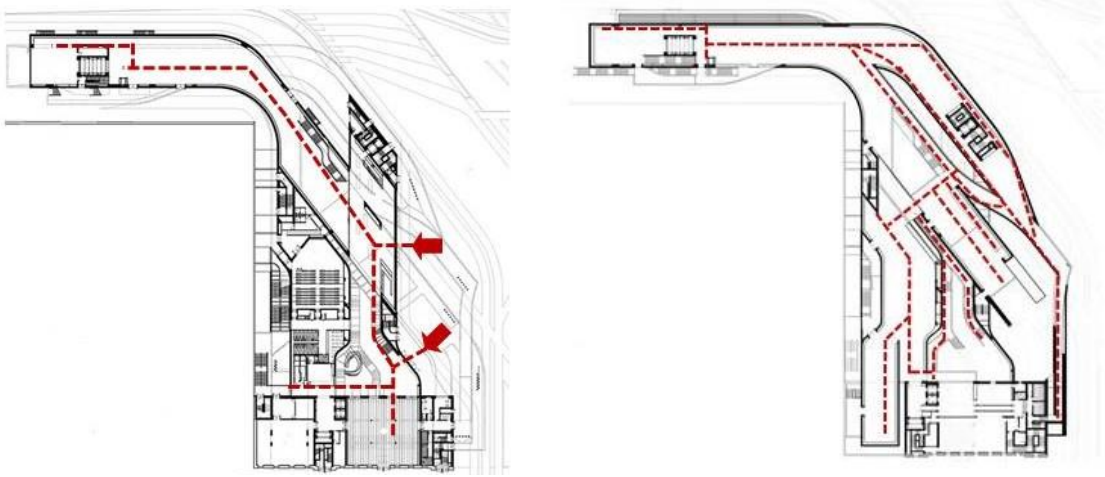

Figure 6. MAXXI Museum circulation scheme (arranged author) (Arkitektuel, 2023)

3.3. MAXXI Museum Promenade Design

Circulation the term seems much too low-key for such a dramatic design. Circulation is one of the most influential components of a design. Circulation areas often serve as the calling card of a building and their individual elements are almost always used as important design features in sophisticated architecture (Schittich, 2013).

One of the main features of Hadid's MAXXI Museum design is the sculptural staircase, which is surrounded by circulation. This unique circulatory system cannot be adequately described by the word circulation. Le Corbusier employs the term "promenade" to characterize the circulation of fiction created through movement and the succession of various viewpoints in his buildings.

3.4. Spatial Elements of MAXXI Museum Promenade Design

The idea of an architectural promenade, which is described as an unexpected architectural promenade in the area, sheds light on how Le Corbusier planned the space with circulation in mind as well as on modern spaces. Promenade is a word for wandering that comes from the French word "se promener," which means to walk or meander. In the past, it referred to well-dressed individuals strolling through the main thoroughfares, seeking visibility. Promenades are now public walking trails where people can enjoy their free time (Macdonald, 2018). Two categories can be used to analyze promenades: building scale and city scale (Soygeniş, 2023).

Le Corbusier was the one who popularized the idea of an architectural promenade and found a way to express himself in the promenade's buildings and signage (Samuel & Jones, 2012). Surprising paths for circulation, architectural promenades provide guests with a variety of unexpected and constantly shifting viewpoints. The promenade makes it possible to establish the relationship between the spaces. In his buildings, Le Corbusier employed promenades with unexpected circulation paths. Le Corbusier created a ramp and gallery as part of the Villa La Roche project, where the homeowners' art collection was on show. He openly acknowledged that he designed a promenade in Villa Savoye, but the concept of a promenade was first realized in Villa La Roche (Samuel, 2010). The sequences in which Le Corbusier portrays these progressively different viewpoints in Villa Meyer are displayed in Figure 7.

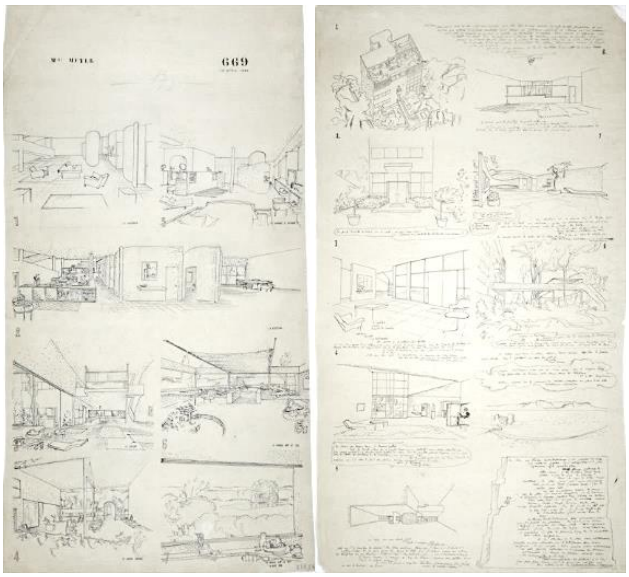

Figure 7. Promenade images and sequences of Madam Meyer's residence (Fondation Le Corbusier, 2020a)

Three fundamental ideas characterize the promenade architecture designed by Le Corbusier: The first involves using a variety of architectural tools to create an entrance that will pique visitors' interest and encourage them to continue; the second involves creating multiple sequential perspectives that follow one another; and the third involves maintaining the relationship between the various components and the architectural whole without interruption (Fondation Le Corbusier, 2020b). Samuel (2010) examined the promenade arrangement in Le Corbusier's buildings using the elements of introduction, questioning habits, orientation, climax, color, and natural light as a dramatic light source in a project

titled "Le Corbusier and the Promenade."MAXXI promenade setup can be examined under the following headings in light of all these conclusions:

• Spatial fluency

• Acting with a sense of surprise and discovery

• Sculpture staircase

• Daylight

• Framing openings that meet the outdoors (Figure, 8).

A navigational path that entices visitors to explore the space is created by flowing geometry, stairs, ceiling beams that enhance the area, details, lighting, unexpected openings that lead to the outside world, galleries, and a promenade for visitors entering the museum (Arkitektuel, 2023). The promenade elements, which are defined in Figure 8, are shaped around the circulation setup, which serves as the central component of the MAXXI Museum's design.

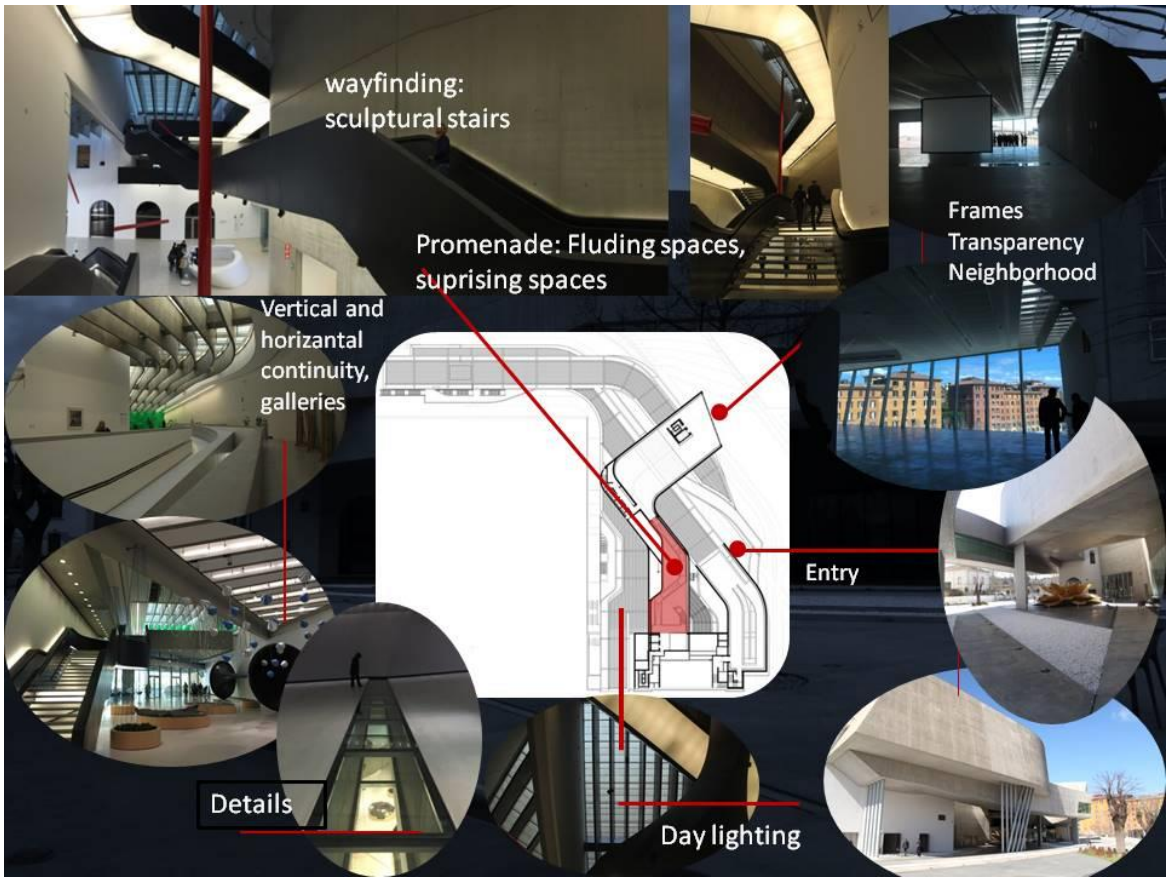

Figure 8. MAXXI Museum promenade elements plan (Arkitektuel, 2023); photograps (Canbakal Ataoğlu, 2016)

Spatial Fluency

Zaha Hadid has emphasized a continuous, almost liquid approach to volumes and forms in MAXXI Museum (Jodidio, 2011). The MAXXI's architecture rises from a daring and original idea for a museum space: flux and force fields, imaginary trajectories traced out by its visitors take shape in the architect's mind and are materialized in space, volumes that project in to the void, walls that curve around and fold upon themselves, unexpected openings to the exterior and look outs onto the full height of the interior charecterisen the path inside the museum and draw the visitor into a complex and intriguing physical and mental experience (Bilotta & Rosati, 2010).

The circulation routes around the site have been envisaged as currents between areas of different densities, a reflection of the compositional paradigms the architects have employed, based on metaphors of liquids, fluidity and porosity. Both the external and internal circulation follows the

general flow of the geometry, with vertical and oblique circulation elements located at areas of confluence interference and turbulence (Broto, 2013).

The concept of flexibility served as the foundation for the plan layout. Because of the exhibition spaces' consistency, temporary and mobile exhibitions can take place in these areas. Obstacles such as walls that could disrupt the flow of the exhibition spaces have been eliminated (Archiweb, 2023).

The MAXXI Museum's plans demonstrate the gallery spaces' continuity in conjunction with curved stairs and ramps. The Figure continuity section plane across the gallery displays the staircase's smooth and continuous movement throughout the atrium (Figure 9).

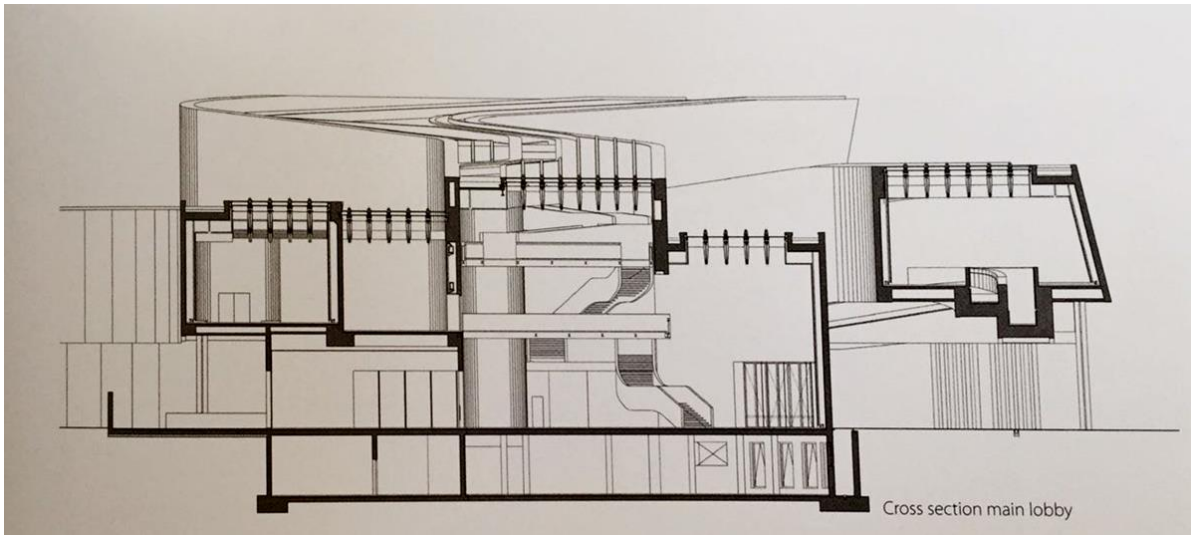

Figure 9. MAXXI Museum section (Arkitektuel, 2023)

Acting with a sense of surprise and discovery

The flow of a guest is where the idea of the free plan originated. As a visitor moves through a building, they perceive both the inside and the outside from a variety of angles and experience various spatial sensations that correspond to various spatial situations (Taricat, 2016).

A procession of images that the viewer sees as he makes his way slowly through the building is known as promenade architecture. Reading the work within a hierarchical sequence of architectural events is the creation of the architectural circulation system. Le Corbusier developed exterior and interior narratives that come to life as the visitor navigates the movement with the aid of the architectural promenade. The syntagmatic space of movement processes is created by architecture (Samuel, 2007, 2010). In the words of Kürtüncü (2014), *"architectural promenade consists of consecutive, memorable experience moments of the perception of the observer wandering in a structured environment".*

Entering the atrium, the main elements of the project are evident: concrete curved walls, suspended black staircases, and open ceilings catching natural light. By these elements, Hadid, intended a new fluid kind of spatiality of multiple perspective points and fragmented geometry, designed to embody the chaotic fluidity of modern life (Hadid Architects, 2024).

The components of the promenade concept have been defined in the study, and the circulation arrangement of Zaha Hadid's MAXXI Museum has been examined using sequences (items that follow one another for a predetermined amount of time, series), as shown in Figure 10. The sequences were put together by organizing photos that were taken while the black staircase, which defines the design's characteristic, was suspended and hugged the curved walls of the museum's atrium. Figure 12 illustrates the spatial richness through the perspectives of the mobile observer created by the traces on the staircase hugging the atrium through the two floors. This atrium features a long, linear, flowing staircase that is part of the curved wall. It rises and falls along the gallery and wraps between floors,

creating a multi-perspective area that invites users to move around and take in the various perspectives.

You can move through the building with movement, curiosity, and a sense of discovery thanks to the stairs, ramps, galleries, fluid corridors, and an interconnecting series of spaces opening to each other with the circulation artery promenade set up throughout the building. This spatial journey is made more surprising by daylight, flowing ceiling traces, installations suspended from ceiling beams, and the framed outdoor landscape opening. As seen in the MAXXI Museum's atrium and floor plan circulation diagram, the museum provides a variety of options for visitors who are open to surprises and exploration (Figure 10, Figure 11).

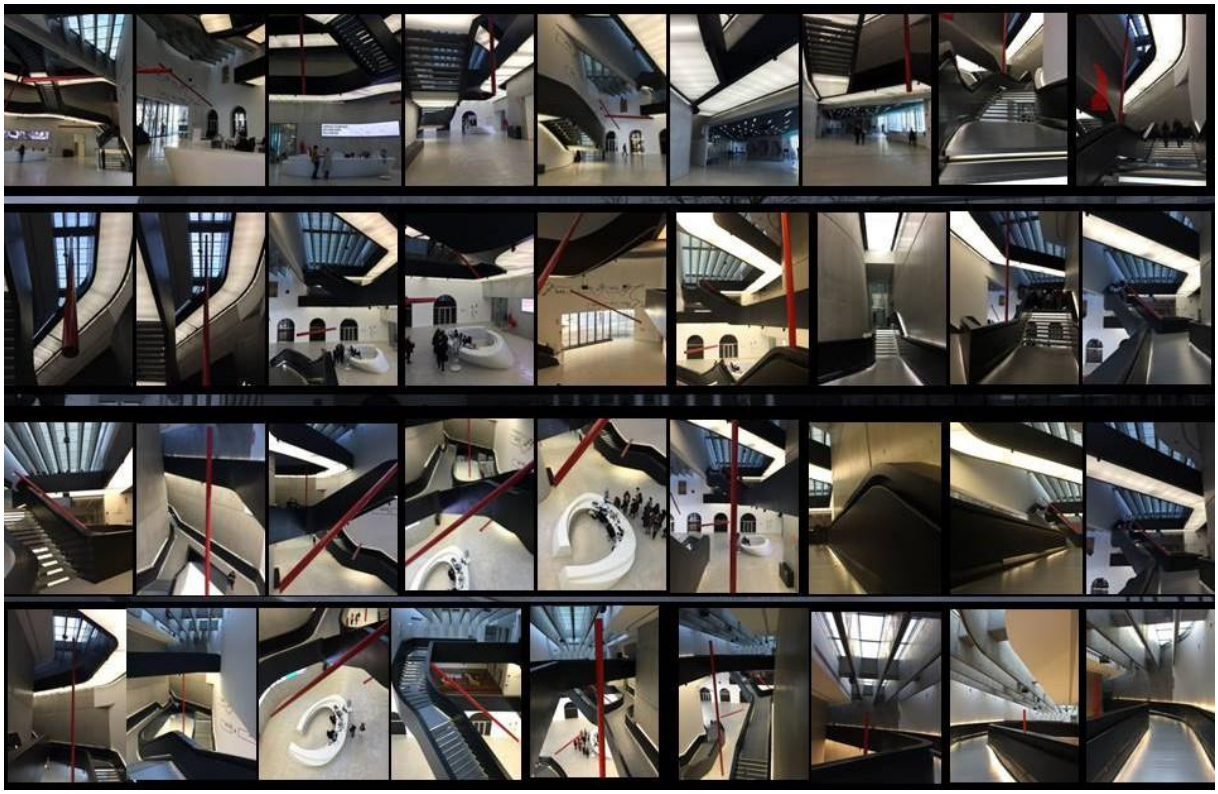

Figure 10. Photographic sequences in the MAXXI Museum atrium, photographs (Canbakal Ataoğlu, 2016)

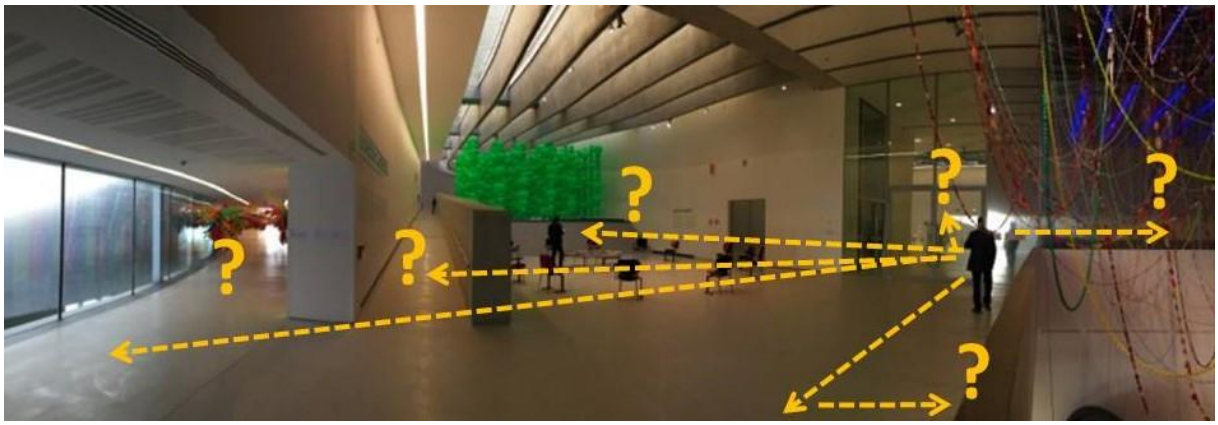

Figure 11. MAXXI Museum alternative circulation selections, photograph (Canbakal Ataoğlu, 2016)

Sculptural staircase

Unlike hardly any other structural element, stairs embody dynamism, making them ideal as enrcihing sculptural features within rooms. Special attention has been paid to themby architects ever since man started to buildfor this reason. It also explains the concentration of the essential chacteristics of a

particular trend in building history, sometimes even in an exaggerated form, frequently observed in stair structures (Schittich, 2013).

As a sculptural form in the MAXXI Museum, the staircase is also in fluid linear form. The full height space of the hall is an intricate geometrical design of stairways and walls made from unfaced concrete, an element that plays a prominent role in the building. By looking upwards from here you soon perceive the existence of a maze-like network of paths, and trajectories; explared progressively, tehe reveal the building's extraordinary spatial mechanism, which is difficult to compherend on the first sight (Bilotta & Rosati, 2010). The curved walls are followed by a flowing linear staircase that encourages movement and space exploration (Figure 12).

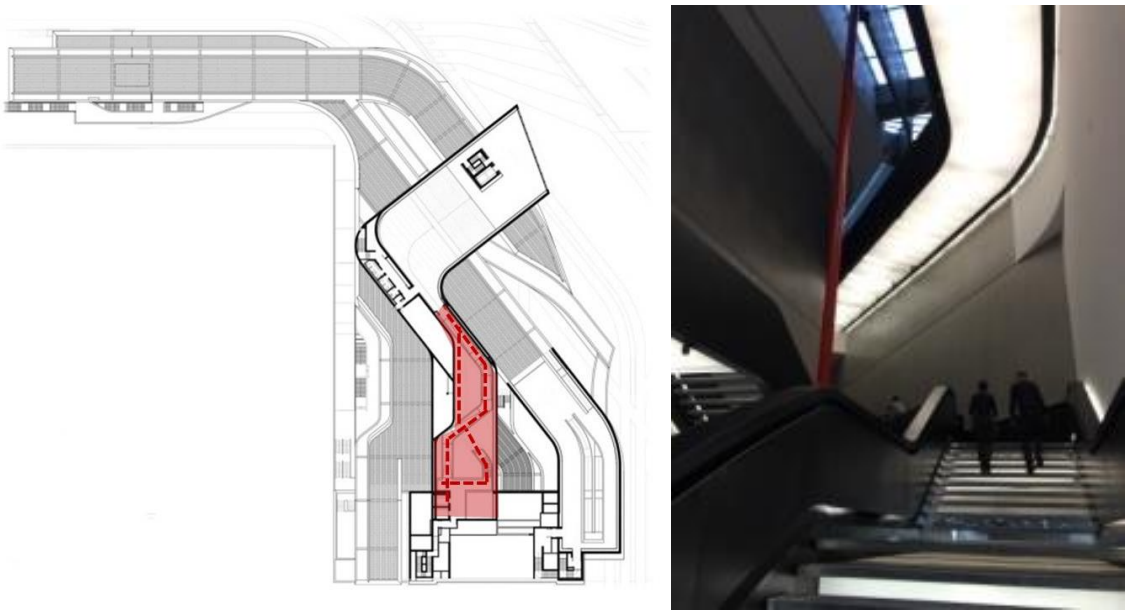

Figure 12. Stairs in the atrium of the MAXXI Museum and circulation scheme plan (Arkitektuel, 2023), photograph (Canbakal Ataoğlu, 2016)

Daylight

"The effective use of daylight is a critical design input that increases spatial qualities, sustainability, and energy efficiency targets in buildings" (Kızılörenli & Tokuç, 2022). Lighting design is important in museum design to illuminate the works correctly. While discussions continue on museum circulation, discussions and research have been conducted on how natural light should illuminate the works in the museum. Details have been developed to ensure that natural light is effective in the space with overhead skylights (Le Corbusier, 1923, 1950). In Le Corbusier's buildings, dramatic daylight and skylights became one of the characteristics of the promenade and the space. In the MAXXI Museum, daylight is brought into the space through the concrete beams on the ceiling and the windows opening to the outside.

"Particular attention has been given to the natural lighting, by the thin concrete beams on the ceiling, together with glass covering and filtering systems. The same beams have a bottom rail from which art pieces are going to be suspended (Archdaily, 2023) (Figure 13).

Figure 13. Daylight in MAXXI Museum, photographs (Canbakal Ataoğlu, 2016)

Framing-openings meeting the exterior

In Le Corbusier's promenade, the visitor meets the views, the landscape and the external environment framed by a surprising circulation structure. “MAXXI Museum’s beams, the staircases and the linear lighting system guide the visitors through the interior walkway, which ends in the large space on third level. From here, a large window offers a view back to the city, though obstructed by a massive core” (Archdaily, 2023).

Like Corbusier's promenade, the MAXXI Museum promenade intersects with landscapes framed outdoors and surprising encounters. The promenade, which sometimes opens to the inner courtyard and the neighborhood landscape from different elevations, creates interaction with the external environment (Figure 14).

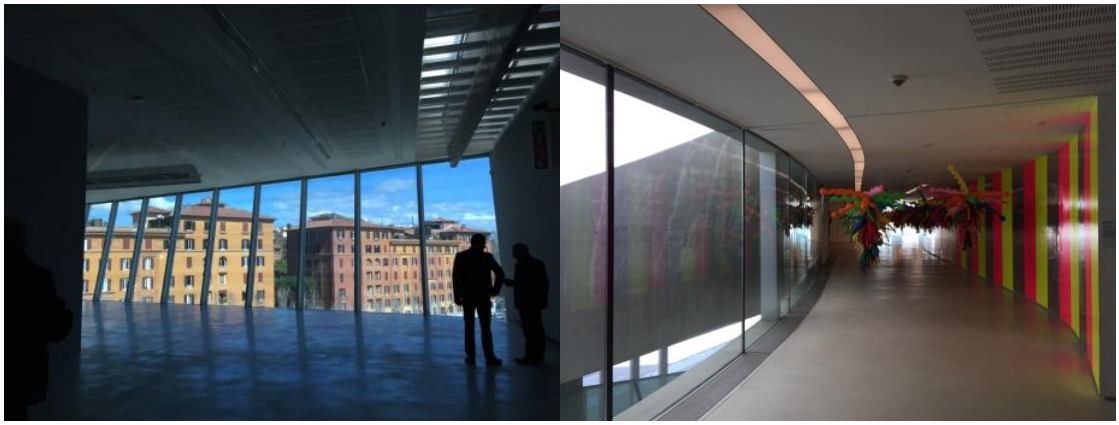

Figure 14. Framing, external environment, photographs (Canbakal Ataoğlu, 2016)

4. Conclusion and Suggestions

The study includes a brief discussion of the evolution of museum circulation and its breaking points. The arrangement of the museum space has been influenced by the Mundaneum project, Le Corbusier's endless spiral circulation museum, and the architectural promenade approach, which enables the discovery of unexpected spaces and diverse perspectives by experiencing the space with movement.

Radical, perceptual, spatial changes and spatial scenarios in circulation area design draw attention, particularly in museum interior design (Canbakal Ataoğlu, 2009; 2016a). The promenade serves as a useful tool for museum circulation and design in this particular context.

The architectural promenade improves the sensory and perceptual experience through a cinematographic spatial journey. According to Samuel & Jones (2012), "promenade architecture is a key term in the language of modern architecture.

The components of Le Corbusier's promenade concept were defined in the study, and sequences—items that follow one another for a set amount of time or series—were used to analyze both these components and the promenade fiction from the MAXXI Museum. The sequences were made by arranging photos that were taken while moving along the black suspended staircase, which is the

museum's signature feature in the atrium (Figure 15). This observation presents a fresh understanding of the museum area, one that is dynamic, and palpable, offers a multitude of viewpoints, flows with discoveries, and contrasts with revelations.

Designed as an unexpected circulation layout, the promenade in Le Corbusier's buildings leads the user around the area with ramps and sculptural stairs, unites them with framed views that open to the outside, enlivens the space with dramatic daylight, and creates a relationship between spaces. The promenade ends with a spatial journey via ramps to the roof terrace reaching the framed view. It starts with the ground floor pilotis defining the entrance in Villa Savoye. The piloted entrance of the MAXXI Museum concludes similarly, with ramps, flowing sculpture staircases, and a framed neighborhood view that opens to the exterior of the gallery on the second floor, all of which are illuminated by natural light. As can be seen in the image, this promenade, a spatial journey experienced through movement, offers a variety of spatial experiences, from the pilots at the ground floor entrance to the framed neighborhood view of the gallery on the second floor.

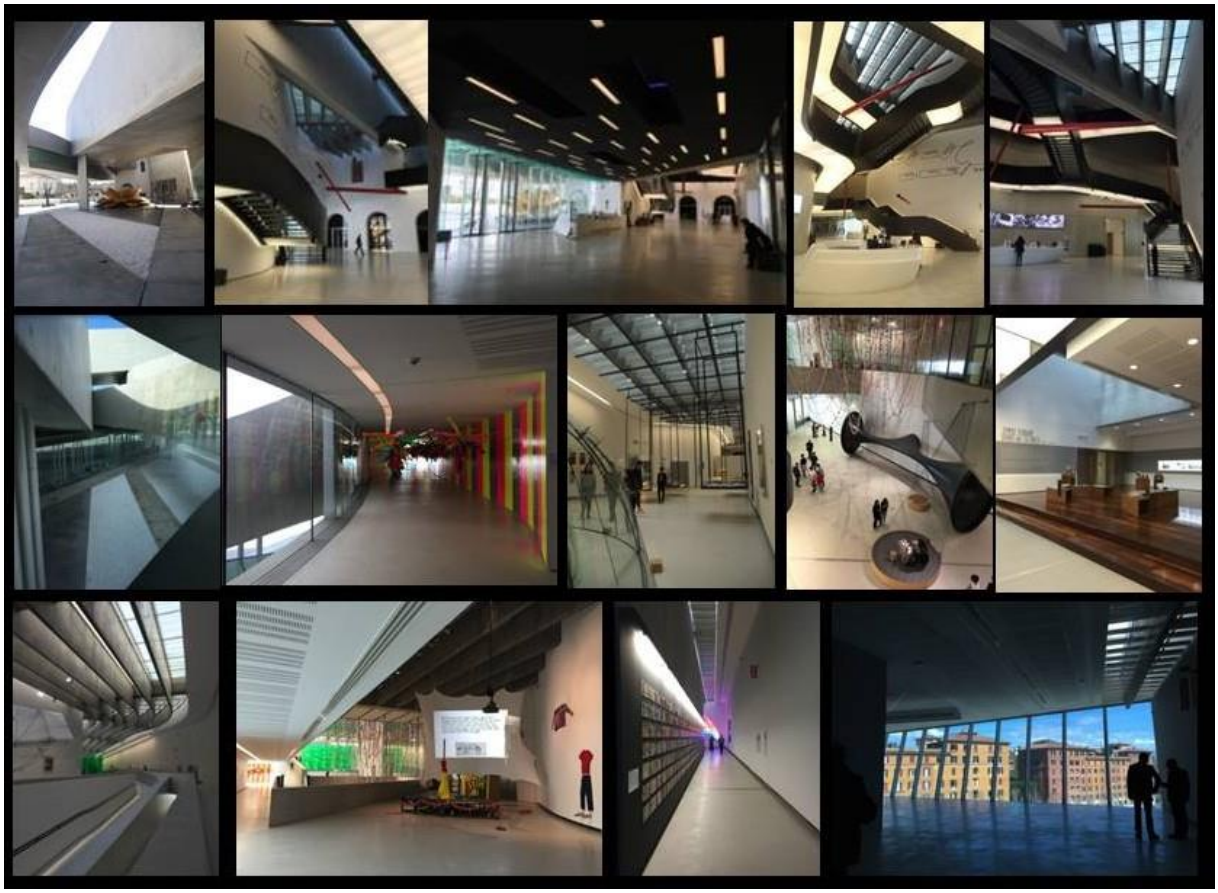

Figure 15. Spatial perspectives on the MAXXI Museum promenade, photographs (Canbakal Ataoğlu, 2016)

MAXXI Museum was analyzed with the following concepts within the framework of Le Corbusier's promenade elements;

- Spatial fluency
- Acting with a sense of surprise and discovery
- Sculpture staircase
- Daylight
- Framing-openings meeting the exterior

According to Taricat (2016), the foundation of Le Corbusier's architectural promenade fiction and free plan understanding is the visitor's movement. The visitor perceives the outside and the inside in perspective from a variety of angles, experiences a range of spatial sensations that correspond to different spatial situations and can perceive spatial situations sequentially with movement and Figure

continuity. Le Corbusier's promenade and Hadid's MAXXI Museum promenade provide evidence for the arguments made by Foster (2013) and Kuban (2001) about the interplay between modernism and deconstructivism.

Kuban (2001) views Deconstructivism as no more than Le Corbusier or other functionalist architects, but rather as a descendant of functionalism and Russian constructivism. According to Kuban, what they were unable to accomplish at the time was to dissect deconstructivism and reconstruct its components.

Known as a deconstructivist architect, Zaha Hadid employed standard architectural drawings to interpret plan, elevation, perspective, and axonometric drawings in a more dynamic way than they appear. She studied Kazimir Malevich's suprematist abstractions. In her initial projects, she made an effort to capture this energy. She stated during the retrospective, "I felt that we needed to re-examine the unproven modernist ideas, not to revive them but to open up new areas in the building's design (Foster, 2011)."

The museum is described as follows in the institutional directory of the MAXXI Museum:

“A challenge to our way of perceiving things and to the traditional idea of an exhibition space, a place where the art and architecture of our time can be experienced in a new way. The old idea of the predetermined path is set aside in favour of multiplicity of possible spatial criss-crossings, without the visitor ever needing to retrace his or her steps” (Bilotta & Rosati, 2010).

For MAXXI Museum;

"Modernist utopian space created the neutrality of many 20th-century museums. Now it is necessary to challenge this situation," said Zaha Hadid, aiming for a new fluid type of spatiality consisting of multiple perspective points and fragmented geometry, as stated by critics (Archdaily, 2023).

The single-perspective linear circulation layout of neoclassical museum typologies, like the Uffizi Museum and the Altes Museum, is significantly different from the galleries and circulation arteries of this new museum.

Featuring Le Corbusier's concept of the promenade, this new museum space, which can be seen in Hadid's MAXXI Museum, offers a spatial journey based on discovery, personal choices, and movement with multiple perspectives and surprises.

It should be noted that Le Corbusier's promenade concept clarifies the boundaries of contemporary space design because it offers more observable and legible spaces and has comparatively fewer alternatives. With its promenade layout, contemporary space creates new identities and rich visuals and sensations in circulation areas.

Furthermore, it is believed that the Promenade concept can direct designers in the creation of rich spaces during the architectural design process, according to an academic evaluation of this study.

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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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There is no conflict of interest.

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Discussion of Spaces as Palimpsest Through an Architectural Design Competition Project: The Case of Student City Complex in New Belgrade

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Abstract

Since their foundation, cities have been in constant change as physical spaces that directly reflect the lives of their inhabitants. The numerous layerings that urban spaces have undergone throughout their history and the continuity of this layering in a space has a palimpsest quality. This study discusses the spatial dimension of the palimpsest concept through the winning project from an international architectural design competition. In this competition, which created an international platform for discussion, the design approaches of the projects in the award group were comparatively evaluated within the framework of the palimpsest concept. As a result of the evaluation, it was concluded that using the palimpsest nature of cities, especially in historical areas, as an input is a design approach that produces holistic solutions in many aspects, such as protection of the space's spirit, sustainability of collective memory and coexistence with the past.

Keywords: Palimpsest, Belgrade, international architectural design competition, urban memory, adaptive reuse.

Palimpsest Olarak Mekânların Bir Mimari Tasarım Yarışması Projesi Üzerinden Tartışılması: Yeni Belgrad Öğrenci Şehri Kompleksi Örneği

Öz

Kentler, kuruldukları tarihten itibaren bireylerin yaşantısının doğrudan yansıdığı fiziksel mekanlar olarak sürekli bir değişim içerisinde olmuşlardır. Kentsel mekanların tarihi boyunca geçirdiği üst üste sayısız katmanlaşma ve bunun mekandaki sürekliliği palimpsest bir nitelik taşımaktadır. Çalışma kapsamında, palimpsest kavramının mekânsal boyutunun, uluslararası bir mimari tasarım yarışmasında birinci seçilen proje üzerinden tartışılması hedeflenmiştir. Uluslararası alanda bir tartışma platformu yaratan bu yarışmada, ödül grubunda yer alan projelerin tasarım yaklaşımları palimpsest kavramı çerçevesinde karşılaştırmalı olarak değerlendirilmiştir. Değerlendirme sonucunda, kentlerin özellikle tarihi alanlarda izler barındıran palimpsest doğasının bir tasarım girdisi olarak kullanılmasının, mekânın ruhunun korunması, kolektif hafızanın sürdürülebilirliği ve geçmişle bir arada yaşama gibi birçok açıdan bütüncül çözüm üreten bir tasarım yaklaşımı olduğu sonucuna varılmıştır.

Anahtar kelimeler: Palimpsest, Belgrad, uluslararası mimari tasarım yarışması, kent belleği, uyarlanabilir yeniden kullanım.

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1. Introduction

When looking at the development of architecture throughout history, its essence is accumulative and layered progress. People's needs and cultural relations have constantly changed and transformed spaces throughout history. This layering of spaces creates a deeper and richer architectural atmosphere and contributes to the continuity of memory by establishing a link between new and old. Most old buildings in a city are isolated then transformed into unused and dysfunctional spaces or seen as architectural monuments representing the past and completely preserved without being involved in daily life. Neither situation is beneficial to the city and its inhabitants. Although it is not possible to make a basic definition of architecture, it would not be wrong to say that architecture's mission to "create living spaces for people" includes more than just leaving buildings alone or preserving them as monuments. In this respect, the possibility that the rich and complex qualities of these old buildings layered on top of each other can serve as grounds for the creation of the new has made it possible to associate architecture with the metaphor of "palimpsest".

Although "palimpsest" basically means parchment that has multiple writings on top of each other, it has been used as a metaphor in a theoretical context in works from different branches of science and art. It has been especially used as a concept in intertextuality and mental layers contexts, where theoretical literary works come to life again with new texts. It has been the subject of studies by critics and theorists such as Gérard Genette (1992) and Jacques Derrida (2016). As a multidisciplinary concept, palimpsest has been the subject of many different studies as a metaphor in architectural literature (Lanz, 2024; Maskineh, 2021; Turgut, 2021; Noppen & Morisset, 1999; Botta, 2012; Machado, 1976). In one of these studies, Öymen Gür, in a text focusing on understanding and creating space, states it is necessary to preserve the existing in order to create urban spaces with character and privilege. For this, it is necessary to understand the palimpsest as a differentiating, laborious but sensitive method (Öymen Gür, 2017). Another important study on this subject is Şentürk's article published in 2018. Through the concept of palimpsest, he diagrammatizes communication technologies in the city's two hundred years of history as the subject of his research (Şentürk, 2018). The concept of palimpsest in architecture has also been the subject of many studies at masters and doctoral levels in international graduate programs (Tran, 2008; Campos, 2005; Soğancı, 2001). One of the comprehensive studies on the concept of palimpsest in the fields of architecture and urbanism is Sağlam's PhD research (2018), completed at Politecnico di Milano - Department of Architecture and Urban Studies, focusing on the urban palimpsest features of Istanbul. The study emphasizes the multifaceted nature of Istanbul's Galata - Pera district, with its rich architectural traces of Byzantine, Genoese and Ottoman periods, and the connections, transitions and continuities between them.

Although many theoretical and philosophical studies exist on the palimpsest concept in various branches of science and art, including architecture, no research addresses this issue as an important design input in international design competitions that will enter the implementation process. This research gap constitutes the main motivation for this study. While the theoretical research in the literature is a valuable guide, it is undoubtedly an important approach to discuss these conceptual perspectives through international competition projects and guide them as important design inputs for future implementation projects. From this viewpoint, the main subject of this study is the international competition on "Student City Complex in New Belgrade" by the Ministry of Education, Science and Technological Development of the Republic of Serbia and the Council of Europe Development Bank. The competition's aim was to increase the accommodation facilities' capacity intended for students by implementing the latest standards in sustainable construction and using student dormitories in university centers – "The Student Housing in Serbia" project was put forward. The project was financially supported by the European Union Development Unit, realized in partnership with the Ministry of Environmental Protection and implemented by UNDP in cooperation with the Embassy of Sweden and the European Investment Bank (Union of Architects of Serbia, 2023).

This study was carried out with the idea that discussing an international architectural design competition opens a historical area through the winning project with the palimpsest concept revealing important results. The multi-layered characteristics of architectural heritage, or traces of history forming many layers in the city, have created a theoretical context in which the palimpsest concept

can be used as a metaphor. The study's main purpose is to discuss the importance and necessity of using the city's palimpsest feature as an input while designing or implementing architectural design for important historical layers of cities through an international architectural design competition. The findings obtained from this study are aimed at guiding future designs, competition proposals and architectural practices by emphasizing the multi-layeredness of cities – that is, the palimpsest feature – as an important input in architectural design.

2. Material and Method

This is a qualitative case study that focuses on the palimpsest feature in architectural space production and discusses the prize-winning project of the International Architectural Competition for Student City Complex in Belgrade, which concluded in 2022. In the discussion, the palimpsest concept is used in its basic meaning of physical layering. The study discusses the physical layering of spaces and formal relationship established with the existing built environment in the context of establishing a relationship with traces of the past, which is also included in the palimpsest concept.

Within the scope of the study, first the palimpsest nature of architectural spaces is explained with data from the literature, then the architectural design approaches of the winning project in the competition are discussed through the palimpsest concept. This discussion is based on the primary and official published data from the international competition project.

The officials from the architectural company that prepared the winning project were interviewed to obtain information about the design process and ideas. In decision 2 by Kocaeli University Science and Engineering Sciences Ethics Committee at meeting number 2023/17 dated 26 December 2023, it was decided there is no drawback in terms of scientific research and publication ethics to use the interview data. The design sketches received from the company officials, with written permission to publish, were used as data to understand the design process within the scope of the study.

Based on the assumption that a creative and original approach that considers the palimpsest nature of spaces in architectural design is preferred by the architectural authorities in the jury, the projects in the award group were evaluated based on five criteria, which were determined comparatively in the context of the palimpsest feature of the space:

1. Considering physical traces in site plan decisions.

2. Considering physical traces in the transformation of existing dormitory buildings.

3. Establishing a formal relationship with existing buildings in the design of new dormitories.

4. Creating a common façade form throughout the campus.

5. Promoting social revitalisation by considering the historical meaning and life in open space design.

In the context of these criteria, the design ideas of the top three projects in the competition were comparatively evaluated.

3. Research Findings and Discussion

This study addresses the concept of palimpsest in the production of architectural space through a recent international architectural design competition. First, the palimpsest characteristic of architectural space is explained then this concept is discussed in the context of adaptive reuse. These concepts are evaluated through the project selected as the winner of the international architectural design competition. These evaluations are supported by the official jury notes and design sketches. It examines the place of the stratification of today's cities throughout history in architectural design and its guidance for new production methods. At the same time, the other projects in the award group are discussed comparatively in terms of similar and different aspects, thus it discusses and brings to the agenda the extent to which the layers of architectural space are effective in the design and how they guide expectations in current architectural design competitions.

3.1. An Architectural Space as Palimpsest

The palimpsest concept has been used metaphorically in the works of many authors from different disciplines. As a concept, it usually indicates a critical approach to the phenomena of collective memory and stratification (Benacer et al., 2022). Etymologically based on the Greek word "palimpsestos", it derives from the root words "palin" meaning repetition and "psestos" meaning smooth rubbed (Ren, 2021). The concept represents an accumulation in the general sense of the word. Although it is used in the first sense as "an ancient document from which part or all of the original text has been removed and replaced by a new text", it has mostly been used in academic literature in its secondary meaning as "something that has many different layers of meaning or detail" (Oxford Advanced Learner's Dictionary, 1997).

Throughout history, cities accumulate many meanings of the past and these layers are covered by new ones over time. Therefore, these layers carry many traces of the city's collective knowledge (Apaydın, 2019). Failure to protect these traces will undoubtedly damage the city's historical knowledge and spatial memory. In his seminal book *The Architecture of the City*, with its critical approach to urban design theory, Aldo Rossi emphasizes that cities are built in layers over a long time and the importance of preserving the collective memory in these layers (Rossi, 1984). Memories in the city, which can be described as whole layers, also have a palimpsest feature that overlaps and intertwines. In this way, the memories that take place in the society are coded through urban images and transferred to the future (Al, 2011).

When a city is viewed in layers through the palimpsest concept, the power of architecture to influence and change collective memory becomes even more evident (Aydın & Yaldız, 2022). Layers carrying historical data appear as spatial productions when considered at the architectural level. Urban actors, who have a say over the city, have incredible influence and at the same time a responsibility over which of the layers will be excavated and revealed or erased. This can lead to erasure of "unpleasant" layers of history from the collective memory or to make more visible the layers that are desired to be in the public eye (Ren, 2021). The palimpsest characteristic of architecture can be emphasized or removed through ideological spatial interventions in line with aims and demands (Cengizkan, 2007). In this context, an important responsibility for architects as space designers is to preserve the tangible and intangible traces of the city while enabling the creation of new original traces.

As Italo Calvino mentions in his book *Invisible Cities* (1974), cities are places of exchange for tangible and intangible phenomena. This expression points to a place where memories and experiences are also exchanged, thus a memory is created that includes common new meanings. It can be said that the palimpsest feature of the built environment, with all its layers, has the potential to create new meaning for design in this context (Tschumi, 1996). Acting with this design approach allows for a respectful approach to the traces of the past while being open to traces that carry new potentials. Thus, historical parts of the city, which are often spatially excluded and neglected, can reach the present day, find an active life and coexist with new traces. In this context, it is important to re-functionalize buildings in line with current spatial needs and demands so they can rejoin daily life.

3.2. Discussing the Architectural Space as Palimpsest Through Adaptive Reuse

As one of the smallest components of urban spaces, buildings are the most important representatives of the city's layers (Lynch, 1990). The palimpsest characteristic of architectural spaces can be read directly through buildings because they carry and reflect important clues about the political, economic and socio-cultural life of the periods in which they were built. The buildings that have survived in different periods contain traces of each and these traces are of great importance in keeping the collective memory of the city alive. However, due to reasons such as changes of society and the city over time and technology advancements, buildings may become unable to respond to current spatial needs. At this point, there are two solutions: demolishing the dysfunctional building and constructing a new functional one in its place or preserving the existing building and making it usable again. The path chosen by the urban actors who have a say about the buildings is of critical importance in order to preserve the city's memory.

For the continuity of collective memory in the built environment, it is important in many respects to preserve buildings that have lost their function and find fresh uses for them within the framework of today's spatial needs and participate in daily life (Eryiğit & Anıktar, 2021). This is also a sustainable approach that respects nature, which causes less damage to nature by utilizing the existing building stock and prevents carbon emissions caused by the production of new construction. With the basic approach that sustainability is a process, not an outcome, it is of great economic and social importance to efficiently use natural resources and adapt existing ones to the life of the individual in the most effective way (Darlow, 1996). From this perspective, all decisions taken for buildings that are brought into daily life provide a significant gain to the city and its users (Hangi & Zabihi, 2012). Building without demolishing can be made possible by rehabilitating the existing elements.

In the literature, studies to bring dysfunctional buildings to the present day mostly focus on disused industrial buildings at central points in cities (Köksal, 2005; Çetinkaya, 2015). However, the issue of adaptive reuse covers the rehabilitation and reuse of all buildings that cannot fulfil their current function or provide comfortable conditions for their users. From this viewpoint, new sustainable design approaches can be developed for all building types, where the existing spatial quality can be improved with the same or a different function. As mentioned earlier on the palimpsest feature of architectural space, this approach, in essence, makes it possible to not just restore dysfunctional buildings to their former glory, but to add new meaning potentials to them in daily life.

Kalman and Letourneau (2020) mention that a two-stage approach should be followed in the design approach for building reuse. The first of these is structural analysis, which includes structural and spatial analysis of the existing building that will be compatible with the determined function and the other is a needs analysis of the people who will use the building. According to these analyses, another issue that should be considered in the functionalization of buildings is to realize spaces that provide comfort conditions in line with user needs while respecting the building's original value. With a correct functionalization study within the framework of architectural value, spatial organization and environmental factors, the building can be sustainably preserved and transferred to the future with its original values; thus, social and cultural continuity can be ensured (İslamoğlu, 2018; Biber & İslamoğlu, 2023).

3.3. Designing with the Architectural Heritage of Belgrade

Belgrade has been occupied by many civilizations throughout history due to its strategic location and natural resources, thus been fed by different cultures (Özkan, 2021). Since antiquity, the urban layers of each period have accumulated on top of each other. In the ancient period, different Balkan races ruled the city until the occupation of the Roman Empire. The city was named with the word "singidun" meaning "castle" in that period and with the Latin word "singidunum" in the Roman period (Aslantaş, 2011). The city, which was occupied many times during the Roman Empire, faced sieges in the Middle Ages as the Ottoman Empire advanced westward. After two failed sieges, the third siege attempt was successful and the city came under Ottoman rule (Katić, 2005; Eroğlu, 2017; Municipality of Belgrade, 2024).

During this period, it became the second most populated Ottoman city in Europe after Istanbul. The city, which was the gateway to the west and an important base for the Ottoman Empire, was named "Dârü'l-Cihâd", which means "Home of Jihad" (Figure 1). During the reign of the Ottoman Empire, the city, which had been under the influence of Christianity for many years, began to be influenced by an architecture with Orientalist characteristics in the built environment (Özkan, 2021).

Figure 1. An illustration of the Ottoman siege of Belgrade in the 16th century (Furst, n.d.)

In the 19th century, when Serbia declared its independence, the city was designated as the country's capital and became known as "Beograd" (Belgrade), a Slavic origin word meaning "White (Beo) City/Fortress (Grad)" in reference to its castle built on a white ridge (Encyclopaedia Britannica, 2023). The city experienced a significant population explosion due to migration; as a result, housing problems emerged. Many unregulated houses built in this period were mostly made from wood and mud and did not even meet minimum hygiene conditions. Under these adverse conditions, one of the most important steps for the country's development was the construction of the railway line. This established a strong connection between Western Europe and important cities in Eastern Europe, such as Sofia and Istanbul. In the late 19th century, foreign travelers recorded that this city, with strong Eastern influences, modernized at an extraordinary pace and resembled Western cities. It is possible to understand the atmosphere of the city at that time from the detailed sketches of Hungarian traveler Felix Philip Canitz (Figure 2) (Blagojecic, 2015).

Figure 2. Sketches of Belgrade's city center in the 19th century by Felix Philip Canitz (Canitz, n.d.)

In the first half of the 20th century, several planning studies were carried out for the city in response to its irregular growth (Figure 3). The first plan for the area west of the Sava River (New Belgrade area) was prepared in 1923 by Russian architect Djordje Kovaljevski. Due to the unfavorable terrain and lack of investment in the New Belgrade area, only a major road, railway line, airport and fairground were built in the area during this period. Another proposal for New Belgrade was put forward by Dragisa Brasovan, one of the leading modernist architects of Serbia in 1941. Called "Sava New Settlement", it included a radial connection between Zemun and the Old Town and was planned to accommodate a population of 500,000 people. This settlement proposed new spatial solutions that responded to social and public needs as well as housing (Dukic, 2015).

Figure 3. Early 20th-century Belgrade cityscape (Chusseau-Flaviens, n.d.)

In Belgrade, the capital of the Federal People's Republic of Yugoslavia established after the Second World War, the New Belgrade district was chosen as the center of government. In this area, which was chosen to represent the ideologies and goals of the new socialist government, urban planning in the form of a grid based on Le Corbusier's modernist approach was realized in CIAM (The Congrès Internationaux d'Architecture Moderne) in 1928. In the context of the principles of modernism, prismatic mega blocks with flat roofs and horizontal transparent surfaces, where form follows function, began to be produced and these structures began to shape the city's face. The construction of New Belgrade began in 1948 with a workforce of 100,000, including the participation of youth labor brigades. Although the period's architectural style is compatible with the idea of "socialist realism", it includes a different approach from other socialist countries. Especially after its separation from the Union of Soviet Socialist Republics, Yugoslavia, while trying to establish its socialist order, established closer relations with Western Europe and the influence of modernist Soviet architects in the city decreased. To create a "contemporary socialist architecture", the architects in Yugoslavia considered the political, social, moral and artistic dimensions of architecture and declared it should serve the people as a whole, not a select group. It was emphasized that there was no place for historical elements in contemporary architecture (Dukic, 2015).

3.3.1. History of the Student City Complex in New Belgrade

In the 1940s, the housing and living conditions for students at the University of Belgrade were uncomfortable, so the issue of building a student complex was raised. The first works for a student complex with 4,500 beds started in 1947. In the wetland area between the Belgrade city center and Zemun district, the post-war New Belgrade was planned to be built and Student City became one of the first large complexes in this area (Figure 4). In 1948, construction of the complex was initiated by the University of Belgrade. Student City, the largest student campus in the Balkans, was built and put into use in phases between 1948 and 1955. It was officially established on 25 September 1952 by a decision adopted by the Federal People's Republic of Yugoslavia (Union of Architects of Serbia, 2023).

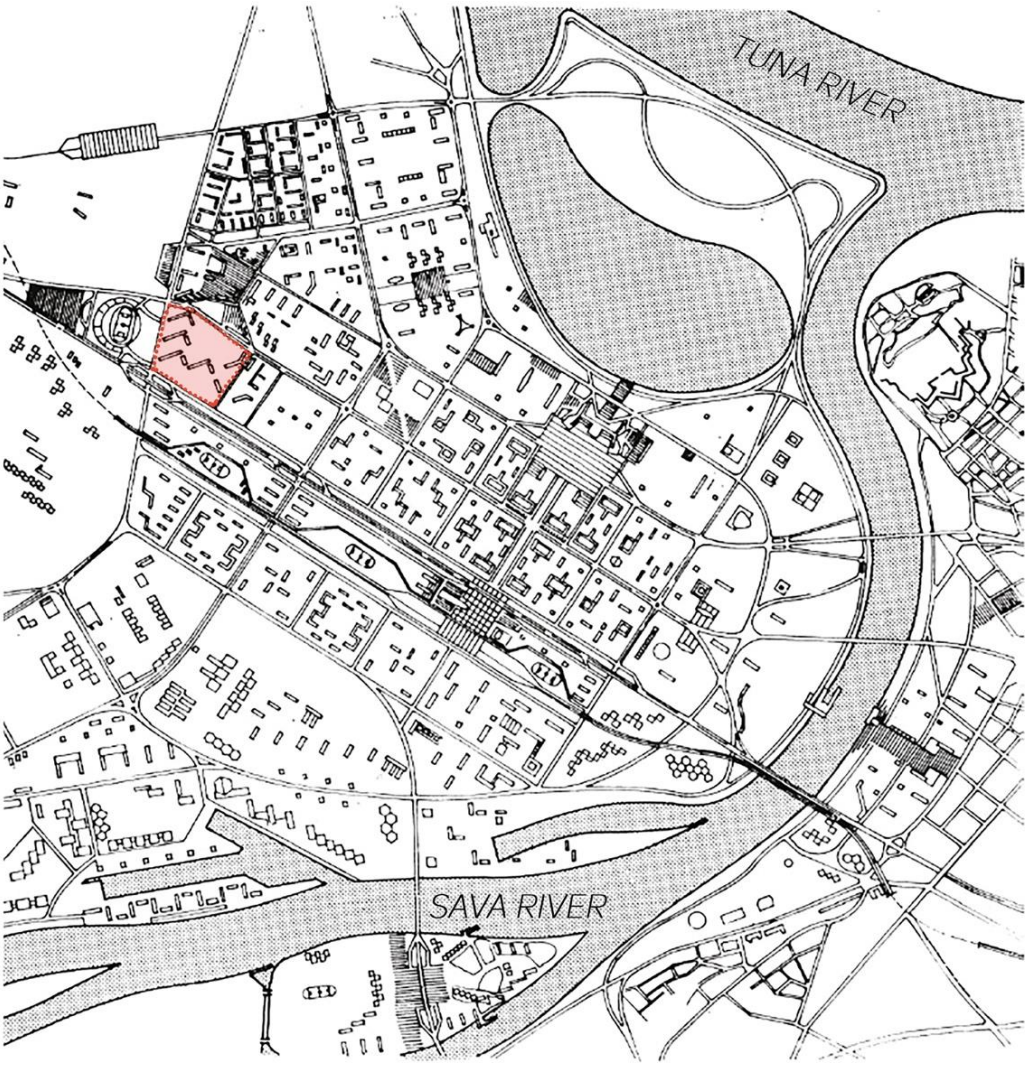

Figure 4. The location of the Student City Complex on the master plan of New Belgrade prepared by the Belgrade Urban Planning Institute in 1958 (Maric, Nikovic & Manic, 2010)

The complex was designed by Croatian architect Drago Korbar. Student City consists of four dormitory buildings with basic support units and each dormitory is independent in terms of management and organization. The special function units within the dormitories complement each other, making Student City a special environment favourable for students to live and work. By the end of the 1950s, 5,340 students were accommodated in the complex. Since its foundation, Student City has hosted a unique social life. Within the first 10 years of its establishment, it became a representative of student solidarity and the revolutionary spirit. The famous student protests of 1968 started in front of Block 1 of Student City. In this respect, it has symbolic value (Figure 5) (Union of Architects of Serbia, 2023).

The campus underwent renovations in 1985 and 1997 to take its current form. This process increased the accommodation capacity, renewed roofs, added lifts to the blocks, renewed the rooms' sanitary installations and added kitchenettes (Union of Architects of Serbia, 2023).

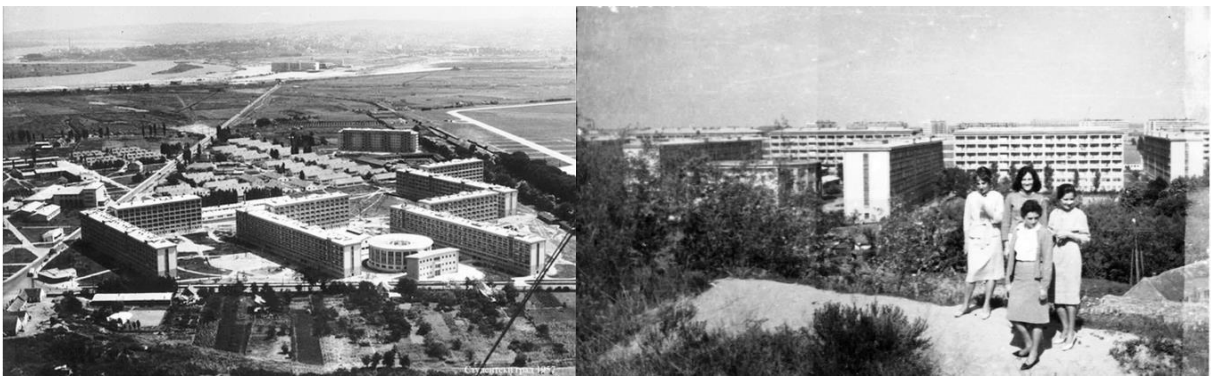

Figure 5. Photographs of Student City Complex (Union of Architects of Serbia, 2023; International Centre for Archival Research (ICARUS), n.d.)

This center, which has been a common place for university students of the former Yugoslavia and present-day Serbia for 60 years, is an important part of the collective memory from its smallest component, the rooms, to all other social units (Figure 6). For example, according to oral history data, when the accommodation units were separated by gender, the front of Block 5, next to the park, was a place for students to meet and spend time together (Union of Architects of Serbia, 2023).

Figure 6. Photographs of the Student City Complex show the collective memory (ICARUS, n.d.)

3.3.2. Architectural competition for the design of Student City Complex in New Belgrade

Student City Complex, built between 1948 and 1955, covers approximately 10,360 hectares in the north-western part of New Belgrade, between Tosin Bunar Street to the west and Zorana Dindica Boulevard to the north. The buildings in the complex underwent extensive renovations between 1985 and 1997, during which the accommodation capacity of each building was increased and lift cores were added. Today, the complex includes four dormitory buildings, a student restaurant, a boiler room facility, a student cultural center and café, open park areas and sports fields. The main gate for access to the estate is on Studentska Street. Vehicular and pedestrian access is also provided via Tosin Bunar Street and Zorana Dindica Boulevard. The dormitory buildings are divided into north and south blocks, with the north block labelled “G” and the south block labelled “F”. Both blocks are connected via pedestrian bridges on the upper floors. The lift cores added after the last renovation work are in G block (Union of Architects of Serbia, 2023) (Figure 7).

Figure 7. Competition area – Student City Complex (Union of Architects of Serbia, 2023)

Since the student dormitories were not only unable to meet current accommodation needs but also needed revitalization throughout the complex, solutions to these problems were sought through an international single-stage architectural project competition. The competition was organized in cooperation with the Ministry of Education, Science and Technological Development of the Republic of Serbia, the Council of Europe Development Bank and the Embassy of Sweden. It was funded by the European Union (Union of Architects of Serbia, 2023).

The Ministry of Education, Science and Technological Development identified the need for accommodation for higher education students in Belgrade at a 1,000 bed capacity. The competition scope was focused on meeting this accommodation need with new buildings within the same complex. The competition aim was to design a new accommodation unit to meet user needs, considering the historical significance plus potential and actual conditions of the site, as well as to produce arrangement and adaptation solutions for the Student City Complex area and existing dormitory buildings. The design and revitalization proposals were expected to have original, modern

multifunctional design qualities and be integrated into the complex, considering the built and natural environment data plus the site's functional and semantic value (Union of Architects of Serbia, 2023).

The competition was announced internationally on 25 July 2022. The criteria to be considered by the jury for evaluation of the competition proposals were grouped under four headings. In the first criterion, the jury explained its expectations for spatial concept and architectural expression. In this explanation, the importance of understanding the unique historical background of the existing construction in the design area and establishing the relationship between context and urban identity were emphasized. The relationship of the design with the cultural heritage and improvement of the urban space's quality were the focus. The second criterion in the jury evaluation was the functionality of the proposed solution and meeting the expected spatial needs. In this context, it was expected to produce spatial solutions that offer efficient and comfortable use. The third criterion was the social and environmental sustainability of the proposed solution. While improving the conditions of the existing environment, it was expected to develop an ecological and sustainable approach in terms of social and environmental aspects. The last criterion evaluated by the jury was the technical and financial feasibility of the proposed solution. In this context, the proposal should be technically easy and economically feasible (Union of Architects of Serbia, 2023).

The deadline for competition submissions was 25 October 2022. A booklet describing the general project concept and graphic visuals, 2D and 3D drawings, 3D animations and 2D and 3D visuals for the electronic exhibition were required for submission. As the competition was open to international participation, project proposals were submitted electronically. Twenty-one projects were submitted and, after the review of the rapporteurship, it was concluded that all projects met the official requirements and would be evaluated. In the first online meeting held on 3 November 2022, the jury members shared their initial opinions on the projects. In the second online meeting held on 7 November 2022, a comparative analysis and pre-selection of the designs were made within the framework of the previously determined criteria. In the third jury meeting on 9 November 2022, a second-round elimination was made after detailed analyses. On 10 November 2022, in the last jury meeting, after a third round of elimination, evaluations were made regarding the award group and rankings were determined (Union of Architects of Serbia, 2023).

In the evaluation, the winning project was selected because it was clearly distinguished from the other projects in terms of the criteria. The jury emphasized that the project selected for first prize offered the most precise, complete and appropriate solution and there was a major qualitative difference between it and the other projects. No project was found worthy of second prize and two projects were given equal third prize. Five projects received honourable mention awards. The results were published on the Union of Architects of Serbia website, along with the official jury evaluations, on 14 November 2022.

The scope of this study is a detailed design approach analysis of the project from Türkiye that won first prize in this international competition. The determination and effect of the palimpsest quality of the space in the design will be discussed within the framework of reuse. It is important to understand that the project represents Türkiye on the international architectural platform and is planned to be built with the support of the European Union in all its details; thus, it is important to examine the conceptual infrastructures of the spatial solutions it produces.

3.3.3. Discussion of the winning project of the Student City Complex Competition

The starting point of the project was the site's historical meaning, referring to its palimpsest character. The aim was to make the most effective use of the existing buildings dating back to the ideological brutalist architecture of the socialist era and to develop a proposal that could integrate with them. The basic approach was to "build without demolishing and coexist with the existing heritage" with the idea that the palimpsest would gain a new quality and richness as it layers on top of each other. This approach is also important in terms of ensuring physical and social sustainability. For this area, which is a part of the city's socialist collective memory, the preservation of memory has been one of the sensitivities in architectural design. In this context, the preservation and survival of the traces of the city's physical and social layers shaped the design. This basic idea provides the opportunity to use the

existing by eliminating its deficiencies and using less cost and energy (C. Sevindik & S. Güvendi, personal interview, October 10, 2023, Istanbul).

When the idea of "demolition" in architecture is considered ideologically, it leads to the erasure of the city's political and social layers, memory and history, and there is no valid rational reason for this situation. While demolition requires a lot of energy and cost, it also destroys people's memories. In this context, demolition cannot be considered an ecological or sustainable approach. The physical and social stratification referred to as palimpsest is what forms the basis of architecture. Therefore, the design was initiated with the basic assumption that these buildings, which are still standing, in use and have witnessed an important period for the city, are no worse than the new buildings to be designed and contain important historical meaning (C. Sevindik & S. Güvendi, personal interview, 10 October 2023, Istanbul).

While looking for ways to be functional and creative in design, it is aimed at developing a design that puts students at the center. In the proposal, which focuses on students in the context of quality of life, the revitalization and reorganization of the Student City Complex, which has not sufficiently fulfilled its function, has been realized with the adaptive reuse approach. It is aimed at creating a healthy transformation project with the idea of revitalizing the social life in the complex as in the old days, increasing the functionality of the dormitories, adapting the new dormitory building well to the complex, creating a walking corridor on the ground floor and creating a living campus. In this way, a common bond was established with the old physical and social layers of the city that formed the palimpsest (C. Sevindik & S. Güvendi, personal interview, October 10, 2023, Istanbul) (Figure 8).

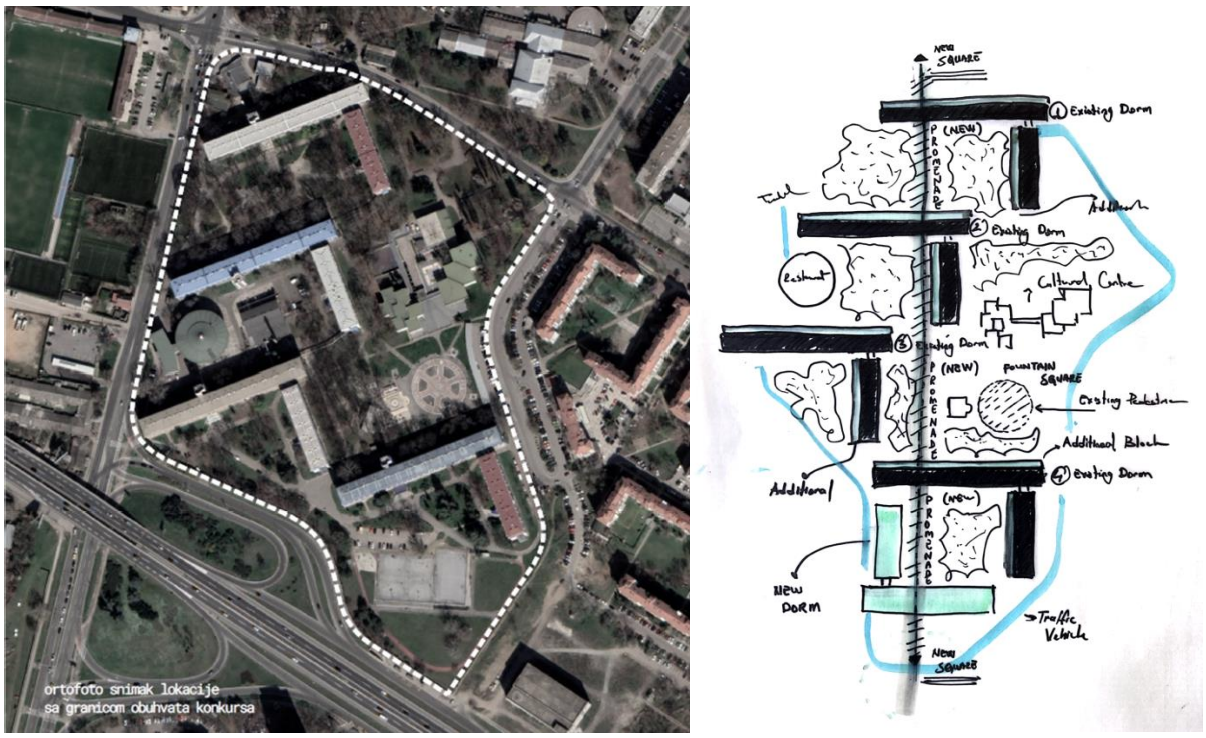

Figure 8. Aerial photo of the project area (Union of Architects of Serbia, 2023); sketch of the first design decisions (Sevindik, 2022)

In light of all these design inputs, the new design for the site is based on the idea that the historical buildings to be revitalized and made suitable for reuse should have a common upper architectural language and form a contemporary architectural layer within the campus. The basic idea is to bring together and harmonize the old layers that form the palimpsest and the new layer in a common contemporary layer. In this context, knowing the architectural language of historical buildings reflecting the period in which they were built is the basis for the new architectural layer. The difficult part of the design is to distinguish between the architectural layers of the past and present while reading the layers of the past and respecting each other. In the design, the idea is to deliberately create contrast in the use of materials to emphasize the existing architectural layer, while preserving the

architectural language of the existing historic buildings by maintaining their scale and proportions and harmonizing with the original structures(Figure 9). Throughout the design, a common contemporary architectural layer is realized, targeted by this principle (C. Sevindik & S. Güvendi, personal interview, October 10, 2023, Istanbul) (Figure 10).

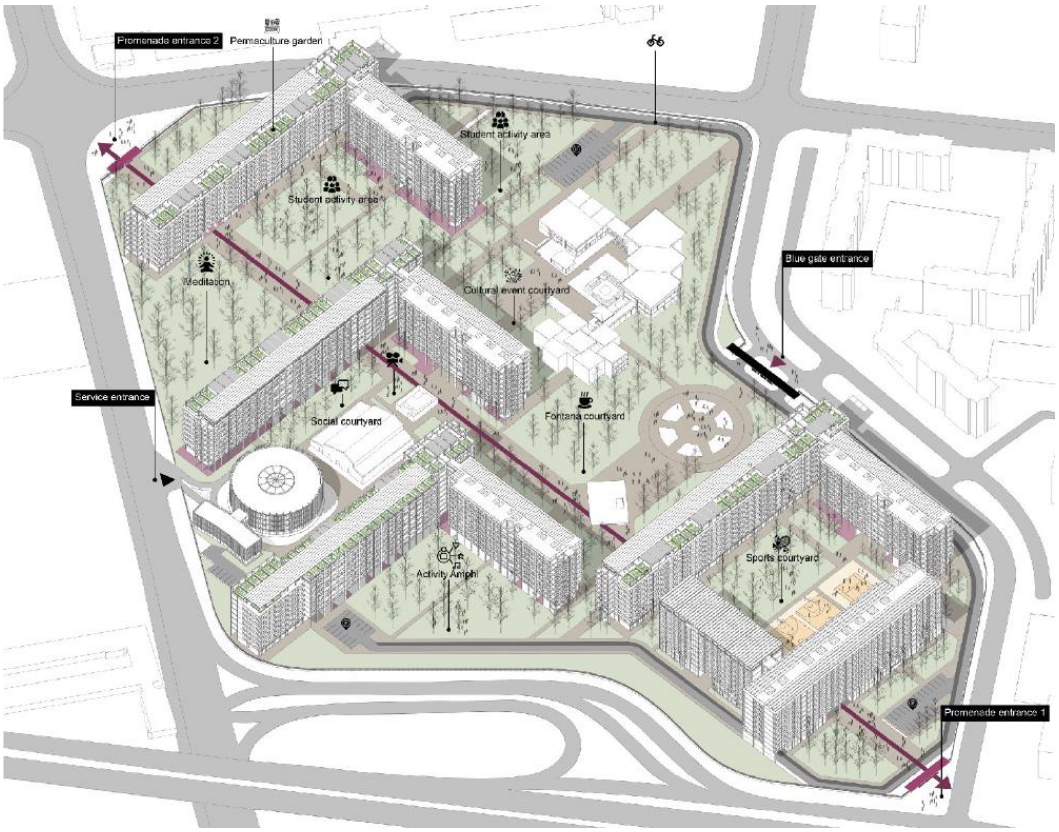

Figure 9. Functional diagram of the winning project's design proposal for the campus in axonometric perspective (Union of Architects of Serbia, 2023)

Figure 10. All layers of the built environment in the campus have been handled with a holistic and harmonious design approach - photomanipulation of the new design proposal with its surroundings (Union of Architects of Serbia, 2023)

An important aim of the design was to revitalize the spiritual/social layers of the palimpsest, which are part of the collective memory. The most important component of this aim is the pedestrian promenade that connects the focal points that support the active revitalization of social life on the ground. All dormitory blocks are physically connected to this pedestrian promenade (Figure 11). In the pedestrian-

oriented design, the square at the main entrance connects the pedestrian promenade to the common socio-cultural activity areas with courtyards built between the buildings (Figure 12). The spaces on the ground floors, which are directly connected to the garden and street, are designed as spaces where students can gather. The landscape, which creates a rich architectural atmosphere with the inner streets and courtyards around the pedestrian promenade, is also intended to create an ecological corridor. The existing vegetation on campus is home to impressive endemic plant species. With the ecological corridor idea, these species are preserved and street and courtyard life are enriched (C. Sevindik & S. Güvendi, personal interview, October 10, 2023, Istanbul).

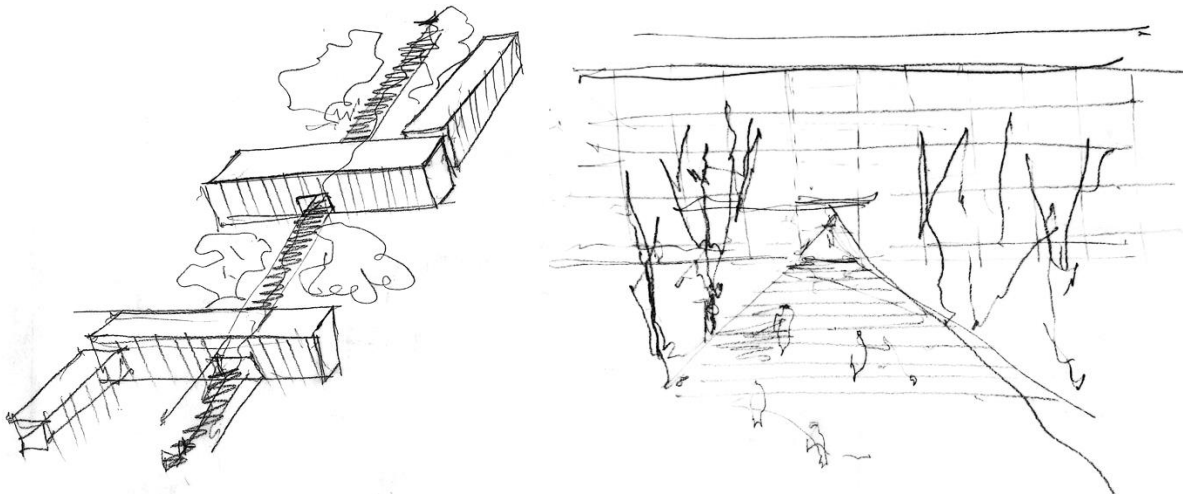

Figure 11. Sketches of the design ideas for the pedestrian promenade between the masses and the entrance – shows a new layer design added on top of the first layer as palimpsest (Sevindik, 2022)

Figure 12. A palimpsest effect was created by addressing the important monumental structures of the built environment with a holistic approach in the design and overlapping the traces of history with the present in the entire design (Union of Architects of Serbia, 2023)

The reusability function, which is at the basis of the palimpsest concept, is reflected in the design by reorganizing the existing dormitory blocks and creating an independent and flexible space that can develop and expand. While the dormitory blocks relate to each other in the north-south direction, they relate to the green area and street in the east-west direction. The dormitory blocks, which have an effective horizontal mass that forms the general architectural characteristic, have a porous structure with the spaces created (Figure 13). In this way, the need for cooling/ventilation in the common areas of the land with the effect of wind is met, while common socialization areas are obtained (Figure 14). The narrow and dark corridors in the existing dormitory blocks are widened as much as the structure allows, creating common working and socializing areas on the upper floors (C. Sevindik & S. Güvendi, personal interview, October 10, 2023, Istanbul) (Figure 15).

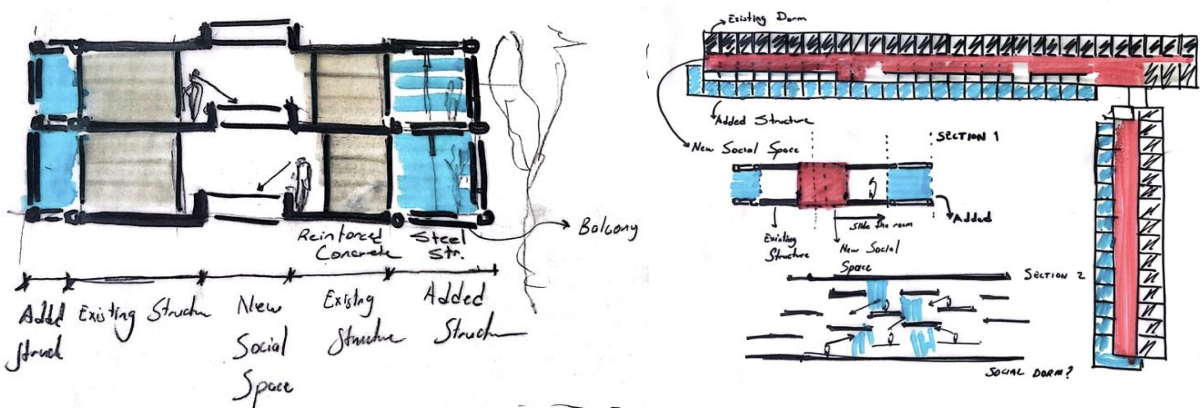

Figure 13. Plan and section sketches of design ideas for the reuse of historical dormitory blocks – preserving the traces of the existing structure and articulating with it (Sevindik, 2022)

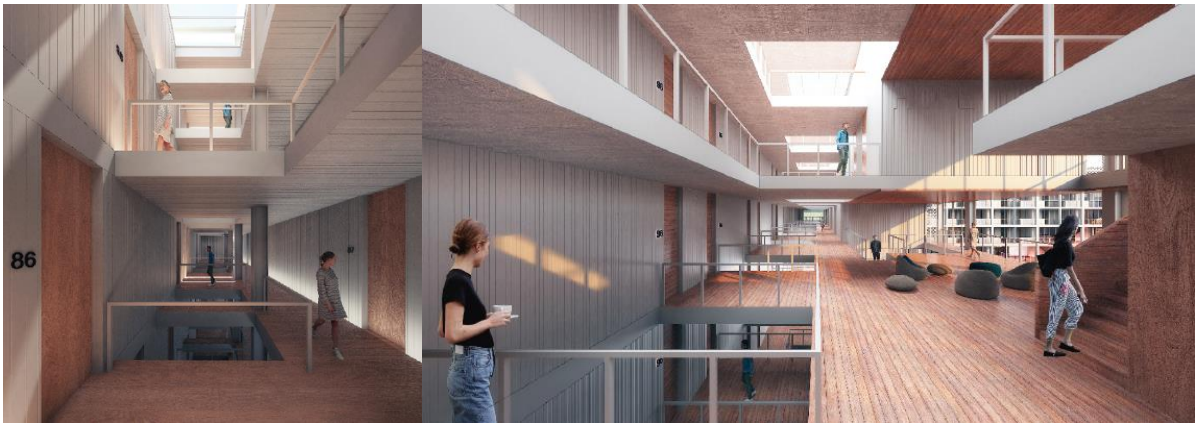

Figure 14. Preserving the interior layers but making them belong to the present day – 3D visuals of the dormitory building interiors (Union of Architects of Serbia, 2023)

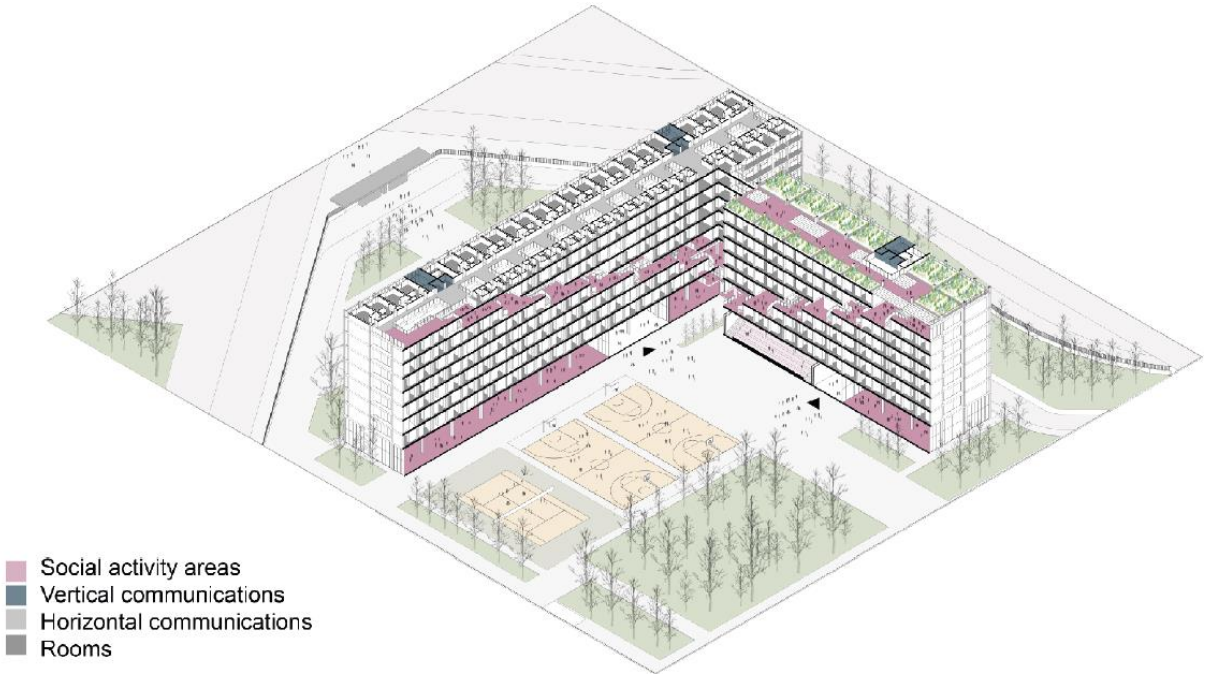

Figure 15. The new dormitory building was designed in harmony as part of the existing structures – functional diagram of the new dormitory building in axonometric perspective (Union of Architects of Serbia, 2023)

Existing site data, physical and semantic relationships were analyzed for the new dormitory buildings. The historical and social layers that emphasize the palimpsest nature of the site have been meticulously considered, respected and made visible. The design aims to create flexible spaces while

remaining faithful to the idea of "simplicity" seen throughout the campus. Ecological criteria are considered in the building positioning and one of the main goals is to create a solution that would maximize the benefit of natural sunlight and ventilation. The new design is intended to engage with the campus' collective memory, create flexible spaces that can be shaped by young people instead of rigid spatial solutions and provide a vibrant social life (C. Sevindik & S. Güvendi, personal interview, October 10, 2023, Istanbul). In the entire design, the idea of "multilayeredness" is addressed from a holistic perspective through the historical, social, physical and semantic layers of the area, and with awareness that the layers are the most important components of the collective memory, respecting them and exploring ways to coexist with them today. With the awareness that destruction of memory is tantamount to destruction of a culture, ideas were developed to ensure the continuity of architectural culture in the region, which is a modern architectural heritage site, and these ideas were found successful and suitable for implementation by the jury members.

While the jury of national experts evaluated the design's strengths, they particularly appreciated the design proposal that transforms contemporary social life, as well as the basic principle of the design that respects the existing architectural heritage, urban texture and old layers of New Belgrade. However, since the winning project will enter the construction process, the jury suggested some minor modifications to improve the project's spatial quality and applicability (Union of Architects of Serbia, 2023).

Since there was no project worthy of second prize, two equal third prizes were awarded (referred to as A and B). The first of these prizes (A) was deemed worthy with the basic idea that it contributes to research on student housing. The proposed new dormitory building aims to create contrast with the existing dormitory blocks in the geometry of its circular form. However, the closed off characteristic of the geometric form carries the danger of the new dormitory building becoming an autonomous structure that is separated from the campus. This was seen as a problem as it could create separation in social life. At the same time, it has been stated the circular form, which cannot establish a relationship with the existing architectural heritage, urban texture and layers, does not produce a successful solution in terms of ecology and sustainability. The proposed architectural construction and façade solution was generally evaluated negatively in terms of technical applicability and cost (Union of Architects of Serbia, 2023). Although the design promised a lively student life within the new dormitory structure, it was not successful enough in establishing a relationship with the existing historical background and architectural heritage of the land (Figure 16). At this point, the fact the proposal is shaped independently from the historical layers of the complex was seen as a point that weakened the design (Figure 17).

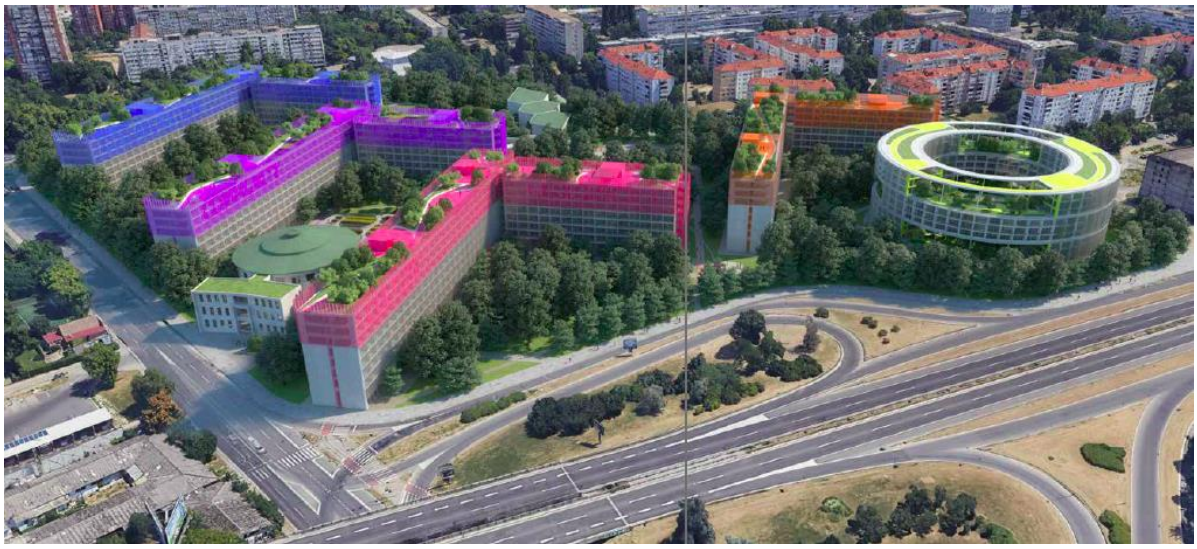

Figure 16. 3D visuals of the design proposal for third prize A (Union of Architects of Serbia, 2023)

Figure 17. 3D visuals of the new dormitory building and existing dormitory buildings for third prize A (Union of Architects of Serbia, 2023)

Unlike the other solutions proposed for the competition, the second project that was awarded the third prize (B) analyses the new dormitory building not in a single mass but in five fragmented masses. The project was evaluated positively for its accessibility on the ground and first floors and its multi-directional design (Figure 18). However, the jury criticized the façades of the new dormitory building for containing a formalist architectural design approach with decorative shapes (Figure 19). Although a positive intention for the utilization of the floor area was understood, it was seen to be problematic in its implementation. Although it is valuable to create a rational improvement plan for the existing buildings and realize this with minimum intervention, it was seen as a deficiency that the proposal was not detailed enough on how it will be implemented (Union of Architects of Serbia, 2023). Although this project relates more to the existing architectural heritage compared to the other third prize project, the new dormitory area is differentiated in the decisions on the ground layout throughout the campus. It was perceived that the relationship of the new dormitory buildings with the existing dormitory buildings is weak. Although the historical layers of the land were considered in the design, the solution was seen as insufficient.

Figure 18. 3D visuals of the design proposal for third prize B (Union of Architects of Serbia, 2023)

Figure 19. 3D visuals of the new dormitory buildings for third prize B (Union of Architects of Serbia, 2023)

When the three prize winning proposals in the international competition are analyzed in comparison with each other, considering the jury's valuable comments, it is seen that the first project differs because it prioritizes establishing a respectful relationship with the historical background and layers, meaning and modern architectural heritage of the land as the first and main goal of the design (Table 1.). The results of this competition are valuable as an indicator of how far the historical overlapping and layering of the space, considering its "palimpsest" feature and shaping it as an important and guiding input of the design, carries the project proposal forward.

Table 1. Comparative design ideas evaluation of the prize winning projects (prepared by the author)

Evaluation Criteria	First Prize	Third Prize A	Third Prize B
1. Consideration of physical traces in site plan decisions	The site plan maintained the same design style in all dormitory blocks. The physical traces of the existing buildings were maintained.	In the site plan, a new circular mass was designed in contrast with the existing prismatic masses. A connection between the circular squares was established in the ground circulation fiction. It could not be determined that the physical traces of the site plan formed input in the design.	In the site plan, new dormitory buildings consisting of five small blocks were designed differently from the existing large dormitory blocks. It could not be determined that the physical traces of the site plan formed input in the design.
2. Consideration of physical traces in the transformation of the existing dormitory buildings	It preserved the existing dormitory blocks as much as possible, but eliminated the problems that make the spaces dysfunctional.	Since detailed information on how the existing buildings will be transformed was not provided, this criterion cannot be fully known.	Since detailed information on how the existing buildings will be transformed was not provided, this criterion cannot be fully known.
3. Establishing a formal relationship with existing buildings in the design of new dormitories	It continued the design approach of the historical dormitory blocks and created a holistic architectural atmosphere on the campus.	The new dormitory building was completely separate from the existing dormitory buildings and designed to be closed inwards as a result of the circular geometric form.	The new dormitory building was completely separate from the existing dormitory buildings, designed in small blocks and with different geometric façade motifs.
4. Creating a common façade throughout the campus	The façade design of the existing dormitory buildings was applied in the newly designed	A common façade form unity could not be achieved throughout the area. The historic	A common façade form unity could not be achieved throughout the area. The historic

	dormitory buildings, creating a holistic visual perception.	buildings were clearly differentiated from the new dormitory building.	buildings were clearly differentiated from the new dormitory building.
5. Social revitalisation by considering the historical meaning and life in open space design	Allocation of the ground floors was entirely to social activities, supporting the streets that will feed the activities with landscaping and creating a pedestrian promenade, which created a strong approach for the campus to regain its prior vitality.	Although the idea of integrating pedestrian passages on the ground with the existing buildings suggested social revitalisation in the open space as in the first project, it was not sufficiently detailed in this project.	Although it was a positively evaluated project in terms of its efforts to create a clear organisation scheme and socially vibrant ground function within the complex, these arrangements were found to be irrational in terms of implementation.

As Andreas Huyssen stated, cities contain complex networks of historical signs that point to their heterogeneous structure (Huyssen, 2003) and these historical markers manifest as urban traces and components of the palimpsest. In its most basic meaning, the fact that palimpsest creates new traces on existing traces that have never disappeared points to a dual situation. The first is to preserve the existing and the second is to construct the new. These two opposite actions contain a contradiction because to create/build something is to make it visible (Botta, 2012). This complexity harbors similar contradictions in the urban space. With the palimpsest metaphor, it conveys that meaningful coexistence of this unity is possible. This coexistence refers to physical and spiritual coexistence. As Freud mentions in his work *Civilization and its Discontents* (2014), an intense relationship exists between spiritual layers and the city/built environment. Collective memory is defined by this network of relationships that individuals establish with urban spaces. In this sense, the palimpsest metaphor expresses the spiritual and physical layers that together make up collective memory. In a built environment created by recognizing and respecting these layers, the sustainability of collective memory can be ensured (Rossi, 1984). This is crucial in terms of enabling the continuation of the society's history and culture.

The components that make up the palimpsest concept, which constitutes this study's idea, are considered an important design input from site plan decisions to the smallest detail of the architectural design in the winning project. In addition, the design is shaped within this framework, which enables the architectural design to be in accordance with the place's spirit, to preserve the collective memory, to enable people to coexist with the traces of the past and to preserve the sense of belonging of the people. The palimpsest approach, which forms the basis of the winning project selected in the international architectural design competition, is also a successful example and guide for future competition projects and architectural applications. This emphasizes the importance of the palimpsest feature in architectural design.

4. Conclusion and Suggestions

Collective memory is a crucial component for the continuity of a city's cultural heritage. It is created, defined and sustained by the environments in which we live. Each layer of the overwritten palimpsest of history has unique significance in a city's history. Therefore, it is one of the most important responsibilities for an architect to sensitively touch a city by reading these traces and recognizing their existence in a respectful design relationship.

Architects can take various approaches when designing historic heritage sites. While this issue is highly political, it also reflects the architect's professional responsibility. The first of these approaches may be demolition of the existing. This approach would physically erase all layers of history and produce a new and context-free design ground. Another approach could be to completely preserve the existing and not intervene with the site. This approach would weaken the use value of the existing building and may cause it to become inactive over time. The right way to design cultural heritage sites is to seek

ways to co-exist with the past. In this way, while collective memory and traces are preserved, new memories can be created. Past and future can be holistically brought together in the same space.

It is undoubtedly valuable to design such heritage sites through international architectural competitions in order to create a quality and sensitive architectural environment, because these sites are international cultural heritages, which shed light on an era beyond national identity and belong to everyone. In this approach, it is important that the Ministry of Education, Science and Technological Development of the Republic of Serbia, the Association of Architects of Serbia and the United Nations Development Unit, which played an important role in organizing this competition with their support, consider this site as a valuable heritage site at the international level and organize an impartial architectural competition open to architects from all over the world.

The results of the jury's work, which was meticulously conducted and contributed by nationally competent academics and experts, emphasize the importance of the palimpsest nature of the spaces that are the subject of the study. The physical overlap in the built environment, the holistic preservation of the traces of history and the respect for this physical layering can be clearly seen in the design of the project, which was selected first with significant difference from the other projects. The jury's comments state and appreciate that living spaces are created in relation to the existing built environment, in accordance with the historical meaning and spirit of the region. With the idea that the spirit of the place is hidden in its layers, the concept of preserving and coexisting these layers adds life to the space with the concept of palimpsest.

This study has shown that the multi-layeredness, physical and spiritual traces of today's cities – in other words, the palimpsest feature of a city – can be effectively preserved and transferred to the future through architectural design. Considering the palimpsest characteristic of space and seeing it as an important component of design – being able to exist in the present with the past without destroying it – is an important responsibility for the architect as a fundamental design approach that connects the past and future, providing spatial potentials. This design approach, which was sustained by the winning project, will provide ideas and guidance to future competition projects, architectural practices and architectural design students.

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Author Contribution and Conflict of Interest Declaration Information

There is no conflict of interest.

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A Liturgical Examination of Lighting and Lighting Elements in Religious Buildings from the Middle Ages to the Present

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Abstract

There have been different historical processes in the use of lighting. It started with a fire in the Paleolithic Period and continued until the Modern Age with lighting elements such as torches, candles, and kerosene. The differences in this process are related to the change in sociological needs and often stem from the form. Especially in the lighting of religious buildings, sociological needs, symbolic narratives, and liturgy were the main elements of differences until the modern age. This research investigates the various forms that lighting elements have taken throughout history, based on different functions, from the Middle Ages to the present. These forms are examined in terms of their liturgical meanings based on their intended use, as well as their requirement for effective symbolic expression in lighting elements as part of the mission they undertake in religious buildings.

Keywords: *Lighting, liturgy, lighting elements, religious buildings, middle ages lighting*.

Ortaçağ'dan Günümüze Dini Yapılarda Aydınlatma ve Aydınlatma Elemanları Üzerine Litürjik Bir İnceleme

Öz

Aydınlatmanın kullanımında farklı tarihsel süreçler yaşanmıştır. Paleolitik Dönem'de ateş ile başlamış olan aydınlatma kullanımı, meşale, mum, gazyağı gibi aydınlatma elemanları ile Modern Çağ'a kadar devam etmiştir. Bu süreçte var olan farklılıklar sosyolojik ihtiyaçların değişimi ile ilgili olup genellikle biçimden kaynaklanmaktadır. Özellikle dini yapıların aydınlatılmasında sosyolojik ihtiyaçlar, sembolik anlatılar ve liturji Modern Çağ'a kadar farklılıkların ana unsurları olmuştur. Bu çalışmada Ortaçağ'dan günümüze kadar olan süreçte işleve bağlı olarak çeşitlilik gösteren aydınlatma elemanlarının dini yapılarda yapının amacına göre üstlendiği misyon ve bu misyonun bir gereği olarak aydınlatma elemanında sembolik anlatımın etkili olabilmesi için aldığı şekiller ve bu şekillerin kullanıma bağlı olarak yüklendiği litürjik anlamlar incelenmiştir.

Anahtar kelimeler: *Aydınlatma, liturji, aydınlatma elemanları, dini yapılar, ortaçağ aydınlatması.*

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1. Introduction

The history of lighting, which is one of man's most basic needs, is at least as old as the history of humanity. This adventure, which started with man's ability to control fire in the Paleolithic era, enabled him to control light and design the environment he was in with this light he could control. According to Talu (2017), this relationship with light was vital for physiological and psychological needs. From ancient times to the present, people have used the power of light to suppress their fears, sometimes to feel safe, and to camouflage or reveal the things around them (Sirel, 2016). Various shapes were tried in buildings to break the effect of the light and protect from the heat coming from the light or to provide optimum benefit from the light while protecting it from the cold outside (Günaydın et al., 2021; Acara, 1997; Çatay, 2002; Küçük & Sümengen, 2022).

The historical process that started with fire continued with torches, candles, and kerosene lighting and later evolved into more modern and different lighting tools with the invention of coal gas and electricity. While electricity and industrialization allowed the production of many different lighting elements, the variation in lighting methods during the Middle Ages was more directly influenced by technological possibilities and liturgical concerns (Gutwirth, 2017; Erdoğmuş, 2008; Acara, 1998). Literature reviews show us that the form of lighting devices brings a symbolic meaning rather than randomness. In this study, the symbolic meanings and forms of the lighting elements and different lightings of historical buildings in Anatolia, which have survived the Middle Ages, will be examined. The authors of the article try to bring a different perspective to the history of lighting.

Lighting, as defined by the CIE (Commission Internationale de L'eclairage: International Commission on Illumination), is the application of light to ensure that the environment and objects can be seen properly (Sirel, 1997). Lighting is grouped under three main headings (Özkaya, 1994).

a. Lighting According to the Illuminated Place: There are two types of lighting, indoor and outdoor, according to the illuminated place.

b. Lighting According to the Origin of Light: Artificial Lighting: It is used when natural lighting (daylight) in buildings is insufficient, or natural lighting is not desired. In addition, it has been observed that natural lighting in historical buildings is sometimes insufficient in the building and negatively affects the function of the building. Thus, when so the existing natural lighting is not used, artificial lighting is used in these buildings. Natural Lighting: It is the type of lighting made with the help of spaces such as windows and doors left in the buildings by making use of daylight. However, since this type of lighting is not sufficient on its own in historical buildings, it is used together with artificial lighting systems. Integrated Lighting: It is a type of lighting that includes the integrated distribution of natural and artificial light.

c. Lighting According to the Purpose of Establishment of the Lighting System: One of the most important factors to be considered in lighting applications in historical buildings, following the function and quality of the building, is the quality and quantity of lighting. In the quality of the lighting, all the details that must be seen should be visible, the surface and texture forms should be perceived correctly, the colors should be well chosen, and looking at the illuminated objects for a long time shouldn't tire the eyes. In the quantity of lighting, the amount of illumination of the building or objects is determined. The types of lighting systems can be categorized based on their intended purposes into three main types (Özkaya, 1994). These can be listed as physiological lightning, decorative lightning, and remarkable lightning. Physiological Lighting: It provides the realization of the conditions related to the light composition, distribution, and intensity required by the eye physiology to see objects with all their real qualities, in a short time, without getting tired. Decorative Lighting: It aims to show the objects in shape and form in a way that can give the designed aesthetic effect. Remarkable Lighting: It aims to draw the observer's attention to an object or event, as seen in Figure 1.

Figure 1. Holy fathers orthodox church England - an example of striking illumination (Hart, 2015).

2. History of Lighting

While referring to the history of lighting, the important elements, places, and dates from the past to the present can be summarized as follows.

Elements used:

a. Torch: The torch, also called a kindling lamp, is a primitive lighting device made by attaching a kindling or other easily flammable wood to an iron pole. It is also called Detal, Helene, Daldes, and Lophnis (Çokay, 1996).

b. Mine and glass lamps: They usually consist of a bowl-shaped oil tank, a hole or wall created for the wick to come out, and an arm or ears for carrying (Sirel, 2016). The oil is usually sulfurous olive oil, and the wick is papyrus or oakum. The religious use of the torch by Demeter and Persephone in Eleusis ceremonies became widespread (Çokay, 1996). With the depiction of Prometheus bringing the fire employing a torch, the renewal of the sacred fire in the festivities held in the name of Athena and Hephaestus occurs through the torch brought by running from outside the city (Thomson, 1990). Even today, the torch carries the Olympic flame (Şentürk & Özdilek, 2007).

c. Kerion/Keros/Candela/Sebare/Cerea: They are candles and candle lamps. After the 7th century, oil lamps were replaced by candle lamps in Istanbul (Kuban & Toprak, 1994).

d. Lykhnouhoi: These are the statues carrying torches or candles (Çokay, 1996).

e.Laterna/Lampeter/Phanos/Hypnos/Lanterna/Mykonos/Phanaria: Today, these tools protect the candle or oil lamp inside from external factors, and they are made with the lantern logic (Çokay, 1996).

f. Oil lamps and candlesticks: For centuries, candles and oil lamps have been used for lighting in residences in Istanbul. In Istanbul, the first glass oil lamps appeared in Turkish baths, mosques, and similar places. After the 16th century, oil lamps were made of brass, bronze, silver, gold, or copper (tombak) polished with mercury. As seen in Figure 2, oil lamps consist of five parts; the body containing the oil reservoir, the nose where the wick is placed, the mirror, the shoulder surrounding the mirror, and the handle opposite the nose (Çokay, 1996). Parts of oil lamp, as seen in Figure 2.

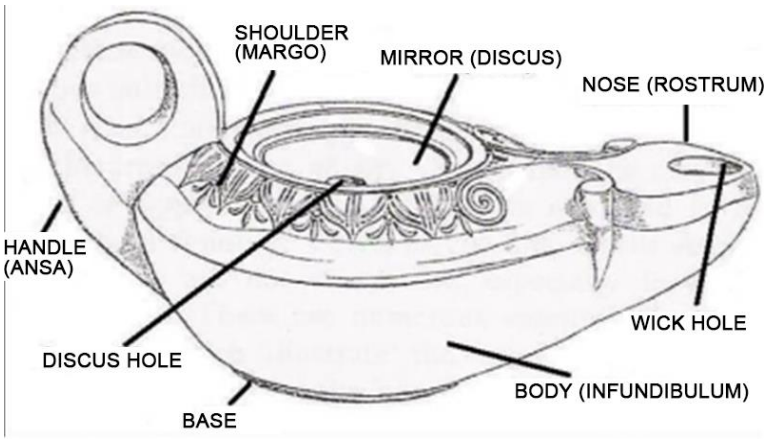

Figure 2. Parts of oil lamp

g. Polycandelon/polykandelon/polycandela/polykandela: They are chandeliers made of highly waxed glass and metal (Sirel, 2016; Acara Eser, 2000). As can be seen in Figure 3, either the polykandillions or the chains of them are embroidered with many symbolic meanings.

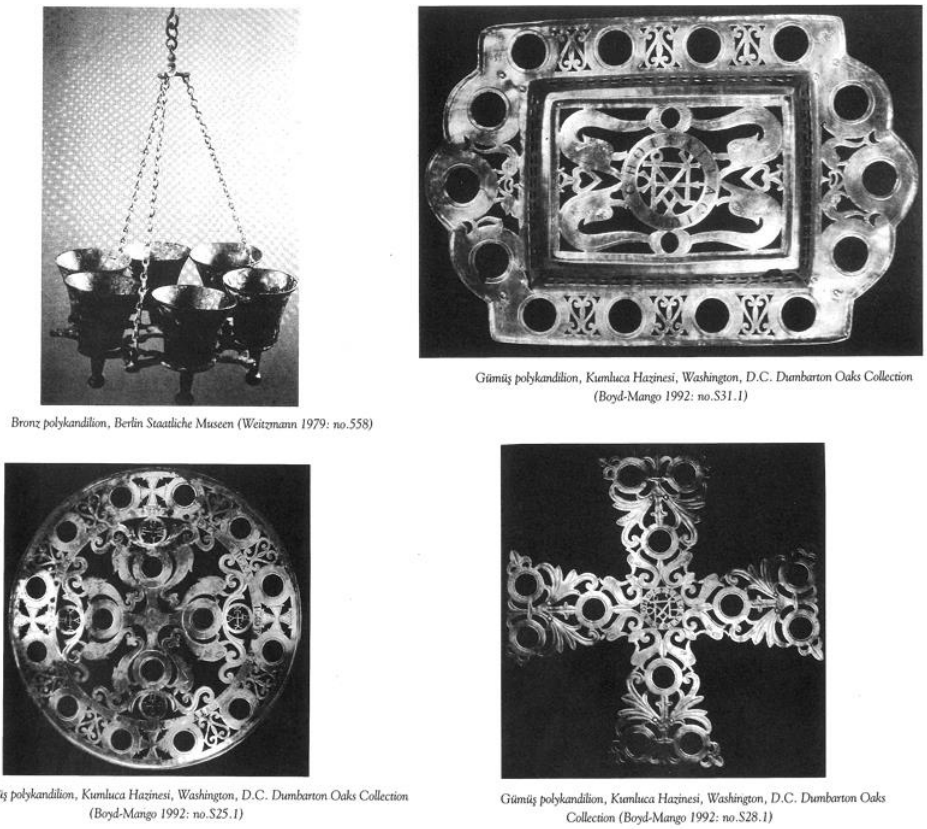

Figure 3. Polykandillion details (in order from left to right, Weitzmann, 1979; Boyd et al., 1992; Boyd et al., 1992; Boyd et al.,1992; cited in Acara, 1997)

h. Candelabra: Large candlesticks used in church altars that sit on the floor; in other words, candelabra, are mostly made of silver (Sirel, 2016). They are placed in the Candelabrum, which functions as a carrier plate that raises the walls from the ground to illuminate them (Çokay, 1996).

I. Kaniskia: It is a different oil lamp. Lanterns with many oil lamps are hung around the church (Sirel, 2016).

j. Spermaceti wax: Spermaceti wax, made with oil extracted from a whale's head, replaces those made with tallow in the early 19th century. Spermaceti means whale in Latin and Greek (Kuban & Toprak, 1994).

Kuban & Toprak (1994) briefly expressed the important times for lighting as follows: When the Spermeçet candle factory was established in Beykoz in 1863, two types of light sources were used in mosques. Large candlesticks placed on both sides of the mihrab and chandeliers hung on the dome with chains corresponding to the polykandelon of the Byzantine period, which is the main light source of the mosque, are also called cannon oil lamps. The root of the word "chandelier," which is used to mean a large oil lamp, comes from Persian and means "hanging up" (Kuban & Toprak, 1994).

Although not certain, Hatay's Kurtuluş Street, formerly known as Herod Street, is the first street to be illuminated worldwide (Dönmez & Uşma, 2023). In Figure 4, important places and dates for street lighting from past to present are expressed (Sirel, 2016).

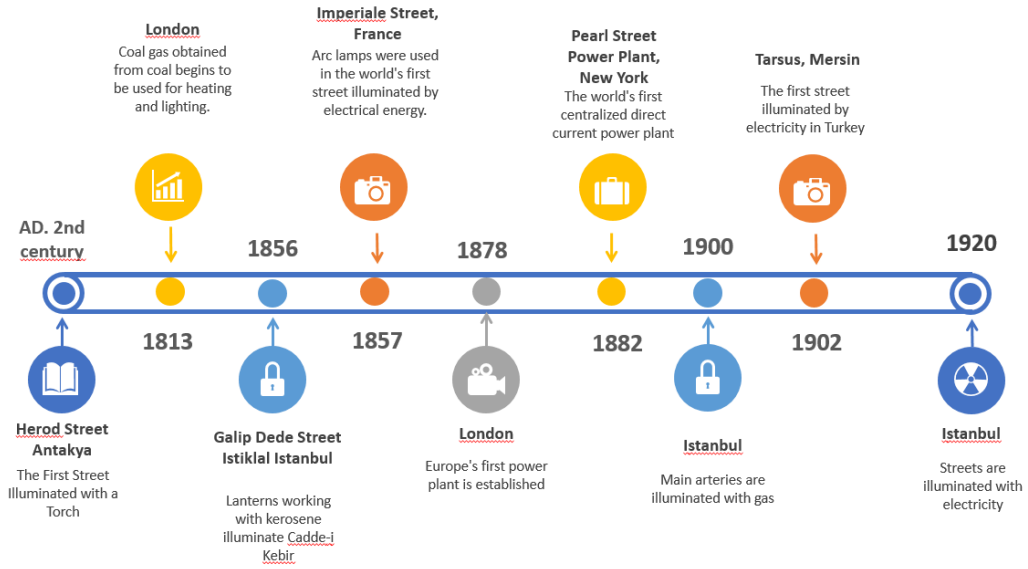

Figure 4. Important years and places for street lighting

Coal gas obtained from coal in 1812 was used for lighting in London in 1813. In 1870, small buildings started to be illuminated with the dynamos developed by the Belgian Z. Gramme. On September 4, 1882, Thomas Edison activated the Pearl Street Power Plant in New York and changed the direction of the lighting (Thomas Edison Lightbulb, 2020). By 1878, Joseph Wilson Swan and Thomas Edison accelerated the production of lamps working with electrical energy. Thomas Edison applied for a patent in 1879 for the lamps he made using high vacuum and carbon filament and was entitled to receive a patent (Joseph Wilson Swan, 2020). Figure 5 shows the development of lighting elements from the past to the present (Sirel, 2016).

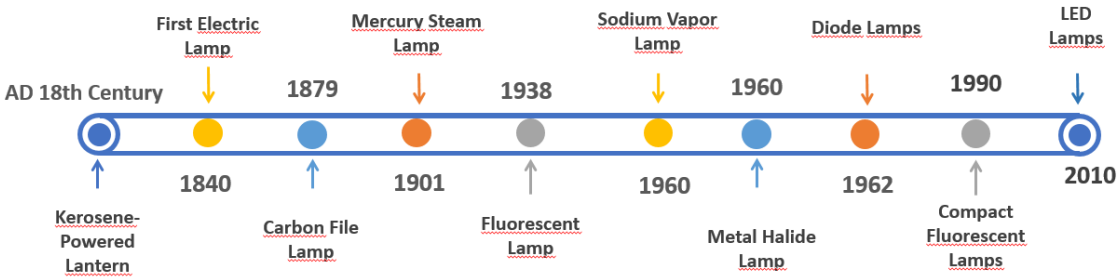

Figure 5. Development of lighting elements

The Ottoman Sultan Abdülmecid built a gas station in the Dolmabahçe Palace in 1853. Dolmabahçe Gazhanesi, built by a French company behind the palace, is the first gas house built in Istanbul by the sultan's order. All the chandeliers and sconces of the palace were lit with gas. The surplus of production at the Dolmabahçe Gas Station, affiliated to the Hazine-I Hassa (private treasury of the Ottoman sultan), was used to illuminate the city in 1855 with the initiative of the Şehremaneti. In 1856, the

streets in Beyoğlu started to be illuminated with gas lamps (Dolmabahçe, 2006). Today's first illuminated streets are Istiklal Caddesi (Cadde-i Kebir) and Galip Dede Caddesi (Kuban & Toprak, 1994). In 1870, the French established Kuzguncuk Gazhanesi and then Yedikule Gasworks in 1881. Hasanpaşa Gazhanesi was established in Kadıköy Kurbağalıdere in 1891 (Engin & Gülsoy, 2016, p. 16-17). In the 1910s, there were 3943 street lamps or street lanterns in Istanbul. After the 1910s, coal gas serving only the heating field was produced and distributed by private companies with foreign capital. The production and distribution business was transferred to IETT in 1945 with the transfer law numbered 4762. With the transfer of Beyoğlu Poligon Gas Factory, whose concession expired in 1984, İETT became a monopoly in gas production and distribution. Coal gas was completely disposed of in 1993 due to the backwardness of the technology related to natural gas and the introduction of natural gas (Havagazı, 2020). In Figure 6, the chronological chart of the important facilities established in Türkiye, which is important for the history of lighting, is given (Dolmahçe, 2006; Sirel, 2016).

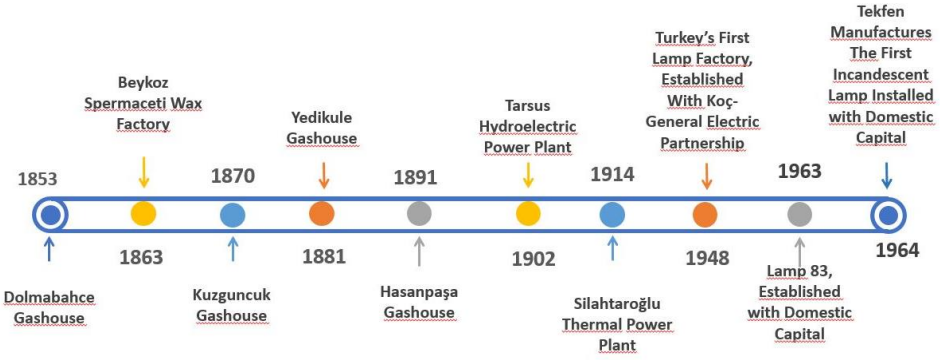

Figure 6. Lighting facilities established in Türkiye

When the first "mercury lamp" was made by Peter Cooper Hewitt in 1901, it emitted a bluish light. It was a new lamp that produced light with a very different technique than an incandescent lamp. Due to its yellow light, the low-pressure sodium vapor lamp produced later was used in a limited outdoor lighting area. Another discharge lamp, the "high-pressure sodium vapor lamp," known in the market as discharge lamps, was introduced in the 1960s. Because its light color was better than "high-pressure sodium vapor" lamps, High-Pressure Mercury" or "Low-Pressure Sodium Vapor" was used especially for road lighting, outdoor lighting, and to a lesser extent, indoors (Çavdar, 1996). A chronological chart of important developments in terms of lighting activities is presented in Figure 7 (Sirel, 2016).

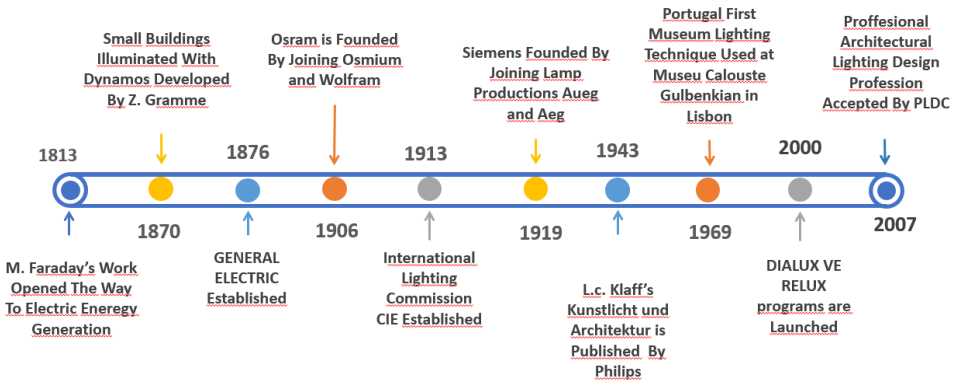

Figure 7. Important lighting activities developments in the World

Since electricity is energy-saving, companies realize that its arrival will decrease the demand for gas, which conflicts with their interests. Considering all these factors, the government is laboring to generate electricity in Tarsus, in an area outside İstanbul for the first time. Established in Tarsus in 1902, a hydraulic power plant started to produce electricity. Electricity was supplied to Tarsus for the first time on September 15, 1902, from the hydroelectric power plant established in the Bentbaşı area

of the Berdan River by the Austrian Dorfs who worked in the Tarsus municipality at that time. Tarsus streets were illuminated first by the electricity produced. The first houses illuminated by electricity were the houses of Müftuzade Sadık Pasha and Kadi Yakup Efendi (Çavdar, 1996). In the Ottoman Empire in 1910, with the enactment of the law called "Benefit-i Umumiyeye Müteallik Privilege," the state opened a tender for establishing a power plant with its initiatives for electricity generation. The Austro-Hungarian capital Ganz Electric Company won this tender and bought the electricity generation-distribution concession from the state for the Rumeli Region for 50 years (Çavdar, 1996). Figure 8 presents a chronological order of important developments in terms of lighting in Türkiye (Sirel, 2016).

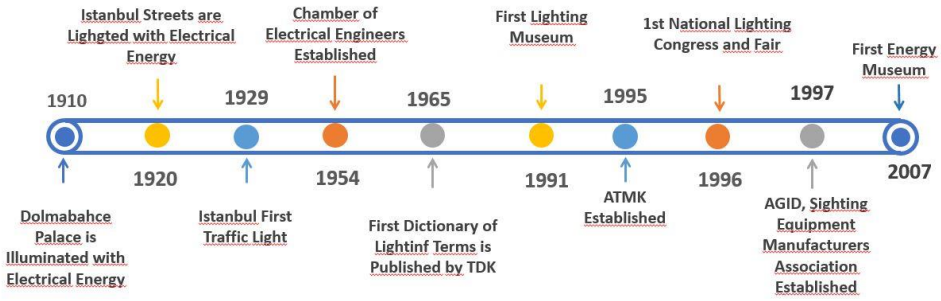

Figure 8. Important developments in Türkiye on lighting

3. Liturgical Characteristics of Lighting Systems Used in Religious Buildings

Civilizations living in Türkiye have left many religious structures that can be considered cultural heritage, reflecting their periods of existence. Interior and exterior lighting elements and artificial and natural lighting techniques that have survived to the present day with religious buildings are also our cultural heritage. The most important point to be considered in interior and exterior lighting in religious buildings is to understand the links between these structures and their symbolic. In religious buildings, two types of lighting are used according to the function of the building and the origin of the light. These are natural and artificial lighting systems. The emphasis on sacred images comes naturally from the oil lamps hanging in front of the icons as the only artificial light source. The weak light given off by the wicks is enough to illuminate the faces of the saints. This weakness of oil lamps and candles is precisely their strength. They only burn the icon and do not illuminate the surrounding area. When looking at the etymological origin of the word Liturgy, which means "rite-worship" in Greek, it means "any service for a common welfare," but in the definition of the church, it is expressed as "a public worship of the church" (Falconer, 2017; Acara Eser, 1997; Ateş, 2021). Today it is widely used in the sense of religious symbolism.

Cassirer (1979) expresses the importance of light and light in developing religious consciousness with these words: "The development of the mythical sense of place is based on the opposition of day and night, light and dark. The dominance of this opposition over mythic-religious consciousness is seen even in the most developed cultural religions." For example, we see Cassirer's belief, in the idea of the universe that emerged from two opposite concepts in Greek mythology, such as Chaos and Cosmos. While drawing attention to the importance of contrasts with the symbol of yin-yang, which is of great importance in Far Eastern philosophy, the principle that life exists with intertwined contradictions is handled (Kılıç, 2005). In Manichaeism, which is extremely important for Turkish culture, the metaphor of light and dark is frequently mentioned with the influence of dualism; light represents power, wisdom, and God, and darkness represents the devil, hell, and evil (Koç, 2020).

According to Cassirer (1979): "As in the case of the Iranian religion, each of these religions can be shown as a perfect development independently of the other, that is, as a global systematization of this opposition. However, even when the idea of difference and contradiction is represented at the dialectical peak, not in determination, this opposition can be considered as one of the hidden motives that are effective in the religious construction of the universe. However, in the creation myths of almost all religions and peoples, the creation process is directly associated with the enlightenment

process. In the Babylonian creation myth, the world is born out of war; Marduk, the God of morning and spring sun, wages this war against the darkness and chaos represented by the monster Tiamat. The victory of the light constitutes the beginning of the world and world order. The Egyptian creation story has also been interpreted as imitating the daily sunrise phenomenon. Here the first act of creation begins with the formation of an egg emerging from the original water. From this egg is born Ra, the God of light; Many different expressions represent its emergence. However, all these explanations are based on the first fact that light originates from night by refracting it. How the awe-inspiring contemplation of this first fact influenced the Jewish creation story and how this contemplation gave its concrete "meaning" to the creation story no longer demands explanation after Herder underlined this relationship and described it in a wonderful and clear linguistic expression". The light of the Menorah, which is also another important notion in Jewish symbolism, symbolizes God (Shemesh, 2020). The Menorah, which will be encountered in synagogues, has become one of the seminal figures of Judaism. The difference from Hanukkah, a 9-branched candlestick used liturgically on the Jewish holiday Hanukkah, is that the Menorah symbolizes the reference to the world's creation in seven days. It veches the luminous and irrepressible divine spirit. On the other hand, Hanukkah is a nine-branched candelabra that is burned with solemn rituals. The branch named Şamaş in the middle is also important, and the order of lighting the candles in the other arms, the burning time, the prayers to be made while burning, and the prayers to be made after they are burned are performed with serious rituals (Hanuka Kuralları ve Yorumlar, 2020; Sönmezer, 2004; Atasağun, 2001).

According to Cassirer (1979): "Herder's ability to place every mental thing not only in the sense of seeing it as products, but in the creative process from which the product's appearance originates, is perhaps most powerful and is perfectly seen only in the interpretation of the first chapter of the Torah. Here, the explanation of the birth of light is the representation of the world's creation. Likewise, the mythical mind re-experiences the world's creation with light at the beginning of every dawn and the birth of every new day. Heraclitus said, "The sun is new every day" is an expression expressed in the mythological mind. In the progression of mythical thought, the contrast of light and dark, day and night, appears as a lively and effective motif. The evolving understanding of the difference between night and day, light and dark, is the most sensitive point in the development of human culture. In "The Names of God," Userer says: "The glory of Light permeates every part of human existence. The main qualities of the glory of light are common to all members of Indo-European societies. They are indeed rich in these qualities; we rule this day mostly unconsciously. Sunlight makes us halfway—awaken from sleep, which is a state of death, to live. "Look at the light," "see the sunlight," and "to be in the light" means to live. "To reach the light" is to be born, and "to lose the light" is to die. Even in Homer's Epic, light is sacred and is salvation; Euripides sees the light of day. Call it "pure."

The construction and layout of the medieval church building reflect the characteristic lines of the symbolic expression of the sky aspects, which are also important for the mythical sense of place. The sun and light are no longer divinity itself. However, they always function as the most immediate and direct manifest signs of the divine, divine redeeming-willing, and divine redeeming power. Christianity's effectiveness and historical victory are due to its ability to absorb and change the pagan idea of reverence for the sun and light." As seen in Figure 9, Holy Ascension Orthodox Church and light.

Figure 9. Holy Ascension Orthodox Church and Light. Photograph by Andrew Gould (Hart, 2015).

According to Hart (2015), A church interior should give the feeling that it is a different place, a sacred space, not from the outside but still separate from the outside world (Hart, 2015). If the interior lighting is as intense as daylight or like a well-lit workplace, then we are reminded that this is a place setting side. One might think of underlighting as "bringing life where it flows" (Ezekiel 47: 9), where the light of the resurrection is refracted, or the mouth of a spring from which the water of life springs forth." As seen in Figure 10, control of natural lighting in Hagia Sophia.

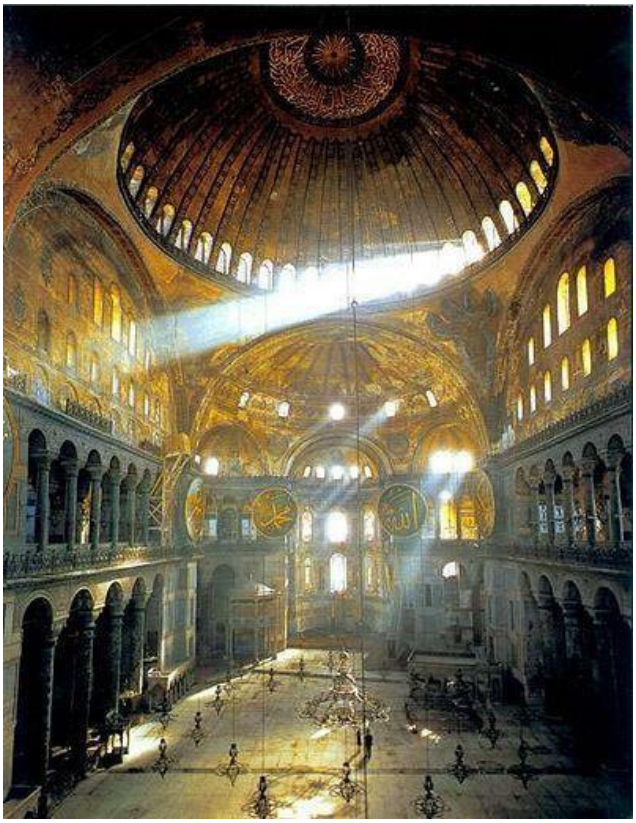

Figure 10. Control of natural lighting in Hagia Sophia (Hart, 2015)

In mosques, on the other hand, the structure in which all surfaces are visible provides the maximum benefit from natural light by arranging the space in a single area where everything can be seen immediately. As seen in Figure 11, interior illuminance level in Suleymaniye Mosque.

Figure 11. Interior illuminance level in Suleymaniye Mosque

There is a mutual interaction between liturgy and architecture in churches. While liturgical influences are clearly evident in the architecture of Early and Middle Byzantine Anatolia, they manifest themselves in the details of the architecture developed after the Iconoclast Period. Architectural details observed especially in churches continue to reflect periodic differences. Ultimately, the liturgy, which underwent a significant transformation with the end of the Iconoclast Period, impacts architecture in various details (Kaya, 2024). In Christianity, different meanings have been attributed to the number of oil lamps: for example, the presence of three oil lamps is a reference to the holy trinity, and the number 12 is a reference to the apostles (Bağbaşı, 2020). Archaeological evidence and detailed descriptions show the importance of oil lamps in sacred areas and religious liturgy (Çakmakçı, 2017). As seen in Figure 12, processing of lettering and cross figures on lighting elements.

Figure 12. Processing of lettering and cross figures on lighting elements (Hart, 2015)

Light as a symbol has a wide place in the Muslim-Ottoman culture and Christian-Byzantine culture. An example of it can be seen in Mehmet Akif Ersoy's poem that he wrote for the Martyrs of Çanakkale. In the poem, "Sureyya with the chandelier and seven lamps hung on the graves of the martyrs" symbolizes the Ülker group (star cluster) consisting of seven stars in the Taurus Sign (Kuban & Toprak, 1994). Religious buildings and tombs are illuminated, and vows are made with candles. In Bektashi

lodges, twelve-sided lamps (sebçerağ) are lit for the twelve imams, and the word "candile," the main light source of those times, has a wide place in daily life or literature. As seen in Figure 13, sebcerag/sebcirag example.

Figure 13. Sebcerag/ sebcirag example (Hart, 2015)

Acara Eser (2000), drawing attention to the liturgical meaning of lighting in the Middle Ages, noted the following (Acara Eser, 2000): "The light, the Sun, is Jesus, which has an important place in daily life and the church because of its function and symbolic meanings. Jesus says, "As long as I am in the world, I am the light of the world" (John 9:5). In addition to light, the means of illumination also have a symbolic meaning; The earliest dated source giving information about illumination in the Byzantine period is the poem by Paulos Silentirarios, in which he describes the opening of the Hagia Sophia church in Istanbul in 563 (Descripto S. Sophiae). In this poem, the author defines "stars of heaven" while describing the oil lamps hanging from the dome (Jabi & Potamianos, 2007; Potamianos, 2019; Crowfoot & Harden, 1931). In the 7th century, Sophonius of Jerusalem said that oil lamps and candles symbolize eternal light in his liturgy. The archbishop of Thessaloniki and the church writer Simeon commented on the symbolic meanings of the lighting in the church; The stars of the lamps hanging on the vaults, the candles, and the correctness and divine light of the lamps indicate that the lamp in the altar symbolizes the church and that there is a correlation between the light in the church and the holy light (Talloen et al., 2017; Galavaris, 1978). He also mentions that the three-light lamps represent the holy trinity, the seven-light lamps represent the seven virtues, and the twelve-light lamps represent the twelve apostles (Bouras, 1982)."

Although the oil lamp is mentioned in many verses, the lamp/light source has different meanings metaphorically:

In verse 13 of Surat an-Naba, the oil lamp is likened to the Sun: "(We made seven layers of solid heaven above you.)…We created an illuminating and warming lamp there."

In the 5th verse of Surah Mulk, the oil lamp is likened to the Star: "We have adorned the nearest sky with lamps. We made them stones thrown at the devils and prepared for them the punishment of flaming fire (in the Hereafter)."

In verse 46 of Surah Ahzab, the Prophet is metaphorically likened to an oil lamp: "O Prophet! We make a witness, a giver of good news, a warner; By Allah's leave, we sent him as a caller to his way and as an illuminating lamp."

In the 35th verse of Surah Nur, the lamp represents Allah's light: "Allah is the light of the heavens and the earth. An example of his light is a lamp holder with a lamp in it. The lamp is in a glass, a star like a glass pearl; (This oil lamp) is lit from a blessed olive tree, which does not belong to the east or the west, whose oil gives light almost even if the fire does not touch it. Light upon light. Allah brings to His light whom He wills. Allah gives examples for people, and Allah knows everything."

In Sufism, oil lamps, candles, and the moon are symbols illuminating the night and darkness (Erol, 2021). The lamp motif is associated with the concept of "light."

Erol stated that the figure of the oil lamp is referred to as "Çerag" in sects and Sufism and has different liturgical meanings (Erol, 2021): "In the Bektashi sect, oil lamps/crags have some special names: for example, Taht-i Muhammedi: While eating twelve candles, representing the twelve imams, in front of it, there is an oil lamp with three wicks in the shape of a crown with a twelve-slice cover called "Kanun Çerağı" or "Horasan Çerağı." The three wicks represent "Allah-Muhammad (s.a.v)-Ali." The only oil lamp at the entrance to the Bektashi square is Hz. Ali symbolizes the light of (Tanman, 2014, p. 405)."

In Sufism, the figure of oil lamps is often depicted and engraved on prayer rugs and test tubes. Oil lamps represent divine light, wise people, or wisdom. Large oil lamps hanging on the prayer rugs, small oil lamps on the sides symbolize the sheikhs, and flowers symbolize the sect's followers (Bayraktaroğlu, 2021). As seen in Figure 14, felt prayer rug and oil lamp motifs are found in Bursa Üftade Lodge. (Photo archive of Directorate General of Foundations; cited in Bayraktaroğlu, 2021)

Figure 14. Felt prayer rug and oil lamp motifs are found in Bursa Üftade Lodge. (Photo archive of Directorate General of Foundations; cited in Bayraktaroğlu, 2021)

4. Conclusion and Suggestions

The differences in lighting and lighting tools from the Middle Ages to the present are different due to the tradition of transferring value judgments with symbolic expression.

The number of lamps in the polykandilions chosen in the liturgical sense is like the narrative space. An attempt was made to preserve the mystery by creating a voluntary dimness in the churches. The light is designed to have a dim ambience at all hours of the day by taking natural light controlled by the saints who are valued in the symbolic narrative. It is thought that this dim ambience pushes the person to relax psychologically. Embroideries and decorations preferred in the Middle Ages are not preferred in lighting elements today. This is due to the transition of lighting fixtures to fabrication production with industrialization.

While a dim ambiance is achieved in churches, the effort to keep the brightness level at maximum in mosques, on the contrary, necessitates the use of natural lighting and the interior setup with the highest level of illumination.

This sense of spaciousness in mosques is like the meeting of Surah Inshirah with architecture. Inshirah means “to open and expand, to attain peace” (Karaman et al., 2007). In mosques, natural and artificial lighting elements are used for an immense sense of space. With a need for extremely clear and understandable surfaces, mosques remove all the ambiguity from the space and emphasize the sense of spaciousness, which differentiates from the churches. Even in Süleymaniye, structurally affected by Hagia Sophia, the interior lighting setup makes itself felt even in the distinctions brought by beliefs such as mystery, spaciousness, light path, and the beam of light, giving the user two completely different feelings of light. Therefore, parameters such as the use of lighting elements in the space and the level of luminosity cannot be considered independently of the liturgy and anxiety of the space. This is why the two worshiping buildings, which function equally, differ so much in lighting, even if the

number of users and interior volume is the same. Therefore, while considering the visual comfort standards, the liturgical concern of the space should not be ignored (Jabi & Potamianos, 2006).

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Spatial Perception: A Critical Bibliometric Inquiry

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Abstract

In this study, it is aimed to answer the research question "what is the place and status of architectural research in perception studies?". At the same time, determining the validity of the VOSviewer program, which is widely used for systematic bibliometric analysis, within the scope of the study constitutes an indirect secondary objective of the research. In this direction, two consecutive bibliometric analyses, each with a different depth, were conducted to see the range of spatial perception studies and to explore its sub-expansions. In this context, two keyword groups were created for the first two phases of the study. Document type and category were restricted to determine the research framework. In this framework, the studies identified in the first phase (n=2727) and the second phase (n=243) were transferred to the VOSviewer program for bibliometric analysis and analyzed. In the last phase of the study, a flow-quantity diagram was created for the article studies identified in the second phase using the Sankey diagram generator (n=92). When the studies scanned in Web of Science were analyzed, it was found that the studies involving the concepts in the research framework were mostly related to the concept of comfort and the least related to the concept of happiness.

Keywords: *Spatial perception, bibliometric analysis, content analysis, architecture, multidisciplinary psychology.*

Mekânsal Algı: Eleştirel Bir Bibliyometrik Sorgulama

Öz

Bu çalışmada ‘‘algı çalışmaları içinde mimarlık araştırmalarının yeri ve durumu nedir?’’ araştırma sorusuna yanıt verilmesi amaçlanmıştır. Aynı zamanda bibliyometrik analizlerin sistematik olarak gerçekleştirilmesi noktasında yaygın kullanıma sahip olan VOSviewer programının çalışma kapsamındaki geçerliliğinin saptanması da araştırmanın dolaylı yoldan ikincil hedefini oluşturmaktadır. Bu doğrultuda mekânsal algı araştırmalarının yelpazesini görmek ve alt açılımlarını keşfetmek üzere her biri farklı derinlikte olan ardışık iki bibliyometrik analiz gerçekleştirilmiştir. Bu kapsamda çalışmanın ilk iki aşaması için iki anahtar kelime grubu oluşturulmuştur. Araştırma çerçevesini belirlemek üzere doküman türü ve kategori sınırlaması getirilmiştir. Bu çerçevede ilk aşamada (n=2727) ve ikinci aşamada (n=243) tespit edilen çalışmalar bibliyometrik analizlerini yapabilmek üzere VOSviewer programına aktarılarak analiz edilmiştir. Çalışmanın son aşamasında, Sankey diyagramı oluşturucusu kullanılarak ikinci aşamada belirlenmiş makale çalışmaları özelinde bir akış-miktar diyagramı oluşturulmuştur (n=92). Web of Science'ta taranmış olan çalışmalar incelendiğinde, araştırma çerçevesindeki kavramları içeren çalışmaların en çok konfor kavramı ile, en az ise mutluluk kavramı ile ilgili olduğu saptanmıştır.

Anahtar kelimeler: *Mekânsal algı, bibliyometrik analiz, içerik analizi, mimarlık, çok disiplinli psikoloji.*

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1. Introduction

Although architectural space design depends on many elements, the most important reference point is the ‘‘human being’’. ‘‘Space constantly encompasses our being. Through the volume of space, we move, see forms, hear sounds, feel breezes, smell the fragrances of a flower garden in bloom. It is a material substance like wood or stone. Yet it is an inherently formless vapor. Its visual form, its dimensions and scale, the quality of its light—all of these qualities depend on our perception of the spatial boundaries defined by elements of form’’ (Ching, 2015, p.100). As supported by Ching, architectural space represents a specific area consisting of elements such as form, material, texture, and color within certain boundaries. Although this space comes to the forefront with its physical quality in terms of separating people from environmental conditions, protecting them in a sense and allowing them to perform certain tasks, it is also of great psychological importance because it affects the moods of the individuals in it. This situation actually reveals the importance of the concept of space perception.

As a result of the inevitability that the physical and psychological effects of architecture are interrelated, spatial perception based on the relationship established with climatic and environmental conditions, as well as the elements that make up the architectural space, positively or negatively affect human physiology and human psychology. For example, a dwelling that lets in the sounds of nature can positively affect the mood, while a dwelling that lets in only street and vehicle sounds will require sound insulation. Indeed, there are empirical studies that provide evidence that living in natural environments has psychological and physiological benefits compared to living in the city. One of these studies was conducted by Zhang, Tan & Yuan (2023). In their study, changes in the psychophysiological state of participants who normally live and study in the city were compared with those who entered a forest environment, and it was found that a natural forest environment had a positive effect on human psychophysiology (Zhang et al., 2023). In terms of the built environment, green buildings as a sustainable urban form can contribute to social sustainability as well as environmental sustainability by promoting people's well-being and pro-environmental behavior (Zhang & Yong, 2021). Similarly, thermal insulation needs may vary according to climate and season. At this point, it is possible to say that thermal comfort is affected by both environmental and psychological factors (Tan, Chung, Roberts & Lau, 2019). Moreover, even the ventilation type of a building in terms of thermal comfort affects the behavioral adaptations and psychological adaptations of the users of that building (de Dear & Brager, 1998). In addition, traditional and cultural habits and environmental harmony are other factors affecting perception. ‘‘Just as it is perturbing when our buildings deny their settings, so it can be pleasurable to find evidence of the opposite tendency’’ (Botton, 2006, p.221). In addition to the perception of the built environment, the perception of landscape can also change depending on cultural identity. ‘‘Socio-cultural factors, that are decisive for cultural identity and socio-cultural background, together with biological and psychological factors influence landscape perception and evaluation’’(Kamičaitytė, Grazuleviciute-Vileniske & Gadal, 2019, p.72). Even, spatial perception, which is a cognitive skill that can develop throughout life and is influenced by many different factors, can also vary depending on the expertise of individuals (Mertins, Danhier, Mertins, Schulz & Schulz, 2019).

Considering all these issues, it is seen that human perception of space depends on many variables for an ideal space design. This situation reveals how important the concept of spatial perception is in the design of an architectural space. In this context, the main purpose of this study is to determine the place and status of architectural studies within perception studies. The secondary purpose of the study is to question the validity of the Vosviewer program, which is frequently preferred for systematic bibliometric analysis, within the scope of the study. For this purposes, the Web Of Science database, VOSviever program and SankeyMatic diagram generator were used to see the range and sub-expansions of the studies on the subject of ‘‘spatial perception’’; the literature on the subject was examined within the framework of the limitations created by using the first and second keyword group.

Thanks to this study, a situation assessment has been realized by systematically looking at spatial perception research, which has a very wide range, from the intersection of architecture and

multidisciplinary psychology disciplines. In addition, this bibliometric determination will also guide the future studies on spatial perception.

1.1. Bibliometric Analysis-Space Studies

Spatial perception is related to many disciplines besides architecture. In this respect, it is inevitable that studies on the subject have been conducted in different disciplines with different methods and perspectives. In the field of spatial perception, there are relatively large-scale studies on urban design or landscape perception, as well as studies related to different building types at the architectural scale. In addition, with the effect of today's developing and widespread technology, studies on virtual spaces prepared by utilizing virtual reality are also increasing. There are many studies in the literature on the perception of spaces in individuals in related fields such as psychology as well as architecture. The diversity of these studies and the fact that they are related to more than one field makes it difficult to analyze these studies with a conventional research method. In this respect, it is very important to analyze the literature data systematically with a relatively general perspective and to look at the issue of spatial perception from the intersection of the interrelated disciplines of architecture and psychology in order to guide future studies.

Pritchard states that bibliometrics is the application of mathematics and statistical methods to books and other media of communication (Pritchard, 1969). Bibliometric research, which examines study patterns using quantitative analysis and statistics, can be descriptive in the form of revealing how many articles a particular organization has on a particular subject, or evaluative in that it can provide data on how a study affects subsequent researchers by conducting citation analysis (McBurney & Novak, 2002). In this respect, bibliometrics refers to the quantitative analysis of the relationships between documents, authors or sources such as journals in order to show the productivity, quality or impact of an individual investigator or research team (Carpenter, Cone & Sarli, 2014).

If scientific analysis is handled in a conventional way, it is possible to encounter some limitations (Varshabi, Arslan Selçuk & Mutlu Avinç, 2022) and difficulties in terms of screening due to the increase in the number of academic publications. In fact, a conventional bibliography simply describes the structure of humanity's accumulated knowledge on a given subject to date and it kind of ignores the relationships between the studies examined (Garfield, 1983). For this reason, it is possible to say that it is difficult to carry out traditional literature surveys meticulously and completely (Snyder, 2019). However, ‘‘The bibliometric method facilitates the investigation of the relationship between research collaboration and variables pertaining to the research problem and the research environment, by applying statistical techniques such as regression, correlation, and factor analysis’’ (Subramanyam, 1982). In this respect, it is possible to say that literature reviews handled with bibliometric analysis method enable faster and more effective data collection.

Additionally, bibliometric analyses also provide an opportunity to make observations using visualization. Bibliometric mapping, which can also be called science mapping, is a spatial representation of the relationships between disciplines, fields, specialities, individual papers or authors, similar to the way geographical maps show physical and political relationships (Small, 1999). In this study, a bibliometric analysis study was conducted in which visual data from article studies related to the subject of spatial perception were also obtained.

2. Methodology

A two-depth three-phase method (Figure 1) was used to conduct a systematic bibliometric analysis to determine the place and status of architectural studies among the wide range of perception studies investigated by the discipline of psychology.

Accordingly, after the first phase, which was carried out to see the range of these studies by looking at spatial perception studies from a general perspective within the framework of the research question in order to evaluate the scientific literature in the context of spatial perception, a second phase was needed to determine the range of studies on the responses of users/perceivers who experience the space in order to explore the sub-expansions of spatial perception studies. A third phase was needed for the content analysis of the studies identified in the second phase. The interpretation of the validity

of the VOSviewer program at the point of bibliometric analysis within the limits of the research is given at the end of the analysis comments in the discussion section. In this framework, the research questions to be answered on the studies on spatial perception in the categories of architecture and multidisciplinary psychology are as follows:

For the first two phases:

- Which countries are prominent?
- Which are the most cited articles?
- Which are the prominent journals?
- What are the prominent concepts?

For the final phase:

- What is the diversity of related studies in terms of the spaces to which they relate?

In the first phase, the keywords ‘‘spatial perception’’, ‘‘space perception’’, ‘‘perception of space’’ and ‘‘perception of architectural space’’ were determined to be analyzed in the Web Of Science database. In order to identify studies containing any or more than one of these four keywords, the expression ‘‘OR’’ was used between the words. In addition, in order to examine the determined keywords within clearer boundaries, the studies to be evaluated were scanned through ‘‘title, abstract and keywords (author keywords and keywords plus)’’. In order to determine the screening framework, document type restrictions were made as ‘‘article’’ and ‘‘review article’’ to examine the prominent articles in obtaining scientific data. The data obtained in the first search were reviewed according to the fields of study. Afterwards, ‘‘Architecture’’ and ‘‘Psychology Multidisciplinary’’ were selected as ‘‘Categories’’ on the Web Of Science database. These data on studies in the fields of architecture and multidisciplinary psychology were transferred to the program called VOSviewer, which allows bibliometric analysis through the Web Of Science database. ‘‘Geographical area analysis, document analysis, source analysis, and keyword analysis’’ were performed through the VOSviewer program.

As the second step of the study, a second bibliometric analysis, which is related to the subject and has relatively narrow limitations, was conducted. For this second analysis, a second set of keywords was created in addition to the keywords in the first phase in order to obtain a narrower research framework for human responses of spatial perception among the studies scanned through the Web of Science database in the first phase. These words are ‘‘happiness’’, ‘‘comfort’’, ‘‘user satisfaction’’, ‘‘well-being/wellbeing’’ and ‘‘quality of life’’. In order to identify studies that included any or more than one of the keywords that make up this second word group, the expression ‘‘OR’’ was used between the words. In addition, the expression ‘‘AND’’ was used between the two word groups in order to scan the studies containing at least one word from the first and second word groups at the same time. In this way, a second scan was conducted to identify the studies that also included these words among the studies scanned in the first analysis. These data obtained from the Web Of Science database were transferred to the VOSwiever program similar to the first phase and the second phase of bibliometric analysis was carried out.

In the third and final phase of this bibliometric analysis study on spatial perception, a flow-quantity diagram was created using the online Sankey diagram generator called ‘‘SankeyMatic’’ over the article studies identified in the second phase. In doing so, the words ‘‘happiness’’, ‘‘comfort’’, ‘‘user satisfaction’’, ‘‘well-being’’ and ‘‘quality of life’’, which constitute the second keyword group determined to narrow the limitations through the Web of Science database, were taken as reference. In this context, it was aimed to determine which types of buildings or fields of study were intensively studied through the article studies identified during the second bibliometric analysis. In doing so, from the studies retrieved from the Web of Science database, those whose main text was in English and Turkish and which could be related to the discipline of design were selected, and those studies that could not be related to any building type or space of study and which had a relatively weak relationship with the subject were ignored.

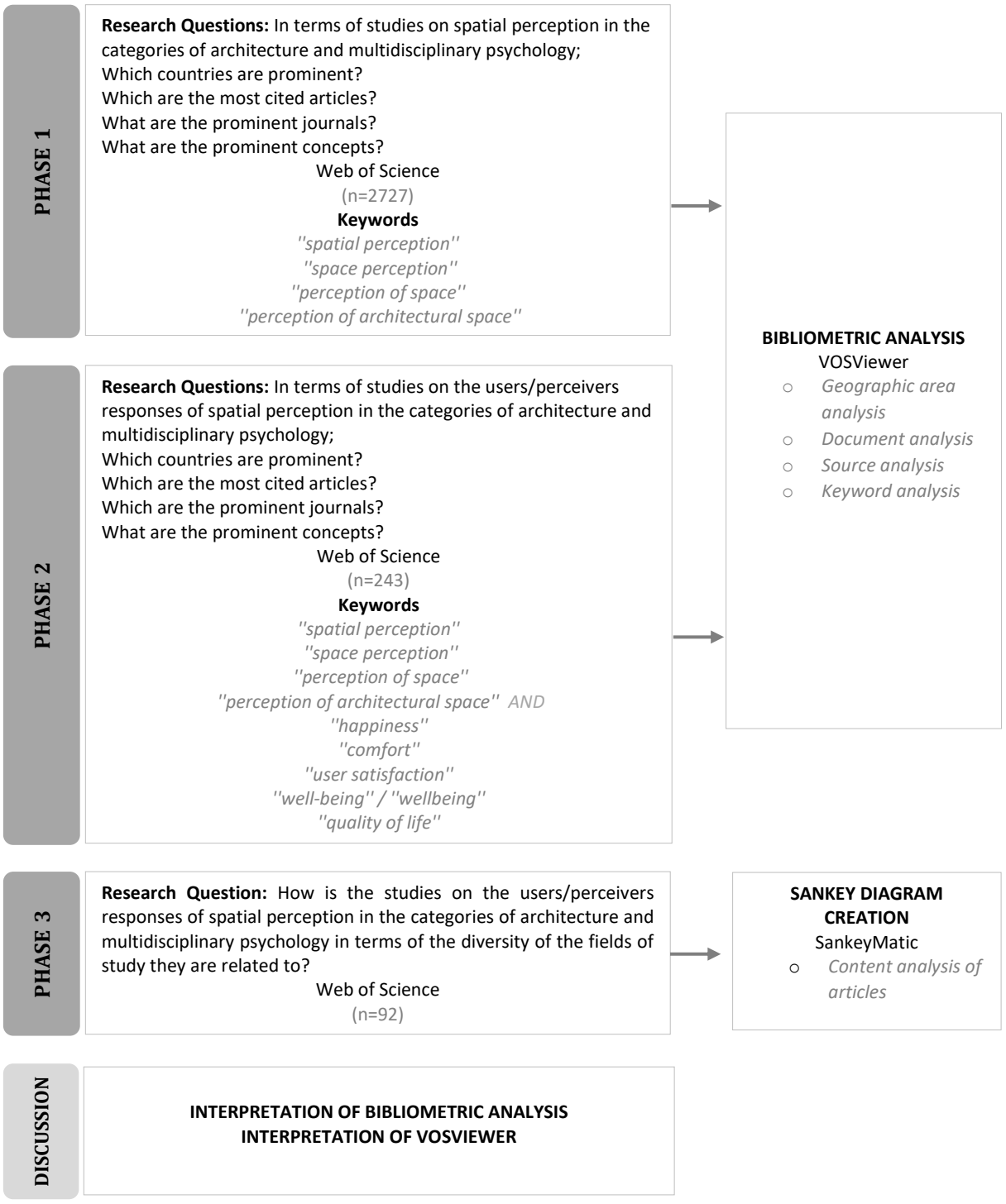

Figure 1. Research method scheme of two-depth three-phase bibliometric analysis of spatial perception

3. Bibliometric Analysis and Findings

After two in-depth analyses of the studies extracted from the Web of Science database into the VOSviewer program on ‘‘geographical area analysis, document analysis, source analysis, keyword analysis’’, a third content analysis was conducted on the limiting keywords, and related study areas of the selected articles.

3.1. Analysis Results of Spatial Perception Studies

As described in the methodology section, the keywords related to the subject to be used in the Web Of Science database were determined as ‘‘spatial perception’’, ‘‘space perception’’, ‘‘perception of space’’, ‘‘perception of architectural space’’. In the first research conducted on this database in this way, 62186 sources were identified.

When the results of the analysis of this initial information are analyzed, it is observed that there are studies in more than 250 research areas in terms of Web of Science Categories, and most studies on this subject are in the field of ‘‘Neuroscience’’ with a rate of 15.906%. ‘‘Experimental Psychology’’ ranks second with 11.070% and ‘‘Psychology’’ ranks third with 8.336%. This situation reveals the intensive relationship between the studies on this subject and psychology. However, with reference to the words in question, 879 studies in the field of ‘‘Architecture’’ ranked 32nd with a rate of 1.414%, while ‘‘Psychology Multidisciplinary’’ ranked 10th with 2252 studies.

Following the overview of research areas in the context of Web of Science Categories, ‘‘architecture’’ was first selected as the ‘‘category’’ on the Web of Science database and the studies (n=879) in this field were reviewed. When the studies on the subject in the field of ‘‘architecture’’ are analyzed according to years, it is determined that although there has been an increase since 1997, most publications belong to 2019. Afterward, only ‘‘multidisciplinary psychology’’ was selected as the ‘‘category’’ through the Web of Science database and the studies (n=2252) conducted in this field were reviewed. When the studies on the subject in the field of ‘‘multidisciplinary psychology’’ were analyzed according to years, it was found that studies on the subject started to be conducted in 1980, at least one study was conducted every year except 1984 and 1990, and although some years varied, there was a regular increase in the studies on the subject as of 1991.

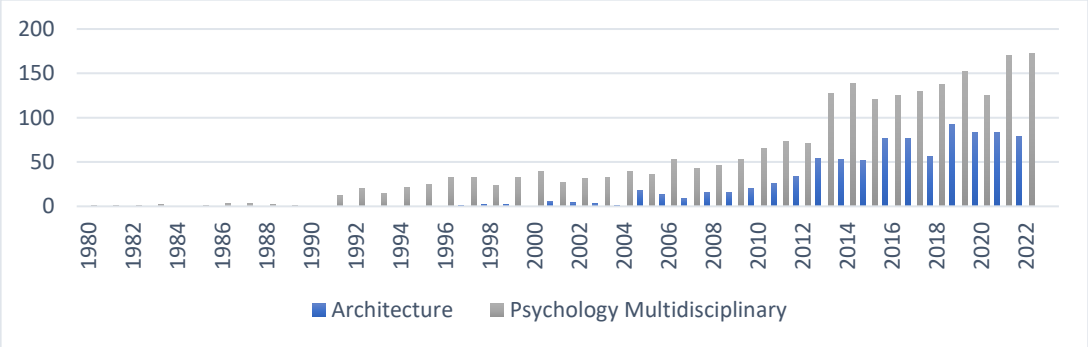

Figure 2. Distribution of publications by year in the architecture and multidisciplinary psychology categories within the framework of phase 1 keywords

Then, the fields of ‘‘architecture’’ and ‘‘multidisciplinary psychology’’ were selected together as categories to determine the study boundaries. It was determined that the total number of studies that belong to these two disciplines together was 3129. Since the year 2023 was ongoing during the study period, it is not included in the annual change graph visualization.

Among these studies, ‘‘article’’ and ‘‘review article’’ were selected as document types in order to examine the articles that stand out in obtaining scientific data. In this way, a total of 2729 studies prepared in the fields of architecture and multidisciplinary psychology, 2558 ‘‘articles’’ and 171 ‘‘review articles’’, were selected for bibliometric analysis in the first phase. These studies were scanned by their names before being transferred to the VOSviewer program. As a result of this scanning, it was realized that 1 study was included with the Early Access version and another study was registered twice. In order for the data to be obtained from the study to be right, only 1 sample of these two studies was subjected to examination; therefore, 2727 studies were identified to be imported into the VOSviewer program. After this first look, the information on the article studies identified on the Web of Science database was imported into the ‘‘VOSviewer’’ program and the bibliometric analysis was continued through the VOSviewer program.

3.1.1.Geographical area analysis

While there are 101 countries with publications in the related field, 24 countries have 25 or more publications. In terms of countries, the country with the most publications in the relevant field is the USA. It is followed by the England and Germany. However, when all publications are considered in terms of continent, Europe is the continent with the most publications (Figure 3). While no studies have been conducted in the related field in Africa, only Brazil from South America has conducted research on spatial perception. In this part of the analysis, the data obtained from Vosviewer were

used only to determine the countries with the most publications on spatial perception.Thanks to this determination, it has been determined that spatial perception is a universal subject.

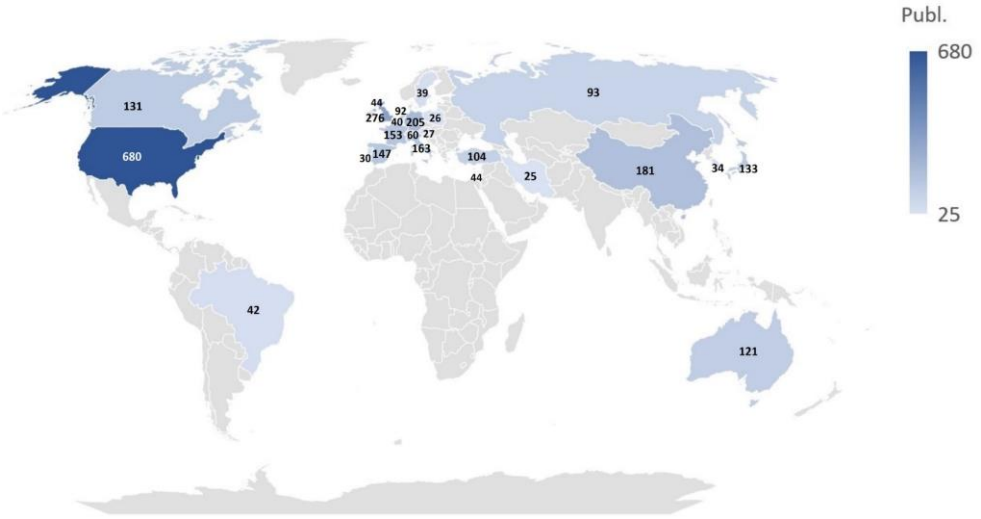

Figure 3. Map image of countries with 25 or more publications within the framework of phase 1 keywords and number of publications

3.1.2.Document analysis

Of the 2727 documents on spatial perception in the fields of architecture and multidisciplinary psychology, 2061 were cited at least once. The table of the 10 most cited documents is given below. (Table 1).

Table 1. Top 10 most cited articles within the framework phase 1 keywords

Article Title	Year	Citation	Source	Author
Construal-level theory of psychological distance	2010	2888	Psychological Review	Trope, Yaacov Liberman, Nira
Defining place attachment: A tripartite organizing framework	2010	1074	Journal of Environmental Psychology	Scannell, Leila Gifford, Robert
Gaze cueing of attention: Visual attention, social cognition, and individual differences	2007	895	Psychological Bulletin	Frischen, Alexandra Bayliss, Andrew P. Tipper, Steven P.
The location of trait emotional intelligence in personality factor space	2007	759	British Journal Of Psychology	Petrides, K. V. Pita, Ria Kokkinaki, Flora
A taxonomy of external and internal attention	2011	700	Annual Review Of Psychology	Chun, Marvin M. Golomb, Julie D. Turk-Browne, Nicholas B.
Why are small and large numbers enumerated differently - A limited-capacity preattentive stage in vision	1994	668	Psychological Review	Trick, Lana M. Pylyshyn, Zenon W.
How to build a baby: 2. Conceptual primitives	1992	610	Psychological Review	Mandler, Jean M.
Remembering the past and imagining the future: A neural model of spatial memory and imagery	2007	593	Psychological Review	Byrne, Patrick Becker, Suzanna Burgess, Neil
Emotion facilitates perception and potentiates the perceptual benefits of attention	2006	535	Psychological Science	Phelps, Elizabeth A. Ling, Sam Carrasco, Marisa
Primacy of wholistic processing and global/ local paradigm: A critical-review	1992	498	Psychological Bulletin	Kimchi, Ruth

In this table, 2 studies that are considered to have a relatively intense relationship with the discipline of architecture are colored in blue. This can be interpreted as the fact that among the most cited studies in the relevant field, the proportion of studies that can be considered related to the discipline of design within the discipline of psychology is quite low. When the 10 most cited articles were evaluated, it was found that there was no significant relationship network between them in terms of citation.

3.1.3.Source analysis

Regardless of citations, there are 283 sources with at least one publication on spatial perception. When we look at the sources with at least 1 citation, this number decreases to 222. The citation relationship network between 111 of these 222 sources consists of 22 clusters and 255 links. It is clearly seen that the journal ‘‘Frontiers In Pschology’’ is the dominant journal in this relationship network where many clusters form dense connections among them (Figure 4). However, another noteworthy point in this network of relationships is the situation of sources for environmental psychology related to architecture. Journal Of Environmental Psychology and Environment And Behavior journals are among the journals that cover research on the scientific examination of the mutual relations between humans and the physical environment. It was observed that these sources were dominant in the clusters they formed within themselves. However, it is possible to say that although the journals related to architecture are visible in terms of citation link, they remain in the background compared to the psychology discipline.

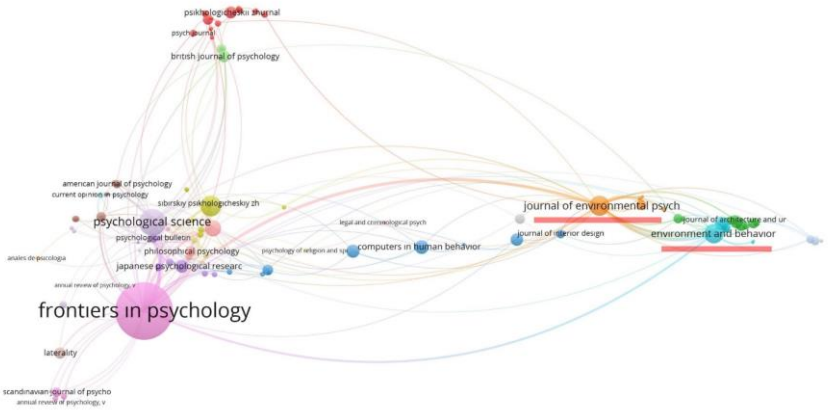

Figure 4. Citation link network of cited sources within the framework of phase 1 keywords

There are 17 journals that contain at least 25 studies on the subject and have at least 1 citation (Table 2). All these journals, although in a sense interdisciplinary, were evaluated in three ways according to their relative density in terms of content. In this table, journals related to design disciplines that have a relatively intense relationship with the discipline of architecture are colored in blue, while journals related to the discipline of psychology are colored in black. Journals that focus on research in the field of environmental psychology, which is located at the intersection of architecture and psychology, are also colored blue due to their relationship with design. Journals that contain research that is specialized in different fields are shown in red, even if they are related to the discipline of psychology. While determining this aspect of the journals; the descriptions on the online home page of each journal were taken as reference.

Seven of these 17 sources include studies directly related to the discipline of psychology. Six of them are related to at least one of the disciplines of architecture and environmental psychology. In addition 4 journals are specialized in different fields, albeit interdisciplinary. Accordingly, in percentage terms, studies related to the discipline of psychology ranked first with 41.17%. Studies related to the discipline of architecture have a rate of 35.29%, while other journals have a rate of 23.52%. This situation shows that journals related to architecture and design can find a place in the discipline of psychology among the sources that stand out with the high number of documents in terms of space perception research. However, it is also seen from the relevant table that some psychology journals are relatively prominent in terms of the number of citations and documents (Table 2).

Table 2. Journals with at least 25 studies and at least 1 citation within the framework of phase 1 keywords

Journal	Documents	Citations	Related fields
Frontiers In Psychology	667	9110	**psychology**
Psychological Science	149	9636	**psychology**
Spatial Vision	86	1986	computation, perception, attention and action
Journal Of Environmental Psychology	85	4660	**environmental psychology**
Environment And Behavior	80	2916	**environmental psychology**
Psychological Review	53	8103	**psychology**
Computers In Human Behavior	40	1043	use of computers&psychology
Megaron	38	29	**architecture**, planning
International Journal Of Human-Computer Studies	37	788	design and use of interactive computer technology
Japanese Psychological Research	36	259	**psychology**
Archnet-Ijar International Journal Of Architectural Research	32	113	**architecture,** urban design and planning, built environment
Journal Of Asian Architecture And Building Engineering	32	97	**architecture** and building engineering
British Journal Of Psychology	30	1573	**psychology**
Psikhologicheskii Zhurnal	30	42	**psychology**
Laterality	26	297	lateralisation
Open House International	26	68	**architecture,** building technology, housing, urban design and planning
Annee Psychologique	25	94	**psychology**

3.1.4. Keyword analysis/Co-occurrences of keywords

When the related studies were evaluated in terms of the co-occurrence of keywords, it was found that there were 290 keywords repeated at least 5 times (Figure 5).

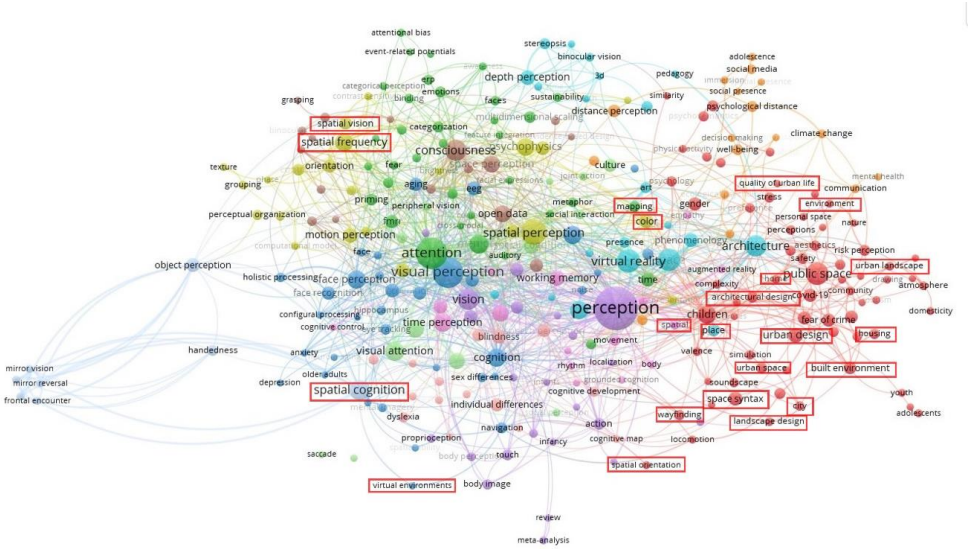

Figure 5. Co-occurences of keywords repeated at least 5 times within the framework of phase 1 keywords

Among these words, perception, attention, visual perception, spatial perception, virtual reality, public space, space, architecture, vision, consciousness were found to be the most frequently used keywords. Words that have a relatively intense relationship with the concept of space are highlighted on the

relationship network. When this visual is analyzed, it is found that most of the studies associated with the concept of space were carried out by associating with public spaces at the urban scale. When this relationship network visualization is evaluated, it is clearly seen that there are quite a lot of concepts related to psychology, but architectural terms can also find a place within this concepts.

3.2. Analysis Results of the Studies on the Human Responses of Spatial Perception

After the first bibliometric analysis on spatial perception, a second bibliometric analysis with relatively narrow limitations was conducted as explained in the methodology section. For this second analysis, studies with the words ‘‘happiness’’, ‘‘comfort’’, ‘‘user satisfaction’’, ‘‘well-being/wellbeing’’ and ‘‘quality of life’’ were scanned together with the first group of words (‘‘spatial perception’’, ‘‘space perception’’, ‘‘perception of space’’, ‘‘perception of architectural space’’) scanned in the first phase through the Web of Science database.

At the point of determining the second keyword group, 1397 keywords that were repeated at least 2 times out of 7838 keywords identified within the framework of the common keyword analysis conducted in the first phase were analyzed. In order to determine those related to positive emotions/outcomes among the studies on the responses of users/perceivers, keywords that were related to the subject were examined. Accordingly, ‘‘happiness (2), comfort (3), user satisfaction (3)’’ were selected among the keywords that were used relatively few times, while ‘‘well-being (11)’’ and ‘‘quality of life (8)’’ were identified as the prominent concepts among the keywords that were repeated relatively many times. In this way, a second analysis was conducted using two keyword groups similar to the first phase.

In this framework, 276 studies were identified after a search on the Web Of Science. Since the year 2023 was ongoing during the study period, it is not included in the annual change graph visualization. When the distribution of these studies according to years is analyzed, it is possible to say that the studies related to the subject have relatively increased in recent years, although the increase and decrease in research continue to vary between years.

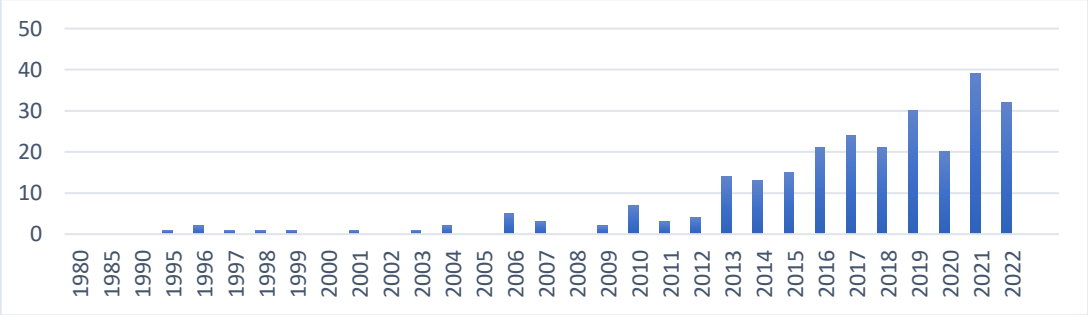

Figure 6. Distribution of publications by year in the architecture and multidisciplinary psychology categories within the framework of phase 2 keywords

In order to determine the boundaries of the research framework, ‘‘article’’ and ‘‘review article’’ were selected as document types to examine the articles within these studies. As a result, the data from 243 documents were extracted and analyzed in the VOSviewer program similar to the first phase.

3.2.1. Geographical area analysis

When the geographical area evaluation of the second bibliometric analysis is considered, it is found that there are 63 countries with at least 1 publication on the subject. Only 16 of these 63 countries have 5 or more publications. In terms of publications, the USA ranks first, Turkey ranks second and China ranks third, while when the related studies are evaluated in terms of continents, it is seen that the total number of studies in the countries located in the European continent is relatively higher than the other continents (Figure 7). Considering the countries with publications in the related field, it was determined that studies were carried out in many different countries. However, no studies were found from the African continent, while only Chile from South America was found to have conducted studies in the relevant field.

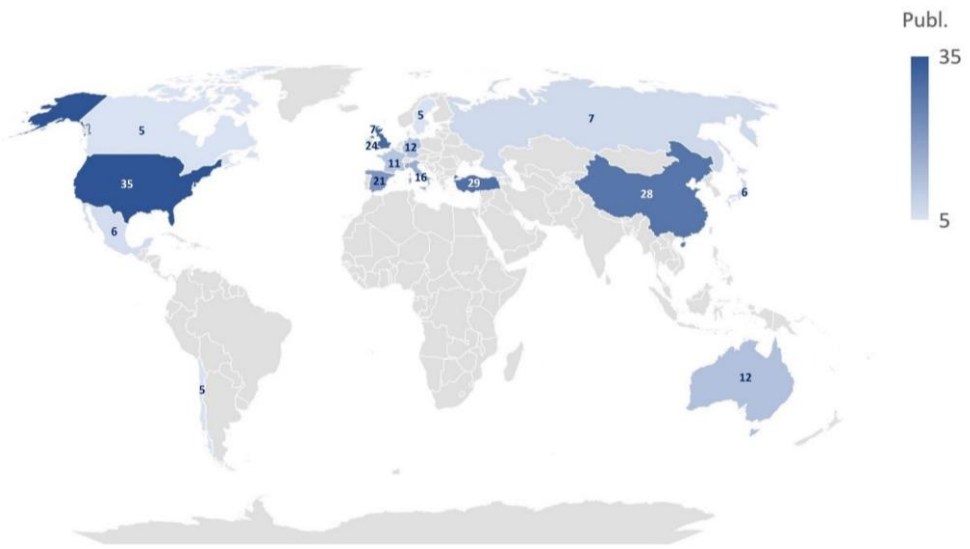

Figure 7. Map image of countries with 5 or more publications within the framework of phase 2 keywords and number of publications

3.2.2.Document analysis

Of the 243 studies in the related field, 172 were cited at least once. Information on the top 10 most cited articles in the field is given in Table 3.

Table 3. Top 10 most cited articles within the framework phase 2 keywords

Article Title	Year	Citation	Source	Author
Developments in trait emotional intelligence research	2016	241	Emotion Review	Petrides, K.V. Mikolajczak, Moira Mavroveli, Stella Sanchez-Ruiz, Maria-Jose Furnham, Adrian Perez-Gonzalez, Juan-Carlos
From the heart to the mind: cardiac vagal tone modulates top-down and bottom-up visual perception and attention to emotional stimuli	2014	185	Frontiers In Psychology	Park, Gewnhi Thayer, Julian F.
Neighborhood satisfaction, physical and perceived naturalness and openness	2010	173	Journal Of Environmental Psychology	Hur, Misun Nasar, Jack L. Chun, Bumseok
Residential development patterns and neighborhood satisfaction: Impacts of density and nearby nature	2006	129	Environment And Behavior	Kearney, Anne R.
Peripersonal and interpersonal space in virtual and real environments: Effects of gender and age	2016	122	Journal Of Environmental Psychology	Iachini, Tina Coello, Yann Frassinetti, Francesca Senese, Vincenzo Paolo Galante, Francesco Ruggiero, Gennaro
The importance of auditory-visual interaction in the construction of 'tranquil space'	2010	100	Journal Of Environmental Psychology	Pheasant, Robert J. Fisher, Mark N. Watts, Greg R. Whitaker, David J. Horoshenkov, Kirill V.
The effects of color and light on indoor wayfinding and the evaluation of the perceived environment	2012	93	Journal Of Environmental Psychology	Hidayetoglu, M. Lutfi. Yildirim, Kemal Akalin, Aysu
The relationship between perceived greenness and perceived	2016	80	Environment And Behavior	Hipp, J. Aaron Gulwadi, Gowri Betrabet

restorativeness of university campuses and student-reported quality of life				Alves, Susana Sequeira, Sonia
Healthcare providers' perception of design factors related to physical environments in hospitals	2012	75	Journal Of Environmental Psychology	Mourshed, Monjur Zhao, Yisong
Multiple environmental burdens and neighborhood-related health of city residents	2012	61	Journal Of Environmental Psychology	Honold, Jasmin Beyer, Reinhard Lakes, Tobia van der Meer, Elke

The fact that 6 of the studies were included in the ‘‘Journal Of Environmental Psychology’’ shows that this journal stands out in terms of receiving citations in the relevant field. Similar to the first phase, in this table, studies that are considered to have a relatively intense relationship with the discipline of architecture are colored in blue. When the top 10 most cited articles are analyzed, it is found that 70% of these studies have a relatively intense relationship with the discipline of architecture. This clearly shows that in studies focusing on the behavioral outcomes of spatial perception, studies with a design perspective, and thus the discipline of architecture, stand out compared to psychology. When the network of citation relationships between the articles was analyzed, it was found that there was a weak relationship network in which only three sources from the discipline of architecture formed a cluster. This situation indicates that the prominent studies in the discipline of architecture do not establish a meaningful citation relationship with research in the discipline of psychology.

3.2.3. Source analysis

In the second phase of the analysis, there are 66 journals with at least one publication related to the subject regardless of citation, but this number decreases to 48 when we analyze the sources with at least 1 citation. In the citation network formed between 9 of the sources with at least 1 citation, 4 clusters and 9 links are formed (Figure 8). This shows the relative weakness of the link between these journals. Among these 9 journals, Frontiers In Psychology stands out. It is seen that Open House International, Environment And Behavior and Journal of Environmental Psychology, which are related to design, form separate clusters in which they form a focal point. Considering this relationship network, it can be said that architecture journals form more clusters in terms of citation.

Figure 8. Citation link network of cited sources within the framework of phase 2 keywords

Similar to the first phase, these journals were evaluated in three different ways according to their relative density in terms of content with reference to the descriptions on the online home page of each journal. Accordingly, journals related to design disciplines that have a relatively intense relationship with the discipline of architecture are colored in blue, journals related to the discipline of psychology are colored in black, and journals that contain research that is specialized in different fields are shown in red. (Table 4).

In this second phase of the analysis, although Frontiers In Psychology journal for the discipline of psychology ranked first in terms of the number of documents, 76.47 % of the citation sources containing at least 3 studies were found to be journals related to the field of architecture. This is a proof that the studies on the human responses of spatial perception are mostly carried out through design disciplines.

Table 4. Journals with at least 3 studies and at least 1 citation within the framework of phase 2 keywords

Journal	Documents	Citations	Related fields
Frontiers In Psychology	57	680	**psychology**
Journal Of Environmental Psychology	19	912	**environmental psychology**
Environment And Behavior	11	435	**environmental psychology**
Architectural Science Review	10	87	**architectural** science**,** technology and the built environment
Open House International	10	27	**architecture,** building technology, housing, urban design and planning
Megaron	9	16	**architecture**, planning
Urban Design International	7	104	**urban design** and management
Computers In Human Behavior	7	93	use of computers&psychology
Frontiers Of Architectural Resarch	7	38	**architecture**
Journal Of Asian Architecture And Building Engineering	7	27	**architecture** and building engineering
Iconarp International Journal of Architecture And Planning	7	6	**architecture,** planning and design
Archnet-IJAR: International Journal of Architectural Research	6	50	**architecture,** urban design and planning, built environment
Journal Of Interior Design	6	8	**interior environment**
American Journal Of Community Psychology	4	28	**community psychology**
Journal Of Green Building	4	16	**architecture,** urban and community planning, building science, engineering, etc.
European Psychologist	3	53	**psychology**
Landscape Architecture Frontiers	3	1	**landscape architecture**

3.2.4. Keyword analysis/Co-occurences of keywords

Considering the studies on the responses of spatial perception on human behavior, there are 9 keywords repeated at least 5 times. Of these, 7 form 3 clusters and have 6 links between them (Figure 9). This is a result of the low number of keywords repeated at least 5 times. Among these keywords, perception, well-being and public space are concepts repeated 10 or more times. The first cluster includes the keywords perception, virtual reality, well-being; the second cluster includes the keywords public space, urban design; the third cluster includes the keywords quality of life and quality of urban life. It may be possible to interpret these data as the existence of studies in which the concept of well-being is associated with virtual reality in the context of the response of spatial perception on human behavior. Moreover, this network of relations shows that architectural terms are visible alongside the concept of perception in the relevant field.

Figure 9. Co-Occurences of keywords repeated at least 5 times within the framework of phase 2 keywords

3.3. Diversity Analysis Results of the Spaces Related to Studies on the Human Responses of Space Perception

In the third and final phase of this bibliometric analysis study on spatial perception, a Sankey diagram was created as explained in the methodology section. Accordingly, the words ‘‘happiness’’, ‘‘comfort’’, ‘‘user satisfaction’’, ‘‘well-being/ wellbeing’’ and ‘‘quality of life’’, which constitute the second keyword group, were taken as reference and the relationship of the studies with these concepts was tried to be determined. For this purpose, the title, abstract and keywords (author keywords and keywords plus) of the studies were reviewed. For the studies that had a relationship with more than one concept, the concept with which it was relatively intensely related was taken as a reference.

In this context, it was aimed to determine which building types or spaces of study are intensively studied through the article studies identified during the second bibliometric analysis. To do this, 92 studies were identified within the research framework as stated in the methodology section. The contents of these studies were analyzed in terms of their fields of study. As a result of the analysis, these studies were grouped under the headings of ‘‘urban area/landscape, house/apartment, office/workplace, university building/units, healthcare building, campus, aged care facility/nursing home, school, shopping center/sales area, coffehouse/restaurant, kindergarten/preschool, art and design gallery, floating space, supportive housing, library, hotel, dormitory’’ and ‘‘corridor’’ according to the types of buildings and spaces they are related to.

In order to create the flow quantity diagram of these studies, an Excel table was prepared with reference to limiting keywords and the fields of study they are related to. With the help of the prepared table, all these data were schematized through the online Sankey diagram generator called ‘‘SankeyMatic’’. The resulting diagram was organized as desired using the size and flow direction settings of the SankeyMatic diagram generator. In addition, the headings associated with ‘‘related study area’’ were arranged and sorted on the diagram from most to least in terms of quantity (Figure 10).

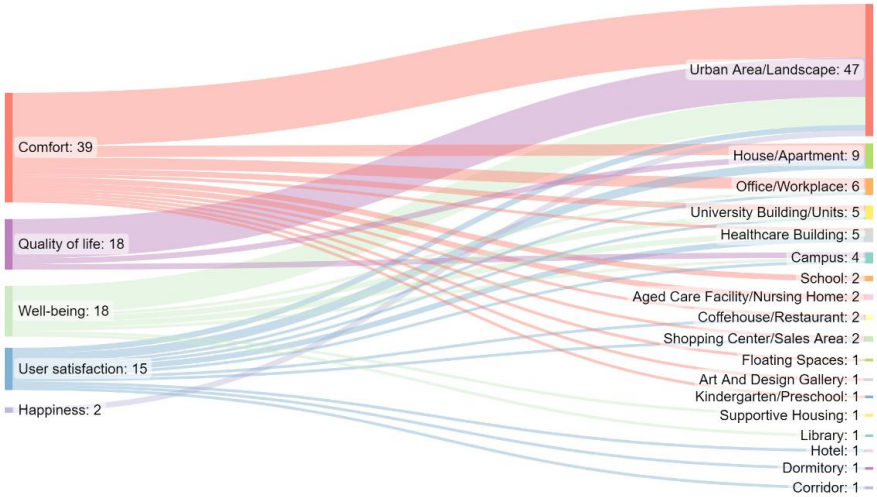

Figure 10. Sankey diagram (limiting keywords-related study area)

As can be seen from the diagram, it was determined that the word comfort was the most common word among the words that make up the second keyword group in the ‘‘title, abstract and keywords’’ of the mentioned studies scanned in the Web of Science. Accordingly, 42.39% of the studies in question are related to the concept of comfort. Although the concept of comfort is the most studied concept among the concepts in the related field, it has been determined that there is no study on this concept in ‘‘campus, library, hotel, dormitory, supportive housing’’ and ‘‘corridor’’ spaces. When the studies included in the scope of the research in the relevant field are taken as a reference, the words quality of life and well-being, which share the second place in terms of quantity, constitute 19.56% of the total amount of studies separately. The concept of quality of life was realized in ‘‘urban area/landscape, house/apartment, campus’’. The studies related to the concept of well-being were conducted in ‘‘urban area/landscape, university building/units, campus, healthcare building, supportive housing,

office/workplace, library''. While 16.30% of the relevant studies are related to the concept of user satisfaction, only 2.17% are related to the concept of happiness. When we look at the research spaces addressed through the concept of user satisfaction; it is determined that there is a wide variety such as ''office/workplace, house/apartment, urban area/landscape, hotel, healthcare building, dormitory, shopping center/sales area, university building/units, campus, coffehouse/restaurant, corridor''. Studies related to the concept of happiness were only conducted in ''urban area/landscape''. This situation shows that the studies in which the concept of ''spatial perception'' is associated with ''happiness'' are still quite insufficient.

In terms of the fields of study they are related to, it is seen that spatial perception studies at the urban scale are quite prominent and related to all the limiting keywords (Figure 10). The fact that studies have been conducted in many different spaces related to the subject was found to be positive. However, it was found that many studies at the architectural scale are considerably less in quantity compared to urban studies.

4.Discussion

When the findings obtained as a result of this bibliometric analysis are evaluated, first of all, it is observed that the subject of spatial perception is related to many disciplines, especially psychology and neuroscience, in addition to architecture. The fact that perception depends on brain processes that transform input from sensory channels explains the dominance of neuroscience and psychology disciplines in spatial perception studies (Morgan & King, 1975, p.91).

Within the scope of this study, although a literature review was conducted in a limited framework by selecting the fields of ''architecture'' and ''multidisciplinary psychology'' as ''category'' through the Web Of Science database, the fact that there are so many categories related to the subject shows that there are many studies written in different category sources that can be related to the subject (Encho, Uchida, Horibe, Nakatsuka & Ono, 2023; Wang, Shen & Shi, 2023; Freitas, Berreth, Chen & Jhala, 2023; Lenzholzer & Koh, 2010; Hughes, Chang, Hu, Talak, Abdulhai, Strader & Carlone, 2024, etc.). This shows that in future research on this subject, different fields can be included in addition to architecture and multidisciplinary psychology in terms of ''category''.

Considering the geographical area analysis in the first phase of the bibliometric analysis, it was found that the United States of America ranked first by a large margin. Similarly, the United States also ranks first in studies focusing on the human behavioral outcomes of spatial perception. This is a relatable situation that the high number of studies that associate user perception with different concepts in the United States (Ye, Huang & Li, 2023). Moreover, the United States of America also stands out in the studies of spatial legibility, a concept that can be related to perception (Burkut & Koseoglu, 2023). This can be interpreted as the fact that America is relatively dominant in studies related to perception. This is supported by the fact that even in previous studies on the perception of music and speech, it has been determined that America is at the forefront. (Tirovolas & Levitin, 2011; Chen & Chang, 2022). Nevertheless, the fact that there are only 16 countries with 5 or more publications worldwide in the second phase of the study shows that should be studied in more countries on the human responses of spatial perception.

When the document analysis was analyzed, in the first phase, 80% of the most cited articles are contextually related to the discipline of psychology. On the other hand, 70% of the most cited articles in the second phase can be considered contextually related to architecture. Among the sources containing at least 25 studies and cited in the first phase of the analysis, 41.17% were journals related to the discipline of psychology, while 35.29% were related to the discipline of architecture/design. When the sources in the second phase were evaluated, it was determined that 76.47% of the sources which containing at least 3 studies related to the architecture/design discipline. This is evidence that when it comes to studies focusing outcomes of spatial perception on human behavior, studies from a design perspective have become prominent and visible. Nevertheless, since experiencing and understanding space in analysis and design is closely linked to the psychological function of space (Bratina, 1997) it is also unlikely that spatial perception can be considered separately from psychology in architectural studies. In addition, the fact that the journal with the highest number of documents in

both phases is a source belonging to the discipline of psychology shows that studies related to psychology still maintain their weight in quantitative terms. This situation can be taken as a sign that architectural studies in the related field should be increased.

In the common keywords evaluation of the bibliometric analysis, in direct proportion to the research framework, it was observed that there were more clusters and a higher density of links in the first phase than in the second phase. When the related keywords are evaluated, especially according to the data in the first phase; it is determined that the concepts related to psychology have a wider spread in the studies on spatial perception, but the concepts associated with architecture and design can also find a place among them. In addition, it was also found that the concept of public space was at the forefront. This is positive in the sense that studies focusing on the perception of neighborhood residents or users of a wider community space in public spaces can prevent inappropriate and even poorly planned renewal plans in cities (Bratina Jurkovič, 2014).

In the third and final phase of the study, when the Sankey diagram of the articles selected within a certain framework according to the fields of study they are related to was examined, it was found that the studies related to the concept of comfort in the related keywords came to the fore with a proportional excess. However, the fact that there are remarkably few studies that include the word happiness in the title, abstract and keywords can be interpreted as the need for more studies related to this concept. In addition, in relation to the study spaces, it was found that the studies on the urban scale were quantitatively dense and are investigated through all of whole related concepts. In this respect, it is not surprising that there are a large number of literature-oriented studies on human-environment relations in urban areas (Xu, Nordin & Aini, 2022; Wang, Sun, Cai, Liu, Wu & Peng, 2022; Zhang, Yu, Zhao, Sun & Vejre, 2020; Meng, Wen, Brewin & Wu, 2020; Tirri, Swanson & Meenar, 2021; Chen, Wang & Zhou, 2021; Ribeiro, Madureira & Carvalho, 2023; Zhang, Li, Chen & Ouyang, 2022; Jia, Chen & Wu, 2021). However, it has been determined that even the concept of comfort, which is the most used concept, has not yet been investigated in all the architectural spaces mentioned. This situation can be interpreted as an emphasis on urban studies, while studies on architectural spaces take a back seat.

For the first two phases of the systematic bibliometric analysis carried out in this study, three of the options of "co-authorship, keyword co-occurrence, citation, bibliographic coupling or co-citation'' map creation based on the bibliographic data provided by Vosviewer were considered. ''Co-citation'' was not included in the scope of the research as it was not included in the framework of the research questions identified. ''Bibliographic coupling'', which provides an idea about the connections between authors, organizations or countries citing the same document or documents, was also not used as it does not provide significant data within the study framework. Similarly, relationship analyses of institutions and authors as the unit of analysis were also excluded since they do not provide significant data on the place and status of architectural research within spatial perception studies. In the analysis of the most cited documents and geographical area, Vosviewer data was used only to create a list.

Although the functionality of VOSviewer is useful for displaying large bibliometric maps in an easily interpretable way (Van Eck & Waltman, 2010), this analysis reveals that the validity and currency of Vosviewer in performing systematic bibliometric analyses is questionable. In addition, this study was not limited to the data obtained through VOSviewer, but made use of the online home pages of the journals in order to conduct a significant analysis of the sources. This analysis concludes that this and similar methods should be critically approached when conducting systematic bibliometric analyses.

5. Conclusion and Suggestions

As a result of this bibliometric analysis, while determining the place and status of architectural research within the perception literature, guiding data have been obtained for future studies in the related field. In this sense, the country with the most studies on the perception of space at the intersection of architecture and multidisciplinary psychology categories is the United States of America, while the continent is Europe. The journal with the most publications on the subject is Frontiers In Psychology. In addition, it is possible to say that the studies on the human responses within the scope of space

perception studies are in a relatively more intense relationship with design disciplines and that architecture has become visible within psychology in this field.

According to the studies on the human responses within the scope of spatial perception literature analyzed through ‘‘title, abstract and keywords’’, it was found that there were mostly studies related to the concept of ‘‘comfort’’. In addition to this, ‘‘happiness’’ was the least used word. This situation shows the inadequacy of studies related to happiness in terms of design at the intersection of architecture and psychology. Especially the pandemic process that has affected the whole world in the recent past and the prolonged stay at home due to the process has brought the issue of whether spaces can fully respond to people's psychological and physical needs and adapt to different possible conditions to the agenda. In research on improving the psychophysiological effects of spatial elements, examining emotional as well as sensory results can be effective in designing spaces that can have positive results for individuals living in today's world. This study, which is a starting point for research that can be conducted in different categories in the related field, recommends that future space perception research should be guided by the concept of happiness.

Another result of the research was obtained as a result of the content analysis in the last phase. According to this, the studies focusing on the human behavioral outcomes of spatial perception have been intensively conducted at the urban scale in terms of the study space. However, although the diversity of the studies, especially on the architectural scale, is positive in terms of the richness of the literature, these studies are relatively few in quantitative terms. This situation shows that it would be appropriate to focus on architectural scale studies on spatial perception.

In addition to these datas, as a methodological criticism, it was determined that not all of the bibliometric analysis results obtained with VOSviewer were aimed at investigating a problem. If researchers want to perform specific and significant bibliometric analyses, instead of using the analysis types offered by VOSviewer and similar software as direct patterns, they should approach their studies by questioning whether they have a semantic value in their own studies, and they should be able to offer different perspectives when necessary.

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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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Evaluation of Plant Use with High Ecological Tolerance for Climate Change Resistant Landscape in Kilis Sample Parks

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Abstract

One of the most important ways to create climate-resilient landscapes in cities is the use of plants with high ecological tolerance in urban open-green spaces. The aim of this study is to evaluate the ecological tolerance factors (frost, salinity, wind, air pollution, and drought) of woody plants in sample city parks of Kilis city (Karataş Park, Fıstıklı Park, and Şehit Terzi Muzaffer Aydemir Park) and to determine if there is a significant difference between the parks in terms of these factors. Firstly, the general area uses, plant species and numbers, and the taxa/natural distribution areas of the plants in each park were determined, and these plants were evaluated according to the factors. Whether there is a significant difference between the ecological tolerance values of plant species in the parks was determined using the "Kruskal-Wallis H-Test for Independent Group". The study findings indicate that there are no significant differences at the $p \leq 0.05$ level in frost, wind, salinity, and air pollution tolerances between the parks; however, there is a significant difference in drought tolerance.

Keywords: *Urban open-green spaces, resilient landscapes, sustainability, ecological tolerance, Kilis.*

İklim Değişikliğine Dirençli Peyzajlar İçin Ekolojik Toleransı Yüksek Bitki Kullanımının Kilis Örnek Parklarında Değerlendirilmesi

Öz

Kentlerde iklim değişikliğine dirençli peyzajlar oluşturmanın en önemli yollarından birisi de kentsel açık-yeşil alan tasarımında kentin ve uygulama alanının ekolojik faktörlerine dayanıklı yani ekolojik toleransı yüksek bitkilerin kullanımıdır. Bu çalışmanın amacı Kilis kenti örnek kent parklarındaki (Karataş Parkı, Fıstıklı Park ve Şehit Terzi Muzaffer Aydemir Parkı) odunsu bitkilerin ekolojik tolerans faktörleri (don, tuzluluk, rüzgâr, hava kirliliği ve kuraklık) açısından değerlendirilmesi ve söz konusu bu faktörler çerçevesinde parklar arasında anlamlı bir farkın bulunup bulunmadığının tespit edilmesidir. Araştırmada öncelikle her bir parkın genel alan kullanımları, bitki türleri ve sayıları, bitkilerin taksonları/doğal yayılış alanları ortaya konulmuş ve söz konusu bitkiler ekolojik tolerans faktörlerine göre değerlendirilmiştir. Parklardaki bitki türlerinin ekolojik tolerans değerleri arasında anlamlı bir farkın olup olmadığı "Bağımsız Gruplar İçin Kruskal Wallis H-Testi" sonuçları ile tespit edilmiştir. Çalışma bulguları parklar arasında don, rüzgâr, tuzluluk ve hava kirliliği toleranslarında $p \leq 0.05$ düzeyinde anlamlı farklılıkların olmadığını; kuraklık toleransında ise farklılığın anlamlı olduğunu göstermektedir.

Anahtar kelimeler: *Kentsel açık-yeşil alanlar, dirençli peyzaj, sürdürülebilirlik, ekolojik tolerans, Kilis.*

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1. Introduction

Climate change is one of the most important environmental challenges facing the world today. It has been proven to be caused by an increase in the concentration of greenhouse gases in the atmosphere. According to the latest reference on this subject, the IPCC's 6th Assessment Report, the surface temperature is found to be 1.09°C higher in the 2011–2020 period compared to the 1900s, parallel to the increase in global greenhouse gases. The report predicts that even under a very low greenhouse gas emission scenario, the Earth's temperature will increase by 1.0°C to 1.8°C by 2100; under a moderate scenario, it will increase by 2.1°C to 3.5°C; and under a very high greenhouse gas emission scenario, it will increase by 3.3°C to 5.7°C (IPCC, 2021).

According to the greenhouse gas inventory data from the Turkish Statistical Institute (TSI) (2023), total greenhouse gas emissions in Türkiye in 2021 increased by 7.7% compared to the previous year, reaching 564.4 million tons (Mt) of CO_2 equivalent (eq.). Per capita total greenhouse gas emissions in the country were 4 tons of CO_2 eq. in 1990, 6.3 tons of CO_2 eq. in 2020, and 6.7 tons of CO_2 eq. in 2021. This increase in emissions has been confirmed to be parallel to the increase in temperature in the country, according to data from the Turkish State Meteorological Service (TSMS). The annual average temperature in the country, which was 12.9°C in 1970, rose to 14.5°C in 2022 (TSMS, 2023). The report *" Climate Projections and Climate Change with New Scenarios in Türkiye"* prepared by the TSMS includes predictions on climate change for Türkiye covering three different periods. According to the report, temperatures are expected to increase and rainfall is expected to decrease by seasons. The report suggests that by 2100, there will be an increase of 2°C to 4°C in winter and 5°C in other seasons in the country, with a 50% decrease in spring rainfall and a 70% decrease in summer rainfall (TSMS, 2015).

The assessments made regarding Turkey in the IPCC's 6th Assessment Report confirm these findings. The report emphasizes that scenarios and projections for climate change show geographical variations, highlighting that climate change will particularly affect North Africa, Italy, the Balkans, and Turkey more. It is predicted that the annual average temperature change in the Southeastern Anatolia region, which includes Kilis, the region where the study area is located, will exceed the global average temperature change (IPCC, 2021). When the meteorological drought map prepared based on the data for the last 24 months (January 2021-December 2022) is examined, it is noteworthy that the province is located in the severe drought region (TSMS, 2023).

It has been unequivocally proven that climate change is caused by human activities (IPCC, 2021). Today, the areas where human activities are most intense are cities. Terms such as "climate-resilient," "climate-resistant," and "resilient city" are commonly used in the literature on cities and climate change, regarding the increasingly important concept of resilience. In all these terms, the necessity for cities, urban systems, and urban dwellers to rapidly recover from climate-related shocks and stresses is emphasized (Leichenko, 2011). The IPCC defines resilience as *" 'the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity of self-organization, and the capacity to adapt to stress and change'"* (IPCC, 2007).

At this point, the fundamental principle of creating resilient landscapes in cities is the accurate interpretation of the area's climatic data and the generation of solutions that minimize natural resource consumption. In recent years, ecological approaches have become increasingly important in ensuring the sustainability of open-green spaces in urban areas (Tel &.Erdoğan, 2021). Korkut et al., (2017) emphasized the significant role of ecological tolerance factors in designs for various types of areas such as urban parks, sports fields, and children's playgrounds to achieve sustainable development. They underscored the need to utilize climatic data such as precipitation, temperature, wind, and sunlight when designing to minimize natural resource consumption. At this point, the selection of appropriate plants is crucial in the areas. The term *'appropriate plant species'* refers to plants that not only serve aesthetic purposes but are also resilient to the environmental factors and ecological factors (frost, salt, temperature, air pollution, drought, wind, rainfall, etc.) of the urban area where they are applied. Choosing species with high ecological tolerance will result in the use of

drought and heat-resistant, low-water-consuming plant species, which will partially contribute to alleviating the water problem arising from global climate change today. In recent years, it has been expressed by scientists that Turkey, which is among countries experiencing water scarcity, will turn into dry and semi-arid areas in the coming years, similar to other countries in the Mediterranean region. This situation particularly emerges as a problem in terms of the continuity of urban park designs that are important both naturally and aesthetically, highlighting the importance of preferring plant elements with high ecological tolerance in urban park facilities (Zencirkıran & Akdeniz, 2017).

The aim of this study is to evaluate the woody plants in three example urban parks (Karataş Park, Fıstıklı Park, and Şehit Terzi Muzaffer Aydemir Park) located in different regions of the city with high intensity of use and plant diversity, in terms of their ecological tolerance factors (frost, salinity, wind, air pollution, and drought), and to determine if there is a significant difference between the parks in terms of these factors.

For this purpose, firstly, the current structural and vegetative status of the parks were determined in the study. Within this scope, the general land uses of each park, the plant species and numbers, and the natural distribution areas of the plants were identified, and the identified plants were evaluated according to ecological tolerance factors. In the second part of the findings, the results of *"Cross-Tabulations"* conducted to evaluate the differences in frost, wind, salinity, air pollution, and drought tolerance between the parks, and the results of *"Independent Groups Kruskal Wallis H-Test"* applied to determine if there is a significant difference in the ecological tolerance values of the plant species used in the parks were evaluated to ensure the evaluation of the differences in tolerance between the parks. As a result of the study, recommendations were developed to increase the use of plants with high ecological tolerance in Kilis city parks.

2. Material and Method

The main materials of the study are Karataş Park (Park 1), Fıstıklı Park (Park 2), and Şehit Muzaffer Aydemir Park (Park 3). The reasons for selecting these parks are their characterization of the city, their locations in different regions of the city, their high intensity of use, and their high diversity/density of plant species. The relevant parks were identified through verbal interviews with the Kilis Municipality Parks and Gardens Directorate.

In order to determine the current status of the parks, AutoCAD 2016 software package was used for the arrangement of the structural and plant projects of the parks, and for determining their spatial distributions, based on satellite images from Google Earth. As access to the tender annexes of the relevant parks was not possible, site plans, structural landscape projects, and plant landscape projects of the parks were prepared using relevant programs. The species and quantities of plants in the parks were determined through field studies conducted with the assistance of a landscape architect. In identifying the plant species in the research area, the studies of Ürgenç, 1990; Pamay, 1992; Yaltırık, 1993a; Yaltırık, 1993b; Güngör et al., 2007; Mamıkoğlu, 2012 were utilized. The natural distribution areas and ecological tolerances (frost, drought, salinity, wind, and air pollution) of the identified species were determined using various sources (Wade & Midcap, 2007; Rayno, 2014; Bayramoğlu, 2016; Güvenç & Demiroğlu, 2016; Zincirkıran & Akdeniz, 2017; Sönmez & Zincirkıran, 2023). The SPSS 23 package program was used to interpret all the data statistically.

It would be appropriate to provide information about the general characteristics of Kilis province, where the study areas are located, as well as the general condition of the parks that constitute the material of the research. Located in the transition zone between the Mediterranean and Southeastern Anatolia regions, the climate of Kilis province is generally classified as Mediterranean. When the long-term average meteorological data of Kilis province is examined, it can be seen that the temperature and precipitation changes in the province are parallel to the trends in the world and Turkey. When the 40-year meteorological data of the province between 1980-2020 is examined, it is determined that the annual average temperature increased from 16.76°C to 18.70°C with an increase of approximately 2°C; while the annual average precipitation decreased from 54.47 mm to 48.23 mm. The long-term average monthly wind speed in the province is 2.2 m/s. The average number of frosty days per month from 1980 to the present is 12 days. While the highest number of frosty days

was recorded as 55 days in 1992, there was no frost in any day of 2018 (TSMS, 2021). When the meteorological drought map prepared based on the data from the last 24 months (January 2021-December 2022) is examined, it is noteworthy that the province is located in the severe drought region (TSMS, 2023).

When the soil analysis results from soil profiles taken during afforestation studies in Kilis province are examined, it is observed that the soil structure of the province is generally clayey, slightly alkaline, free of salts (0.0–0.15 EC mS/cm), and highly calcareous (8.54% – 82.2%). The soil is generally poor in organic matter (0.52% - 3.39%) (Kilis Forestry Directorate, 2010).

Additionally, according to the results from one air quality monitoring station in Kilis province, measurements were conducted for five main pollutants causing air pollution. It was determined that the only pollutant for which the limit value was exceeded is Particulate Matter (PM10); the limit value for other pollutants was not exceeded (Rebuplic of Türkiye Ministry of Environment, Urbanization and Climate Change, 2019).

The most important material of the research consists of the selected sample parks in the city. The largest park evaluated in the research is Karataş Park. The park is located in the Aşiti neighborhood of the central district of Kilis city. Built in 1960 and revised twice in 2000 and 2017, the park has a total area of 68,753 m². The second-largest park evaluated in the research is Fıstıklı Park, located in the Mehmet Rıfat Kazancıoğlu neighborhood of the central district of Kilis city. Completed by the Kilis Municipality in 2016, the park has an area of 14,534 m². The third-largest park evaluated in the research is Şehit Terzi Muzaffer Aydemir Park. Completed by the Kilis Municipality in 2016, the park has an area of 2,960 m² and is located in the Atatürk neighborhood of the central district of Kilis city. (Figure 1-2).

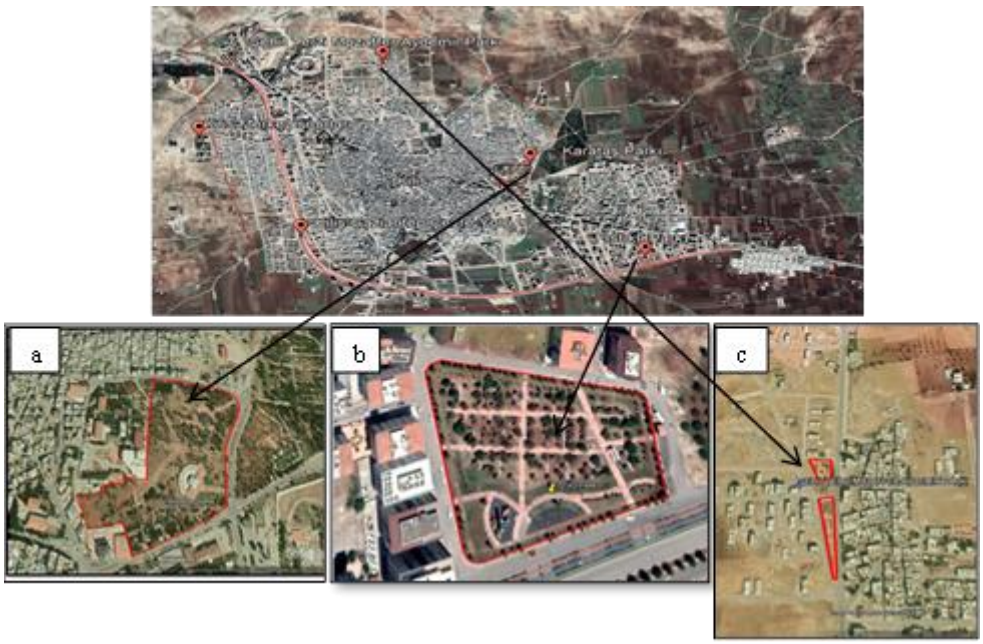

Figure 1. The locations of the parks (a) Karataş Park (P1); (b) Fıstıklı Park (P2) (c) Şehit Muzaffer Aydemir Park (P3) (Google Earth, 2021)

Figure 2. Some images from the parks (a) Karataş Park (P1) (b) Fıstıklı Park (P2) (c) Şehit Muzaffer Aydemir Park (P3) (taken by authors,2021).

The research was conducted in 4 stages;

In the first stage; the structural and plant projects of the 3 relevant parks, which constitute the basic material of the study, were digitized using the relevant drawing program (Autocad 2016). The species and quantities of plants in the parks were determined during field studies conducted by a landscape architect between May and September, as referenced in the materials section. These identified species were processed on the structural landscape projects of the areas using the relevant drawing program to create the plant projects of each park.

In the second stage*;* the ecological tolerances of the identified species (frost, drought, salinity, wind, air pollution, and drought) were determined using a 3-level rating (1: Low tolerance, 2: Moderate tolerance, 3: High tolerance) proposed by Zencirkıran & Seyitoğlu Akdeniz (2017), as well as the sources mentioned in the materials section. In this stage, ecological tolerance tables were created based on the species in each park, and the ecological tolerance status of the parks was evaluated in general through frequency analysis.

In the third stage*;* a data set containing all tolerance levels of the plant species used in the parks and all data related to the parks was created using the SPSS 23 package program. To find the average differences between variables (parks), the *"Frequency Distribution of Two or More Variables: Cross-Tabulation (Crosstab)"* method, which is one of the descriptive statistics methods, was used. The purpose of the crosstab is to provide the frequency and percentage distribution of participants in research according to two or more classificatory (categorical) variables. In screening and experimental studies, crosstab is used when it is desired to describe the personal characteristics of participants related to two classificatory variables. The crosstab allows the researcher to see and evaluate the percentages based on row and column margin totals and overall totals of the fissures formed according to at least two variables in the same table. In addition, crosstab provides the opportunity to generally examine opinions determined in any classification or ranking scale in terms of subgroups formed according to a classificatory variable (Büyüköztürk, 2012).

In the fourth stage; the percentages indicating the tolerance level of each park determined in the crosstab were entered into a new data set. The "Independent Groups Kruskal Wallis H-Test" was used on the new data set to determine if there was a significant difference between groups. The Kruskal Wallis test tests whether the mean ranks of two or more independent samples differ significantly from each other. In the analysis, the scores of k samples for a dependent variable are compared. This test requires observations to be independent of each other and at least ordinal scale for the dependent variable. Since the analysis does not require the assumptions of normal distribution and equality of variances in each subgroup (sample) created according to the group variable, it is an alternative to one-way analysis of variance. The statistical process is based on considering the groups' scores as a set and assigning rank values to the scores starting from the

smallest score, and finding the sum of ranks. The Kruskal Wallis test is used to test the significance of the difference observed in the scores of groups in experimental studies with single-factor groups consisting of a small number of subjects. This procedure is recommended when the normality assumption of one-way ANOVA, which is a parametric test, is not met (Büyüköztürk, 2012).

3. Findings

The research findings were evaluated under two main headings: general findings related to the parks and findings related to the analysis results.

3.1. Findings Related to the Parks

Karataş Park (Park 1) has a total area of 68,753 m^2. This area includes 5,104 m^2 of grass area and 33,135 m^2 of soil area, totalling 38,239 m^2 of permeable area. The park consists of 30,514 m^2 of impermeable areas. The park features functional areas such as children's play area, fitness area, amphitheater, administrative building belonging to the Parks and Gardens Directorate, guard room, kiosk, toilets, ornamental pool, and a mini football field. The permeability rate of Karataş Park is 55.76% (Table 1, Figure 3).

In Karataş Park, there are 36 species of plants with a total of 2600 plants. Among these plants, 70 are trees; 187 are shrubs in the angiosperm taxon; 2058 trees and 385 shrubs are in the gymnosperm taxon. *Pinus brutia, Cupressus sempervirens*, and *Ligustrum japonica* are among the most commonly used species in the park. 15 species and 1672 plants are among the natural species found in our country, while 21 species and 928 plants consist of exotic species that do not have a natural distribution in the country. The naturalness percentage of Karataş Park is 64.3% (Table 2).

When the plants in Karataş Park are classified according to frost tolerance; it was determined that 930 plants (36%) have low frost tolerance; 79 plants (3%) have moderate frost tolerance; and 1591 plants (61%) have high frost tolerance. When the plants in the Park are classified according to wind tolerance; it was found that 1770 plants (68%) have low wind tolerance; 14 plants (1%) have moderate wind tolerance; and 816 plants (31%) have high wind tolerance. When the plants in the Park are classified according to salinity tolerance; it was determined that 504 plants (19%) have low salinity tolerance; 21 plants (1%) have moderate salinity tolerance; and 2075 plants (80%) have high salinity tolerance. When the plants in the Park are classified according to air pollution tolerance; it was found that 335 plants (13%) have low air pollution tolerance; 21 plants (1%) have moderate air pollution tolerance; and 2244 plants (86%) have high air pollution tolerance. When the tolerance of plants in the Park to drought is evaluated; it was determined that 101 plants (4%) have low drought tolerance; 272 plants (10%) have moderate drought tolerance; and 2227 plants (86%) have high drought tolerance (Table 3).

Fıstıklı Park (Park 2) has a total area of 14,534 m^2 of this area, 10,162 m^2 consists of permeable areas (lawn area, soil area, sand pit, and walking path); 4,372 m^2 consists of impermeable areas (children's play area, fitness area, concrete walkway, cafe). Outside the park, there are WC and guard room. The permeability rate of Fıstıklı Park is 69.9% (Table 1, Figure 3).

The number of plant species in Fıstıklı Park is 20, with a total of 545 plants. Of these, 152 are trees and 126 are shrubs in the angiosperm taxa, while 33 are trees and 234 are shrubs in the gymnosperm taxa. The species *Robinia pseudoacacia* "Umbraculifera," *Oenothera lindheimeri*, and *Nerium oleander* are among the most used species in the park. Of the total 217 plants belonging to 8 different species, are naturally distributed in Türkiye, while 328 plants from 12 species are exotic. The naturalness percentage of Fıstıklı Park is 39.81% (Table 2).

When evaluating the frost tolerance of the plants in Fıstıklı Park, it was determined that a total of 216 plants (40%) belonging to 10 different species have low tolerance to frost, while no plant species have medium tolerance to frost. Additionally, a total of 329 plants (60%) belonging to 10 different species have high tolerance to frost. Regarding wind tolerance, it was classified that 347 plants (64%) have low tolerance to wind, while no plants have medium tolerance to wind. Furthermore, 198 plants (36%) have high tolerance to wind. In terms of salinity tolerance, it was found that 273 plants

(50%) have low tolerance to salinity, while no plants have medium tolerance to salinity. Additionally, 272 plants (50%) have high tolerance to salinity. For air pollution tolerance, it was observed that 237 plants (43%) have low tolerance, while no plants have medium tolerance. However, 308 plants (57%) have high tolerance to air pollution. Regarding drought tolerance, it was found that 25 plants (4%) have low tolerance, 238 plants (44%) have medium tolerance, and 282 plants (52%) have high tolerance to drought (Table 3).

Şehit Muzaffer Aydemir Park (Park 3) has a total area of 2,960 m^2. This area consists of 1,136 m^2 of soil area and permeable area, and a total of 1,824 m^2 of impermeable area (children's play area, fitness area, and hard surface). The permeability rate of Şehit Terzi Muzaffer Aydemir Park is 37.7% (Table 1, Figure 3).

Table 1. Spatial uses of the parks

	Park 1	**Park 2**	**Park 3**
PERMEABLE AREA	**Area (m^2)**	**Area (m^2)**	**Area (m^2)**
Grass field	5,104	4,636	-
Ground area	33,135	4,633	1,116
Sand Pool	-	36	
Walking path (Tile dust)	-	893	
Total Permeable Area	**38,239**	**10,162**	**1,116**
IMPERMEABLE AREA			
Children's playground-Fitness area (Rubber flooring on concrete)	2,042	347	218
Walking path (Fire brick, mortar flooring)	21,440	-	-
Walking path (Concrete)	-	2,385	-
Hard flooring (Keystone, mortared flooring)	2,012		-
Hard flooring (Tile, mortared flooring)	364	968	1,626
Parks and gardens directorate administrative building	164	-	-
Artificial turf (Carpet laying on concrete)	1,254	-	-
Amphitheater	2,856	-	-
WC	84	-	-
Buffet	74	-	-
Decorative pond	69	-	-
Guard room	155	-	-
Cafe	-	95	-
Fitness area (Rubber flooring on concrete)	-	257	-
Roofed bench-concrete floor	-	320	-
Total Impermeable Area	**30,514**	**4,372**	**1,844**
TOTAL AREA	**68,753**	**14,534**	**2,960**

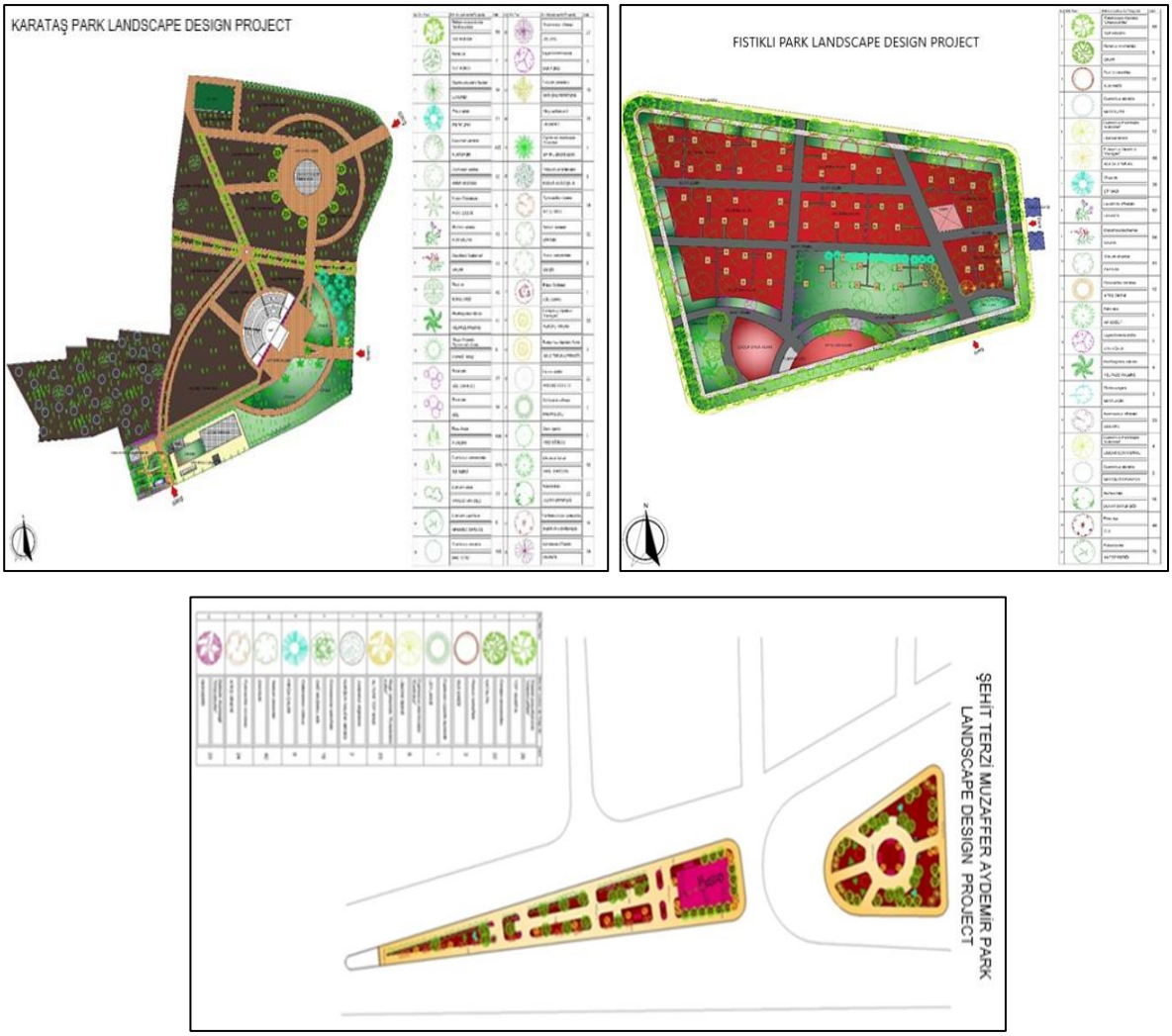

Figure 3. Landscape projects of the parks (drawn by the authors, 2021)

The park has a total of 12 plant species and 203 plants. *Nerium oleander, Robinia pseudoacacia* 'Umbraculifera', *Thuja orientalis* 'Pyramidata aurea', and *Berberis thunbergii* 'Atropupurea' are among the most commonly used species in the park. Of the total 203 plants in Şehit Terzi Muzaffer Aydemir Park, 71 are trees and 23 are shrubs of the angiosperm taxon, while 20 trees and 89 shrubs are of the gymnosperm taxon. There are 108 plants belonging to 5 species that are natural in Türkiye, and 95 plants belonging to 7 species that do not have a natural distribution in the country. The naturalness percentage of Şehit Terzi Muzaffer Aydemir Park is 53% (Table 2).

When classified according to frost tolerance, it was determined that 118 plants (58%) in the Park had low tolerance to frost, while no plant species had medium tolerance, and 85 plants (42%) had high tolerance to frost. 97 (48%) were slightly wind tolerant, 9 (4%) had medium wind tolerance, and 97 (48%) had high wind tolerance of the plants in the Park. When classified according to salinity tolerance, it was found that 95 plants (47%) had low tolerance to salinity, 9 plants (4%) had medium tolerance, and 99 plants (49%) had high tolerance to salinity (Table 3).

Table 2. Plant species in the parks and their natural distribution areas

Species name	Natural Distribution	Parks		
		Number of Plants		
		P1	P2	P3
Ampelopsis veitchii	North America	14		
Berberis thunbergii ''Atropupurea''	Japan			23
Buxus sempervirens	Spain, Portugal, France, Germany and Bulgaria	6		
Callistemon citrinus	Australia			9
Catalpa bignonioides	Western-North American, Exotic			22
Chrysanthemum japonense	Asia and Northeast Europe	28		
Cortaderia selloana	South America	2		
Cotoneaster salicifolia	Türkiye			18
Cupressocyparis leylandii	hybrid species	14	1	1
Cupressus arizonica	North America, Arizona, Mexico	163	9	
Cupressus macrocarpa ''Goldcrest''	Southwestern North America, California	2	16	8
Cupressus sempervirens	Anatolia, Aegean Islands, Iran, Italy	676		
Euonymus japonica	Japan, Korea and China	56	48	
Euryops pectinalus	South Africa	16		
Hedera helix	Central, Southern and Eastern Europe, Türkiye	22	16	
Jasminum sambac	Chinese	12		
Juniperus horizontalis	Central, Southern and Western Europe, Western Asia			2
Lagerstroemia indica	Eastern Asia, Philippines, China, Japan	3	7	
Laurus nobilis	Balkans, Mediterranean, Black Sea, Aegean , Marmara	22		
Lavandula officinialis	Mediterranean and Aegean		52	
Ligustrum japonicum	Europe-West Asia	465		
Lonicera caprifolium	Chinese	6		
Lonicera nitida	East Asia and China	23		
Malus floribunda	Europe, Asia and America	1		
Morus alba	China and Far East	7		
Nerium oleander	Southern Europe and the Mediterranean	52	61	42
Oenothera lindheimeri	Southern North America, Exotic	10	64	
Picea pungens	North America, Colorado, Exotic		3	
Pinus brutia	Türkiye	684		
Pinus pinea	Aegean, Mediterranean coast, Türkiye	21		
Pistacia vera	Türkiye		58	
Pittosporum tobira ''Nana''	Japan and China	8		
Platanus orientalis	Eastern Asia, Philippines, China, Japan		5	
Prunus cerasifera	West Asia and the Caucasus		17	3
Pyracantha coccinea ''Praecox''	Southern Europe, Mediterranean, Italy, Balkans	24	12	24
Robinia pseudoacacia ''Umbraculifera''	West-North America	58	66	28
Rosa meilland	Northern hemisphere	14	44	
Rosa rampicanti	Northern hemisphere	27		
Rosmarinus officinalis	Mediterranean and Aegean	27	23	
Salix alba	Türkiye, North Africa, Europe and Asia		3	
Salix caprea ''Pendula''	Europe, Asia and Northern Iran	1		
Thuja oriantalis ''Pyramidata aurea''	Turkestan, Iran, Türkiye	6		23
Thuja orientalis	North America	42	38	
Viburnum lucidum	Southern Europe and the Mediterranean	58		
Washingtonia robusto	Mexican	11	4	
Wisteria sinensis	Central, Southern and Eastern Europe and western Asia	13		
Yucca gloriosa	South of north america	6		

Among the plants in Şehit Terzi Muzaffer Aydemir Park, 36 plants (18%) were found to have low tolerance to air pollution, 9 plants (4%) have moderate tolerance, and 158 plants (78%) have high tolerance to air pollution. According to the findings regarding the drought tolerance of the plants in the park, while 1 plant (1%) has low drought tolerance and 31 plants (15%) have moderate drought tolerance, 171 plants (84%) have high drought tolerance (Table 3).

Table 3. Ecological tolerance levels of plant species in the parks

Species name	Parks			Ecological Tolerance Criteria and Degrees														
				Frost			Wind			Salinity			Pollution			Drought		
	P1	P2	P3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Ampelopsis veitchii	●					●		●		●					●			●
Berberis thunbergii ''Atropupurea''			●			●			●	●					●			●
Buxus sempervirens	●			●					●	●					●	●		
Callistemon citrinus			●	●				●			●			●				●
Catalpa bignonioides			●	●			●			●					●			●
Chrysanthemum japonense	●			●			●			●			●			●		
Cortaderia selloana	●		●					●		●			●					●
Cotoneaster salicifolia			●	●			●					●			●			●
Cupressocyparis leylandii	●	●	●			●		●				●			●			●
Cupressus arizonica	●	●				●	●			●			●					●
Cupressus macrocarpa ''Goldcrest''	●	●	●			●			●			●	●					●
Cupressus sempervirens	●					●	●					●			●			●
Euonymus japonica	●	●			●		●			●					●	●		
Euryops pectinalus	●			●			●			●			●					●
Hedera helix	●	●				●				●					●	●		
Jasminum sambac	●			●			●			●			●				●	
Juniperus horizontalis			●			●			●			●			●			●
Lagerstroemia indica	●	●		●			●			●			●					●
Laurus nobilis	●		●			●				●					●	●		
Lavandula officinialis		●				●			●	●					●			●
Ligustrum japonicum	●			●			●					●			●			●
Lonicera caprifolium	●					●	●					●			●		●	
Lonicera nitida	●					●	●					●			●		●	
Malus floribunda	●					●	●					●			●		●	
Morus alba	●					●			●			●			●		●	
Nerium oleander	●	●	●	●			●					●			●	●		●
Oenothera lindheimeri	●	●				●	●			●			●					●
Picea pungens		●	●			●	●			●					●	●		
Pinus brutia	●			●					●			●			●			●
Pinus pinea	●				●		●				●			●				●
Pistacia vera		●		●			●			●			●				●	
Pittosporum tobira ''Nana''	●			●			●					●			●	●		
Platanus orientalis		●				●	●			●			●			●		
Prunus cerasifera		●	●	●					●	●		●			●			●
Pyracantha coccinea ''Praecox''	●	●	●	●					●	●					●			●
Robinia pseudoacacia ''Umbraculifera''	●	●	●			●			●			●			●		●	
Rosa meilland	●	●				●	●					●			●		●	
Rosa rampicanti	●			●					●			●			●		●	
Rosmarinus officinalis	●	●		●			●					●	●					●
Salix alba		●				●			●	●			●			●		
Salix caprea ''Pendula''	●				●		●			●					●	●		
Thuja oriantalis ''Pyramidata aurea''	●		●			●			●			●			●			●
Thuja orientalis		●				●	●			●			●					●
Viburnum lucidum	●			●			●			●					●		●	
Washingtonia robusto	●	●		●			●			●			●				●	
Wisteria sinensis	●			●			●			●			●			●		
Yucca gloriosa	●			●			●					●	●			●		

1: Low tolerance *2: Moderate tolerance* *3: High tolarence*

3.2. Findings Regarding Analysis Results

The results of the "Cross-Tabulation (Crosstabs)" conducted to evaluate the differences in average:

Frost, wind, salinity, air pollution, and drought tolerance between the parks are provided in the following tables (Species-based only). When the cross-tabulation for frost tolerance is examined, it can be seen that Park 1, which has high frost tolerance, is at 50%, followed by Park 2 at 32.4% and Park 3 at 17.6%. According to the analysis results, the average of plant species with low frost

tolerance used in all parks is 47.1%; the average of plant species with moderate frost tolerance is 2.9%; and the average of plant species with high frost tolerance is 50% (Table 4).

When the cross-tabulation is examined, it can be seen that Park 1, which has high wind tolerance, is at 40.9%, followed by Park 3 at 31.8% and Park 2 at 27.3%. Additionally, the average of plant species with low wind tolerance used in all parks is 61.8%; the average of plant species with moderate wind tolerance is 5.9%; and the average of plant species with high wind tolerance is 32.4% (Table 4).

When the relevant table is examined, it is determined that Park 1 has the highest salinity tolerance with a rate of 54.8%. According to the analysis, the salinity tolerance percentages of Park 2 and Park 3 are equal at 22.6%. Additionally, the average of plant species with low salinity tolerance used in all parks is 51.5%; the average of plant species with moderate salinity tolerance is 2.9%; and the average of plant species with high salinity tolerance is determined to be 45.6% (Table 4).

When the results of the Cross Table are examined, it can be seen that Park 1 has the highest air pollution tolerance with a rate of 55%; followed by Park 2 with a rate of 25%, and Park 3 with a rate of 20%. Additionally, the average of plant species with low air pollution tolerance used in all parks is 38.2%; the average of plant species with moderate air pollution tolerance is 2.9%; and the average of plant species with high air pollution tolerance is determined to be 58.8% (Table 4).

Lastly, when values related to drought tolerance are examined, it can be observed that Park 1 has thehighest drought tolerance with a rate of 47.2%; followed by Park 2 with a rate of 27.8%, and Park 3 with a rate of 25%. Additionally, the average of plant species with low drought tolerance used in allparks is 17.6%; the average of plant species with moderate tolerance is 29.4%; and the average of plant species with high drought tolerance is determined to be 52.9% (Table 4).

Table 4. The results of the cross-table analysis conducted on plant species in the parks

Parks	**Ecological tolerance percentages (%)**														
	Frost			**Wind**			**Salinity**			**Pollution**			**Drought**		
	1	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
P1	53,1	100	50	61,9	25	40,9	51,4	50	54,8	50	50	55	75	50	47,2
P2	28,1	0	32,4	31	25	27,3	37,1	0	22,6	38,5	0	25	25	35	27,8
P3	18,8	0	17,6	7,1	50	31,8	11,4	50	22,6	11,5	50	20	0	15	25

Results of the Kruskal-Wallis H-test

The results of the "Kruskal-Wallis H-Test for Independent Groups," conducted on the dataset created by entering the percentages indicating the tolerance degrees of each park determined in the cross-tables into a new dataset, to determine if there is a significant difference in the ecological tolerance values of plant species used in the parks, are given in Table 5.

When considering the mean ranks of the groups in the analysis results, it is determined that Park 1 has the highest tolerance for all factors. The details are as follows:Park 1 is the park with the highest frost tolerance, followed by Park 2 and Park 3;

- Park 1 is the park with the highest wind tolerance, followed by Park 3 and Park 2;
- Park 1 is the park with the highest salinity tolerance, followed by Park 3 and Park 2;
- Park 1 is the park with the highest air pollution tolerance, followed by Park 3 and Park 2;
- Park 1 is the park with the highest drought tolerance, followed by Park 2 and Park 3 (Table 5).

The results of the Kruskal-Wallis H-test indicate that there are no significant differences at the $p \leq 0.05$ level in frost, wind, salinity, and air pollution tolerances among the parks; however, there is a significant difference in drought tolerance. According to this finding, it can be concluded that the tolerance levels of plants used in all parks are almost similar for frost, wind, salinity, and air pollution factors, but the drought tolerance levels of plants used in the parks are significantly different (Table 5).

Table 5. Comparison of the ecological tolerance groups of the parks, Kruskal-Wallis H-test results

Ecological tolerance	Park name	Mean	Degree of freedom (DF)	X^2	p
Frost tolerance	Park 1	8,00±	2	5,804	0,055
	Park 2	4,17±			
	Park 3	2,83±			
Wind tolerance	Park 1	6,17±	2	1,098	0,578
	Park 2	3,83±			
	Park 3	5,00±			
Salinity tolerance	Park 1	7,83±	2	5,040	0,080
	Park 2	3,17±			
	Park 3	4,00±			
Air pollution tolerance	Park 1	7,67±	2	4,506	0,105
	Park 2	3,33±			
	Park 3	4,00±			
Drought tolerance	park 1	8,00±	2	6,880	0,032*
	park 2	4,83±			
	park 3	2,17±			

*p<0.005

4. Discussion, Conclusion and Suggestions

The population growth and expansion towards rural areas in cities are increasing day by day. This situation has made cities the most important actor causing climate change. Cities are both the perpetrator and the victim of climate change and are also one of the most important areas of struggle against the effects of climate change (UN; 2014). In this struggle process, one of the most important focal points in cities is urban open green spaces. The sustainability of urban open and green spaces and the creation of landscapes resistant to climate change are crucial in urban designs, considering the environmental factors and ecological characteristics (salinity, temperature, drought, precipitation, etc.) of the city and the implementation area, using plants with high ecological tolerance, which are resistant to global climate change (Zencirkıran & Akdeniz, 2017; Yener, 2020; Güzel & Ulus, 2021; Sönmez & Zencirkıran, 2023), and especially for the city of Kilis located in the severe drought zone, is extremely important.

In this study, woody plants used in three sample urban parks located in the city center of Kilis were evaluated in terms of ecological tolerance factors. As a result of the evaluations of frost, wind, salinity, air pollution, and drought tolerances, it was determined that the tolerance factor with an average below 50% in the sample parks is wind when considering the total number of woody plants used; however, when considering only species, wind and salinity factors fall below the 50% average. It was found that 54.3% of woody plants used in the relevant parks and 50.7% of plant species have high frost tolerance; 38.3% of total plants and 37.8% of plant species have wind tolerance; 56.7% of total plants and 46.8% of plant species have salinity tolerance; 73.7% of total plants and 59.3% of plant species have air pollution tolerance; and 74% of total plants and 57.4% of plant species have good drought tolerance.

When the frost, wind, salinity, air pollution, and drought tolerances of the plants used in the relevant parks are evaluated separately, it is determined that 61% of the plants identified in Park 1 (Karataş Park) are highly tolerant to frost; 31% to wind; 80% to salinity; 86% to air pollution; and 86% to drought. In Park 2 (Fıstıklı Park), it is found that 60% of the plants are highly tolerant to frost; 36% to

wind; 50% to salinity; 57% to air pollution; and 52% to drought. In Park 3 (Şehit Terzi Muzaffer Aydemir Parkı), it is determined that 42% of the plants are highly tolerant to frost; 48% to wind; 49% to salinity; 78% to air pollution; and 84% to drought. In this case, it is determined that Park 1 has the highest tolerance to frost, salinity, air pollution, and drought, while Park 3 has the highest tolerance to wind. Additionally, when considering the mean ranks of the groups in the Kruskal-Wallis H-Test analysis results, it will be seen that Park 1 has the highest average value in all ecological tolerance factors. Therefore, considering the construction years of the parks, it can be concluded that ecological tolerance factors were more considered in the selection of plants used in Park 1, which is the oldest park.

The study conducted evaluations and analyses taking into account both the total number of plants and the number of plant species in the parks. The study findings indicate that the ecological tolerances of the parks change when the plant species and the number of plants are evaluated separately, and that the same results are not reached. In Turkey, studies have been conducted by Sönmez & Zencirkıran (2023) in Ankara-Altınpark; Zencirkıran & Akdeniz (2017) in sample urban parks in Bursa; Yener (2020) in different coastal parks in Istanbul (Avcılar, Maltepe, Kartal, and Sarıyer); and Güzel & Ulus (2021) in 32 selected sample areas in Ordu, regarding the ecological tolerance assessments of plant species used. However, these studies did not analyze the plants in the parks based on the total number of plants. Therefore, this study differs from the other studies in this regard.

It has been determined that more than half of the plants and plant species used in the sample urban parks in Kilis have a high tolerance to frost. Although this rate is quite high, when the meteorological data specific to the city is examined, it will be seen that frost events do not pose an ecological risk in the province.

When the soil analysis results for Kilis province are examined, it is determined that the salinity level in the city center is low. However, salinity in soil occurs in two ways: natural and artificial. The natural formation occurs in arid-semiarid, flat or nearly flat basins where there is inadequate drainage in the soil, due to the transport of salts by precipitation, or due to the capillary rise of salts under extreme temperature conditions. Artificial formation, on the other hand, occurs due to irrigation or fertilization; in semi-arid and arid regions with insufficient rainfall, it is formed by the accumulation of fertilizers used in high concentrations in areas with intensive cultivation over many years (Sönmez & Sönmez, 2007). In our study, the average of plant species with high salinity tolerance in the sample parks of the city was determined to be 46.8%. Therefore, selecting plant species with high salinity tolerance in species selection is advantageous for a city like Kilis, which has low rainfall, high temperatures, and therefore high soil salinity due to artificial factors.

The average tolerance of plants used in the sample urban parks to air pollution is 59.3%. This finding is particularly important for parks and green spaces surrounded by potential areas with high air pollution (such as roads with heavy traffic and densely populated residential areas), considering that the only pollutant exceeding the limit in Kilis province based on measurements is Particulate Matter (PM10).

According to the results of the "Kruskal-Wallis H-Test for Independent Groups" conducted to determine if there is a significant difference in the ecological tolerance values of plant species used in the parks, except for drought tolerance, there were no significant differences at the $p \leq 0.05$ level in frost, wind, air pollution, and salinity tolerances among the parks. It was determined that the tolerance levels of plants used in all parks, except for drought tolerance, are almost similar.

When the average temperature and precipitation values of the city of Kilis are evaluated over the years, it is determined that temperatures have risen and the precipitation rate has decreased. Therefore, it would be appropriate to state that the most important tolerance factor in terms of ecological tolerance in the city is tolerance to drought. It has been determined that 57.4% of the plant species used in example parks have a high tolerance to drought. When evaluated based on the total number of plants used, it can be seen that drought tolerance is at good levels in all 3 parks; with a plant ratio of 74% having high drought tolerance. It has been found that in the two city parks

established after Karataş Park, more than 50% of the preferred plant species have low water consumption. This indicates that water scarcity, caused by the climate change and drought problems resulting from the increasing global warming issues, is taken into account in the city parks established in recent years.

The selection of plant species from natural species in urban areas is an important factor for utilizing the dominant ecological tolerance factors of the region positively and increasing the ecological quality of the region in terms of the sustainability of green areas. In this study, the naturalness values of plants used in parks have also been determined. The rate of use of natural species in parks was determined to be 64.30% in Park 1, 39.81% in Park 2, and 53.00% in Park 3. Therefore, the naturalness average of all parks is 52.37%. Maaşoğlu & Demiroğlu (2022) evaluated 10 parks completed in Kilis city between 2015-2019 in terms of xerophilic landscape design principles. The average rate of use of natural plants in all parks in the relevant study was determined to be 25.20%. The average naturalness value of the plants used in the sample 3 parks is higher than this rate.

The use of native plants in parks is also important in reducing water consumption and increasing the drought tolerance of parks. The parallelism between the rate of use of natural plants in parks identified in the study and the rate of tolerance to drought confirms this information. In his study, Bayramoğlu (2016) found a low rate of use of natural species in the example of Karadeniz Technical University campus, whereas in the study of Karaca & Kuşvuran (2012), it was stated that, as in the example of Çankırı city parks in terms of aesthetics and functionality, it is necessary to prefer natural species that can replace these species or species with lower water consumption instead of species with high water consumption.

Various researchers have emphasized the importance of native plant species in reflecting the identity and culture of the cities we live in and ensuring the continuity of these species, as well as their important role in preventing drought (Ertop, 2009; Tülek & Barış, 2011; Baykan & Birişçi, 2013). Similarly, in the study by Çetin & Mansuroğlu (2018), it is emphasized that selections should be made for the use of natural plants in xerophilic landscape applications under Mediterranean conditions. Furthermore, the study examined a limited number of plant nurseries and found that exotic species, which are aesthetically appealing, are predominant. Therefore, it is also emphasized that it is important for local producers to reduce this cost and turn to local plants for sustainability.

Studies conducted by scientists and ecology experts in different regions of the world demonstrate the positive environmental effects of using native plants in parks and urban areas. These studies emphasize that in landscape designs, native-local plants, being adapted to local climate and soil conditions, require less maintenance and therefore incur lower costs (such as water, fertilizer, insecticides, mowing, etc.). They are also more resilient to extreme climate conditions and create natural habitats for regional wildlife, thereby promoting biological diversity (Meurk & Swaffield, 2007; Mingguo & Guocang, 2007; EPA, 2010; Hanula & Horn, 2011; Ignatieva & Ahrné, 2013).

Based on scientific studies and research, the sustainable design of urban parks and urban green spaces depends on the selection of plant species with high likelihood of resilience within the range of ecological tolerance limits, including low water consumption, tolerance to drought, frost, air pollution, salinity, and wind. Additionally, the use of native plant species found in the specific flora of the region is of great importance. Therefore, in newly established parks, this factor must be taken into consideration, and more emphasis should be placed on design plants that are suitable for ecological tolerance.

It is the responsibility of municipalities to plan and manage all open green spaces open to the use of everyone living within the municipal boundaries. The design, implementation, maintenance, and repair of urban open green spaces and the plants in these areas, managed by the Parks and Gardens Directorate, are technical issues that must be handled professionally. Therefore, it is crucial for the technical staff and personnel working in relevant units within the municipality to have the necessary qualifications and quantity. This is an important condition for the sustainability of green spaces. In landscaping works in open green spaces, principles should be established in collaboration with academics in relevant departments of universities to ensure that urban parks are landscaped in

accordance with ecological tolerance factors. Informative meetings and seminars should be organized, and educational publications should be prepared.

The study was conducted in three different regions of Kilis city; Karataş Park (Park 1), Fıstıklı Park (Park 2), and Şehit Muzaffer Aydemir Parkı (Park 3), which have high usage intensity and plant diversity. The study is important in providing guidance for sustainable plant use in the design of parks in Kilis city, which is located in a severely drought-prone zone according to the 2022 drought data, and facing today's cities combating global climate change. The limiting factors of the research are the absence of the final versions of the structural and plant projects of the parks in a computer environment and the difficulty of plant identification studies in a hot-dry climate region. Therefore, this research was limited to the 3 parks that characterize the city. The method of this research is applicable by using different statistical methods that may vary depending on the diversity of plant species, to all parks of the city and/or different green infrastructure components of the city (medians, promenades, etc.). In this sense, the study has the potential to be developed further.

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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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Evaluation of Thermal Comfort Online Simulation Tools Usage Through Distance Education Process in an Applied Graduate Course

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Abstract

Through Covid 19 pandemic, education field has experienced mandatory transition to distant education. The case study held in Indoor Comfort Management postgraduate course. In order to examine how direct sunlight affects the adaptive thermal comfort of the user, simulations were made with online tools to evaluate thermal comfort within the scope this course at Yaşar University. The SolarCal and ComfTool of CBE online tools are used. This article aims to question the contribution of online simulation tools to education via a questionnaire given to students to grasp aspects of adaptive thermal comfort. The use of these aforementioned online tools and formulas can enrich studies and draw conclusions in limited facilities for professionals especially for architectural and engineering industries. The results of the survey will be analyzed to ensure the applicability of such a methodology in similar learning environments for easy understanding of the various adaptive thermal comfort indices at once.

Keywords: *Thermal comfort, distant education, online tools, interior design, indoor comfort.*

Uzaktan Eğitim Sürecinde Isıl Konfor Çevrimiçi Simülasyon Araçlarının Uygulamalı Bir Yüksek Lisans Dersinde Kullanımının Değerlendirilmesi

Öz

Covid 19 pandemisi ile birlikte eğitim alanında uzaktan eğitime zorunlu bir geçiş yaşanmıştır. Örnek olay çalışması İç Mekan Konfor Yönetimi yüksek lisans dersinde gerçekleştirilmiştir. Doğrudan güneş ışığının kullanıcının adaptif termal konforunu nasıl etkilediğini incelemek amacıyla Yaşar Üniversitesi'nde bu ders kapsamında termal konforu değerlendirmek için çevrimiçi araçlarla simülasyonlar yapılmıştır. CBE çevrimiçi araçlarından SolarCal ve ComfTool kullanılmıştır. Bu makale, uyarlanabilir ısıl konforun yönlerini kavramak için öğrencilere verilen bir anket aracılığıyla çevrimiçi simülasyon araçlarının eğitime katkısını sorgulamayı amaçlamaktadır. Yukarıda bahsedilen çevrimiçi araçların ve formüllerin kullanımı, özellikle mimarlık ve mühendislik endüstrileri için profesyoneller için sınırlı imkanlarda çalışmaları zenginleştirebilir ve sonuçlar çıkarabilir. Anketin sonuçları, çeşitli uyarlanabilir termal konfor endekslerinin bir kerede kolayca anlaşılması için böyle bir metodolojinin benzer öğrenme ortamlarında uygulanabilirliğini sağlamak için analiz edilecektir.

Anahtar kelimeler: *Isıl konfor, uzaktan eğitim, çevrimiçi uygulamalar,iç mekan tasarımı, iç mekan konforu.*

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1. Introduction

With the effect of the COVID-19 pandemic, distance education has become mandatory and the online education process is well-adopted by many organizations in the field. For educators and students, it is important to conduct distance education clearly to enable continuation of the learning process. For this reason, online tools that will contribute to learning, which are used in distance education have become more important. Online education should be conducted not only as a transfer of knowledge, but as an experiential process (Hodges et al., 2020). The connection between the student and the lesson is created by the instructors through planning the content of the lesson with versatile tools. Planning online learning requires a focus not only on defining the content but also on how to support the different types of interactions that are important to the learning process. During the transition to online education, many curricula needed to be updated accordingly. While creating online educational content, it was tried to enrich the education and training with experiential methods. Compared to the face-to-face education approach, how distance education/ online education, affects the education and learning of students will be examined through this article.

Mandatory online education was held in a graduate course named Indoor Comfort Management at Izmir Yaşar University, in the spring semester of 2019-2020. The course, which was face-to-face at the beginning of the term, continued online starting on week 7 due to COVID-19 pandemic uncertainty and concerns. After the change in the syllabus, some studies and experiences planned to be tested with in-course exercises, converted to be conducted with online tools. This course examines indoor comfort parameters (mainly thermal comfort) and occupant satisfaction. Thermal comfort means keeping the indoor thermal conditions at a certain level for user satisfaction. It has been a common practice to discover building occupants' satisfaction with the indoor environment by assessing their perception of thermal comfort. Thermal comfort, one of the main environmental factors required to ensure quality in the interiors, was analyzed with online tools in parallel with self-testing on how students felt in their environments. A total of 9 studies were carried out. With the limitations of online training, tools based on CBE's (Center for Built Environment) SolarCal and Comf Tool and ASHRAE Standards were used to analyze adaptive thermal comfort levels, created and shared by Berkeley Lab, UCL.

This study explains how online tools can play an active role in adaptive thermal comfort education and what level of tutoring is available for design students. The survey conducted for this specific study expresses how the online simulation tools used by the students help them to comprehend the thermal comfort aspects of the interior space they live in by comparing survey results and calculation method results. The aim is to see how these tools may contribute to education especially when face-to-face option is not active.

In the distant education process with online tools, experimenting values of adaptive thermal comfort parameters play an important role with simulations. Therefore, in this study, experiments were conducted on two different days (Sunny and Cloudy to see the effect of sun radiation) in the study. The different parameter values entered caused the students to compare two different situations for their internal environment included in the experiment and to master the validating tools online. In distance education, the use of online tools will be explained as a practical and instructive method that can be experienced by all users in the future.

The aim of this study is to learn the contribution or challenge on education by integrating two different online simulation tools about thermal comfort in comparison to applied testing. The effect on students' learning within the scope of the Indoor Comfort Management course during distance education is investigated via online surveys.

1.1. Literature Review

The literature of this study is classified under three different subjects. The research that constitutes the thermal comfort studies related to online basic simulation tools has been examined first. The studies describing the online tools usage in online education constitute another part of the literature

section and finally, a literature study on the use of online tools in thermal comfort studies as a combination of the two has been investigated.

1.1.1. Thermal comfort studies related to online basic simulation tools

People spend most of their time indoors, therefore indoor environmental quality (IEQ) appears to be a major concern. IEQ is a combination of 4 main environmental factors as indoor comfort, and thermal comfort, indoor air quality, acoustic comfort and visual comfort (Pereira et al., 2014). Thermal comfort is the main concern of the upcoming case study, which is also a subject related to the satisfaction of the occupants. Indoor spaces should be comfortable for the occupants and thermal sense levels should be within their acceptability limits (Su et al., 2023; Uzun & Pakdamar, 2023; De Dear & Brager, 2002; Nicol & Humphreys, 2002; Brager & De Dear, 1998).

According to the scanned literature, there are many studies on thermal comfort in different fields. Designers engineers, and architects have carried out different study perspectives. Some studies are created by using various online tools and subjective surveys made to users. Research conducted by measurement and questionnaires for high school students in Portugal showed that the temperature outside the comfort zone was detected, but it was stated by the students that this situation was not disturbing (Pereira et al., 2014). It was understood that the measurements and the subjective evaluations of the building occupants were parallel.

Other studies are conducted with online simple simulation tools such as SolarCal, CBE thermal comfort tool, and AccuRate. Such studies have focused on environmental parameters such as air temperature, relative humidity, clothing insulation, metabolic rate, and air velocity, and using Fanger 7-point scales, the thermal sensation and thermal disturbances of the building occupants were tried to be evaluated.

The study of Arens et al. (2015) describes SolarCal, as a new public online web-based tool for predicting solar effects on comfort. ''The SolarCal model computes an increase in MRT equivalent to shortwave gains from direct, diffuse, and indoor-reflected radiation on a person. This is used to compute PMV using the method prescribed in ASHRAE Standard 55-2013'' (Arens et al., 2015). SolarCal, which is used in this study, says that it can be used at the beginning of architectural and engineering designs for the user to prevent the negative effect of the sun on the user, which will affect the comfort level.

There is a study describing the CBE thermal comfort tool, which is the tool used in the online course. It is the last version compatible with ANSI/ASHRAE-55 (2017), ISO-7730 (2005), and Comite'Europe'en de Normalisation, C. E. N. 16798–1 (2019) Standards (Venticool.eu., 2022). The Center for the Built Environment (CBE) is an article explaining that the thermal comfort tool is a free and open-source online tool for calculating and visualizing thermal comfort indices. This tool, which can be used without any practical analytical or programming skills, is used by more than 49,000 users each year (Tartarini et al., 2020). The authors explain that it is used in different fields such as education, research and architecture. The CBE thermal comfort tool is an online tool with a high rate of use thanks to its practical and easy accessibility, as well as being accepted as an official comfort tool by ASHRAE in 2017.

Huizenga et al. (2006) revealed a study that determined the level of thermal comfort with a questionnaire. In this study, it is aimed to conclude whether office workers are satisfied with the comfort related to indoor thermal conditions. More than 34,000 questionnaire responses were given in the study conducted in 215 buildings (Huizenga et al., 2006). As a result of this study, inferences can be made that it affects productivity in office environments. There are implications for how to increase occupant comfort and productivity (Huizenga et al., 2001).

1.1.2. Online education and online tool studies

In this study, a literature review on online tools conducted that will establish the relationship between online training and easy thermal comfort assessment. Shared literature has been focused on explaining the effect of easily accessible online tools in teaching. With online education, it has been revealed that instructors and students use different lecturing techniques to enrich the educational content.

Campos et al. (2020) in their study, which encourages students' direct participation in simulation-based knowledge, four different situations that encourage intrinsic motivation and use different simulation

tools in applied learning activities designed by instructors and developed under their supervision and guidance are analyzed as an example. Training supported by simulation tools creates a good method for studies as it allows realistic models. It facilitates and improves learning processes (Campos et al., 2020; Hodges et al., 2020).

Holmberg (1977) defined distance teaching/education as a method of imparting knowledge, skills and attitudes which is rationalized by the application of division of labor and organizational principles as well as by the extensive use of technical media, especially for the purpose of reproducing high quality teaching material, which makes it possible to instruct great numbers of students at the same time wherever they live (Holmberg, 1977).

1.1.3. Online education and thermal comfort studies

A literature review has been made on online tools used in thermal comfort education. There are studies involving combinations of online simulation tools and adaptive thermal comfort.

Albatayneh et al. (2017) describe the calculation program called AccuRate an evaluation software that assigns a star rating to residential buildings in Australia based on the calculated annual heating and cooling energy requirements. This approach includes improving the overall thermal performance of building users.

Schiavon et al., (2014)'s paper describes a web application for thermal comfort visualization and calculation according to ASHRAE Standard 55. This online and free tool emphasizes that it can be used by students, instructors, architects, and engineers. Given its free availability and high interaction, another web application is suggested as a form of learning in postgraduate and undergraduate building courses or where other users can evaluate the thermal comfort results of their designs (Schiavon et al., 2014).

2. Material and Method

Thermal performance evaluation for the studio case study was prepared by using the adaptive thermal comfort model in living rooms in different locations of Izmir. In the study using 4 different methods, 2 different online tools were used. SolarCal was used in step 1, CBE Thermal Comfort in step 2, Survey questions were asked from occupants in step 3, and the final step was calculating PMVnew with the help of manual SolarCal formal. "Exposure to sunlight indoors produces a substantial effect on an occupant's comfort and on the air conditioning energy needed to correct for it, yet has in the past not been considered in design or thermal comfort standards (C.E.N., 2007). A public online model of the effects of solar radiation on human heat gain and comfort has been developed to make this possible. SolarCal is a whole-body model for ease of use in early design. Its predictions compare closely (<0.1 PMV mean absolute error) the results of a human subject test. It can be used to determine the allowable transmittance of fenestration in a perimeter office" (Arens et al., 2015, p.5).

Three different methods were applied to define thermal comfort in the course content and the results were compared through the second half of the semester. These were done with online tools, surveys, and calculation methods. To learn the contribution of the online tools of the suggested tutorial, a questionnaire was presented to the participants of the course to evaluate. Adaptive thermal comfort education can be complex so student views should be considered. A questionnaire was conducted including the study methods they used while learning and their evaluation of their ideas after this study in 2021. The main method of this specific study is a questionnaire (Appendix I) prepared to understand the contribution of the methods and online tools used for the work done in the course through online education. The evaluation part is the most valuable output.

Material consists of three different methods used for the exercise:

a. Online thermal comfort simulation tools

Thermal comfort prediction and visualization tools may help designers and building operators to better design, operate, and understand thermal comfort (Schiavon et al., 2014). It is important for designers

to design their designs inline with indoor comfort parameters. Tools that help us to understand the level of indoor thermal comfort used for teaching purposes in this applied course.

With the limitations of online education, to analyze the adaptive thermal comfort levels, the SolarCal and Comf Tool of CBE (Center for the Built Environment) generated and shared by Berkeley Lab, UCL based on ASHRAE Standards. These online tools, which constitute the objective part of the study, were used in two different conditions, on sunny and cloudy days, with different values of radiance (and related MRT) added as input. The parameters considered in simulations are dry bulb air temperature (DBT), mean radiant temperature (MRT), air velocity (m / s), relative humidity (RH), metabolic rate (BMR), and clothing insulation (clo) (Fanger, 1970). Thermal comfort is defined as the predicted mean vote / percentage of people dissatisfied (PMV / PPD). The range of PMV values is important in determining thermal comfort ranges. Another index for thermal comfort is PPD. This index, developed in conjunction with PMV, shows the proportion of people who are dissatisfied with the ambient temperature defined by Fanger first in 1970 and feel uncomfortable.

Thermal comfort is defined by the ASHRAE 55 standard as a condition of mind expressing satisfaction with the thermal environment. According to ISO, Thermal comfort can be affected by different types of physical, physiological, or psychological processes. Adaptive thermal comfort training is provided to learn the change in people's comfort sensations due to the cultural and physical differences of the environment and to adapt accordingly.

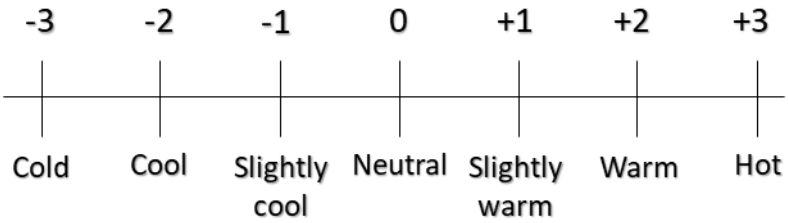
b. Adaptive thermal comfort survey

Physical measurements alone are not sufficient to define the thermal sensations of the individual users. Therefore, in addition to the thermal comfort and adaptive thermal comfort simulations with online tools, surveys and formula calculations were also made. While defining the thermal comfort level of the environment in which they live, the students made a questionnaire with themselves and/or their family members using that area exposed to the sun in sunny day conditions.

Fanger 7-point scale

To understand the thermal sensation in the subjective result, a questionnaire was prepared using the Fanger 7-point scale original evaluation grade scale (Table 1). Occupants give points based on their thermal comfort in the environment survey given in the scale defined in Table 1 (Fanger, 1970).

Table 1. Fanger 7-point scale original evaluation grade scale (Fanger, 1970)



PMVnew formula

PMV model has later been questioned assessing the ability to predict thermal sensation (Humphreys & Nicol, 2002; Baizaee et al., 2012). By using the formula called PMVnew method provided by Humphreys & Nicol (2002) about adaptive thermal comfort grading scale, a comparative evaluation of the results of the questionnaire with the PMV original scale adapted with the new PMV adaptive scale. Then, site results can be compared with online simulation tool results.

c. Prepared Survey on Online Tools Used in Online Education

In the context of this course, a survey was conducted to understand the impact of the simulations made online on students in thermal comfort education. This questionnaire was applied to a total of 9 people who attended the Indoor Comfort Management graduate course in the spring term of 2019-2020. The questionnaire has been prepared with such questions to determine whether the use of the

mentioned online tools contributes to students' learning or becomes a challenge. The effect of the thermal comfort indexes on the comprehensibility of the subject in the online tool experiment, where the variability according to different simulations is made, will be evaluated with the answers of the students who participated in this survey. The purpose of this survey is to understand the instructiveness of the online simulation tools through mandatory distance education process caused by COVID-19 pandemic.

Details of Methods applied:

With the COVID-19 pandemic, the syllabus of the Indoor Comfort Management course evaluated in this article has also changed as in many online converted courses. Online simulation tools have been added as an alternative for the course that cannot be carried out as planned at the beginning of the term. The fact that these tools can be used free of charge and online has caused students to continue their education efficiently.

a. Online thermal comfort simulation tools

Thermal comfort prediction and visualization tools can help designers better design, operate and understand thermal comfort. In this course, it was used for educational purposes for students. In the study conducted in the online course, the students determined the parts of their living spaces that receive direct sunlight as their study areas. The surveys were carried out in the spring days of 2020, in the 3rd and 4th weeks of April, in residential units. These case studies were carried out in the living rooms of houses in Izmir. Thermal comfort simulations were made using online tools. The online tools used in this study were used to find the effect of solar radiation and daylight on the PMV values of the participants. The SolarCal (MRT Calculator Tool of CBE) Tool was developed to quickly and easily understand the effect of sunlight in environments with simple geometries (Arens et al., 2015).

In addition, in order to better understand the effects of the sun, each participant made an online CBE Thermal Comfort Tool simulation, which does not take the sun as a parameter, and evaluated the results obtained from two online tools. SolarCal Tool, CBE Thermal Comfort Tool were used in this study. Conclusions are drawn by using the thermal comfort parameter inputs in both online tools.

CBE thermal comfort

With CBE's Thermal Comfort Tool related to ASHRAE Standard 55, air temperature, MRT result, airspeed, relative humidity, metabolic rate and clothing level of the occupant were used. Solar Cal adaptive comfort parameter value of MRT is added within this tool for simulation results.

SolarCal (MRT calculator tool of CBE)

It is an interactive tool that calculates and displays average radiant temperature (MRT) and estimated comfort within an area based on room surface temperatures and solar energy gain from windows and skylights (Tartarini et al., 2020).

Room dimensions, number of windows, window sizes, window glass (single or double glass), user's sitting position, floor, and wall materials, These are important for entering the emission values into the simulation tool as data. It is also effective in feeling the sunlight effect more.

The wall temperature is necessary for this simulation tool (Arens et al., 2015). By examining SolarCal research Solarcal inputs have been included. These inputs are window surface which determines of the subsurfaces to be treated as a window, alt (degrees from horizontal): solar altitude, az (degrees clockwise from north): solar azimuth, fbes: fraction of body exposed to sun, asa: average shortwave absorptivity, Idir: direct-beam (normal) solar radiation (W / m^2), Rfloor: floor reflectivity (Arens et al., 2015).

Simulations made with online tools were experienced by the students through dividing them into sunny and cloudy days. The families of the students were exposed to the sun by staying in the same position for about half an hour close to the window, where they spent time in their living areas on sunny and cloudy days in spring.

Each student has reached some inputs for simulation by using the temperature of the room he / she simulated and the weather information of the day (expected to be very similar in other parameters). Room dimensions and features also appear as different parameters. The emissivity values of the floor, wall and window materials of the room are used as inputs of the walls (Table 2). Window dimensions and window emissions are also written in the SolarCal online tool as factors affecting thermal comfort.

Table 2. The transmittance & emissivity values of materials (ThermoWorks, 2019)

Material	Light transmittance (T_{vis})	μ-value
Single glazed	0.90	5.68
Double glazed (Air filled)	0.81	2.83
Conventional double glazed unit	0.81	2.70
Double glazed unit with low-e coating	0.74	1.70
Argon filled double glazed unit with low-e coating	0.74	1.10
Polycarbonate panel	0.72	1.84
Double glazed (Argon filled)	0.70	1.40
Triple glazed (Krypton filled)	0.62	0.68

The Heating, Ventilating, and Air Conditioning system is not open during this experiment. A clothing value of 0.7 was obtained for occupants with long-sleeved T-shirts and long trousers. The students made experiments in this area with their family members. Students seated their families in a room with at least half an hour of sun to control their thermal feel on sunny and cloudy days. To analyze users' thermal sensations, questions were asked on the Fanger-7 point scale. Sun azimuth and sun altitude are found on the website for experiment day which is required for simulation (From https://www.sunrise-and-sunset.com/en/sun/turkey/izmir). Direct beam solar radiation input is found according to direct beam solar radiation on the solar altitude angle table (Table 3).

Table 3. Direct beam solar radiation on the solar altitude angle (Arens et al., 2015)

Solar altitude angle [o]	5	10	20	30	40	50	60	70	80	90
Direct beam solar radiation [W/m2]	210	390	620	740	810	860	890	910	920	925

b. Adaptive thermal comfort survey

Questionnaire questions were asked to occupants using the space after sitting on the windowsill for 30 minutes. The occupants' thermal sensation levels were defined by their answers to the questions. Fanger 7-point scale and PMVnew formula were used to reach the PMV value of the survey answers. The simulation results and the survey results were similar for the majority of course students.

PMV_{new} formula

Comparative evaluation is done by comparing PMV results obtained from simulations and the formula named as PMVnew method provided by Humpreys & Nicol (2002) to assess whether qualitative results were found. A new and still scientifically worked formula for adaptive thermal comfort.

PMVnew = 0.8 (PMV- DPMV- ASHRAE) *Formula 1*

*DPMV- ASHRAE = -4.03 + 0.0949Top + 0.00584 (% RH) + 1.201 (met * clo) + 0.000838Tout2 Formula 2*

c. Prepared Survey on Online Tools Used in Online Education

PMV model has later been questioned assesing the ability in predicting thermal sensation (Baizaee et al., 2012).

Within the scope of this study, questionnaire questions were prepared to be answered by 9 students who took the Indoor Comfort Management course at Yaşar University. In the online parts of the course, it has been tried to obtain information about how the online tools used affect students learning. In these survey questions, there are questions about the thermal comfort evaluation simulation that each student makes in his / her own environment. Along with the requirements of distant education, it was aimed to get the participants ideas about how online tools contributed or challenged the education process.

This questionnaire consists of 10 questions that target to learn how the online education is supported by online tools. The questionnaire was delivered to the students taking the course by e-mail. All students taking the course willingly participated in the survey and shared their opinions.

3. Findings and Discussion

This study explains a case study about the thermal comfort experience through, one of the parameters of indoor comfort, in the indoor management control applied course given at Yaşar University in the spring semester of 2019-2020. Simulations were made with online tools for generic thermal comfort and its adaptable thermal comfort coupling. The contribution of this to education will be concluded with the opinions of the students.

Distant education is a method of transferring knowledge, skills and attitudes that are rationalized by the application of division of labor and organizational principles, as well as the widespread use of technical knowledge (Peters, 1973).

Distant education brings new ideas and new approaches to creativity into students' minds (Kauser, 2021). Luna et al. (2018) tested the effect of integrating various learning strategies, namely simulations and case studies, into the curriculum of a Management Engineering course at the Universidad del Pacifico.

Among the many benefits provided by simulation training resources, their easy integration into blended and online courses is a notable fact that promotes their spread and popularity among universities and training centers worldwide (Campos et al., 2020).

It was concluded that the simulations managed by the instructors facilitate the development of the students' analytical thinking. With free online tools for LEED thermal comfort credits, thermal comfort calculations and visualizations, according to ANSI/ASHRAE-55 (2017), ISO-7730 (2005), and Comite'Europe'en de Normalisation, C. E. N. 16798–1 (2019) standards, architects, engineers or design students can easily define thermal comfort.

Online education has also contributed to the teaching, in example: thanks to the simulation tools used by the students that help them to understand the thermal comfort of their living environment. Simulations with online tools create an important experience in determining adaptive thermal comfort.

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When asked whether online tools are an advantage or a compelling factor for understanding thermal comfort sense, 3 of the students said it was an advantage, while 4 students said it was challenging, and 2 people were undecided (Figure 1).

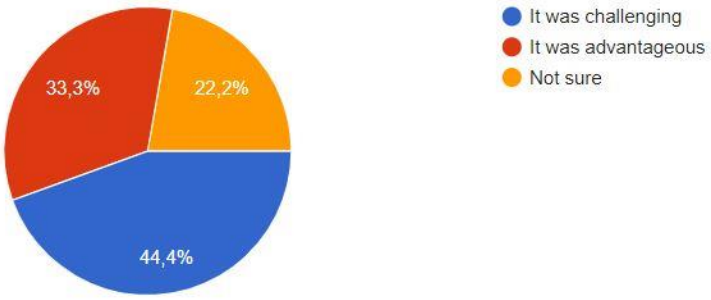

Figure 1. Chart created by author from Appendix I question "Do you think the use of more online tools for understanding applications of thermal comfort became a challenge or advantage for you?"

It is important for the instructors, who have a role in helping the students to adapt in distance education, to contribute to the lessons and explain the use of tools in an understandable way. Therefore, a question was asked the students about how the influence of the instructor affected this process. It represented 5 students strongly disagree while being evaluated as 1 strongly agree. The majority of the students said that the course instructor helped explain the online tools (Figure 2).

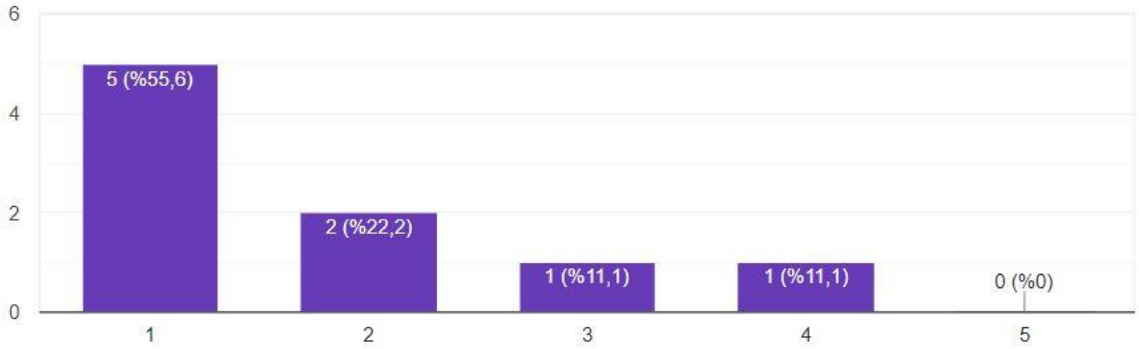

Figure 2. Chart created by author from Appendix I question "How do you agree that the course instructor explained and gave resources about the clear use of online tools? (1-5 Strongly Agree- Strongly Disagree)"

More than 50% of students agreed that SolarCal and Comf Tool of CBE (Center for the Built Environment) facilitate simulating adaptive thermal comfort measures are clear interfaces and freely accessible to be used in distant education (Figure 3).

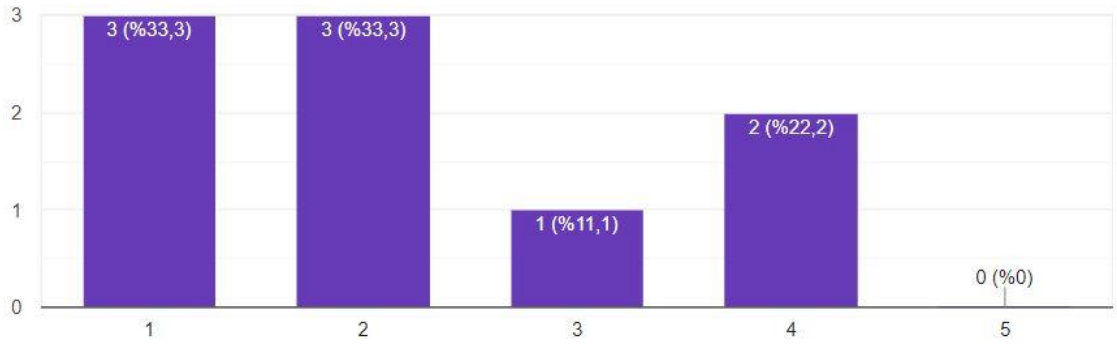

Figure 3. Chart created by author from Appendix I question "Are SolarCal and Comf Tool of CBE (Center for the Built Environment) online simulation tools used in distant education made it easier to simulate adaptive thermal comfort measures with its clear interface and free access? (1-5 Strongly Agree- Strongly Disagree)"

SolarCal and Comf Tool of CBE (Center for the Built Environment) online simulation tools used in distant education made it easier to simulate adaptive thermal comfort measures with its clear interface and free access.

After the simulations students conducted with the online tools, the participants were asked a question about the degree of their ability of using these tools. Some of the students who use online tools define themselves as average dominant, while others define themselves as above average (Figure 4). We can understand that the online tools used have easy and understandable steps during the application phase as all participants rated their usage level as average and above.

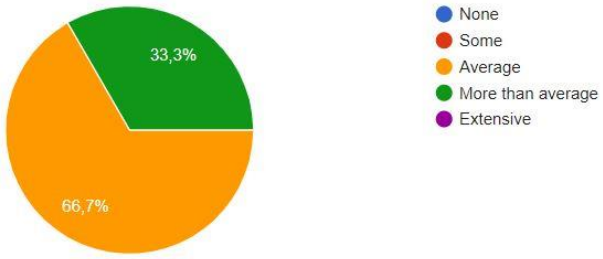

Figure 4. Chart created by author from Appendix I question "How would you rate your usage of online simulation tools introduced for rating adaptive thermal comfort?"

A question was asked to understand if the thermal comfort status performed gave similar results with different methods. In this question, 5 of the participants say that the results for the simulation and survey they conducted in parallel to understand the thermal comfort of the building occupants overlap. While 3 participants remain undecided, 1 participant says that the simulation and survey results do not match (Figure 5).

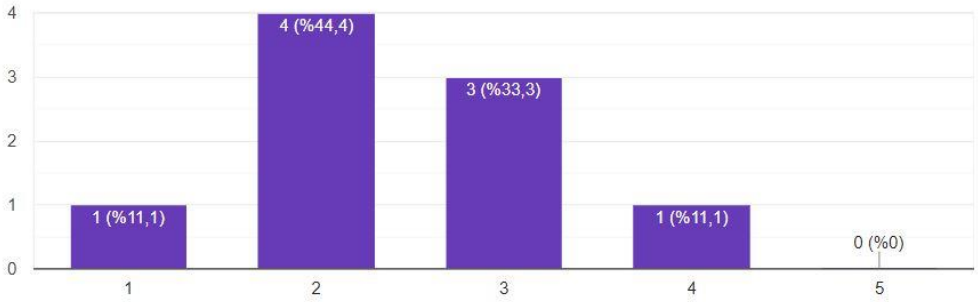

Figure 5. Chart created by author from Appendix I question "Did the simulation and the survey conduct parallel to understand the thermal comfort of the occupants give similar results as anticipated? (1-5 Strongly Agree- Strongly Disagree)"

The students agreed with the questionnaire that using online tools and exercise/case study/ test in the distant learning process helps to better understand adaptive thermal comfort (Figure 6).

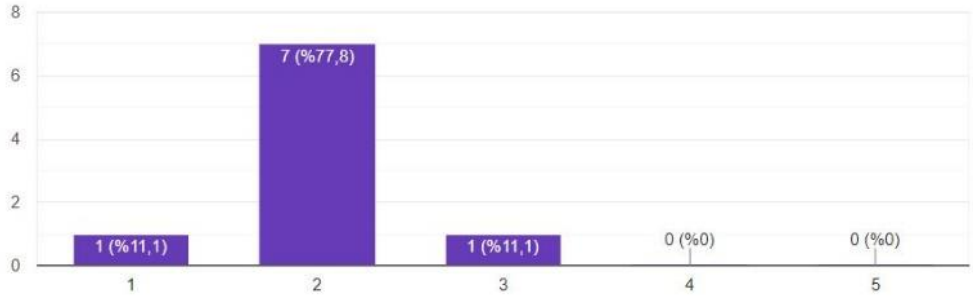

Figure 6. Chart created by author from Appendix I question "Through the test/case study exercise given, to what extend did you have the chance to understand the concept of adaptive thermal comfort measures? (1-5 Strongly Agree- Strongly Disagree)"

The question was asked that the effect of solar radiation on adaptive thermal comfort was experienced and simulated with redesigned online exercises and questionnaires. While 7 of the participants joined, 1 participant was undecided. 2 people did not participate in this judgement.

In an open-ended question (Question 10- What are the benefits and disadvantages of distant learning through online simulation tools in the Graduate Course INAR 5570 Indoor Comfort Management), the benefits and disadvantages of distant education implemented with online tools were asked. Some participants mentioned that the technical courses become more clear with online tools. According to these students, it is more beneficial to use online tools accompanying case study exercises for consolidating technical knowledge learning outcomes. These courses defined as courses, which becomes difficult to comprehend according to the answers of with distant education through this open ended question.

Despite these thoughts, majority of the students believe that if the experiments were done face-to-face in the classroom accompanying simulations, their understanding of newly introduced concepts would be even higher (Figure 7).

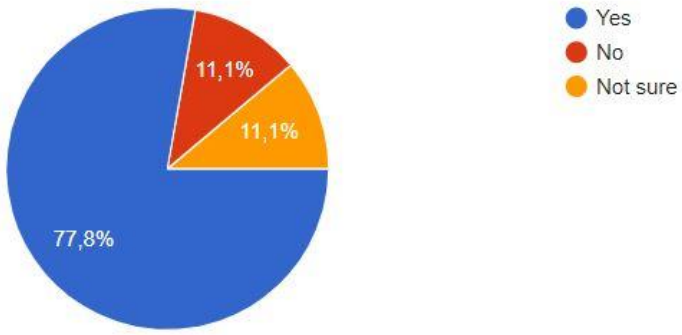

Figure 7. Chart created by author from Appendix I question "Do you believe if the experiments could be held in face to face class environment- your understanding of newly introduced concepts would be higher?"

The questionnaire answered by the course participant students stated that the simulations made with the online tools used in distant education also contribute to the development of the students graduate education, facilitate the understanding of the adaptive thermal comfort experience for future as well. However face-to-face interaction will be even more beneficial according to majority of student replies.

4. Discussion and Conclusion

As COVID-19 or similar pandemic conditions appear, distance education will continue to gain momentum all over the world. In distance education, the tools used are important for students to adapt to the online lessons and to receive the needed education level as aimed at a graduate course. In online courses, online tools have become a helpful element in understanding the lessons properly.

Various online tools are used in distance education (Buda, 2009; Puustinen & Rouet, 2009; Tang & Austin, 2009; Yaman et al., 2008). Agustí-Juan et al. (2017) says, simulation software and tools improve the learning experience when applied activities are also used by instructors in the education of students. Simulation-based activities in higher education programs have increased in recent years with computers becoming more personal and easy to move (Qudrat-Ullah, 2010).

Web-based online free tools offer important opportunities for designers and design students. It is known that the objective part of thermal comfort measurements are made with some online tools as a result of the guidance of the lecturer. One of the most actively used simulation programs is called ECOTECT and is made depending on the window configurations. In a study using ECOTECT 11.0, the Software was used to explain the effect of different building orientations on thermal comfort as well as validate it using measured data (Anand et al., 2017). This simplified tool can help architects and

building designers evaluate the performance of buildings in the early design stages with simple input parameters.

The adaptive thermal comfort approach helps building users achieve thermal comfort strategies effectively such as natural ventilation, seasonal clothing, solar exposure or control / shading (D'Ambrosio Alfano et al., 2014). There are tools that create some adaptive thermal comfort model. These are Accurate, CBE Thermal Comfort Tool, SolarCal, and some other tools described in the literature. CBE and SolarCal tools are used in parallel with a case study survey on thermal comfort levels within the sun exposed (MRT effect) rooms of student spaces under sunny and cloudy conditions with a few occupants. Material and adjustments of detailed methods are all given in Section 2 of this study.

Online tools are defined by students and educators as enriching the course content. The online tools used in the Indoor Comfort Management applied graduate course, which is the subject of this paper, have contributed to thermal comfort training according to results of the survey in Section 3.

A subjective evaluation of thermal comfort education has been made by volunteering graduate students (all class of 9) taking the Indoor Comfort Management course. All students who have taken and finalized the course participated this survey voluntarily. As experienced through the course and the transition to distance education, the effects of thermal comfort online tools used in distance education on students' learning process have been examined by this case study.

When we look at the results of the survey, the students said that the use of online tools made the learning process more useful and training was effective through online course. Despite this, most of the students stated that they preferred to use this online tool in a face-to-face education instead of distance education. Student responses are satisfactory as a result of seeing the benefits of using these tools in distance education. Thus, it can be concluded that online simulation tools that will contribute to thermal comfort education provide easy understanding and accessibility for the students and can be helpful to other groups as well.

Online simulation tools can also become important teaching tools in distance education or other professional platforms. Being easily accessible, they become practical teaching tools for students and other professionals in need. Students can develop their experiences with the online simulations they experience with the guidance of their instructors. In the distance education process, online tools can become an opportunity for students as well as these tools can be used in face-to-face education to reinforce the learning of new technical concepts such as adaptive thermal comfort. Multiple online tools introduced in paralel with real case testing studies are effective at experiencing the multi-dimensional components of adaptive thermal comfort and solar effect at once with simple interfaces.

Limitations of this study can be defined as:

- Number of participants is limited with defined graduate course students only.
- No past familiarity of students with the online simulation software knowledge and interest is questioned (P.S. Some students can be more tech-savvy than others).

Further study can be carried out on questioning the effect of the distance education of adaptive thermal comfort simple online tools on professional such as designer architects and mechanical engineers.

Acknowledgements and Information Note

This article is produced from a term report of Non-Thesis Master's Degree program, completed in 2021 at Interior Architecture in the Department in Graduate School of Yaşar University. The article complies with national and international research and publication ethics. Ethics Committee approval in the study is taken by the Ethics Committee of the University on 03.05.2021 dated meeting.

Author Contribution and Conflict of Interest Declaration Information

1st Author % 80, 2nd Author % 20 contributed. There is no conflict of interest.

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Appendix I

ONLINE EDUCATION ASSESSMENT

The purpose of this research project is to understand the instructivity of the online simulation tools through mandatory distant education process caused by COVID-19 pandemic. This is a research project being conducted by Dilan Yanar at Yaşar University. You are invited to participate in this research project because you have taken the INAR 5570 Indoor Comfort Management graduate course in the spring semester of 2019-2020.

Your participation in this research study is voluntary. If you decide not to participate in this research survey, you may withdraw at any time.

The procedure involves filling an online survey that will take approximately 10 minutes. Your responses will be confidential and we do not collect identifying information such as your name, email address or IP address.

We will do our best to keep your information confidential. All data is stored in a password protected electronic format. To help protect your confidentiality, the surveys will not contain information that will personally identify you. The results of this study will be used for scholarly purposes only and may be shared with related scholarly research team.

Thank you for your participation.

1. Read and agree with the consent form

Uygun olanların tümünü işaretleyin.

☐ Yes

2. What do you think about revising the content of the course in line with distant education. Do you think use of more online tools for understanding applications of thermal comfort became a challenge or advantage for you?

Yalnızca bir şıkkı işaretleyin.

◯ It was challenging
◯ It was advantageous
◯ Not sure

3. The course instructor explained and gave resources about the clear use of online tools .

Yalnızca bir şıkkı işaretleyin.

	1	2	3	4	5	
Strongly agree	◯	◯	◯	◯	◯	Strongly Disagree

4. SolarCal and Comf Tool of CBE (Center for the Built Environment) online simulation tools used in distant education made it easier to simulate adaptive thermal comfort measures with its clear interface and free access.

Yalnızca bir şıkkı işaretleyin.

	1	2	3	4	5	
Strongly Agree	◯	◯	◯	◯	◯	Strongly Disagree

5. How would you rate your usage of online simulation tools introduced for rating adaptive thermal comfort?

Yalnızca bir şıkkı işaretleyin.

- ◯ None
- ◯ Some
- ◯ Average
- ◯ More than average
- ◯ Extensive

6. The simulation and the survey conducted parallely to understand the thermal comfort of the occupants gave results as anticipated.

Yalnızca bir şıkkı işaretleyin.

	1	2	3	4	5	
Strongly Agree	◯	◯	◯	◯	◯	Strongly Disagree

7. Through the online exercises given, I had chance to understand concept of adaptive thermal comfort measures.

Yalnızca bir şıkkı işaretleyin.

	1	2	3	4	5	
Strongly Agree	◯	◯	◯	◯	◯	Strongly Disagree

8. Using the online tools in the distant education process made me gain a better understanding of adaptive thermal comfort.

Yalnızca bir şıkkı işaretleyin.

	1	2	3	4	5	
Strongly Agree	◯	◯	◯	◯	◯	Strongly Disagree

9. The effect of solar radiation on adaptive thermal comfort experienced and simulated with the redesigned online exercise and surveys.

Yalnızca bir şıkkı işaretleyin.

	1	2	3	4	5	
Strongly agree	◯	◯	◯	◯	◯	Strongly disagree

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GIS-Based Risk Assessment on Sea Level Rise and Flooding in Alsancak Harbour Behind Area

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Abstract

According to climate change projections outlined in the Intergovernmental Panel on Climate Change 6th Assessment Report, sea levels are expected to rise between 0.37 and 1.88 meters by 2150. The rise in sea level poses a significant threat to coastal areas, including industrial heritage zones frequently developed around ports. Alsancak Harbour Behind Area is a significant location due to its essential industrial heritage. The main objective of the research is to evaluate the potential risks related to floods and long-term sea level rises in the Alsancak Harbour Behind Area. Thus, the research aims to assess the potential risks associated with flooding and long-term sea level rise in the Alsancak Harbour Behind Area within the context of industrial heritage. It also measures the area's resilience to these risks and discusses planning decisions. The 'Coastal Risk Screening Tool' was used to create a coastal flood map according to determined three different scenarios. The result shows that the valuable industrial heritage buildings such as the Coal Gas Factory, Old Flour Mill-II and Tariş Alcohol Factory, new high-rise residential areas, port facilities and transportation arteries are at high or medium risk, especially in 2100 and 2150.

***Keywords:** Flooding, Izmir, industrial heritage, urbanization.*

Alsancak Liman Arkası Bölgesine Yönelik Deniz Seviyesindeki Yükselme ve Sel Baskınının Olası Etkilerinin CBS kullanılarak Analizi

Öz

Hükümetler arası İklim Değişikliği Paneli 6. Değerlendirme Raporu İklim değişikliği senaryolarına göre su seviyesinde 2150'ye kadar 0,37 ile 1,88 m arasında bir artış beklenmektedir. Su seviyesindeki yükselme özellikle kıyı alanlarını dolayısıyla genellikle liman çevresinde gelişen endüstriyel miras bölgelerini tehdit etmektedir. Alsancak Liman Arkası sahip olduğu yapılar itibari ile içerisinde endüstriyel kültür varlıklarının kümelendiği önemli bir alandır. Araştırmanın temel amacı İzmir'de Alsancak Liman Arkası Bölgesindeki taşkın ve uzun vadeli deniz seviyesi yükselmesi ile ilgili potansiyel riskleri endüstriyel miras kapsamında değerlendirmek, bölgesinin bu risklere göre dayanıklılığını ölçmek ve planlanmasına dair kararların bu kapsamda tartışılmasına imkan sağlamaktadır. *Araştırma belirlenen üç farklı senaryoya göre sel baskını haritası oluşturmak için 'Kıyı Riski Tarama Aracı' kullanılmıştır. Araştırmanın sonuçları Havagazı Fabrikası, Eski Un Değirmeni-II ve Tariş Alkol Fabrikası gibi değerli endüstriyel miras yapılarının, yeni yüksek katlı yerleşim alanlarının, liman tesislerinin ve ulaşım arterlerinin özellikle 2100 ve 2150 yüksek veya orta risk altında olduğunu göstermektedir.*

***Anahtar kelimeler:** Su baskını, İzmir, endüstriyel miras, kentleşme.*

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1. Introduction

Coastal areas have fragile ecosystems due to many factors such as floods, storms, coastal erosion, sea level rises and often the interaction of several of them (Hsiao et al., 2021; Satta, 2014; Zellou & Rahali, 2019). However, these areas host a large part of the world's population. Currently, approximately 2.75 billion people worldwide inhabit within 100 km from the coast (Reimann et al., 2023; United Nations, 2008, 2017). Areas located around the coast experience potential dangers that can lead to negative consequences due to the dense concentration of people and valuable assets stead in vulnerable areas (Reimann et al., 2023). Although the rapid urbanisation of coastal areas brings economic benefits and provides the region with transportation and development opportunities, it raises concerns about the environmental deterioration of the coastal areas (Liz Creel, 2003). Human activities have been one of the biggest threats to the destruction of coastal and ocean ecosystems due to this increase in the number of people living in these regions and their needs (Gattuso et al., 2015; Hinrichsen, 1999; Sharma & Chatterjee, 2017; Zhai et al., 2020). Urban expansion, agricultural production, industrial activities, mining (Zhai et al., 2020) and microplastics (Sharma & Chatterjee, 2017), threaten oceans and seas as human activity. Gattuso et al. (2015) highlight the increase in CO2 during the industrial era and report that increases in atmospheric carbon dioxide (CO2) have consequences such as global warming, melting glaciers, ocean acidification, and sea level rise.

This concentration of population in coastal areas and the economic dependence on them caused the expansion of the coastal regions towards the sea through land reclamation (Sengupta et al., 2023). Land reclamation refers to the process that involves altering the natural coastline and converting underwater areas into usable land for various purposes. The reasons behind these reclamation processes are the necessities of coastal cities for agricultural, industrial, commercial, recreational and residential areas (Martín-Antón et al., 2016; Sengupta et al., 2023). The coastline of Turkey is more than 8000 km long (Samsunlu et al., 2000) and there are 28 coastal cities, along with 191 districts and 181 villages or towns situated below the 10 m contour line Türkiye, resulting in areas vulnerable to sea level rise (Kuleli, 2010). In alignment with the global pattern, the populations of 28 coastal cities in Turkey in 2000, 2010 and 2020 were approximately 34, 39 and 46 million (Kocadağlı, 2022) respectively, which is slightly more than half of the country's total population and is in a constant increase throughout the period. Due to intensive migration from Turkey’s eastern and south-eastern parts (Karaca & Nicholls, 2008), the population density in coastal cities is relatively high compared to the hinterland, considering that coastal cities constitute 28% of Turkey's total surface area (Kocadağlı, 2022). As a coastal city, Izmir ranks third in population and holds second position in population density (Baser, 2020).

Izmir's population, approximately 1.2 million in 1965, has almost quadrupled, reaching about 4.5 million in 2022 (TUIK, 2022). One of the most important factors affecting this rapid population growth is the migration movement that started in Turkey in the 1950s. After Izmir gained more strategic importance, especially after the 1960s, it became one of the provinces that received the most immigrants from rural areas of Turkey (Işık, 2017).

As a result of the increasing population and urbanisation pressure on the coasts of the Izmir Gulf, the city has expanded incrementally towards the sea since the 1970s through reclamation for mostly recreational, industrial and infrastructural purposes (Kösenciğ & Güneş, 2023).

However, this expansion towards the sea has destroyed Izmir's coastal ecosystem, making the city more vulnerable to floods (Ak, 2021). Green areas along the Gulf of Izmir through land reclamation have caused the degradation of coastal habitats (IZM et al., 2017). For example, 1258.57 hectares of vegetation in the salt plain in the Gediz Delta was reclaimed, decreasing by more than 40% between 1963 and 2005. Reclamation was seen as an opportunity to increase the available land area, but environmental impacts of land reclaimed from the sea were not considered (Hepcan et al., 2012). One of the primary environmental threats facing coastal areas is climate-induced sea level rise (Reimann et al., 2023) and its resultant effects on the cities (Neumann et al., 2015). Although the land reclaimed

from the sea meets the land demand in the city, it exposes these areas to coastal floods due to storms and rising water levels (Xu et al., 2021). The research aims to reveal the lands obtained through land reclamation for port and infrastructure purposes in the Alsancak Harbour Behind Area. It is also intended to assess the risk of possible flooding and long-term sea level rises to see the effects on the district.

2. Alsancak Harbour Behind Area

2.1 Study Area

The geographic extent of the Alsancak Harbour Behind Area is shown in Figure 1. The study area is located within district of Konak in Izmir, encompassing the distinctive neighbourhoods of Umurbey and Ege. The study area consists of large industrial buildings that are still operational, have been repurposed, or are currently vacant., areas created by the demolition of industrial buildings, small and medium-sized commercial units, and large port and warehouse buildings. These buildings are the main spatial characteristics of the area. The Turkish Railways facilities also cover a huge space in this area and are an important characteristic of it. The study area also comprises of current residential buildings, high-rise residential building projects, and an urban transformation project by the İzmir Municipality.

Figure 1. Study area map.

While the Umurbey neighbourhood includes primarily commercial areas, the Ege neighbourhood covers mostly residential area. Ege and Umurbey had a population of 2238 people in 2021 (TUIK, 2022), 1025 buildings (IBB open data portal), 2975 dwellings, and 812 workspaces (Konak Municipality, 2023) (Table 1).

Table 1. Existing dwelling, workspace, and population in the research area.

Neighbourhoods	Population (2021)*	Number of buildings**	Number of dwellings ***	Number of private workplace(2)***	Number of IHB ****
Ege neighbourhood	1929	467	1887	257	0
Umurbey neighbourhood	309	558	1088	555	13
Total	**2238**	**1025**	**2975**	**812**	**13******

*Population data will be obtained from TUIK 2021 Sonuçları
**Number of buildings (data was obtained from Izmir Metropolitan Municipality Open Data Portal)
***Number of dwellings and workplaces (data were obtained from Konak Municipality)
****IHB: Industrial Heritage Building (IZKA, 2021). Data was obtained from the Izmir Industrial Heritage Inventory. Please see Figure 3 for identification of the buildings.

2.2 History of the study area

Industrial investments gained momentum with the Industrial Incentive Law in 1927 in Turkey, according to Izmir Province Yearbook (1929). The number of industrial investments, with more than ten labourers, increased approximately from 289 to 936 in İzmir between 1950 and 1961 (Tümertekin, 1961). İzmir is a metropolitan city with 10% of the industrial establishments in Turkey and nearly half of the industrial establishments in the Aegean Region (Ünal, 2019). These investments in İzmir are concentrated mainly in the post-harbour area which is called “Alsancak Harbour Behind Area” located between Halkapınar-Basmane, Çınarlı-Bayraklı and Bornova (Figure 1) within the central region of the city between 1950 and 1960 (Karadağ & İncedere, 2020).

Izmir has played a significant role in the industrialisation process, meeting the industrial needs of Turkey since the beginning of the industrial era due to its geographical privilege. On the other hand, this industrialisation process affected the urban development of Izmir. According to Tümertekin, while residential and industrial areas are integrated into Istanbul, these areas are separated in Izmir (Tümertekin, 1961). One of the most important reasons behind this segregation is the boundaries of Alsancak Harbour Behind Area. This district is pretty unique in terms of its industrial heritage, land use pattern, and urbanisation policies. This area, which consists of Ege and Umurbey neighbourhoods, was separated from its vicinity by distinctive physical boundaries. The triangular-shaped area is surrounded by the railway line reaching Alsancak train station, Alsancak port, and Meles Stream.

In terms of industrial heritage, the Alsancak Harbour Behind Area holds paramount significance. The Darağaç axis, starting from the Punta (Alsancak) Train Station and continuing towards Bayraklı, stands out as the areas where food activities are concentrated, and the Basmane Train Station and Halkapınar Water Factory axis are the area where leather enterprises and oil factories are concentrated (IZKA, 2021). However, changes in Turkey's macroeconomic policies after 1980 and the decisions taken regarding the relocation of urban industrial areas led to the end of production of many factories in the Alsancak Harbour Behind Area (Ayik & Ögel, 2022). The preservation of industrial heritage in Turkey began to be discussed in the 1990s (Karadağ & İncedere, 2020). Thus, it led to the re-functioning of factories in this district from the 1990s to the present day.

While part of the factory area of Sümerbank is operated by the Ministry of National Education, Soil Crops Office Silos (Figure 2) and Railway Campus are still in the same function today. The Railway Maintenance and Repair Shops were established to provide maintenance and repair locomotives, encompassing an area of 50,393 square meters. The second-largest industrial complex in the district, the Sümerbank textile industry, was officially registered as a "Cultural Heritage to be Protected" on March 29, 2001, under the provisions of Laws No. 2863 and 3386. In the same decree, the necessity of preserving the production equipment reflecting the manufacturing process of the İzmir Sümerbank Textile Industry for transformation into an industrial museum was also underscored (IZKA, 2021).

Figure 2. TMO silos.

Coal-Gas Plant, one of the iconic industrial structures of Alsancak Harbour Behind Area, has maintained its original function from 1867 until 1995 and was restored after being used as a bus depot for a while. It was re-functioned as a cultural centre in 2008. The building is currently located in a medium-risk area in case of a possible water rise (IZKA, 2021).

Old Flour Mill I, which functioned as a factory until the 1980s, was transferred to the Yaşar Education and Culture Foundation in 1996, and in 2002, it took over the educational function as the Alsancak campus of this university (IZKA, 2021). Afterwards, the foundation converted this building into a museum (Figure 3) completing the restitution and restoration works in 2021. This museum encompasses an enclosed area of roughly 6000 square meters, consisting of temporary and permanent exhibition areas, a library, offices, a conference hall, a cafeteria and sales units (YEKV, 2018, 2022). Tuzakoğlu Flour Mill was converted into an IBB vocational training. In addition, the Tekel Maintenance Supervisor's Office and guesthouse in the research area have been converted into the Architecture Center (IZKA, 2021).

Figure 3. Photos of Selcuk Yasar Museum (Old Flour Mill I) from Liman Street (left) and Şehitler Street (right).

2.3. Development of Residential Areas in Study Area

The process that started with the international competition announced by Izmir Metropolitan Municipality in 2001 was effective in this change of land use in this region. The competition aimed to encourage the generation of ideas for creating a new city centre between Turan and Alsancak by assuming the function of the existing city centre. In 2003, Izmir Metropolitan Municipality produced a master development plan at a scale of 1/5000, based on the data obtained from the projects that won places in this competition (Erdik & Kaplan, 2009). This plan envisages the use of land for tourism, trade and cultural purposes behind the Alsancak harbour. However, it can be said that this process, which started in 2001, has paved the way for the rise of skyscrapers in this area today, due to the uncertainties regarding floor heights both in the competition and in the master development plans.

Large residential construction projects such as "Pekerler İnşaat, Allsancak," "Teknik Yapı, Evora İzmir" and "Teknik Yapı, Divan Residence" have started in this district pointed out by (Peker, 2019) as demolished area for the construction. According to the Izmir Municipality public reports and the information on their website, the total number of existing dwellings will double in the following years (Table 2).

Table 2. Planned dwellings and workspaces in the research area.

Projects	Neighbourhood	Number of dwellings	Number of private workplaces	Source
Allsancak-Pekerler İnşaat	Ege	1069	37	(Emlak Konut, n.d.)
Evora İzmir-Teknik Yapı	Umurbey	1057	41	(Teknik Yapı, n.d.-b)
Divan Residence-Teknik Yapı	Ege	670	4	(Teknik Yapı, n.d.-a)
Urban Transformation Project-IBB	Ege	784	244	(IBB, n.d., 2023)
Total		3502	326	

In addition to new residential projects within the borders of Alsancak Harbour Behind Area, the construction of similar mega-residential complexes continues just on the east side of Meles Stream (Figure 4). This district, known for its industrial identity, is evolving into an area with a different identity due to the construction of these mixed-function skyscrapers and this construction trend that is expected to continue in the future.

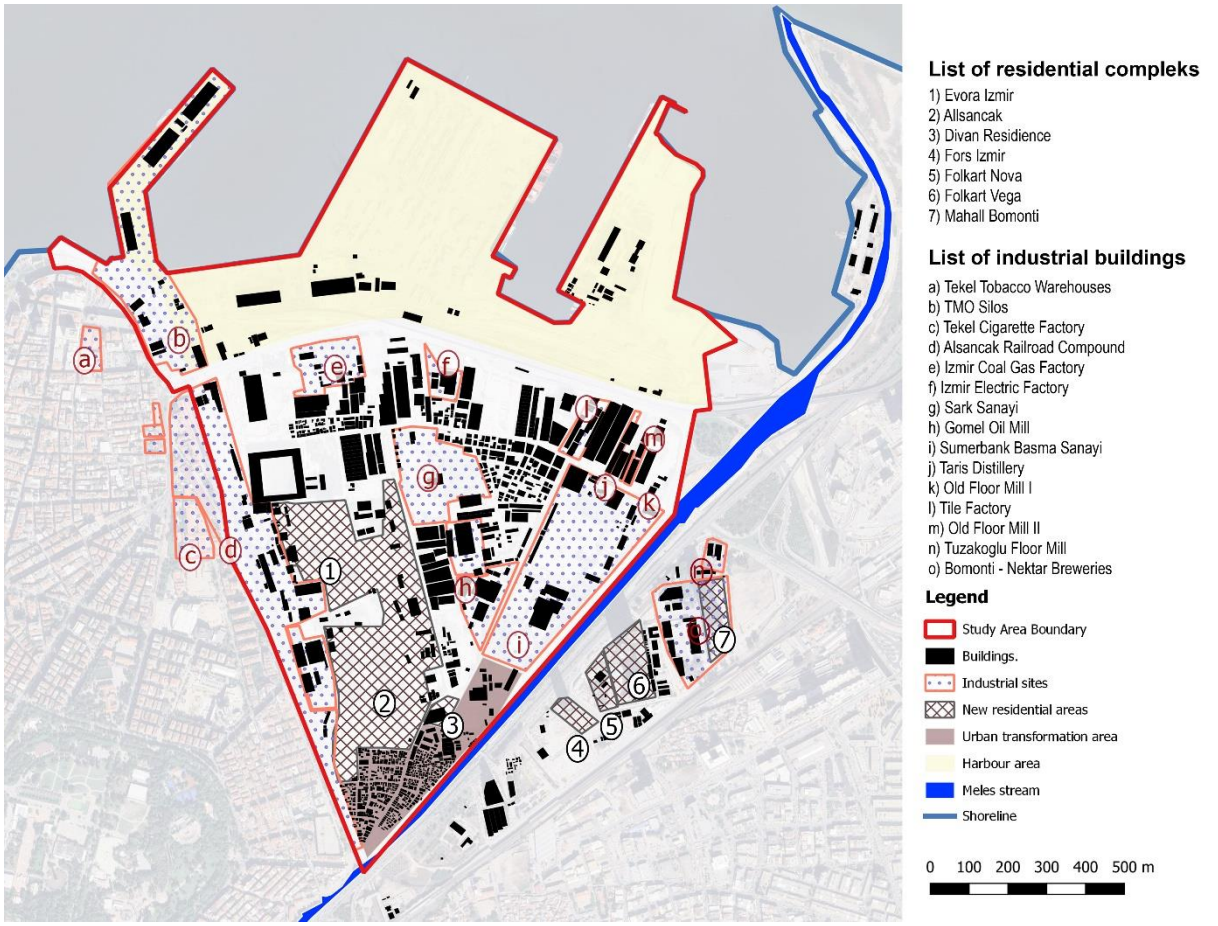

Figure 4. Map showing industrial, new residential complexes* and urban transformation area** in Alsancak Harbour Behind Area.

Note: * Boundaries of new residential complexes were identified through their websites and catalogues of the relevant projects (Teknik Yapı, n.d.; Pekerler İnşaat, 2020; Teknik Yapı ve Halk GYO, n.d.; Güçsan Yapı, 2021; Saya Grup, 2021; Türkerler, n.d.). ** The Izmir Industrial Heritage Inventory published by IZKA was used to determine the locations of industrial sites (IZKA, 2021).

Figure 5. View of Evora Izmir project rising on the land of Tariş (left) and Allsancak project from Ege Neighbourhood (right).

Two high-rise residential projects (Figure 5) are currently under construction in the Alsancak Harbour Behind Area. Both projects contrast in height, scale and form with the fabric of the two neighbourhoods in the region. The existing fabric consists of Umurbey Neighbourhood with the sparse

gross density, where industrial areas are located, and Ege Neighbourhood transformation area with medium gross density, which is mainly composed of low-rise residential buildings (Table 3).

Table 3. Neighbourhoods' surface areas and gross densities.

Neighbourhoods	Area (hectare)	Gross density* (population/hectare)	Urban Transformation area *** (hectare)	Gross density in urban transformation area (population/hectare)
Ege neighbourhood	23.49	82.12	7	274.8
Umurbey neighbourhood	160.44	1.92	-	-
Total	**183.93**	**-**		**-**

*The research utilised the density rating as determined by the Master Development Plan. In calculating the density, the populations of the neighborhoods for 2021 were taken into account.
** Urban transformation boundaries were obtained by transferring the boundaries to QGIS environment in the project prepared by IBB (IBB, n.d.). See Figure 4 for the boundary.

2.4. Climatic Features and Reclamation Works in Alsancak Harbour Behind Area

Alsancak Harbour Behind Area, which is situated close to the historical port of Izmir has a direct correlation with the Aegean Sea, which has played a pivotal role as a crucial conduit for trade and transportation throughout history. This advantageous coastal location has notably influenced the growth and evolution of maritime-related industries within the district, thereby contributing to its distinctive industrial heritage. To meet the demand for trade, this harbour area was formed by a land reclamation throughout history and eventually attained its present form.

Alsancak Port is a natural harbour that is the centre of Izmir's industrial and commercial activities. It consists of both Passenger Port and Freight Port areas. In Alsancak Harbour, which is still operated as a public enterprise today, there are docks for passenger, cargo and container purposes and various storage areas and service buildings such as warehouse, dock master, passenger hall, port operation building, protection and security chief, fire brigade, warehouse workshops, technical manager, closed shed, CFS, Flammable material, Social building, Arkas building, old container washing agency offices, office, and Container Operation Building (IZKA, 2019).

Izmir is impacted by river floods in three key river basins: "Küçük Menderes", "Gediz" and "Kuzey Ege" Basins (AFAD, 2021). 54%, 24.91% and 16% of Izmir province are located on the borders of the "Küçük Menderes", Kuzey Ege and Gediz basins, respectively (SYGM, 2019b, 2019a, 2019c). Additionally, the district shares a significant association with the Meles streams, which traverse the city of Izmir. The Alsancak Harbour Behind Area presents hydrological and geographical features that make it prone to flooding. These features include its proximity to sea level and the presence of Meles Stream. Therefore, the region's hydrologic cycle dynamics; the precipitation, run off, evaporation, infiltration and basin storage capacities are crucial. The "Küçük Menderes Havzası" Flooding Management Plan (SYGM, 2019b) indicates that the flood risk of the Meles Stream is categorised as a medium, while the Meles Stream Side is considered to have high flood risks. It is important to note that these risk levels are not static and are subject to change due to the rapid urbanisation process (Miller & Hutchins, 2017) in the district. The expansion of urban areas and associated modifications to land use patterns contribute to an increase in the overall flood risk potential of the area.

Due to climate change, sea levels are increasing in coastal cities and this increase is expected to continue in the future (NASA, n.d.-b). There are studies that reports the global mean see level rise in between 0,2 m and 2.0 at 2100 (Hall et al., 2016; Parris et al., 2012; Sweet et al., 2017). Predictions regarding sea level rise are critical for understanding its impact on cities. NASA has developed one of the most important studies for this purpose. They make predictions about the increase in sea level for

certain major cities in the future under different scenarios, using the Sea Level Projection Tool, which they developed based on the Intergovernmental Panel on Climate Change (IPCC) 6th Assessment Report (NASA, n.d.-b).

The Shared Socio-economic Pathways (SSPs) were developed according to different climate mitigation scenarios due to the climate policy. Lee (2021) states that "SSP-1-2.6 for sustainable pathway, SSP-2-4.5 for middle-of-the-road, SSP-3-7.0 for regional rivalry, SSP-5-8.5 for fossil fuel-rich development." and SSP-1-1.9 scenario for "the assessment of the 1.5 C Paris Agreement goal". SSP-1-1.9 is the lowest then SSP-1-2.6, SSP-2-4.5 and SSP-3-7.0 follows, then SSP-5-8.5 is very high scenarios according to Greenhouse Gas Emissions (NASA, n.d.-b). According to these scenarios, the expected increase specifically for Mentes, Izmir under different scenarios is listed below for the years 2050, 2100 and 2150, respectively (Table 4).

Table 4. Sea level rises for Izmir under five scenarios (NASA, n.d.-b).

Scenarios	2050	2100	2150
SSP1-1.9	0.20 m	0.41 m	0.61 m
SSP1-2.6	0.23 m	0.50 m	0.74 m
SSP2-4.5	0.24 m	0.60 m	0.97 m
SSP3-7.0	0.25 m	0.70 m	1.18 m
SSP5-8.5	0.27 m	0.79 m	1.35 m

This study ignores the impact of floods and only calculates the water level that changes due to climate change. However, even in this case, a water level increase is expected to vary between 0.58 m and 1.34 m by 2150 which is evidence that a large majority of the area will be submerged. The research aims to produce scenarios for situations where sea level rise due to climate change and flooding occur together in the Alsancak Harbour Behind Area and argues that these factors should be considered holistically.

3. Methodology

This research aims to evaluate the area called Alsancak Harbour Behind Area according to risk levels in case of possible sea level rise and flood in specific periods in the future: 2050, 2100, and 2150. To accomplish this, research was designed as three stages: (1) data collection and creating base maps for the case study area, (2) creating risk zones, and (3) performing holistic risk assessment analyses by overlapping the data collected in the first two stages.

3.1 Case Study Selection

Alsancak Harbour Behind Area contains significant industrial heritage, both large and small-scale, that holds historical, cultural, and industrial value. Therefore, it is of great importance to the city of Izmir and its citizens. After most of the factories in this region lost their functions, the Liman Arkası area has become a construction site for high-rise residential buildings. However, this district behind the port is susceptible to flooding, having experienced numerous floods in the past and more frequently in recent times (Table 5). This research has chosen this region as a case study to measure the potential damage caused by a flood disaster and sea level rise and to determine the extent to which important historical structures in the area may be affected.

Table 5. Flood events occurring in the immediate vicinity of the Alsancak Harbour Behind Area

Date	Region affected	Source
20.02.1965	Mersinli, Halkapınar	
11.26.2000	Konak	(AFAD, 2021)
14.11.2001	Konak	
04.12.2012	Kordon, Alsancak	
21.09.2015	Cumhuriyet Squares, Konak	
18.01.2018	Kordon, Alsancak	(Ak, 2021)
23.12.2019	Kordon, Gundogdu	
05.02.2020	Cumhuriyet Squares	
26.02.2023	Alsancak	(IBB, 2023; Konak Municipilaty, 2023)

3.2 Data collection and preparation of base maps

The first phase of the research involves geospatial data collection. Maps were produced showing roads, numbers of buildings, industrial sites, and housing complexes that have recently been built, are being built, or are planned, urban transformation area (Table 6). These maps were generated according to the Open Street Map and Google Satellite Map 2023 data at the QGIS environment.

Table 6. Data types collected at QGIS environment.

Geo-spatial data	Type
Transportation axes Shoreline	Line
Buildings Industrial sites New residential sites Uban transformation site Harbour area Meles stream	Polygon

3.3. Identification of Risk Scenarios

The second stage holistically identifies risk zones against sea level rise and floods. Research uses tool was developed by 'Climate Central' and usable as an open web source. This tool called the Coastal Risk Screening Tool, was developed to make predictions based on the 2022 Sea Level Rise Technical Report (U.S. government) and the IPCC 6th Assessment Report (NASA, n.d.-a). This tool enables to see the change in water level caused by flooding and the increase in sea level caused by climate change. The assessment of sea level rise is based on the elevation of the sea surface in this tool. Flood, as a separate factor, affects the rise in sea levels and its effect can be in two ways: annual or moderate. Another setting examines sea level rise based on the luck factor (from good to bad luck), resulting from the

effects of heat-trapping pollution and global warming. Scenarios regarding the risk situations identified by the research are as follows (Table 7):

Table 7. Scenarios identified in the research for Alsancak Harbour Behind Area based on the coastal risk screening tool.

Risk	Scenario*
Highest	Sea Level + Annual flood + good luck
Medium	Sea Level + Moderate flood + medium luck
Lowest	Sea Level + Moderate flood + bad luck

* Pollution Pathway is determined as the Current Trajectory (SSP3-7.0) for all scenarios.

The Climate Central Tool uses the local annual flood data of Muis et al. (2016) for Türkiye. It uses sea level, annual, and moderate flood data to generate different scenarios. The tool utilizes data from the IPCC's Sixth Assessment Report and follows the IPCC's Fifth Assessment Report model. According to this model, these values depend on the geographical location, the trajectory of climate pollution, and the responsiveness of temperatures and sea levels to pollution and warming. The coastal flood map simulation uses CoastalDEM elevation data (NASA, n.d.-a). The tool utilizes the sea-level projections of the IPCC Report, and this research determined the pollution pathway to be SSP3-7.0.

The elevation data has limitations because of vertical measurement errors, such as in buildings, vegetation, and random noise. Furthermore, (NASA, n.d.-a) reports that "These maps are not based on physical storm and flood simulations and do not take into account factors such as erosion, future changes in the frequency or intensity of storms, inland flooding, or contributions from rainfall or rivers." as a limitation for the tool (Table 8).

Table 8. Data and data constraints

Data Sources		
Elevation Data	CoastalDEM	Climate Central
Soil Infiltration Data	NA	
Pollution Trajectory	IPCC (AR 6)	
Erosion Data	NA	
Storm Data	NA	
Inland Flooding Data	NA	
Rainfalls Data	NA	
List of Current Residental Buildings	Open Street Map, Google Satellite Map	
List of Residential Building Projects	Web Pages of related firms and IBB	
List of Industrial Buildings	IZKA, 2021	
List of Port Buildings and Facilities	IZKA, 2019	

3.4. Risk Assessment Analysis

At this stage, risk analysis was carried out based on three primary risk zones determined through geospatial data collected during the field study. The damage that will occur in case of possible flood and water level rise has been presented in three different periods (2050, 2100, 2150) and future projection scenarios. It was examined under three headings: the number of buildings, industrial areas and infrastructure.

4. Findings

This research developed a hazard map that holistically shows the impact of sea level rise and flooding using three criteria: Flood intensity, luck factor and pollution pathway Thus, risk zoning was obtained

for the district, representing different scenarios under three layers: Highest, Medium and Lowest. Figure 6, 7 and 8 shows that the most important factors in determining flood-prone areas in Alsancak Harbour Behind Area are the geographical and hydrological elements of the area. This triangular-shaped district has the risk of being exposed to water flow from both the Aegean Sea and the Meles Stream. Its proximity to water resources and location in low-lying lands increase the risk of these areas being flooded in the future.

The research also shows that in addition to the human activities that cause sea-level rise, the activities such as land reclamation and rapid urbanisation process on these areas are another crucial factor affecting the flood and sea level rise risk assessment for the district. Alsancak Harbour Behind Area, which has been incrementally expanded towards water throughout history through land reclamation as a result of human activities, is at high risk. From an urban development perspective, new residential areas rising next to the Meles River increase the potential damage from floods and sea-level rise. Furthermore, these buildings decrease the soil's infiltration capacity, which increases the risk of flooding. This research developed coastal flood maps and assessed potential damage for the area based on future projections for 2050, 2100, and 2150. However, it did not consider changing soil infiltration capacity as a factor for flooding.

According to the risk map of 2050 (Figure 6), the 'Passenger Port' section on the left side of the harbour obtained through land reclamation is at high risk. This area is important in terms of being one of the important industrial areas containing TMO Silos and also being a key transfer point connecting the 'Freight Port' and Liman Street. In case of a possible rise in water level, there is a high probability that the passenger hall and other buildings located on the platform in this area will be damaged. Also, the possibility of Passenger Port being disconnected from the rest of the harbour is considerable. In addition, Altınyol, Halkapınar Junction and Liman Street, which connect the Port area to Bayraklı and other districts of Izmir, are at medium risk.

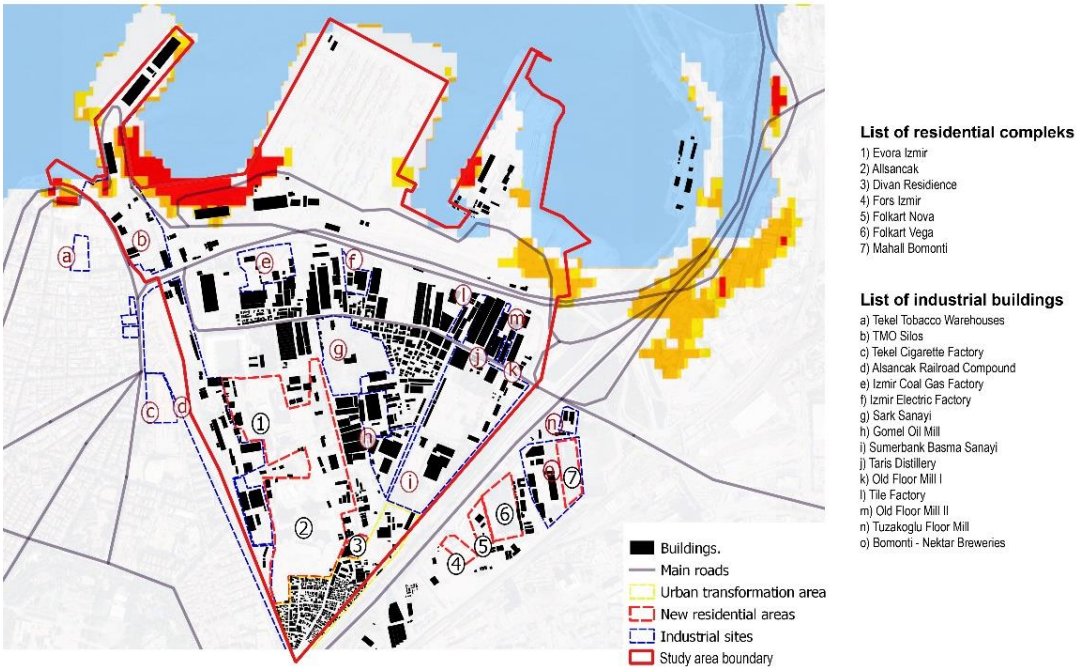

Figure 6. Flood and sea level rise risk assessment of Alsancak Harbour Behind Area for 2050.

The risk assessment map dated 2100 (Figure 7) shows that transportation arteries are at serious risk. It is estimated that the promenade between Ataturk Street and Kordon, the roads between Passenger Port and Freight Port, the connection point of the D gate of the Port with Halkapinar junction, Altinyol and Liman streets will be at very high risk in 2100. In addition, some of the important industrial sites in the area between Liman Street and Sehitler Street may be at risk of flooding. Old Flour Mill I, built

in 1895, is located in a medium-risk area. In case of a possible water level rise, all open, semi-open and closed areas of the museum with different functions are expected to be submerged. It is seen that there is a tendency for flood-prone areas to spread along the Meles River until 2100. The risk of flooding due to the flow and capacity of the river is effective in this pattern. These areas along the Meles River will be at risk, albeit low.

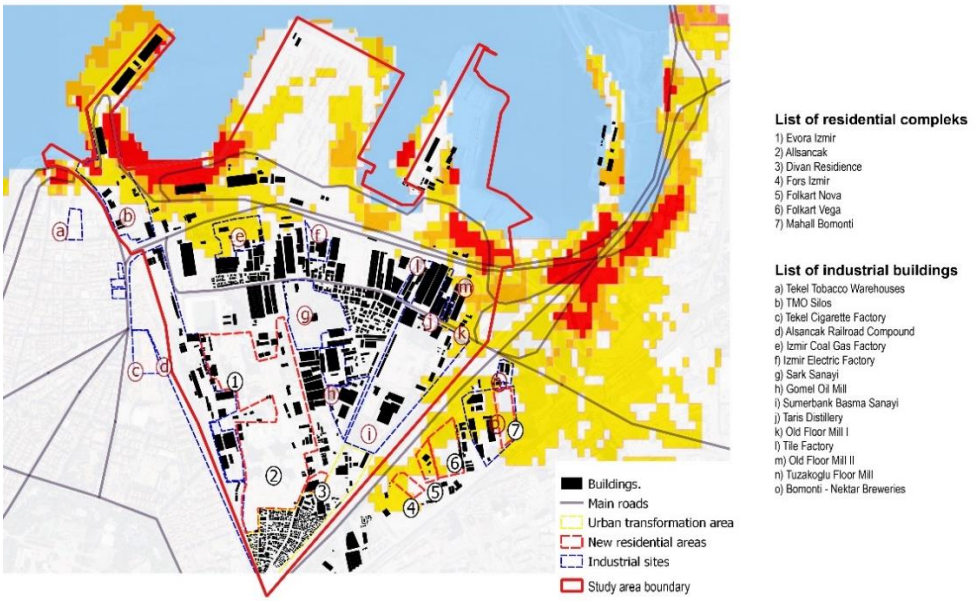

Figure 7. Flood and sea level rise risk assessment of Alsancak Harbour Behind Area for 2100.

According to the risk assessment map dated 2150 (Figure 8), high and medium-risk areas stand out in both passenger and freight ports. Unlike other maps, this assessment shows that medium-risk areas leak into the inside of triangular-shaped district where important industrial sites are located. Coal-Gas Plant, which occupies an area of 23,250 square meters with a cafeteria, reading room, sales units, restaurant and exhibition halls (IZKA, 2021) at medium risk of being damaged by this situation. Other important buildings at medium risk are Old Flour Mill-II and Tariş Distillery. The first building is currently used as an office while the second one functions as a parking area (IZKA, 2021).

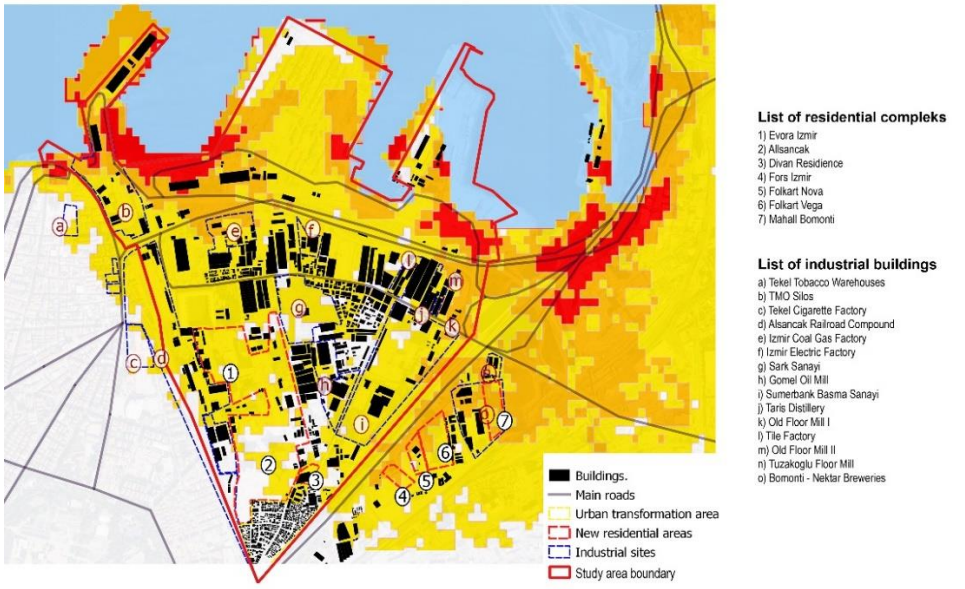

Figure 8. Flood and sea level rise risk assessment of Alsancak Harbour Behind Area for 2150.

5. Conclusion and Recommendations

The research reveals that transportation arteries will be at medium risk in 2050 and at high risk in 2100 and 2150. This means that the physical linkages of the district with its immediate surroundings will be in jeopardy. This research also shows that some of the buildings that have an important place in the industrial identity and urban memory of the city are located in flood-prone areas. While the Old Flour Mill I is at medium risk by 2100, the Coal-gas Plant, Old Flour Mill-II, and Tariş Distillery are at medium risk by 2150.

According to the tendency of flood-prone areas to spread along the Meles River, a large part of the new planned urbanization areas will be at medium risk by 2100. Allowing the construction of high-rise buildings due to current planning decisions causes a great risk considering the geological and hydrological characteristics of the area.

Based on the identified risks, the study recommends that settlements be located in less risky areas, particularly away from the Meles Stream. Although the location of the urban transformation project, which is currently ongoing next to the Meles Stream, may remain the same due to the rights of previous stakeholders, urgent action must be taken to prevent damage before construction begins. The initial step should be safeguarding current green spaces for soil infiltration, establishing new green spaces, or implementing permeable surfaces to enhance natural drainage. To preserve natural drainage and prevent population growth in areas vulnerable to sea level rise, it is advisable to refrain from constructing new residential buildings.

Additionally, it is crucial to assess the risks of sea level rise before repurposing industrial buildings that may be susceptible to damage, such as Old Flour Mill I and II, Coal Gas Plant, and Tariş Distillery. It is recommended that the sea walls surrounding the coastal filling area be raised, as this is the area that is most at risk. Furthermore, in order to protect the region against flood risk, it would be beneficial to increase the existing green areas and facilitate the discharge of flood water by utilising floor coverings made of permeable materials. The municipality should implement adaptation strategies, such as raised foundations and flood barriers, to mitigate the impact of sea level rise. Additionally, the Old Flour Mill II, which is currently a museum, could be repurposed as an attraction to raise awareness about the effects of sea level rise on coastal heritage. Furthermore, transportation arteries should be re-evaluated before 2100 to ensure the safety of harbour activities in light of sea level risks. Furthermore, the deployment of early warning systems for the region is also recommended.

Urban planning is one of the most important tools in demanding alternative futures of Alsancak Harbour Behind Area. This research has the potential to be used as a guide for the urban policies regarding the Alsancak Harbour Behind Area, which is a critical region in terms of its industrial heritage and being a commercial centre. This research draws attention to the problematic aspects of the current planning decisions of this region, which is under rapid urban transformation. In addition, it presents a realistic and unique methodology, addressing sea water rise and annual flooding situations. This methodology can help planners, decision-makers and architects in making decisions about this district, showing flood-prone areas in the future.

This research aims to aid policymakers in estimating the spatial impact of increasing coastal sea levels. However, it is recognized that such estimations require a comprehensive approach that encompasses soil infiltration, storms, and precise elevation data to generate accurate results. Therefore, this study has yet to introduce a new tool. Instead, it provides a unique analysis of the case area and its results, which is crucial for local authorities. This study's existence, despite its limitations, will be a valuable contribution to this fast-developing region.

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Author Contribution and Conflict of Interest Declaration Information

1st author contributed 40%, 2nd author contributed 40%, and 3rd author contributed 20% to the research. There is no conflict of interest.

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Atmospheric and Radiometric Normalization of Satellite Images for Landscape-Level Environmental Monitoring: The Case of The Mediterranean Region

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Abstract

Ensuring atmospheric and radiometric consistency among the frameworks of satellite data used in regional studies is a critical requirement for change detection studies employed in regional planning monitoring. The purpose of this article is to provide a guide for the necessary atmospheric correction and radiometric normalization processes required in generating environmental data at the landscape level for physical planning. In this context, adjustments were made to remove atmospheric effects before merging multiple ASTER satellite image frames used in a project supported by TÜBİTAK, covering landscape-level environmental inventory and monitoring. The Dark Object Subtraction method with the Cos(t) model was utilized in the atmospheric correction process. Subsequently, separate regression relationships were computed for each band by considering overlapping areas on adjacent tracks of ASTER data, and radiometric normalization was performed based on these regression equations. Thus, differences between satellite images used in monitoring land changes and affecting multiple frames were minimized.

Keywords: *Radiometric normalization, land cover mapping, change detection, ASTER.*

Peyzaj Düzeyinde Çevresel İzleme İçin Uydu Verilerindeki Atmosferik ve Radyometrik Etkilerin Normalleştirilmesi: Akdeniz Bölgesi Örneği

Öz

Günümüzde onlarca faklı platform ve aygıttan çok bantlı ve yüksek yersel çözünürlüğe sahip uydu verileri sağlanmaktadır. Bölgesel çalışmalarda kullanılan uydu verilerinin çerçeveleri arasında atmosferik ve radyometrik uyumun sağlanması, bölgesel planlama çalışmalarının izlemede kullanılan değişim çalışmaları için önemli bir gereksinimdir. Bu makalenin amacı, fiziksel planlamaya peyzaj düzeyinde çevresel veri üretilmesi sürecinde gerekli olan atmosferik düzeltme ve radyometrik normalizasyon çalışması için bir rehber sunulmasıdır. Bu kapsamda TÜBİTAK tarafından desteklenen, peyzaj düzeyinde çevresel envanter ve izlemeyi kapsayan projede kullanılan birden fazla ASTER uydu görüntü çerçevesinin birleştirilmesi öncesinde, atmosferik etkilerin ortadan kaldırılması için düzeltmeler yapılmıştır. Atmosferik düzeltme işleminde Cos(t) modeli ile Koyu Obje Çıkarma (DOS) yöntemi kullanılmıştır. Daha sonra ASTER verilerinin komşu izleri üzerindeki çakışan bölgeler dikkate alınarak her bant için ayrı ayrı regresyon ilişkileri hesaplanmış, söz konusu regresyon eşitlikleri dikkate alınarak radyometrik normalizasyon yapılmıştır. Böylece arazi değişimlerinin izlemede kullanılan ve birçok çerçeveyi ilgilendiren uydu görüntüleri arasındaki farklılıklar minimuma indirilmiştir.

Anahtar kelimeler: *Radyometrik normalizasyon, arazi değişim haritalama, değişim tespiti, ASTER.*

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1. Introduction

Studies related to landscape planning and management require consistent, georeferenced, regularly obtained data covering large areas. Nowadays, information technologies comprising remote sensing and geographic information systems (GIS) offer opportunities to enhance the processes of collecting, organizing, correlating, and analyzing data pertaining to rural (Purwanto et al., 2023; Ruiz et al., 2022; Lelong & Herimandimby, 2022; Garcia-Pardo et al., 2022; El Mortaji et al., 2022; Asam et al., 2022; Gasparovic & Dobrinic, 2021; Akın & Gül, 2020; Tassri et al., 2019; Khorrami et al., 2019) and urban (Ul & Mak, 2021; Ghaseminik et al., 2021; Luo et al., 2020; Chetia et al., 2020; Tavares et al., 2019) landscapes, thus presenting significant potential for landscape planning and management processes. Consequently, these technologies facilitate the generation of numerical predictions concerning habitat conditions and changes in natural and cultural ecosystems at the level of landscape units. This enables more effective monitoring and analysis of landscape dynamics, supporting informed decision-making in various fields such as environmental management, urban planning, agriculture, forestry, and biodiversity conservation. Thus, the integration of remote sensing and GIS technologies holds promise for advancing landscape research and management practices.

Changes occurring in land cover, coastal lines, or wetland systems are among the key indicators of landscape-level changes (Rostami & Fathizad, 2022; Getachew & Manjunatha, 2022; Islam et al., 2019)

Identifying landscape-level environmental indicators and assessing them with auxiliary data layers are crucial aspects of landscape monitoring. In this context, satellite remote sensing, which has undergone significant evolution over the past approximately 50 years since its inception for civilian purposes, provides advantages such as low data and labor costs per unit area, as well as speed, repeatability, and high monitoring frequency. Presently, studies utilizing remotely sensed data are conducted in various application areas, ranging from determining temporal and spatial variability of vegetation cover (İşler & Aslan, 2021) to detecting forest fires (Karaca & Güllü, 2019). These applications demonstrate the versatility and effectiveness of remote sensing in monitoring and managing landscapes, contributing to informed decision-making and sustainable resource management practices.

Geospatially referenced resource inventories (e.g., land cover and land use maps) covering large areas and landscape-level environmental monitoring enabling change detection provide significant contributions to decision-making in planning from global to local scales (Rauf et al., 2022; Aghababaei et al., 2022; Bujan et al., 2021; Boussadia-Omari et al., 2021; Khatami et al., 2020). As evident from this description of landscape-level environmental monitoring, satellite imagery is primarily used in studies ranging from mapping land cover, detecting changes, or both, conducted at various scales from global to local. These applications underscore the importance of remotely sensed data in informing decision-making processes related to environmental management, land use planning, and sustainable development initiatives. By leveraging satellite imagery and advanced geospatial technologies, stakeholders can better understand landscape dynamics, assess environmental changes over time, and formulate evidence-based policies and strategies for effective resource management and conservation efforts.

The diversity and abundance of current satellite data does not diminish the importance of past datasets. Past data can be of critical importance as the need for information on past land cover increases in monitoring programs. In regional studies, an area of interest is generally covered by multiple scenes. Therefore, radiometric consistency between image scenes must be ensured for mapping and change detection. Inconsistencies may exist between paths and/or rows. They may also be due to different environmental conditions or sensor calibration between imaging data. Normalization of these inconsistencies is a prerequisite for many mapping and change detection studies. The objective of this paper is to provide a guide to radiometric normalization, which is essential in the production of landscape-level environmental data for spatial planning.

2. Material and Method

2.1. Material

2.1.1. Study area

The research area covers the districts of Mersin province, namely Mersin Center, Tarsus, and Erdemli, located on the Mediterranean coast of Turkey. Considering the sizes of Mersin Center, Tarsus, and Erdemli districts, the research area has a total area of 5874 km². The southern boundary of the research area is formed by the Mediterranean Sea, while the area is separated from the interior of Anatolia by the Taurus Mountains to the north. The annual average temperature of the research area is 18.7°C, while the average temperature during the winter months ranges from 9 to 15°C. The annual total precipitation amount in the area is approximately 594 mm. Characterized by a typical summer drought, December is the rainiest month, whereas August is the driest. Rainfall values measured on the coast are lower than those in the higher elevations (MGM, 2022).

The Taurus Mountains, surrounding the research area from the north, extend in an east-west direction as a high ridge between the Konya Plain of Central Anatolia and the Mediterranean. This mountain range gradually recedes from the sea towards the east of the research area, creating extensive plains between the mountains and the sea. The central districts of Mersin and Tarsus are situated in these plains. The section of the Central Taurus Mountains within the borders of Mersin province is referred to as the Bolkar Mountains. The Bolkar Mountains, with the highest peak being Mount Medetsiz (3524 m), separate the Mersin territory from the Anatolian plateau. The main characteristic of the Western and Central Taurus Mountains is their formation of high and continuous ridges, interspersed with vast plateau plains.

One of the significant geomorphological units within the research area is valleys. Rivers are deeply entrenched within these valleys. The Mediterranean climate characteristics extend from south to north along these valleys deep into the Taurus Mountains. Terraces, harboring fertile agricultural soils, are found on the slopes of these valleys. Among these valleys and plains, notable ones include the Tarsus Valley and the Tarsus and Berdan Plains.

2.1.2. Terra ASTER data

The satellite data set used in the research is derived from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) obtained through the American-Japanese joint venture TERRA satellite. In order to conduct land cover mapping for the current state of the area, seven ASTER Level 3A frames covering the entire area were utilized (Abrams et al., 2008). The ASTER data consists of 9 bands obtained at visible and near-infrared energy levels and 5 bands obtained at thermal infrared. While the visible and near-infrared bands have a spatial resolution of 15 meters, the mid-infrared data has a spatial resolution of 30 meters, and the thermal infrared data has a spatial resolution of 90 meters (Table 1) (Abrams et al., 2008).

Table 1. Band values in ASTER datasets (Abrams et al., 2008)

Band	Wavelength(μm)	Resolution (m)	Definition
VNIR_Band1	0.520 - 0.60	15	Visible-green band
VNIR_Band2	0.630 - 0.690	15	Visible-red band
VNIR_Band3N	0.760–0.860	15	near infrared band
VNIR_Band3B	0.760–0.860	15	near infrared band
SWIR_Band4	1.600–1.700	30	shortwave infrared band
SWIR_Band5	2.145–2.185	30	shortwave infrared band
SWIR_Band6	2.185–2.225	30	shortwave infrared band
SWIR_Band7	2.235–2.285	30	shortwave infrared band
SWIR_Band8	2.295–2.365	30	shortwave infrared band

Continued from Table1			
SWIR_Band9	2.360–2.430	30	shortwave infrared band
TIR_Band10	8.125–8.475	90	Longwave/thermal infrared band
TIR_Band11	8.475–8.825	90	Longwave/thermal infrared band
TIR_Band12	8.925–9.275	90	Longwave/thermal infrared band
TIR_Band13	10.250–10.950	90	Longwave/thermal infrared band
TIR_Band14	10.950–11.650	90	Longwave/thermal infrared band

ASTER data has been preferred due to its high spatial and spectral resolution. The general statistics of the data sets are provided in Table 2.

Table 2. Statistics of visible and near infrared data bands of ASTER datasets used

Data set	Date	Band	Min	Max	Ort (μ)	SD* (σ)
AST3A1_060529_0525vnir	29.05.2006	1	0	255	77,909	61,394
		2	0	255	57,159	49,909
		3N	0	255	62,984	52,828
		3B	0	255	57,359	49,048
AST3A1_060529_0526vnir	29.05.2006	1	0	255	47,383	37,329
		2	0	255	25,123	24,676
		3N	0	255	18,215	26,444
		3B	0	226	15,635	23,631
AST3A1_051109_0527vnir	09.11.2005	1	0	255	36,495	29,786
		2	0	255	20,887	21,997
		3N	0	255	15,398	19,442
		3B	0	255	17,976	23,012
AST3A1_050517_0574vnir	17.05.2005	1	0	255	96,902	74,610
		2	0	255	81,815	66,594
		3N	0	255	72,205	53,551
		3B	0	255	70,388	52,263
AST3A1_050517_0575vnir	17.05.2005	1	0	255	83,466	64,860
		2	0	255	65,682	55,848
		3N	0	255	67,287	52,155
		3B	0	228	63,668	50,510
AST3A1_060529_0576vnir	29.05.2006	1	0	255	87,838	68,422
		2	0	255	69,905	58,275
		3N	0	255	68,740	50,724
		3B	0	255	63,754	47,331
AST3A1_060824_0577vnir	24.08.2006	1	0	255	73,935	54,831
		2	0	255	55,217	44,100
		3N	0	255	52,753	39,023
		3B	0	255	54,534	40,259

*SD: Standard Deviation

2.2. Method

Regional land cover and land use mapping are increasingly being conducted with data of higher spatial resolution. However, the increase in spatial resolution leads to an increase in the amount of input data used and consequently in the number of frames used, as well as in the amount of work and time required for data processing. One of the significant stages in studies containing multiple image frames is the production of normalized image mosaics. This approach, which involves classifying a single

merged image instead of individually classifying image frames, may lead to the generation of land cover information with higher accuracy.

Image preprocessing is applied to minimize potential errors that may arise from spatial and radiometric discrepancies in satellite data before the stages of image preprocessing, classification, and change detection. In regional mapping and change detection applications where numerous datasets are processed, georegistration and radiometric correction are two critical stages of preprocessing. Georegistration involves resampling satellite data from image to image and/or entering point coordinates from the field-collected reference data and other images. Thus, the spatial coordinates in satellite data can be expressed in any projection system such as geographic latitude/longitude or Universal Transverse Mercator (UTM).

The ground coordinates collected for the georeferencing of the images were determined by considering easily identifiable features such as intersections of main roads, port/jetty facilities, and surrounding human-made objects that contrast with the environment. This information was gathered with the assistance of GARMIN GPSmap 276C. The data collected in the field with GPS were georeferenced by combining them, if necessary, with data from topographic maps.Change detection studies conducted using the radiometric properties of images generally require the use of radiometrically normalized/corrected images.

Considering the challenges of correction, relative radiometric correction is used as an alternative (Tan et al., 2012; Biday & Bhosle, 2012; Sadeghi et al., 2017)

In this approach, unlike absolute methods, simultaneous in situ measurements during satellite passage are not required. The fundamental approach in relative correction methods involves using a reference image. The radiometric properties of other images are adjusted to fit the reference dataset (Liu et al., 2022; El Hajj et al., 2008).

The Dark Object Subtraction (DOS) method is a widely used atmospheric correction technique. In this method, it is assumed that any brightness value recorded by the sensor for a pixel corresponding to a dark object or feature on the Earth's surface is due to atmospheric path radiance. The Cos(t) model incorporating the cosine of solar zenith angle (Chavez, 1996; Chavez, 1988), and an extended DOS method estimating the effects of absorption by atmospheric gases and Rayleigh scattering, are commonly employed in atmospheric correction (Chavez, 1996).

The utilization of Pseudo-Invariant Features (PIF) or Dark and Bright Pixel Clusters (DB) are among other normalization methods (Schroeder et al., 2006).

The reflection of PIFs in multiple images can be employed without the need for absolute correction of surface reflectance, ensuring that these images appear to have been acquired under the same sensor, calibration, and atmospheric conditions (Kiage et al., 2007; Liu et al., 2012).

PIF-based normalization, which involves calculating image-based linear regressions to compare images, requires the selection of target features whose reflectance values are assumed to remain constant over time. PIFs can be selected manually or automatically (Sadeghi et al., 2017; Barazzetti et al., 2016). Targets such as asphalt/concrete roads, roofs, parking lots, airports, deep lakes, dense and closed pine forests, beaches, concrete surfaces, and both new and old asphalt surfaces can be used as PIFs (Rahman et al., 2015; Yuan & Elvidge 1996; Yang & Lo, 2000).

Image-based normalization processes typically rely on linear regression models. The accuracy of georegistration is crucial when using all pixels in both images to calculate normalization coefficients. As mentioned above, customizing the comparison reflectance dataset through PIFs or "dark and bright pixel clusters" can contribute to producing more accurate results (Schott et al., 1988).

In cases where multiple images obtained at different dates are used to create a mosaic, a dataset of unchanged objects can be selected from the overlapping areas. In this study, among the 7 images from 3 adjacent paths, the images from the first path were acquired on May 17 2005, the images from the second path on May 29 2005 and the images from the third path on August 24 2006 and November 9 2005. Accordingly, the second path was considered as the reference; the images from the first and

third paths were normalized accordingly. Regression used for radiometric normalization was applied between the visible and near-infrared wavelengths of the 1st, 2nd, and 3rd bands of the ASTER data on the neighboring paths, resulting in corrected images ready for classification.

3. Research Findings and Discussion

3.1. Atmospheric Correction and Normalization Design

Since the launch of the first Landsat satellite in 1972, numerous normalization methods have been developed. A significant portion of these methods involves using a reference frame within a dataset containing multiple frames that are minimally affected by atmospheric conditions and normalizing other frames to this reference frame. These radiometric matching methods mentioned are divided into two main categories. The first category relies on generating a function that relates radiance values of the same features in the overlapping areas of two adjacent frames, while the second category is based on matching targets with a specific surface reflectance regardless of their locations.

In the first category, methods utilize different regression forms to correlate unchanged objects in overlapping areas, while in the second category, there is no requirement for the unchanged targets to be the same objects within two different frames. Regression applied to overlapping areas for the radiometric normalization of frames to be used in mosaic formation has been widely used in regional projects.

Atmospheric correction and radiometric normalization are preprocessing methods commonly required in monitoring studies with multispectral and multi-temporal coverage. These processes constitute a significant stage in monitoring studies of various geographical scopes and scales, ranging from urban change detection and monitoring (Jenerowicz et al., 2019) to detecting changes in tropical rainforests (Lobo et al., 2015), monitoring bioproductivity in grassland areas (Prieto-Amparan et al., 2018) and predicting biomass and succession in forest ecosystems (Janzen et al., 2006; Schroeder et al., 2006; Lopez-Serrano et al., 2016). Additionally, these processes are often necessary for change detection requiring time-series analyses (Gu et al., 2011).

In the study, atmospheric correction was initially performed by combining data acquired from the same paths and on the same dates for radiometric normalization of ASTER data. Subsequently, regression functions between adjacent paths were calculated, taking into account these steps, and using these regression functions, mosaics were obtained from the corrected images in the final stage (Figure 1).

The atmospheric correction process utilized a image-based method known as the Cos(t) method. This approach relies on normalizing atmospheric transmittance by accounting for the effects caused by varying solar zenith angles seasonally. Based on the calculation of the cosine of solar zenith angle, this method incorporates the advantages of the Dark Object Subtraction (DOS) method. The DOS method assumes that observed reflectance values differing from zero in satellite data for areas known to have reflectance values close to zero are due to atmospheric effects. For atmospheric correction, ASTER reflectance values were first converted to radiance values. This conversion is performed as described in Equation 1 (Pudale & Bhosle, 2007).

$$\text{Radyans} = (\text{Reflectance value} - 1) \times \text{Unit Conversion Coefficient} \quad (1)$$

The transformation coefficients for ASTER data are provided in Table 3, while the maximum radiance values are given in Table 4.

The highest and lowest reflectance values calculated for ASTER data frames, taking into account the values mentioned above, are presented in Table 5 along with the reflection values (DN pus) observed in the satellite data in areas where a zero value is expected. These values are compiled from the header files of ASTER data, which contain information such as solar elevation, date and time of data acquisition, and viewing angle.

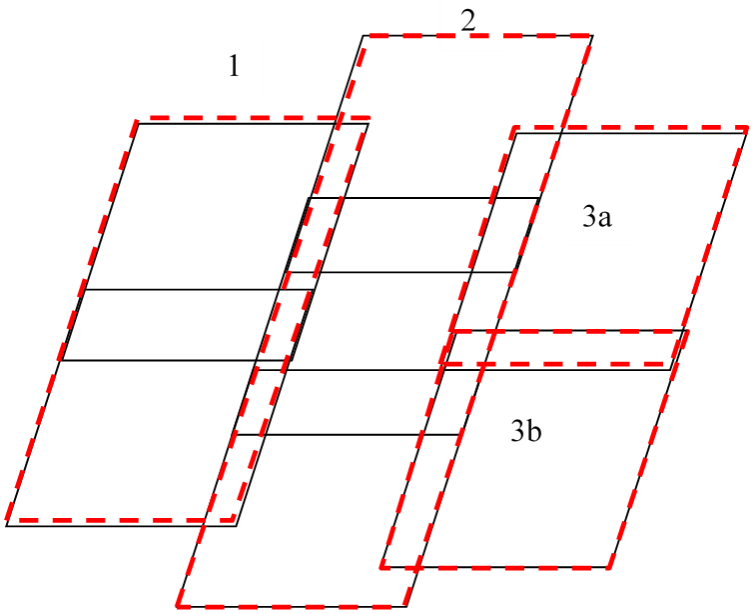

Figure 1. Reference (2) and neighboring (1, 3a, 3b) frames in radiometric normalization of aster data

Table 3. Transformation coefficients for each band in ASTER data (Pudale & Bhosle, 2007)

	Conversion Coefficient (W/(m²*sr*µm)/DN)			
Band	High gain	Normal gain	Low gain 1	Low gain 2
1	0,676	1,688	2,25	N/A
2	0,708	1,415	1,89	
3N	0,423	0,862	1,15	
3B	0,423	0,862	1,15	

Table 4. Highest radiance values for different gain values of the ASTER data bands

	Highest reflectance value (W/(m²*sr*µm)			
Band	High gain	Normal gain	Low gain 1	Low gain 2
1	170,8	427	569	N/A
2	179,0	358	477	
3N	106,8	218	290	
3B	106,8	218	290	

Table 5. Parameters used in atmospheric correction of ASTER data

Band	**Min. reflectance**	**Max. reflectance**	**DN**	**Solar**	**Time**	**Date**	**Angel**
1_1	-0,676	171,7	53	67,801853	08:36:55	17.05.2005	2,837
1_2	-0,708	179,8	22	67,801853	08:36:54	17.05.2005	2,829
1_3	-0,862	218,95	11	67,801853	08:36:54	17.05.2005	2,863
2_1	-0,676	171,7	56	69,388783	08:31:38	29.05.2006	-5,677
2_2	-0,708	179,8	24	69,388783	08:31:37	29.05.2006	-5,669
2_3	-0,862	218,95	11	69,388783	08:31:36	29.05.2006	-5,7
3a_1	-0,676	171,7	78	60,525251	08:37:16	24.08.2006	8,588
3a_2	-0,708	179,8	37	60,525251	08:37:15	24.08.2006	8,503
3a_3	-0,862	218,95	24	60,525251	08:37:14	24.08.2006	8,567
3b_1	-0,676	171,7	37	35,475225	08:34:58	09.11.2005	8,588
3b_2	-0,708	175,58	16	35,475225	08:34:57	09.11.2005	8,487
3b_3	-0,862	140,15	8	35,475225	08:34:57	09.11.2005	8,567

3.2. Testing phase

The appearance of the test area, where two different paths were merged with mosaic operations before and after this stage, is illustrated in Figure 2.

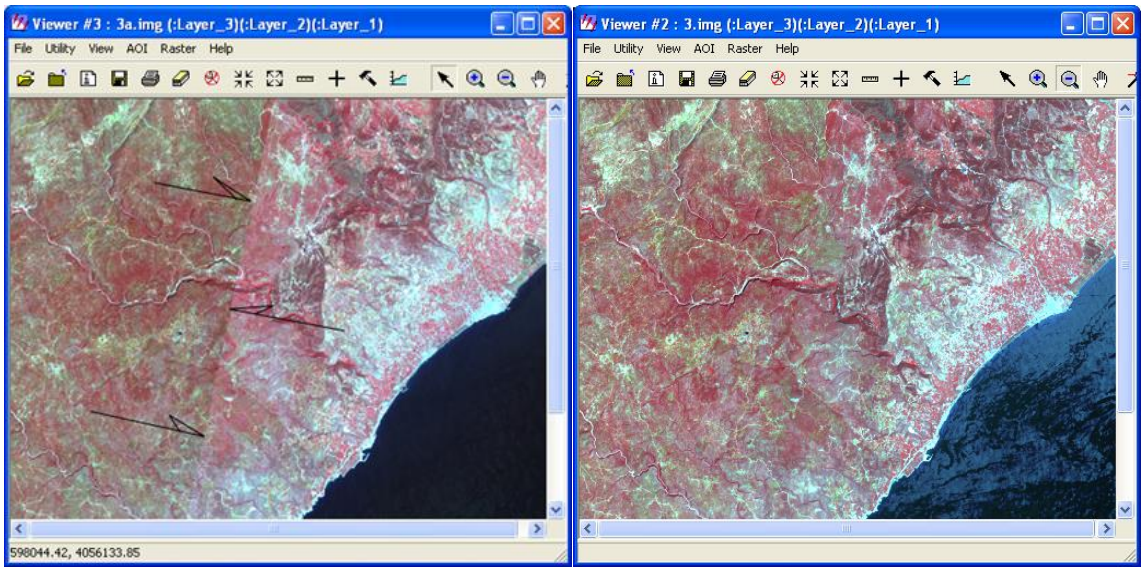

Figure 2. Mosaic images of the test area before and after normalization (the difference between neighboring traces before normalization is clearly visible)

3.3. Calculation and Merging of Corrected İmages

The regression functions used for radiometric normalization of neighboring paths of ASTER data are provided in Figure 3.

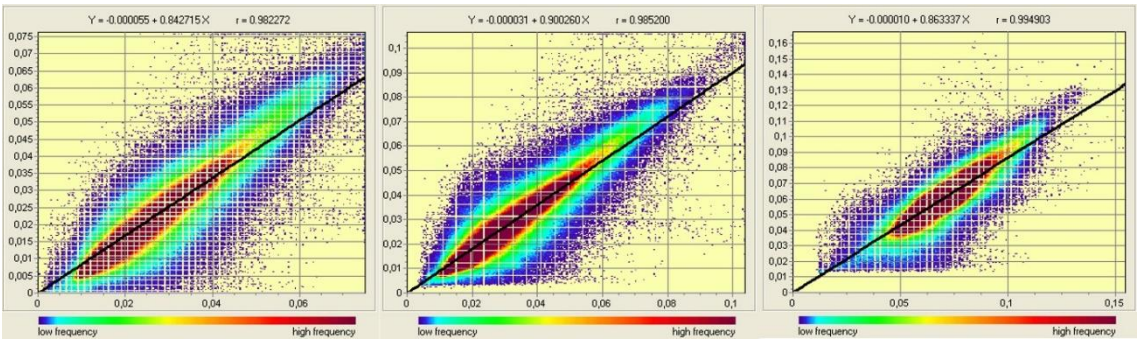

Figure 3. The regression relationship between the green (left), red (middle) and infrared (right) bands of the images in tracks 1 and 2 covering the research area

Regression functions were calculated for the neighboring frames (3a, 3b) using frame 2 as a reference, as shown in Figure 1, and after this stage, the normalized images were merged with a mosaic operation. The mosaic images before and after the regression application are presented in Figure 4.

Following radiometric normalization, the mosaic image obtained in the previous step was clipped based on the boundaries of the study area. The prepared image for classification is presented in Figure 5.

This image was obtained by displaying the 1st, 2nd, and 3rd bands (corresponding to green, red, and infrared wavelengths) as blue, green, and red (BGR), respectively, known as false color composition. In this type of visualization, areas with high reflectance due to vegetation appear with a dominant red color, highlighting vegetative features.

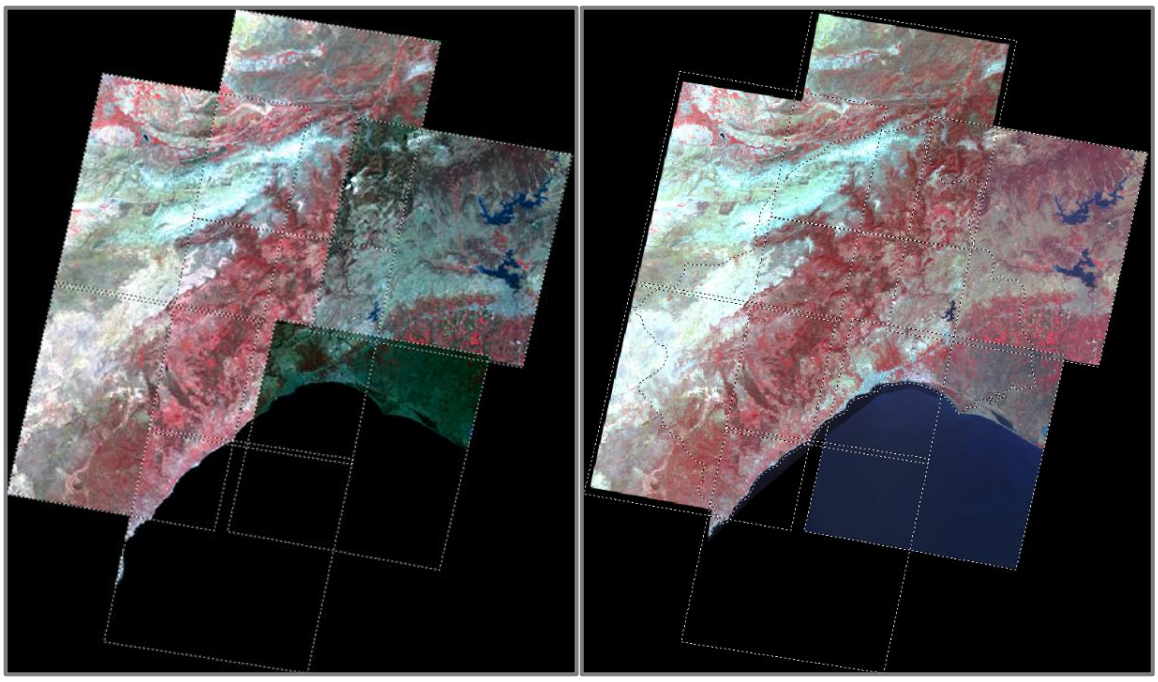

Figure 4. Mosaic images before (left) and after (right) radiometric normalization

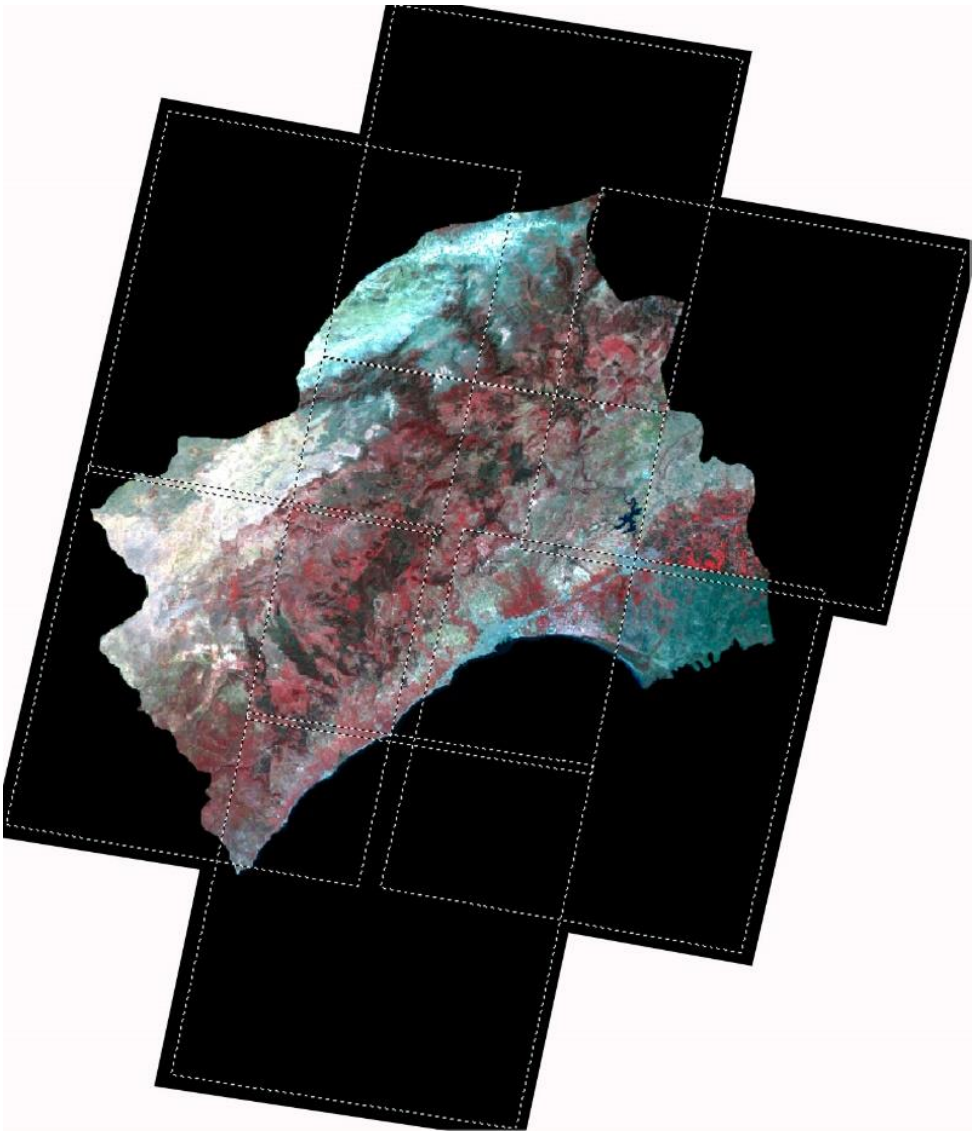

Figure 5. Radiometrically corrected aster data based on research area boundaries

In this study, seasonal effects were observed only in the southeastern part of the study area. The corresponding region comprised harvested bare agricultural fields, while the adjacent upper frame consisted of cultivated agricultural lands.
As seen in Figure 5, the reflectance values differ in the upper right and lower frames of the merged image. The image frame corresponding to the upper right corner belongs to August, while the one corresponding to the lower corner belongs to November. In the image frame from August, where agricultural fields are present, the infrared reflectance is high, hence the dominance of red color. In contrast, in the image from November covering the southern part of the same plain, where there are no crops in the agricultural fields, similar areas appear gray instead of red as observed in the upper frame.

4. Discussion and Conclusion

The potential issue with using multiple image frames in image classification lies in the high susceptibility of automatic, manual, or hybrid image classification methods applied to image mosaics created without preprocessing to errors, resulting in low thematic accuracy maps. Without correction processes applied, during the classification of merged frames, areas with similar land cover/land use (LC/LU) characteristics may be assigned different classes due to varying illumination effects and/or atmospheric conditions.

Despite the various advantages of using ASTER data in large-scale landscape mapping studies, leveraging these advantages depends on the proper preprocessing of the data frames. The primary advantage provided by the ASTER dataset, compared to LANDSAT data, is its relatively high spatial resolution and the large area coverage provided by a single image frame. The ASTER scanner, operating since the year 2000 via the EOS-Terra platform, particularly in its initial years, offered superior spatial resolution compared to other operational platform data. This superiority in spatial resolution positions ASTER data as significant for retrospective mapping and change detection studies.

Yuan & Elvidge (1996) employed Relative Radiometric Normalization (RRN), a procedure used to prepare multitemporal image datasets for detecting spectral changes associated with events such as land cover changes. This procedure reduces differences arising from unequal imaging conditions rather than changes in surface reflectance, as stated in this study. In this study utilizing Landsat data, it was noted that the linear regression technique yielded the best results (Yuan & Elvidge, 1996).

Du et al. (2002) emphasized the necessity of radiometric correction for multitemporal land cover change studies. They provided information about a new procedure for radiometric normalization in their study. They statistically selected Pseudo-Invariant Features, PIFs and utilized Principal Component Analysis, PCA for this purpose. The new procedure was applied to Landsat-5 TM images from three different years. They noted a reduction in errors in radiometric consistency among multitemporal images with this procedure (Du et al., 2002).

In their study, Scheidt et al. (2008) created an image mosaic of the study area using atmospherically corrected and radiometrically accurate ASTER data with Thermal Infrared, ASTER TIR bands for their analysis. They utilized a test site for the radiometric normalization technique. They selected Pseudo-Invariant Features, PIFs by using a correlation threshold between brightness values. They noted the advantages of this approach for TIR band data, including analyzing data obtained at different dates as a single continuous compositional dataset and separating brightness temperature from surface emission for quantitative surface composition analysis, thereby reducing errors in the intersection line in the emission mosaic (Scheidt et al., 2008).

This study presents a process for normalizing ASTER data frames for use in large-scale landscape mapping studies with a 60 km swath width. In the study, atmospheric correction was performed by combining data acquired from the same paths and on the similar dates for radiometric normalization of ASTER data. Subsequently, regression functions between adjacent paths were calculated, taking into account these steps, and using these regression functions, mosaics were obtained from the corrected images in the final stage.

In addition, the presence of seasonal variations between frames/strips and the phenological differences in vegetation cover within frames can complicate the generation of high-quality data suitable for processing. To address this issue, it may be preferable to select frames from the same seasons in such studies. In cases where this is not feasible, as mentioned in this study, it is advisable to classify separately the same land cover types exhibiting phenological differences due to seasonal effects (e.g., cultivated areas versus harvested agricultural lands).

Additionally One of the most crucial aspects in change detection studies is achieving the highest possible accuracy in geographic registration. This is because the accuracy of geographic registration directly affects the quality of intermediate products (e.g., binary masks) and final output products (e.g., change maps) generated during the change detection procedure. Failure in achieving accurate geographic registration diminishes the statistical accuracy of the study.

In summary, the correction processes presented in this study are crucial for various applications that utilize Land Cover/Land Use maps, such as environmental planning, conservation, urbanization, industrial development, tourism, transportation, and others.

Furthermore, when dealing with multiple frames/strips, seasonal variations and phenological differences within frames can pose challenges to data processing, emphasizing the importance of selecting frames from the same seasons or classifying land cover types separately based on phenological differences.

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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 Holistic Approach to Creating Ethical Sensitivity and Awareness in Landscape Design Education

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Abstract

The starting point of the present study was the observation of the increasing number of unethical behaviors among the students of landscape design education in recent years. The purpose of the study was to determine the ethical perceptions of students, and their ethical awareness, ethical behaviors, ethical preferences, ethical judgments, and ethical decision-making skills in the design process. In this context, the ethics concept and the importance of ethics in design education were explained, and a questionnaire was used to the students. Among the 199 students, 149 students participated in the study voluntarily. As a result of the study, it is possible to argue that the ethical perceptions and awareness of ethical/unethical behaviors of the students in design were high, their ethical decision-making skills improved, and they could make ethical choices and ethical judgments. Despite this fact, it is up to the students to make ethical choices and act ethically by showing ethical sensitivity in their designs. Ethics in design courses and how ethics education can be integrated into design courses were explained to provide ethical sensitivity and awareness to students in landscape design education.

Keywords: *Ethics, ethic perception, ethic sensitivity, ethic awareness, ethic in design education.*

Peyzaj Tasarımı Eğitiminde Etik Duyarlılık ve Farkındalık Yaratmak için Bütüncül Bir Yaklaşım

Öz

Son yıllarda peyzaj tasarımı eğitim sürecinde öğrenciler arasında etik olmayan davranışların gözlemlenmesi ve giderek artması bu çalışmanın çıkış noktası olmuştur. Çalışmanın amacı; Selçuk Üniversitesi, Mimarlık ve Tasarım Fakültesi, Peyzaj Mimarlığı Bölümündeki öğrencilerin etik algılarını; tasarım sürecindeki etik farkındalık, etik davranış, etik tercih, etik yargı ve etik karar verme becerilerini belirlemektir. Bu kapsamda etik kavramı ve tasarım eğitiminde etiğin önemi açıklanmış; öğrencilerin etik algı, etik farkındalık, etik davranış, etik tercih, etik yargı ve etik karar verme becerilerini belirlemek için anket uygulanmıştır. Araştırmaya öğrenim görmekte olan 199 öğrenciden 149 öğrenci gönüllü katılmıştır. Araştırma sonucunda öğrencilerin etik algılarının, tasarımda etik olan/olmayan davranışlara yönelik farkındalıklarının yüksek olduğunu, etik karar verme becerilerinin geliştiğini, etik tercih ve etik yargılama yapabildiklerini söylemek mümkündür. Buna rağmen tasarımlarında etik duyarlılık göstererek etik tercihte bulunmaları ve etik davranmaları öğrencilerin inisiyatifine kalmaktadır. Peyzaj tasarımı eğitiminde öğrencilere etik duyarlılık ve farkındalığın kazandırılması için tasarımda etik dersi ve tasarım derslerine etik eğitiminin nasıl entegre edilebileceği açıklanmıştır.

Anahtar kelimeler: Etik, etik algı, etik duyarlılık, etik farkındalık, tasarım eğitiminde etik.

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1. Introduction

"Ethics is knowing the difference between what you have a right to do and what is right to do."
Potter Stewart

The word "ethics" is derived from the Greek word "ethos" and means personality, character, and lifestyle and is associated with theories about moral actions (Hiort Af Ornäs & Keitsch, 2015). The word is used in three different meanings (i.e., "temper, personality and character", "customs, habits, customs and traditions", and "the homeland, hometown, place of residence, or the house where a person resides" (Bodur, 2017; Kuçuradi, 2020). Also, ethics is a concept associated with the behaviours and actions that people perform on a social scale and that have consequences affecting other people, and the thinking processes shaping them (Kurt et al., 2015). Every person has to exhibit an ethical attitude in every action he or she takes (Ilgaz & Bilgili, 2006). Not all human actions can be evaluated in the scope of ethical values, and it is very difficult to mention any human activity that is not associated with ethical values (Aydın, 2022).

To date, studies on ethics have focused on revealing the basis of all human behaviours and actions. As a subdiscipline of philosophy, ethics determines moral duties and responsibilities in determining what is good and what is bad. Ethics is an important part and a systematic field of study not only in philosophy but also in other disciplines (Aydın, 2012). In this respect, ethics is also the field of study of axiology, in other words, the philosophy of values. Axiology focuses on the definition of value fields such as ethics (moral philosophy), aesthetics (philosophy of art), and epistemology (philosophy of knowledge), their formation processes, limits, and relationships with each other. Ethics seeks answers to questions such as value qualities such as good/bad, aesthetics beautiful/ugly, and epistemology is the subject of value qualities such as right/wrong. Axiology, on the other hand, investigates the values that form the basis of individuals' behaviours (Çetintaş, 2015). The axiological study asks "Do values have a source, are they internal or external (independent of individuals), are they objective or subjective, fixed or variable, are there absolute values for societies in every period, do values change among societies and over time?" (Özlük, 2016).

The fact that humans are at the core of education is among the most important reasons why ethics must be included in education. The fact that the general purpose of education is "a process of changing behaviours" has led to the emergence of a very close relationship between ethics and education. The disciplines of education and ethics, which are based on humans, intersect at the point of guiding human behaviours (Ilgaz & Bilgili, 2006). To date, ethics has mainly been considered a separate course in the design curricula (e.g., professional ethics and professional deontology). Today, awareness of the ethical aspects of design is becoming increasingly important (Sonneveld, 2016). The reason for this is that ethical problems in design have been increasing in recent years and uncertainties are being mentioned regarding the solution of the problems (Çelik, 2018). The design has powerful effects on the world, which has always had an ethical aspect. Design schools still treat ethics as a separate course, and acting ethically in design is left to the initiative of students (Sonneveld, 2016). Ethics in design is one significant area deserving further consideration by all concerned (Nini, 2020). Ethical issues must display integrity of behaviours with the knowledge, skills, and abilities that students acquire with their will, not with the transfer of teachable knowledge (Aydınlı, 2015). For this reason, an integrated approach is necessary in design education (Sonneveld, 2016). There are many possibilities for embedding content related to ethical issues in design curricula (Nini, 2020).

Every situation, condition, event, institution, and action that changes and improves life and the quality of the living environment affecting all beings is included in the field of ethics (Özlem, 2004). Landscape architecture, which designs living spaces for living creatures, especially human beings, must be considered within the scope of ethics in terms of the design action and the education process. However, there are no definite and clear definitions of being ethical or acting ethically in landscape design of designers. For this reason, the ethics concept in landscape design has become a relative concept varying among people and including different interpretations and inferences. When faced with ethical dilemmas and deviations, which are often faced in landscape design, designers act

according to their ethical values (Çelik, 2018). Those who act in the field of design, those who train designers and designer candidates must analyze the development of design so far along with their reactions to economic, political, and cultural changes, and sometimes the models of creating these changes, with a different perspective than today, in parallel with the ecological, economic and social conditions of the present world, and as a result, they must determine some basic principles (Şişman, 2006).

The basic notion of the present study was the recent observation and increasing number of unethical behaviours among students in landscape design education. The purpose of the study was to determine the ethical perceptions of students at Selçuk University, Faculty of Architecture and Design, Department of Landscape Architecture, and their ethical awareness, ethical behaviours, ethical preferences, ethical judgments, and ethical decision-making skills in the design process. In this context, the ethics concept and the importance of ethics in design education were explained, and a questionnaire was administered to determine the ethical perceptions, ethical awareness, ethical behaviours, ethical preferences, ethical judgments, and ethical decision-making skills of students. Based on the questionnaire results, an answer was sought to the question of how ethical sensitivity and awareness, ethical creativity, ethical analysis, ethical judgments, ethical decision-making, and ethical discussion skills can be acquired. Ethics in design courses and how ethics education can be integrated into design courses are explained to provide ethical sensitivity and awareness to students in landscape design education.

1.1. Ethics in Landscape Design Education

As design expands its scope from creating products to re-imagining systems, ethics has become an increasingly hot topic in design research (Özkaramanlı, et al., 2022). In education, ethics has an undeniable role in terms of the targets, values, and processes of education. The issue of ethics becomes even more important in education, which has an important mission, especially in bringing about certain behavioral changes in individuals (Aydın, 2022). Issues such as placing humans at the core of education, the targets set for the education system, the methods employed to achieve these targets, how the contents of the curriculum are decided, how the feedbacks are evaluated, the consistency of the ethical thoughts and actions of educators, and their commitment to their profession clarify the relationship between education and ethics (Ilgaz & Bilgili, 2006).

When the academic literature was reviewed, it was found that the subject has been discussed in many different dimensions in studies conducted on ethics and design, for this reason, it is difficult to adequately address the issues from a broad perspective (Dindler et al., 2022). Approaches representing ethical methods have emerged in the academic literature and design practice regarding design and are particularly focused on clarifying the normative dimensions of design and outlining strategies for incorporating ethical values into design (Donia & Shaw, 2021). Today, awareness of the ethical aspects of design is increasing and becoming more and more important with each passing day. Design has very strong effects on the world because it changes the world, and these effects always have an ethical aspect (Sonneveld, 2016). As a result of the widespread dissemination of ethical issues, ethics education is considered fundamental in the education of the next generation of both designers and engineers (Vilaza & Bækgaard, 2022).

The increased focus on ethics has developed in parallel with the rapid growth of technological improvements and capacity as a result of professions on a global scale establishing close contact and interaction through technological tools (Gray & Boling, 2016). In this context, it is possible to state the reason for the increased ethical problems in landscape design in recent years as a result of the inadequacy of ethical acquisitions in design education and the interaction with technology.

The most important characteristic of design education is that it focuses on skills on how to use versatile data inputs systematically in the design process (Altıparmakoğulları, 2022). University education does not only mean providing concrete knowledge to students, but rather focusing on what is difficult to define, and what is not certain. Abstract concepts such as intuition, common sense, emotional intelligence, ethics, sense of responsibility and justice, flexibility, and creativity come to the forefront in a world where uncertainty increases and education becomes individual and open-ended. Design

education, which is intertwined with abstract concepts, has a complex and contradictory structure that is comprehensive, open-ended, ambiguous, and difficult to define, understand, classify, and format. For this reason, architectural design education must be open-ended and methods must be developed to cope with its uncertainty (Yürekli & Yürekli, 2004). Recently, as a concept that is difficult to understand and open to discussion (Bozkurt, 2016), ethics has become an ambiguous and relative concept in landscape design education that does not have clear limits, varies according to students, and contains different interpretations and inferences. The reason for this can be explained as the lack of absolute and clear definitions of being ethical and behaving ethically in landscape design, known and applied by students. For this reason, ethical sensitivity and awareness must be acquired in design during the education process and placed within the informational framework.

The statement of Theodore Sturgeon "Ethics is not a fact to be sought, but a way of thinking" (Sturgeon, 1963) emphasizes that ethical values are a consciousness embedded in the way of thinking affecting actions of individuals, and this must be acquired through education. Ethical behaviours are based on the value system that individuals develop throughout their lives. The value system is formed by the combination of factors that are affected by each other, such as individual characteristics (gender, age), family, religious beliefs, social value system, education, and social, cultural, and economic characteristics (Akıncı Vural & Coşkun, 2011). Ethical awareness and ethical actions, which emerge through the interaction of many factors, are acquired through both informal education (family, social environment, mass media, etc.) and formal education (education curriculum). In this context, ethical values education is an integrated whole and must start in the family and be supported by education. With the combination of all these, values associated with professional ethics must be acquired as well. It is necessary to acquire design-related ethical values based on the designer's ethical values during the design education process and then to raise awareness about sensitivity and professional ethics and put them into action (Figure 1).

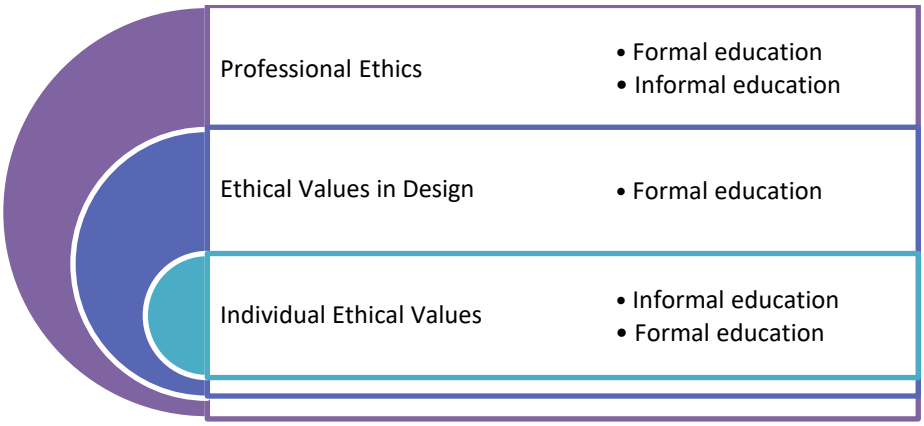

Figure 1. List of ethical values that the designer must acquire

Ethics emerges in the designers themselves, in their education, in their design actions, in their design products, between the designers and their customers, and the institution and society they work for (Ertürk, 2017). Recently, the issue of ethics in design has come to the forefront after the problems experienced at the education level, and efforts to prevent unethical and problematic actions in design are becoming widespread. Students are frequently faced with problems caused by ethical dilemmas and deviations in landscape design education. For this reason, it is necessary to examine and question the education curricula and to what extent ethics is included in the design of these curricula in landscape architecture.

Design courses start with Basic Design and continue with Landscape Design, Computer Aided Design, Planting Design, Special Purpose Design, and Project I, Project II, Project III, and Project IV courses in different semesters at Selçuk University, Faculty of Architecture and Design, Landscape Architecture Department (Table 1). There is neither a course on ethics in the landscape architecture design education curriculum nor an integrated approach to design ethics. It is for this reason that design education has to contain for different approaches to teaching ethics and ethical behavior.

Table 1. Design courses at the Department of Landscape Architecture

Design Courses	Semester	Compulsory/ Optional
Basic Design	I. Semester	Compulsory course
Landscape Design	II. Semester	Compulsory course
Computer Aided Design	III. Semester	Compulsory course
Planting Design	IV. Semester	Compulsory course
Project I	V. Semester	Compulsory course
Project II	VI. Semester	Compulsory course
Project III	VII. Semester	Compulsory course
Special Purpose Design	VII. Semester	Optional course
Project IV	VIII. Semester	Compulsory course

The Professional Deontology course, which is an elective course in the eighth semester, is associated with professional ethics and does not have any content associated with design ethics and ethics in design education (Table 2). Also, raising awareness of ethical values and ethical-based responsibilities is not possible with professional ethics in design. The deontological approach sets some rules in a way that considers ethics a system of rules and tries to solve the complexities and conflicts in professional practice with these rules (Mutlu & Yoğurtçu, 2022). This causes a significant deficiency in terms of ethics in design education. Firstly, it may be more effective to provide students with ethical values, actions, and responsibilities in design at the undergraduate level, and then provide training on professional ethics.

Table 2. The purpose and content of The Professional Deontology course

	The purpose of the course	The content of the course
The Professional Deontology	The purpose of this course is to teach basic concepts of the main features of the code of ethics, code of ethics and rules of law relationship, ethics, work ethics, professional ethics, professional ethics and morals a variety of concepts and ethics.	Deontology definition and concept
		Ethics definition and history, ethics regulation
		Principles of ethics (autonomy principle, the principle of beneficence, no harm principle, the principle of justice)
		Examination of moral teachings that assume people have certain duties
		Examination of duty and rules arising from moral teachings concrete projection in various professions
		Explaining the responsibilities and duties of landscape architects
		Explanation of moral values and ethical principles while applying the landscape architecture profession
		Ethical and legal problems and solution approaches in landscape architecture profession
		Recent developments in the profession of landscape architecture and ethical issues arising from them, and solution approaches
		General discussion on case study

2. Method

In the present study, a mixed study design was adopted, combining qualitative (perceptual evaluation of facts) and quantitative (questionnaire and scale) study methods. Phenomenology focuses on describing and evaluating the experiences of individuals. The experiences, perceptions, and meanings of individuals about a phenomenon are revealed through phenomenology. Phenomenology comes from the philosophical tradition and is used to describe psychological reality by revealing the true

meaning of experiences (Onat Kocabıyık, 2015). Phenomenology was preferred as the method because ethics is a sub-discipline of philosophy and the field of study of axiology. In the present study, ethics was examined in terms of landscape design education. Phenomena emerge in different ways such as lived events, experiences, perceptions, tendencies, concepts, and situations. Phenomenology focuses on phenomena that are aware of but do not have an in-depth and detailed understanding (Yıldırım & Şimşek, 2005). The phenomena in the present study were the ethical perceptions, ethical awareness, ethical behaviors, ethical preferences, ethical judgments, and ethical decision-making skills of students in the Department of Landscape Architecture. Based on these facts, it was explained how ethical education can be integrated into design education as learning objectives.

The present study was conducted with the voluntary participation (sample) of students (population) of Selçuk University, Faculty of Architecture and Design, Department of Landscape Architecture (Table 3). According to the qualitative and quantitative methods, students' ethical perceptions and ethical awareness, ethical behaviours, ethical preferences, ethical judgments, and ethical decision-making skills in the design process were examined. In the data collection stage, quantitative data were obtained with a questionnaire (closed-ended questions) and a 3-point Likert scale, and qualitative data was obtained with open-ended questions. The questionnaire form consisted of 2 questions that defined demographic characteristics, 2 closed-ended questions to determine ethical perception and awareness of ethical/unethical behaviours in design, and 3 open-ended questions with 20 propositions prepared following the 3-point Likert scale under the factors of ethical behaviours, ethical choice, ethical judgments, and ethical decision-making. Propositions regarding the facts are presented in a sequence. On one side, there are positive proposition options (always), which means accepting, agreeing, and supporting the phenomenon, and on the other side, negative proposition (never), meaning rejecting, disagreeing, and not supporting the phenomenon, on the other side. The middle value reflects agreement and disagreement (sometimes) with the phenomenon at the same time. A 3-point Likert scale was preferred so that students could give clear answers to propositions about facts because ethics is a difficult concept to evaluate.

Microsoft Excel program was used to organize the data obtained with the online questionnaire form, and the SPSS 21 (Statistical Package for the Social Science) statistical program was used to analyze the study data. Findings on students' gender and education levels are given with frequency distributions and percentage rates. The reliability coefficient (Cronbach Alpha) was calculated on the 3-point Likert scale, and the evaluation of the cases was also made with a percentage distribution. Open-ended questions were encoded and evaluated by the researcher. The questionnaire and scale were used as an electronic questionnaire between 10-30 January 2023. The purpose of the study and the fact that the data obtained would be used for scientific evaluation was explained to the students, and the students participated in the questionnaire voluntarily.

3. Findings and Discussion

The study was conducted with the voluntary participation of 149 students out of 199 students who were studying in the Department of Landscape Architecture. The distribution of the students who participated in the questionnaire according to their education levels is given in Table 3. Among the students who participated in the questionnaire, 74% were female and 26% were male (Table 3). This can be explained by the fact that the number of female students (148) in the department is more than that of male students (51). Also, studies do not show that there is a definitive connection between gender and ethical behaviours. The general perception is that women are more ethical than men, but contradictory results were reported in previous studies examining the effects of gender factors in the context of ethical decision-making. Although some studies reported that men tend to behave more ethically than women, other studies found that women exhibit more ethical behaviours than men. Some studies concluded that women and men make similar decisions regarding ethics and exhibit similar behaviours (Özen Kutanis et al., 2005).

Table 3. Education levels and participation rate of the students who participated in the questionnaire

Education levels	1st-grade	2nd-grade	3rd-grade	4th-grade	Total
Number of students	63	31	55	50	199
Number of students who participated in the questionnaire	47	20	42	40	149
Participation rate	75%	65%	76%	80%	75%

The students were asked "What does ethics mean to you?" to determine students' perceptions about the ethics concept and were asked to choose the most appropriate definition among 5 ethical definitions. Within these definitions, the expression "it is a set of standards, values, and principles that guide the behaviours of individuals, institutions, and professionals and help determine good-bad and right-wrong" was given to meet the ethics concept. Although the students did not take any courses on ethics, 61.1% of the first graders, 63.8% of the second graders, 65% of the third graders, and 81% of the fourth graders chose the correct definition of ethics. The fact that students' correct answers to the definition of ethics increased according to grades suggests that the level of ethical awareness increases as the level of education progresses. However, this can also be interpreted as students' knowledge skills develop for ethical awareness that is not reflected in decisions and behaviours, but their ethical abilities do not develop in parallel (Kuçuradi, 2020) and they are at a general level of awareness about ethics. It is noteworthy that students associated ethics with the rules to be followed in business life at the lowest level at all levels of education (Table 4).

Table 4. Definitions of the ethics concept and students' perception of ethics according to education level

Ethics definition	1st-grade	2nd-grade	3rd-grade	4th-grade
Forms of behaviors that result from individuals' education, culture, and understanding of life.	26.5%	18.1%	23.5%	10.9%
A set of standards, values, and principles that guide the behaviors of individuals, institutions, and professionals and help determine good-bad and right-wrong.	**61.1%**	**63.8%**	**65%**	**81%**
They are written rules regulating social life.	8.3%	4.3%	5%	2.4%
The rules that must be followed in business life.	1.3%	2.3%	1.5%	1.2%
The rules of behaviors that individuals must comply with in society.	2.8%	11.5%	5%	4.5%

An evaluation was made according to the participation of the students in the propositions to determine the student's ability to distinguish ethical and unethical behaviours in design. The high level of the answers to ethical behaviours, searching different ideas and designs according to educational levels (93.6% - 85% - 88.1% - 90%), examining others' ideas and designs (76.6% - 90% - 85.3% - 90%), citing sources when using ideas and designs (87.2% - 90% - 83.8% - 92.5%), being inspired by others' ideas and designs but creating own designs (76.6% - 85% - 71.4% - 90%) suggests that they can distinguish between ethical and unethical behaviours at all levels of education (Table 5). However, despite this awareness, it is up to the students' initiative to make ethical choices and act ethically by showing ethical sensitivity in the designs. This prevents knowledge from turning into action and being reflected in behaviours. For this reason, students must be supported and their awareness must be increased about ethical choices and behaviors during the design education process.

The propositions "presenting others' ideas and designs as their own", "using others' ideas and designs exactly" and "making sloppy designs" were described as unethical behaviours by the students who participated in the study (Table 5). The propositions "using others' ideas and designs after changing

them", "bringing together others' ideas and designs and presenting them as a novel design", and "using the same design in different places" are situations where it is difficult to make a clear distinction in terms of ethics. For this reason, it is natural that students cannot make a clear distinction between these propositions. "Having a student or a professional design and draw a project for money" (4.3% - 15% - 0% - 0%) and "Having another student design and draw a project for money" (4.3% - 20% - 2.4% - 2.5%) were situations that made ethical evaluation difficult. Despite this, students' agreement with these propositions was quite low (Table 5). Each individual's perception of ethics, the meanings they associate the ethics concept with, and their interpretation of ethics might be different. For this reason, ethical thoughts and behaviours vary according to individuals, socio-cultural characteristics, events, situations, and time (Akıncı Vural & Coşkun, 2011).

Table 5. Awareness of ethical and unethical behaviors in design

Ethical/Unethical Behaviors in Design	1st-grade	2nd-grade	3rd-grade	4th-grade
Searching for different ideas and designs	**93.6%**	**85%**	**88.1%**	**90%**
Presenting others' ideas and designs as one's own	0%	0%	0%	0%
Examining other people's ideas and designs	**76.6%**	**90%**	**85.3%**	**90%**
Using other people's ideas and designs one-to-one	0%	0%	0%	0%
Using other people's ideas and designs after changing them	17%	40%	21.4%	35%
Citing sources when using others' ideas and designs	**87.2%**	**90%**	**83.8%**	**92.5%**
Combining other people's ideas and designs to present them as a novel design	6.4%	10%	7.1%	10%
Using the same design in different places	14.9%	10%	7.1%	17.5%
Making sloppy designs	0%	0%	0%	0%
Being inspired by others' ideas and designs but creating one's design	**76.6%**	**85%**	**71.4%**	**90%**
Having a design and project drawn by a student or professional in return for money	4.3%	15%	0%	0%
Making another student's design and drawing his/her project in return for money	4.3%	20%	2.4%	2.5%

Internal consistency coefficients (Cronbach Alpha) were calculated for the reliability analysis in the ethical behaviours, ethical preferences, ethical decision-making, and ethical judgment scales used in the study, and the reliability level was determined (Table 6). The purpose of the present study was not to develop a scale, but the reliability coefficient and level of the scales were determined and the evaluation of the scales was made according to percentage rates.

Table 6. Reliability coefficients of ethical behaviors, ethical choice, ethical decision-making, and ethical judgment scales

Scales	Measuring range	Number of Items	Cronbach's Alpha (α)	Confidence Interval
Ethical behaviors	3-point scale	5	0.620	Low Reliability
Ethical choice	3-point scale	5	0.646	Low Reliability
Ethical decision making	3-point scale	3	0.804	High Reliability
Ethical judgments	3-point scale	7	0.737	Medium Reliability

Students were asked to rate the given propositions with a 3-point Likert scale to determine the ethical behaviors of the students in the design process, and an evaluation was made on 2 ethical behaviors and 3 unethical behaviors in design. According to the results of the analysis, 48.9% of 1st-grade students said always, 45% of 2nd-grade students said sometimes, 59.5% of 3rd-grade students said always, and 55% of 4th-grade students said sometimes accepted others' opinions, and said that they did not find it appropriate to use others' designs. Students at all learning levels agreed that when using others' ideas and designs, the source must always be cited (85.1% - 85% - 81% - 80%). A total of 95.7% of 1st-grade students, all 2nd-grade and 3rd-grade students, and 85% of 4th-grade students said that they did not use others' ideas and designs as if they were their own. Students sometimes "used other people's ideas and designs after changing them" (59.6% - 80% - 64.3% - 67.5%) and "tried to fit others' ideas and designs together by bringing them together" (51.1% - 60% - 42.9% - 67.5%) (Table 7).

Table 7. Ethical behaviors of students in the design process

Ethical Behaviors in the Design Process	1st-grade	2nd-grade	3rd-grade	4th-grade	Scale
I do not find it appropriate to use other people's ideas and designs.	6.4%	25%	4.8%	20%	Never
	44.7%	**45%**	35.7%	**55%**	Sometimes
	48.9%	30%	**59.5%**	25%	Always
When other people's ideas and designs are used, they must be cited as sources.	2.1%	0%	2.4%	0%	Never
	12.8%	15%	16.7%	20%	Sometimes
	85.1%	**85%**	**81%**	**80%**	**Always**
I use other people's ideas and designs as if they were my own.	**95.7%**	**100%**	**100%**	**85%**	**Never**
	2.1%	0%	0%	12.5%	Sometimes
	2.1%	0%	0%	2.5%	Always
I use other people's ideas and designs after modifying them.	38.3%	10%	26.2%	22.5%	Never
	59.6%	**80%**	**64.3%**	**67.5%**	**Sometimes**
	2.1%	10%	9.5%	10%	Always
I try to bring other people's ideas and designs together and make them fit together.	44.7%	35%	54.8%	25%	Never
	51.1%	**60%**	**42.9%**	**67.5%**	**Sometimes**
	4.3%	5%	2.4%	7.5%	Always

Ethical actions and virtues are considered together with making a choice, which is determined "by the mind" and directs the individual to the idea of "being in the middle" (Mutlu, 2009). The ethical choices of students in the design process show that they experience ethical dilemmas, depending on their educational levels. Students said that they always preferred to develop their ideas and designs (83% - 80% - 83.3% - 75%), and sometimes examined the ideas and designs of others but preferred not to use them (51.1% - 70% - 47.6% -72.5%). Students also said that they did not prefer to use others' ideas and designs (74.5% - 55% - 76.2% - 65%). Despite this, students sometimes made designs inspired by others' ideas and designs (72.3% - 60% - 69% - 72.5%), and using others' ideas and designs contributed to their learning (55.3% - 45% - 52.4% - 47.5%) (Table 8).

Ethical judgment ability requires the individual to be able to distinguish between right and wrong and to internalize ethical values. Although the ethical perception and judgment ability of each individual are different (Dönmez et al., 2022), students at all education levels gave common answers to ethical judgment propositions at different levels. The fact that students were not affected by others' ideas and designs (51.1% - 65% - 83.3% - 75%) but also felt uncomfortable (74.5% - 50% - 76.2% - 47.5%) and guilty (70.2% - 40% - 71.4% - 42.5%) shows that there is a conflict between conscientious aspects and individual ethical values (Table 9).

Table 8. Students' ethical choices in the design process

Ethical Preferences in the Design Process	1st-grade	2nd-grade	3rd-grade	4th-grade	Scale
I prefer to develop my ideas and designs.	0%	0%	0%	2.5%	Never
	17%	20%	16.7%	22.5%	Sometimes
	83%	**80%**	**83.3%**	**75%**	**Always**
I examine other people's ideas and designs but choose not to use them.	4.3%	0%	4.8%	5%	Never
	51.1%	**70%**	**47.6%**	**72.5%**	**Sometimes**
	44.7%	30%	47.6%	22.5%	Always
I prefer to use other people's ideas and designs.	**74.5%**	**55%**	**76.2%**	**65%**	**Never**
	25.5%	45%	23.8%	35%	Sometimes
	0%	0%	0%	0%	Always
I design based on other people's ideas and designs.	17%	15%	31%	12.5%	Never
	72.3%	**60%**	**69%**	**72.5%**	**Sometimes**
	10.6%	25%	0%	15%	Always
Using other people's ideas and designs contributes to my learning.	21.3%	10%	31%	7.5%	Never
	55.3%	**45%**	**52.4%**	**47.5%**	**Sometimes**
	23.4%	45%	16.7%	45%	Always

Table 9. Students' ethical judgments in the design process

Ethical Judgments in the Design Process	1st-grade	2nd-grade	3rd-grade	4th-grade	Scale
Using other people's ideas and designs does not affect me in any way.	40.4%	30%	14.3%	15%	Never
	51.1%	**65%**	**83.3%**	**75%**	**Sometimes**
	8.5%	5%	2.4%	10%	Always
I feel uncomfortable when using other people's ideas and designs.	2.1%	15%	7.1%	22.5%	Never
	74.5%	**50%**	**76.2%**	**47.5%**	**Sometimes**
	31.9%	35%	16.7%	30%	Always
I feel guilty when using other people's ideas and designs.	4.3%	25%	11.9%	25%	Never
	70.2%	**40%**	**71.4%**	**42.5%**	**Sometimes**
	25.5%	35%	16.7%	32.5%	Always

Ethical decision-making is defined as a logical process involving how to decide on the most morally correct action through systematic thinking in a situation where there are contradictory and conflicting options (Berggren & Severinsson, 2006). Ethical decision-making is a choice process, which is affected by the personal characteristics of the individual. According to educational status, students gave different levels of common answers to the propositions in terms of ethical decision-making skills (Table 10). These results may not reflect the truth, as individuals tend to hide their unwanted behaviors/mistakes. The students' answers support the propositions, but their actions during the design process differ, which is the starting point of the study. However, the results obtained still show that students' ethical decision-making skills have improved, but they are not reflected in their behaviors or they do not know how to reflect it.

Table 10. Students' ethical decision-making skills in the design process

I examine others' ideas and designs during the design process because…	1st-grade	2nd-grade	3rd-grade	4th-grade	Scale
they will affect me.	29.8%	40%	40.5%	42.5%	Never
	59.6%	**60%**	**54.8%**	**52.5%**	**Sometimes**
	10.6%	0%	4.8%	5%	Always
I just examine them and ignore them.	4.3%	15%	28.1%	37.5%	Never
	61.7%	**80%**	**48.1%**	**52.5%**	**Sometimes**
	34%	5%	23.8%	10%	Always
I examine them to develop a solution.	6.4%	10%	4.8%	10%	Never
	42.6%	35%	31%	37.5%	Sometimes
	51.1%	**55%**	**64.3%**	**52.5%**	**Always**
I apply them one on one.	**100%**	**100%**	**88.1%**	**82.5%**	**Never**
	0%	0%	9.5%	17.5%	Sometimes
	0%	0%	2.4%	0%	Always
I make them like a novel design by making small changes.	**68.1%**	**70%**	**54.8%**	**55%**	**Never**
	27.7%	20%	38.1%	35%	Sometimes
	4.3%	10%	7.1%	10%	Always
I make them like a novel design by making major changes.	29.8%	25%	23.8%	12.5%	Never
	48.9%	**60%**	**50%**	**62.5%**	**Sometimes**
	21.3%	15%	26.2%	25%	Always
I combine multiple designs to make them like a novel design.	**55.3%**	**60%**	**50.0%**	**32.5%**	**Never**
	34%	30%	45.2%	57.5%	Sometimes
	10.6%	10%	4.8%	10%	Always

In the question, "Why would you use other people's ideas and designs in the design process?", the students were asked to choose 5 of the options that suited them. The word "inspiration", which means "to be inspired by something", was not specifically used in this question because inspiration, which has a very important place as the starting point of the design process, is defined as the blending and shaping of the data obtained as a result of a deep study about the source of inspiration in the designer's self and transforming it into an original product or project (Gürcüm & Kartal, 2018), although it is clearly defined in the design. It is not easy to determine its limits and distinguish between inspiration-imitation-stolen. For this reason, it is very difficult to be sure that whether a student or a professional designer, stay on the right side of inspiration and create projects that are original and make a difference in design.

It is seen in Table 11 that the first reason for using others' ideas and designs at all education levels is because they feel inadequate (74.5% - 75% - 83.3% and 80%). First graders said that they use the internet in the second place because they can easily access different ideas and designs (42.6%) and in the third place because they have limited time (38.3%). Second Graders come in second because they like other people's ideas and designs or think they are better (40%), in third place because time is limited (35%), if they have difficulty making a design (35%) and because what is explained in the course is not enough (35%). Third Graders said that they used it secondly because they had limited time (50%) and thirdly because they liked other people's ideas and designs or thought they were better (47.6%). Fourth graders said that they used it when they had difficulty in making designs in the second place

(45.7%) and in the third place, they used it because they liked other people's ideas and designs or thought they were better (42.9%) (Table 11). Designing and creating the form involves a difficult process in the design phenomenon that includes dynamic variables. Students and young designers cause disruptions in design culture by copying the data and images they see, especially on social media, which has become widespread in recent years (Uluçay Özsavaş, 2017). In parallel with technological developments, the rapid production and dissemination of data, easier access to data, and increased competitive environment sometimes lead to the emergence of originality and ethical problems in design. In such a case, the correct use of technology and technological opportunities also requires ethical behaviors in landscape design. Artificial intelligence applications, which have become increasingly widespread in recent times, ethical concerns arise in tandem with technological innovation.

Table 11. Reasons why the students use others' ideas and designs

Reasons to use other people's ideas and designs	1st-grade	2nd-grade	3rd-grade	4th-grade
I use them because they provide convenience.	25.5%	30%	19%	28.6%
I use them because time is limited.	**38.3%**	**35%**	**50%**	40%
If my friends use them, I use them too.	0%	0%	0%	5.7%
I use them to obtain high grades.	21.3%	5%	7.1%	2.9%
I use them because I feel inadequate.	**74.5%**	**75%**	**83.3%**	**80%**
I use the internet because I can easily access different ideas and designs.	**42.6%**	30%	23.8%	37.1%
I use other people's ideas and designs because I like them/I think they are better.	34%	**40%**	**47.6%**	**42.9%**
I use them if I have difficulty making a novel design.	25.5%	**35%**	38.1%	**45.7%**
I use them because what is taught in class is not sufficient.	36.2%	**35%**	33.3%	34.3%
I use them because the faculty member teaching the course supports it.	17%	25%	33.3%	22.9%

The best way to explain a situation is to enable the students to understand the situation better by experiencing the behaviors s/he is doing to someone else. Understanding other people's emotions, feelings and behaviors is also a key skill in the whole life. It can enable to resolve conflicts, ethical dilemmas, and deviations. Ethics and empathy act as a moral compass that steers students in their actions and discussions on personal and educational issues. Empathy is an important determinant of ethical behavior, and a necessary building block in creating students who have ethical values and behaviors. To develop empathy, students were asked open-ended questions "What would you think, how would you feel, what would you do if your ideas and designs were used by others?" With these questions, the purpose was for them to make perceptual evaluations, in other words, experiential judgments about ethical behaviors and preferences. In this way, they realized the unethical situation that the behavior they committed to developing their designs unknowingly created, and revealed the situation they faced and the reactions they would give when the same behavior was directed at them (Figure 2). Students said very strictly and firmly that they would take measures to seek and protect their rights when unethical behaviors were directed toward their work.

Figure 2. Students' reactions when their ideas and designs were used by others

4. Conclusion and Suggestions

The results of the present study, which included the evaluations of the ethics concept in terms of landscape design education, were discussed within the framework of the philosophical discourse based on ethos (style of existence, way of living, character, personality trait, habit), which is the root of the word ethics. People frequently associate ethical issues with philosophical problems and include the ethical dimension in the philosophy dimension. However, the dimension of ethics exceeds the scope of philosophy. The ethical dimension is the way people "do something right", but "doing something right" is not only an ethical matter but also a matter of practice (Wenming, 2018). Ethical principles must be adopted in design and internalized by designers, reflected in decisions and actions, and rooted in curricula and professional practice processes, instead of legalization and sanctions. In this context, how ethical principles will be reflected in behaviors and practice is the most important part and must be acquired during the education process.

Based on the developments in design, planning, production, and communication technologies, the use of rapidly produced and widely distributed data affects the individual, society, economy, culture, politics, and nature, requiring the designer to ethically question his actions and decisions in the design process and practices. A fully integrated approach to ethics in landscape design education does not exist to establish the ethics concept as a way of thinking and to provide ethical sensitivity and awareness to students in the education process. Instead of teaching ethics as a separate course in design education, an integrated approach is necessary throughout the undergraduate education curriculum. Ethics education is given as a separate course called Professional Ethics or Professional Deontology in landscape architecture departments. Acting ethically in the design process is up to the students' initiative, which often leads to a weak awareness of ethics in their designs.

No official documents are available revealing responsibilities based on ethical codes, rules, and principles regarding landscape design in Turkey. There are no precise and clear definitions of being ethical or acting ethically in landscape design applied and adopted by designers. For this reason, the ethics concept in landscape design has become a relative concept that varies from person to person and includes different interpretations and inferences. When faced with ethical dilemmas and deviations often experienced in landscape design, designers act according to their ethical values (Çelik, 2018). The problems in professional actions also manifest themselves in the design education process. While students develop their knowledge, skills, and abilities regarding design, their ethical abilities

must also be developed simultaneously. The knowledge, skills, abilities, and critical thinking acquired through different ways of thinking and seeing during the design education process will be the basis for the development of ethical sensitivity and awareness. When an environment that fosters ethical values is created on this basis prepared during design education, ethical sensitivity, and awareness will develop spontaneously.

According to Mıstıkoğlu et al. (2017), the targets of ethics education in design are as follows.

- To increase awareness about ethics,
- To develop the desire to behave ethically,
- To ensure that the principles of ethical behaviors are learned,
- To improve ethical decision-making,
- To provide skills for solving ethical problems.

Ethics has long been a part of design, and it has been examined how designer student candidates interact with ethics during the education process. In design, ethics is about moral behaviors and responsible choices in design practice (Schloesser, 2022). As a result of the increased ethical problems, ethics education is considered fundamental for training the next generation of designers and engineers (Stahl & Eke, 2024). Design students' learning experiences in college-level curricula play a major role in shaping their careers. The approaches and underlying philosophies to which students are exposed can lead to specific opportunities in the field and help shape their mindsets as practitioners. There is also increasing student and institutional interest in educational programs that address issues of ethics in practice. This situation often presents educators with the challenge of incorporating such issues into existing design curricula (Nini, 2020).

The purpose of ethical education is to enable students to make ethical judgments for themselves. According to the results of this research, it is explained how ethics in design courses and ethics education can be integrated into design courses were explained to provide ethical sensitivity and awareness to students in landscape design education. An "Ethics in Design" course can be added, ethical approaches can be discussed in design courses, information about ethical issues can be provided on the faculty website, and an education strategy can be developed that enables educators to set an example to raise ethical awareness and sensitivity in design education.

Addition of the "Ethics in Design" course: The "Ethics in Design" course can be added to undergraduate courses in the 1st or 2nd semesters. Within the scope of this course, the ethics concept and morality, ethical/unethical behaviors and practices, achievements of ethical behaviors, and responsibilities of designers (responsibilities towards themselves, users, society, environment, and other designers) in design can be explained. The good-bad and right-wrong aspects of the interaction of students with each other and with other designers can also be explained and evaluated in terms of concepts such as conscience and responsibility and presented for discussion. Ethics education in design can also be given within the scope of examining the ethical problems faced during and after the design process because design education takes place through experiencing the design process and action.

According to axiology, when it is desired to produce some kind of value, a broad, deep, and solid foundation of knowledge is necessary, and to reach such knowledge, the rules containing ethical values must be understood. In design, ethical values education must aim to create a culture in which unethical behaviors and actions will not occur. A more effective approach would be to establish the idea that acting ethically will give designer qualities such as dignity, honesty, accuracy, and reliability rather than revealing and punishing unethical behaviors and actions during the design education process.

Discussing ethical approaches in design courses: The designer's way of thinking, decisions, and actions are decisive in behaving ethically in design and are greatly affected by individual ethical values, which are acquired through informal education and formal education. For this reason, firstly, students' value systems and individual ethical values must be developed and uncovered. Perceiving and interpreting these values is the result of the ethical instinct that individuals have because the virtues possessed by individuals are shaped within social life (Dinçeli, 2017). It can use an approach where explanatory and complementary contents related to ethics are threaded through the various design courses in the

Department of Landscape Architecture so that they can be strengthened and reinforced over time. An educational approach can be developed to uncover the skills to help students use their own values and individual ethical values in the design process and actions. In each design course, unethical situations and behaviors specific to the project topic can be explained and students can be made aware. The choices made from the beginning to the end of the design process can be evaluated in terms of the effects and consequences that may emerge. In design courses, ethical analysis and discussions can be effective in gaining and developing ethical thoughts and actions by questioning the importance, effects, and results of the designs made by students. Students who try to foresee the importance, effects, and future outcomes of their designs can act more responsibly during the design process. If a professional ethics course is provided after these achievements, it will be more effective in professional life. Instilling ethical values and awareness in design education will make it easier for students to decide how they must behave on their own after graduation.

Information on the website: The ethical decision-making process is affected by the structural characteristics of the institution in which students work as well as their characteristics. In this context, as well as designing courses, data that contain the definition and explanation of unethical behaviours in design can be provided to students on the faculty and department web pages. Considering that there is the interaction between students in different departments of the same department or even the same faculty, students can be made aware of ethical/unethical behaviours in design by providing data on the web page.

Training of educators: Of course, the acquisition and sustainability of ethical awareness is a condition that comes with experience and seniority, but the problems faced in this respect indicate that there is confusion in teaching ethical rules to students (Dikici, 2021). To raise designers who have ethical awareness in design, exhibit ethical actions, and are sensitive to ethical problems, educators must first have these qualifications. Educators' display of ethical actions in the educational process and their work can contribute to designer student candidates' learning by taking role models.

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The article has a single author and there is no conflict of interest.

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The Evaluation of Local Commercial Typologies Based On Adaptive Reuse Models: (Tabriz Bazaar)

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Abstract

The modernization of Islamic countries has brought significant changes to heritage buildings, particularly in construction and architecture. The Bazaar, as one of the most important heritage buildings, has played a crucial role in shaping people's identity, culture, and political, economic, and social characteristics. However, the development of new trade centers and the city's expansion after the Industrial Revolution caused a shift in the Bazaar's functions, resulting in its loss of values and social roles in the lives of new generations. To preserve heritage buildings for future generations, cultural sustainability approaches have been considered, and adaptive reuse models are being used worldwide. This study focuses on historical typology in Tabriz, Iran, and uses adaptive reuse models (ARMs) to evaluate the Tabriz Ground Bazaar based on cultural sustainability. The study aims to achieve the potential of rehabilitation by utilizing the SWOT analysis. The selection of Tabriz Ground Bazaar as the case study was based on the quantitative research methodology.

Keywords: *Rehabilitation, Tabriz Bazaar, adaptive reuse model (ARM), commercial typology, sustainability.*

Yerel Ticari Tipolojilerin Uyarlanabilir Yeniden Kullanım Modellerine Dayalı Değerlendirilmesi: (Tebriz Çarşısı)

Öz

Modernleşmenin gelişiminden bu yana, İslam ülkeleri miras niteliğinde olan yapılarında önemli değişiklikler yaşamıştır. En önemli kültür yapılarından biri olan Çarşı, insanların kimliğini şekillendirmiş ve sosyal, kültürel, ekonomik ve politik bir rol oynamıştır. Sonuç olarak, modernleşmeye bağlı olarak şehrin genişlemesi ve yeni ticaret merkezlerinin artması sonucu, Çarşı'nın önemli işlevlerinin dağılımını etkilemiş, değerlerinin ve yeni nesillerin hayatındaki sosyal rollerinin azalmasına neden olmuştur. Miras yapılarının gelecek nesillere hizmet edecek şekilde sürdürülebilirliği, kültürel sürdürülebilirlik yaklaşımı olarak dünya çapında uyarlanabilir; yeniden kullanım modelleri kullanılarak sağlanabilir. Bu çalışma, rehabilitasyon potansiyeline ulaşmak için kültürel sürdürülebilirlik ve uyarlanabilir düşüncesinden hareketle, yeniden kullanım modellerine dayalı olarak Tebriz Çarşısı'nı değerlendirmek için SWOT analizini kullanılmaktadır. Gömülü teori, İran'ın Tebriz kentinde tarihsel tipolojiye odaklanan ARM'leri (uyarlanabilir yeniden kullanım modelleri) seçmek için nitel bir araştırma yöntemi olarak kullanıldı. Nicel araştırma yöntemi temel alınarak, ARM araştırma yöntemi ile değerlendirilmek üzere durum çalışması olarak Tebriz Ground Bazaar seçilmiştir.

Anahtar kelimeler: *Rehabilitasyon, Tebriz Çarşısı, uyarlanabilir yeniden kullanım modeli (ARM), ticari tipoloji, sürdürülebilirlik.*

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1. Introduction

Numerous events such as earthquakes, expanding roads, global climate changes, land value increases, and modernization have led to damage to many buildings. These events pose risks to the cultural and identity patterns of marginal, ethnic, and national cultures. Iran is one of the developing countries affected by modernization, which has caused rapid change in all community areas. Despite having struggled with countless problems and disputes for thousands of years, Tabriz Bazaar remains one of Iran's most important identities and safeguards. It plays a protective role in the social and cultural field. To ensure the durability of valuable historical buildings, attention should be paid to the sustainability of the building. Regional planning, urban planning design, architecture, preservation, and management of cultural heritage are the main fields of planning and design. These disciplines are responsible for the sustainable development of cultural heritage while taking into account environmental, social, economic, and cultural issues. Adaptive reuse has emerged as a key strategy in the conservation of heritage buildings, transforming them to meet new needs while retaining their historical significance. This approach aligns with sustainable development goals by promoting the reuse of existing structures, thereby reducing the need for new materials and minimizing environmental impact (Plevoets & Cleempoel, 2011). The adaptive reuse of historic buildings encompasses renovation, development, and modernization, reflecting the changing needs of communities while preserving historical, social, and aesthetic contributions. Modernization and new products have greatly affected people's lifestyles. However, many modern cities in Iran have suffered from chaos in architecture and urban planning. The mindless imitation and transformation of Western urban development and architecture, without considering their methods, has led to the destruction and forgetting of some historical symbols and images that are important to the urban identity. Iranian cities have deep traditions and urban patterns associated with these traditions. Bazaars, as one of the urban fabrics, have a strong identity and historical cities have started to become more active since the 1960s. Over time, some bazaars were demolished, some became disused historical monuments, and some continued to exist despite the changes. Unfortunately, some old bazaars have lost their sense of self-worth and are now abandoned places within the city. Therefore, it is necessary to evaluate whether a bazaar has the potential to provide new functions and rehabilitate it accordingly. To achieve this, the "Adaptive Reuse Model (ARM)" evaluation framework was designed to assess the market's potential for rehabilitation based on the working gap. This framework involves analyzing the strengths, weaknesses, opportunities, and threats (SWOT) associated with the building, providing a comprehensive understanding of its potential for adaptive reuse (Bullen & Love, 2011).

This study aims to identify the strengths and weaknesses of the Tabriz Bazaar, an important heritage site located on the trade route, in terms of its cultural and identity factors. The study uses the method of reuse models to accomplish its goal. The Tabriz Bazaar has been a meeting point for Western and Eastern cultures since ancient times, making Tabriz a multicultural city. Moreover, this city is one of the legacy architectural cities of ancient urbanization. The qualitative method used in this study focuses on the impact of modernity on the traditional trade center, particularly the Tabriz Bazaar, which forms the urban formation of the city, and the transformation of the architectural style and functions of the trade centers. In addition, the study considers the development of Tabriz's planning system and cultural and value changes as dependent variables. The Australian Burra Charter ICOMOS in 2013 and in the ICOMOS (1964), Venice Charter provides guidelines for assessing and monitoring alterations and additions to heritage buildings (ICOMOS, 2013).

These charters emphasize the importance of retaining cultural significance while adapting buildings for contemporary use. The study proposes that heritage buildings with unique cultural significance and vital communities should be protected and preserved to strengthen the four dimensions of sustainable development, including environmental sustainability, inclusive social development, inclusive economic development, and cultural vitality. Therefore, the study aims to evaluate the cultural sustainability potentials of Tabriz Bazaar based on worldwide certification systems known as adaptive reuse models (ARM). The study integrates environmental and cultural sustainability to gain important knowledge on managing and preserving historic structures for future generations. The study concludes that ARM is the most advanced way to evaluate historical structures in terms of cultural sustainability.

1.1. Definition of Cultural Heritage (Tabriz Grand Bazaar)

Cultural heritage is a reflection of the lifestyles that have shaped communities over time, and that are passed down from one generation to the next with their useful habits (ICOMOS, 2000). An inherent characteristic of cultural heritage is that attention must be paid to the protection of immovable heritage, such as the preservation or restoration of architectural sites. Views on architectural and historical value, as well as conservation theory regarding heritage, differ between East Asia and the West; as a result, various approaches to heritage conservation have been developed according to each culture. In architectural heritage studies, the overlap between renovation and conservation, and more specifically, authenticity in conservation, is a fundamental issue that needs to be taken into account (Poulios, 2011; Weiler & Gutschow, 2016; Zhang et al., 2022).

Preserving heritage involves building a memory that helps us express our cultural identity and fosters in people a sense of continuity and belonging, a greater appreciation for human creativity and cultural diversity. The cultural diversity in each city's built environment is what attracts and appeals to tourists through its unique architecture, historic sites and buildings, parks, shopping districts, and cultural impressions gathered in the streets and tourist buildings (Ashworth & Tunbridge, 1990; Law, 1993; Ryu & Kwon, 2021). Foster stated that the development, strengthening, and rehabilitation of HB, one of the conservation landmarks, is an adaptive reuse of cultural heritage that reveals changing community needs. A wide range of sustainable development is illuminated, taking into account conservation, local needs, and enhancing the value of built heritage. The contribution of cultural heritage to the well-being of citizens and sustainable development should also be stated in the protection and conservation of cultural heritage assets based on the European Union (2020), Foster (2020), as well as in cultural heritage strategies. Despite the extensive research on the preservation and protection of cultural heritage, the market, which is the main core of the formation of the city, has encountered weaknesses and gaps such as technological aspects, transformability, value after adaptation, identification, flexibility, energy degree, legal and environmental quality. These are all elements that will contribute to sustainable development. The bazaar has been a kind of expression of unity, integrity, solidarity, perseverance, indivisibility, and sincerity from ancient times to the present day. The bazaar has a catchy spirit that comes from people's emotions and behavior. Thus, emotion manifests through the soul, and the soul introduces and defines environments and places through experience. Many people, from one civilization to another, from one generation to the next, have achieved identity and human, material, and spiritual gains for themselves with the existence and identity characteristics in the market, through identity elements. As a result, the bazaar and its identity evolved and changed over time. Throughout history, the formation of bazaars and the nature of their customers have changed through communication and connection with other nations, their cultures, and beliefs.

1.2. Chronology Plan of Tabriz Market and its Impact on Modernization

Tabriz is a city located in the northwest of Iran, and it is the most populous city as well as the capital of East Azerbaijan province. Tabriz is known for being a popular destination for handicrafts. The "World Handicrafts Council" has even recognized Tabriz as the "World Carpet Weaving City." Due to its historical significance, many people visit Tabriz every year. The city is situated at an altitude of 1351.4 m (4433.7 ft) above sea level and is surrounded by the Gul River, Bitter Stream (river), Lake Urmia, Sehend Volcanic Mountain, and Einali Mountain. The history of this city dates back to 1500 BC. Tabriz is located in the heart of the large and fertile province of Azerbaijan and guards one of the gates of Iran. Tabriz, which served as a significant military base in the 9th century, developed into an economic and commercial hub during the same period. By the 12th and 13th centuries, it had become the capital of the country. Due to its prime location on the Silk Road, Tabriz reached the pinnacle of its social and economic prosperity between 1316 and 1331. The city's strategic position on the popular West-East and Southeast-East trading routes allowed it to produce highly valuable industrial products such as silk, cotton, equipment, and pottery. Investors were encouraged to invest in the city as it was exempt from taxes. As a result, the Safavids chose Tabriz as their kingdom's capital in the early 16th century, transforming it into a powerful administrative center. However, the city experienced economic depression in the last quarter of the 17th century and political instability as a result of Ottoman

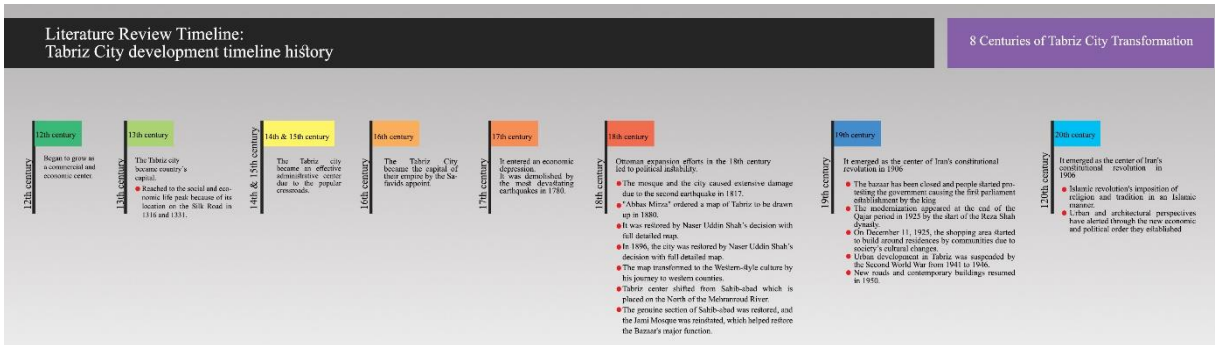
expansion efforts in the 18th century. Unfortunately, Tabriz was hit by several devastating earthquakes between the mid-17th century and the mid-18th century, with the most severe one occurring in 1780, during the Qajar dynasty's early years. Despite the destruction, the city was immediately rebuilt and continued its life. However, another earthquake in 1817 damaged the important historical mosque and a significant portion of the city. In 1880, Prince Abbas Mirza commissioned a detailed map of Tabriz, including its neighborhoods and elements. Although the city was restored, Naser Uddin Shah decided to change some of the city's views after visiting the West in 1896 and being influenced by it. Upon his return to Iran, he changed some construction methods and building facades based on Western culture.

However, architects and art students of that time lacked sufficient knowledge of Western architecture and culture to design buildings based on Western models. The city underwent several transformations in the 19th century, with public buildings and life's focal point organized around a large square north of the Mehranroud River, moving from Sahib-abad to its current location near Ali-Kapu, south of the river. The Sahib-ul-Amr square is located below the authentic area of Sahib-abad. The reconstruction of the Juma Mosque has helped restore the central role of the Bazaar (UNESCO, 2009a).

Tabriz, a city in Iran, emerged as the epicenter of Iran's constitutional revolution in 1906. After the Qajar period in 1925, Reza Shah changed everything in a modern way. The city did not have the opportunity to maintain traditional life and continue its experiences after modernization came to the city. As a result, some of the upper and middle classes of society have changed their residences and allowed communities to shop in the environment where they reside (Mazaheri, 2006). On December 11, 1925, the parliament handed over the government of Iran to King Reza Pahlavi, and Tabriz, like the rest of the city, now adapted to a modern urban system. During the Second World War, from 1941 to 1946, urban construction stopped in Tabriz, as in other cities. New roads were built again in 1950, (UNESCO, 2009b).

The Islamic revolution in Iran in 1979 had different effects at the end of the 19th century and the beginning of the 20th century. As a result of the ideological consequences of the Islamic revolution, Iran subjected its religious and Islamic tradition to the imposition of its architectural field. Therefore, an architectural style similar to chaos was experienced. The Iranian revolution resulted in the collapse of traditional society. Their urban and architectural perspectives were changed with the new economic and political order they established. All cities in Iran, especially Tabriz, were affected by the modernization transformation. According to the statement mentioned above, the urban formation of Tabriz Bazaar has developed with new elements such as streets, settlements, roads, and functional buildings in different historical periods. This transformation and development began to manifest itself with increasing hectares and urbanization from the 8th, 11th, 13th, and 19th centuries until the Islamic Revolution (Table 1). As a result of the transition from tradition to modernity, a comprehensive urban transformation took place in the city center of Tabriz. The area around the Friday Mosque, known as Tabriz city center, has lost its valuable historical texture as a result of this transformation (Figure 1).

Table 1. Tabriz city development timeline history



Carvanseria Tabriz in the ancient Persian empire/ Remains of the Palace Zobeideh , Tabriz by Eugène Flandin 1851/ Tauris (Tabriz): View of the ruins of the Arg Alishah citadel/ The gate of Tabriz. Eugène Flandin 1841.

After Qajarian period (1796–1797) until nowadays

Passage Shams Tabriz (1990) Atlas Shopping Center (Contemporaray)

Figure 1. Periodic Changes in the Trade Center (Golkarian, 2021a).

In Tabriz, the city center's spatial structure has become a significant economic hub for worship and pilgrimage services. A major Tabriz city center reconstruction project was initiated in 2006, with a focus on this planning (Tash, 2006). According to the project, the areas surrounding Cuma Mosque and Erk Castle were isolated with green belts, while the rest of the old city was renovated into modern shopping malls, residential towers, and hotels. However, this urban planning approach caused harm to the city's histology and anthropology, which tarnished the identity of the bazaar structure. The bazaar is a space that replaces "historical" architecture in strategically placed artificial contexts that are purified from the visual pollution of modernity, filtered by time but isolated, and visited by the general public (Deriu et al., 2016). The concept of identity cannot be divided into economic, political, legal, or environmental development (Fakuhi, 2014). Legal identity allows people to enjoy the protection of the legal system and exercise their rights and property. As Vronskaya (2021) interprets Sokol'skii's (1912) view, cheap building is about optimization and modernization of the economy, rather than relying on self-help techniques and traditional materials. An economical building is not made out of the cheapest materials, rather it is constructed using methods that minimize surplus value and useless expenses, starting from the design stage till the end. The economic structure of a city can cause changes in the physical structure of places, which in turn can affect the dependence, harmony, and interest of people in that place. Therefore, changes in the economic structure also affect the social structure, which reflects the values of the nation. Social identity is formed by the difference between individual and united identity.

What is important in social identity is the difference between individual and united identity. It is knowing that there is a difference. Social identity emerges as a lifestyle phenomenon and is in strong demand because it reveals self-actualization and realization. Social identity is comprised of thoughts, symbols, and behavioral patterns classified in the cultural sector. It is important to recognize that identity is formed by connecting themes and ideas, and it has a strong relationship with political aspects. Political unity can be a significant factor in shaping social and national identity. Therefore, any policy change can affect the Bazaar, which is the first place to be impacted by economic changes. Such changes can create new thoughts and behaviors, leading to changes in identity and culture among its residents and customers. These changes gradually manifest in distinguishing oneself from others, preserving unity in the face of multiplicity, and ensuring continuity in the face of change.

Technology in the physical and environmental domains encompasses different aspects such as innovation, effectiveness, benefits, risks, and requirements, each having a distinctive character. The historical context of a city is a part of its cultural existence, reflecting the identity and visual values of that city, creating the common memory of its inhabitants, and showing the lifestyle of their ancestors.

The environmental spaces that define identity consist of two parts: the sum of beliefs and thoughts and social and national structures such as Historical Identity, place identity, and Cultural Identity, which influence other aspects of identity. Culture is a part of identity that develops and strengthens community and society. It leads to intellectual growth and moral and aesthetic development in society. Environmental identity gives people a boost of "self-actualization" and "self-awareness" from the natural environment but does not respond to human behavior. For instance, the Bazaar is not just a trade center but also hosts educational, political, economic, and religious issues. It is also a monument and art center for tourists. Therefore, it should not be seen as a separate environment. To ensure the sustainability of this valuable historic building, attention should be paid to its adaptive reuse, as communities have much to gain from such efforts. It is important to recognize that identity is formed by connecting themes and ideas, and it has a strong relationship with political aspects. Political unity can be a significant factor in shaping social and national identity. Therefore, any policy change can affect the Bazaar, which is the first place to be impacted by economic changes. Such changes can create new thoughts and behaviors, leading to changes in identity and culture among its residents and customers. These changes gradually manifest in distinguishing oneself from others, preserving unity in the face of multiplicity, and ensuring continuity in the face of change. Technology in the physical and environmental domains encompasses different aspects such as innovation, effectiveness, benefits, risks, and requirements, each having a distinctive character. The historical context of a city is a part of its cultural existence, reflecting the identity and visual values of that city, creating the common memory of its inhabitants, and showing the lifestyle of their ancestors. The environmental spaces that define identity consist of two parts: the sum of beliefs and thoughts and social and national structures such as Historical Identity, place identity, and Cultural Identity, which influence other aspects of identity. Culture is a part of identity that develops and strengthens community and society. It leads to intellectual growth and moral and aesthetic development in society. Environmental identity gives people a boost of "self-actualization" and "self-awareness" from the natural environment but does not respond to human behavior (Law, 1993; Ryu & Kwon, 2021). For instance, the Bazaar is not just a trade center but also hosts educational, political, economic, and religious issues. It is also a monument and art center for tourists. Therefore, it should not be seen as a separate environment. To ensure the sustainability of this valuable historic building, attention should be paid to its adaptive reuse, as communities have much to gain from such efforts (Kerr, 2004).

1.3. Applicability and Reuse of Heritage Buildings

The notion of adaptation applies to either the entire structure or to particular components within it, as posited by Douglas (2006). As per the opinion of Wilkinson (2012), the term "adaptation event" encompasses all activities linked to a specific authorization for existing buildings. Such events could range from a change in use, an addition to the structure, a renovation of a location, or an upgrade. In the case of multi-tenant properties, several such activities may coexist within the same building (Wilkinson, 2011). Building adaptation, as asserted by Langston (2010, p.5), can contribute to the economy, environment, and social welfare of society and, accordingly, should be a crucial factor to consider in terms of the availability of existing buildings (Wilkinson, 2011; Vasilache et al., 2013). Adaptive reuse is an investment strategy in real estate that arises from various conditions that render existing buildings obsolete, building adaptation is the act of transforming and enhancing the physical and economic characteristics of a building, prolonging its lifespan, and reducing the risk of redundancy, which is to say, enhancing its physical and economic qualities (Idemen et al., 2016; Langston, 2014). Adaptive reuse can significantly reduce total waste and life cycle costs, as well as increase the usefulness of historic structures (Blagojević & Tufegdžić, 2016; Rodrigues & Freire, 2017).

Buildings that have undergone three levels of rehabilitation or renovation for new purposes are called "adaptive reuse" buildings.

- These levels are "no significant change in the cultural texture,"
- "minimum impact changes,"
- "reversible changes" (Latham, 1999; ICOMOS, 2000, p.12).

Snyder (2005) asserts that the cultural and social perspective in the adaptation of industrial structures in the USA has been agreed upon, and our architectural heritage enables the maintenance of the validity of the social and cultural values reflected in historical structures for future generations. Wilkinson (2012) established the following criteria that indicate the possibility of architectural-historical buildings being sustainable: building age, adaptation trends over the years, area height and form, aesthetics, building quality, location, and several changes (Wilkinson, 2012). Continuity is the most crucial factor as comprehensive changes create a sense of loss, which contributes to the formation of a sense of identity throughout society (DETR, 2000; Lichfield, 2009).

As Rodrigues & Freire (2017) highlight, European cities often retrofit historic buildings to become multifunctional centers while preserving their historic values, reconciling historic preservation and sustainable design as a significant challenge of adaptive reuse. Furthermore, historic buildings involve myriad materials and construction techniques depending on the geographical region and construction period (Rodrigues & Freire, 2017). Tabriz Bazaar, which is a crucial edifice, contains local and natural materials such as yellow stone and red brick and traditional construction methods, depending on its geographical location. Additionally, the effects of adaptive reuse on the life cycle of Tabriz Bazaar, waste, cost reduction, and improving building functionality have been demonstrated (Bullen & Love, 2010; Rodrigues & Freire, 2017).

1.3.1. Adaptive Reuse Potential (ARP)

The Adaptive Reuse Potential (ARP) model is a tool that assesses the useful and physical life of historic buildings. It takes into account various obsolescence criteria such as physical, economic, social, functional, technological, legal, and political factors. This model helps determine the appropriate time for the building's structural evaluation, which can help increase the building's performance. Additionally, a detailed analysis can help determine the most suitable time for conservation organizations and investment (Golkarian, 2021b). The ARP model can assist in identifying the optimal time for the adaptive reuse of historic buildings and is a valuable tool for property management, Adapt-Star Model (Farjami, 2021).

1.3.2. Adapt-Star Model

According to experts in conservation science and Rodwell (2008), cultural heritage plays a crucial role in sustainable development and national identity. The ARP model, which identifies seven factors that contribute to building obsolescence, has been updated and transformed into the STAR model. This new model helps designers make more informed decisions about a building's durability, future reuse, and integration with sustainable environments. (Conejos et al., 2014) have further enhanced the ARP model by linking the seven obsolescence factors and design criteria to create an evaluation framework. This framework is presented in Table 2 and Figure 2, and it provides a comprehensive tool for evaluating a building's ability to withstand the test of time and remain relevant in today's sustainable world (Farjami& Türker, 2021).

Table 2. adaptSTAR model (Conejos et al., 2014)

Category	Criterion
Long Life (Physical)	Structural Integrity
	Material Durability
	Workmanship
	Maintainability
	Design Complexity
	Prevailing Climate
	Foundation
Location (Economic)	Population Density
	Market Proximity
	Transport Infrastructure
	Site Access
	Exposure
	Planning Constraints
	Plot Size
Loose Fit (Functional)	Flexibility
	Disassembly
	Spatial flow
	Convertibility
	Atria
	Structural Grid
	Service Ducts and Corridors
Low Energy (Technological)	Orientation
	Glazing
	Insulation and Shading
	Natural Lighting
	Natural Ventilation
	Building Management Systems
	Solar Access
Sense of Place (Social)	Image/ Identity
	Aesthetics
	Landscape/ Townscape
	History/ Authenticity
	Amenity
	Human Scale
	Neighbourhood
Quality Standard (Legal)	Standard of Finish
	Fire Protection
	Indoor Environmental Quality
	Occupational Health and Safety
	Security
	Comfort
	Disability Access
	Energy Rating
	Acoustics
Context (Political)	Adjacent Buildings
	Ecological Footprint
	Conservation
	Community Interest/ participation
	Urban Masterplan
	Zoning
	Ownership

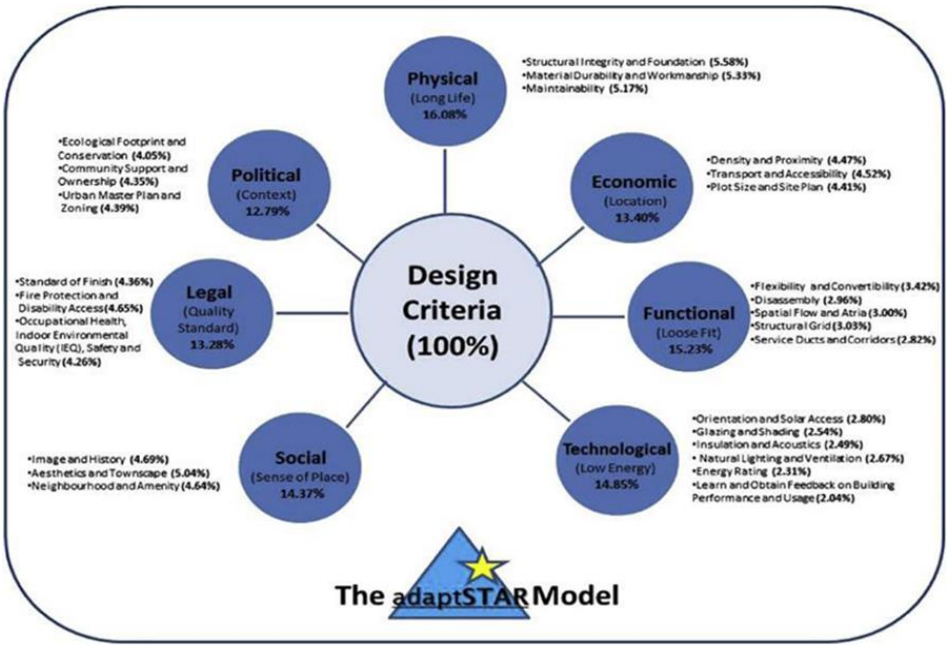


Figure 2. adaptSTAR model, (Conejos et al., 2014)

1.3.3. Preliminary Assessment of Adaptation Potential (PAAM)

In 2011, Wilkinson developed the Preliminary Assessment of Adaptation Model (PAAM) after analyzing 1237 building adaptations in the "alteration" stage in the CBD between 2009 and 2011, (Langstone et al., 2013). The PAAM analysis is based on various criteria in six different stages, as shown in Table 2. Used this well-known model to create a reliable diagram that presents the relationships between the critical key decision-making criteria and building adaptation, as shown in Table 3.

Table 3. PAAM's design principles criteria (Wilkinson, 2014)

Category	Attribute
Economic	Current value Investment value Yields Increase in value post adaptation Construction and development costs Convertibility (ease of conversion to other use and costs associated with the conversion)
Physical	Building height/number of storeys Floor plate size Shape of floor plate Service core location Elasticity (ability to extend laterally or vertically) Degree of attachment to other buildings Access to building Height of floors Structure Floor strength Distance between columns Frame Deconstruction (safe efficient and speedily) Expandability (volume and capacity) Flexibility (space planning) Technological and convertibility Dis-aggregability (reusability / recyclability)
Location and land use	Transport Access (proximity to airports, motorways, train stations, public transport nodes, buses and trams) Land uses (commercial, residential, retail and industrial or mixed use such as office and retail) Existing planning zones Rezoning potential Density of occupation
Legal	Ownership – tenure Occupation – multiple or single tenants Building codes Fire codes Access acts Health and safety issues Convertibility
Social	Community benefits – historic listing Transport noise Retention of cultural past Urban regeneration Aesthetics Provision of additional facilities / amenities Proximity to hostile factors Stigma Age
Environmental	Internal air quality Internal environment quality Existence of hazardous materials (asbestos) Sustainability issues

2. Material and Method

Tabriz market is a cultural heritage that was once the heart of the city and its first settlement point. However, with the advent of modern shopping malls, its importance has declined. This research was conducted with the aim of investigating the history of the formation of the market-oriented city from the Qajar period until now. In addition, it aims to increase the value and cultural significance of the market through logical transformation processes such as new, mixed or extended uses. As a result of the reconstruction, reconstruction and organization of the Tabriz market, it shows the importance of maintenance and reveals the changing needs of the local population. This research uses both qualitative and quantitative methods to comprehensively evaluate the adaptive reuse potential of Tabriz market.

The qualitative aspect of this study includes the collection and analysis of data on cultural heritage, restoration, and adaptive reuse. This method includes historical analysis, and literature review to understand the cultural significance of the market and its transformation over time. The selection of adaptive reuse models (ARM) is based on a theoretical research method that focuses on the historical typology of Tabriz, Iran. This approach allows for an in-depth exploration of how the market has evolved and how it is sustainably adapted for contemporary use.

The quantitative research method includes a case analysis of Tabriz's land market using the ARM research framework. This method quantifies adaptive reuse potential using specific evaluation models and certification systems.

Adaptive Reuse Models (ARM)

To evaluate the adaptive reuse potential of Tabriz market, this study uses several established models and frameworks.

Adaptive Reuse Potential (ARP): This model assesses the suitability of heritage buildings for adaptive reuse by considering factors such as structural integrity, historical value, and potential for new uses. The ARP framework helps identify buildings on the market that are most suitable for renovation and conversion.

Adapt-Star Model: The Adapt-Star model provides a systematic approach to assess and rank heritage buildings based on their adaptive reuse potential.

Preliminary Assessment of Potential for Adaptation (PAAM): The PAAM framework provides a preliminary assessment tool for assessing the feasibility of adaptive reuse projects. This includes a rapid assessment of the building's current condition, potential new functions, and the socio-economic benefits of adaptive reuse.

The application of these models is grounded in the broader framework of cultural sustainability and heritage protection.

Collection and processing of information was collected through field surveys, photographic documentation, and archival research. This included a thorough examination of the physical condition of the market, interviews with local business owners, and consultation with urban development experts.

Data analysis: Qualitative data were analyzed using thematic analysis to identify key themes and patterns related to cultural heritage and adaptive reuse. Quantitative data have been analyzed using statistical methods to assess the potential of adaptive reuse based on the criteria set by ARM. (Figure 3).

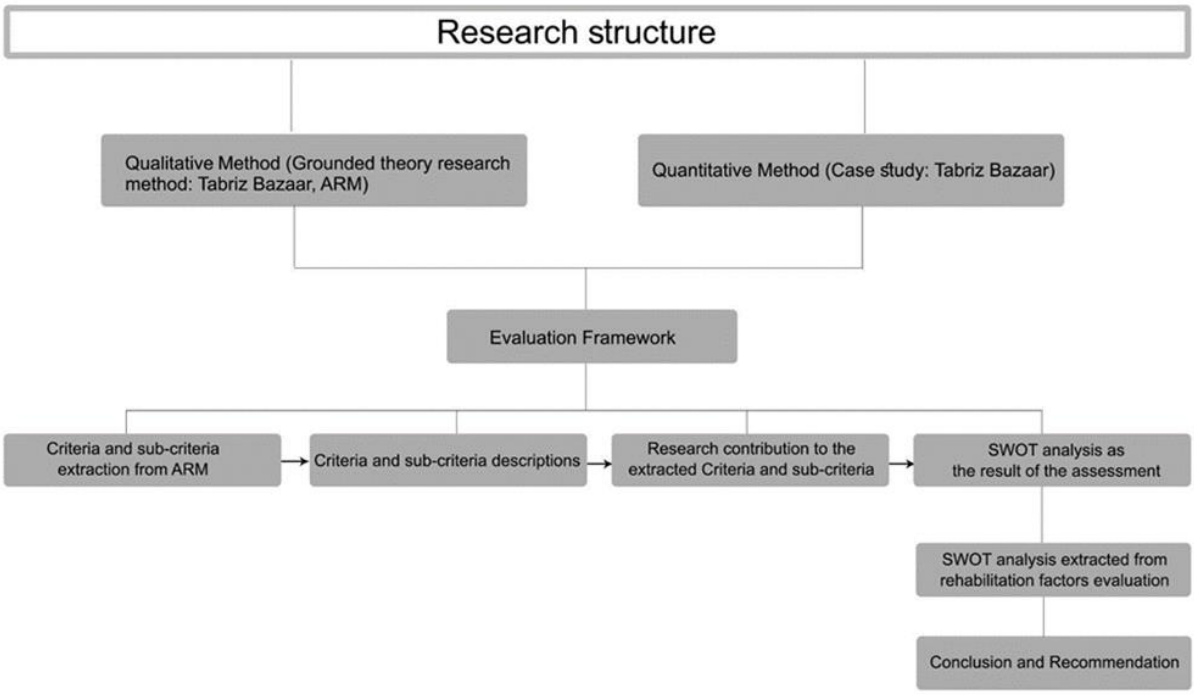


Figure 3. Article methodology structure (by author)

3. Findings and Discussion

The evaluation of Tabriz Bazaar, including its physical, economic, social, functional, technological, political, legal, and environmental improvement factors, has been discussed. The first step involved extracting criteria and sub-criteria from selected ARM systems worldwide. In the second stage, their descriptions and details were examined. Based on the research contribution to the extracted criteria and sub-criteria, the following step was reached.

Finally, a SWOT analysis was completed to evaluate the results. The ARM system was used to collect data and integrate it with the protection approach of Tabriz Bazaar. Based on the ARM system analysis, it was concluded that Tabriz Bazaar can be revitalized and improved. The study also highlights the potential of adopting ARM to revitalize heritage buildings by using strengths and opportunities as key steps. To determine if it meets the characteristics of a heritage structure (Tabriz Bazaar) among ARM's overarching criteria and sub-criteria, the rehabilitation criteria such as physical, economic, social, functional, technological, political, legal, and environmental were evaluated according to ARM sub-criteria explanations and research contributions (Table 4, Table 4a, Table 4b, Table 5, Table 5a, Table 6, Table 6a, Table 7, Table 8, Table 9, Table 10 and Table 11).

The economic criterion, which has only 13.04% of the 100% rate of the ARM system, was evaluated in each sub-criteria and given 1.44%. To measure the adaptation potential of Tabriz Bazaar, each sub-criteria was analyzed in the bazaar. As a result, the ARM criteria available in the Tabriz market were calculated as 1.44% and the total percentages were taken.

Reason for Selection: The physical condition of a heritage building is fundamental to its adaptive reuse potential. Parameters such as structural integrity, building materials, and accessibility are crucial in determining the feasibility of adaptive reuse projects. For Tabriz Bazaar, which is a historical and complex structure, evaluating these aspects ensures that any reuse plan is realistic and preserves the structural heritage.

According to the international criteria, which has only 16.08% at 100% of the ARM system, 0.85% is given to the lower values. To use the adaptation potential of Tabriz bazaar, each sub-change was analyzed in the bazaar. As a result, the ARM criteria available in the Tabriz market were calculated as 0.85% and the total percentages were taken (Table 5, Table 5a).

Table 4. Adaptive reuse model, physically

CRITERION		SUB-CRITERIA	DESCRIBING	RESEARCH CONTRIBUTIONS	CONCLUSION
ADAPTIVE REUSE MODEL CRITERIA	PHYSICAL (16.08%)	Structure (0.85%)	Issues regarding the adaptation process to protect the building structure	In the traditional Iranian city structure, the Bazaar developed in a linear manner. It serves as the backbone of the city and moves towards the foundation gates. After the 20th century, automobiles brought new usability and forms of movement to Iranian cities and made indispensable changes in the size of streets and the traditional structure of cities.	POWER AND OPPORTUNITY: As a core of the city, it establishes a connection between all parts of the city.
		Structural integrity and infrastructure (0.85%)	Strengthening the ground structure of the building with the aim of meeting different future building uses and loading scenarios - Creating the basis for potential vertical expansion of the facility and strengthening of the structure.	Advanced readiness for change is the transition from a "traditional" structure to a "modern" one with new developments and advanced materials.	STRENGTH: The imposition of preserving one's own identity against modernity. WEAKNESS: Deformation of external structures and elements due to modernity. THREAT: Losing values and self-identity under the influence of modernity.
		Floor plate size/ Typical floor area (2.68%)	It is useful to have this information for adaptive reuse to introduce new functions.	The floors generally consist of soil that flattens over time. The shops should have been no more than three meters wide, which would have been sufficient for the craftsmen to attend to their business and put most of their products for sale within easy reach. The floor is usually raised 2 or 3 feet above ground level.	WEAKNESS: Due to narrow corridors, there is insufficient space for traders.
		Location of service core (0.85%)	Not making any changes to the main service location may be effective in the adaptation of the heritage building.	Dokkans as interactive spaces, rastes as main communication arteries, saras as the main bodies of the Bazaar and timçes as public spaces actively contribute to urban life.	STRENGTH: Dokkans as interactive spaces, rastes as main communication arteries, saras as the main bodies of the Bazaar, and timçes as public spaces actively contribute to urban life.
		Flexibility (0.85%)	Ease of extending the building laterally or vertically. Other characteristics of flexibility are building form, organizational space and ease of compartmentalization. (ability to extend laterally or vertically)	This Bazaar has improved the quality of space by connecting residential and commercial areas and encouraged social interactions, making the public's public activities tightly connected to the Bazaar.	STRENGTH: Social interactions are encouraged by connecting residential and commercial areas of the context.
		Material durability and workmanship (0.85%)	The more durable materials used, the longer the life of the building.	Tabriz Bazaar is generally made of red brick and yellow stone piles and is built with a wooden structure ceiling and roof system.	STRENGTH: Using red brick and yellow stone piles as durable materials.

Table 4a. Adaptive reuse model, physically

CRITERION		SUB-CRITERIA	DESCRIBING	RESEARCH CONTRIBUTIONS	CONCLUSION
ADAPTIVE REUSE MODEL CRITERIA	PHYSICAL (16.08%)	Degree of connection to other buildings (0.85%)	Degree of connection to other neighboring buildings and access to the site	Residential neighborhoods are located in the spaces between the city gates and the markets.	STRENGTH: Market's dominance in the surrounding area OPPORTUNITY: Easy accessibility to surrounding buildings.
		Building access / Site access (0.85%)	Access to buildings and regulations in building design.	The market route usually starts from the main gate of the city and ends in the city center, sometimes extending to the side gate of the city. The existence of a network of different connecting roads within the bazaar and the ability of passers-by and citizens to use them helped the bazaar to continue its expansion (Figure 5.21). Crossovers often connect the city center to roads around and outside the city. (Figure 5.20).	STRENGTH: Raste and Corridors connect the doors of the Bazaar in the interior. WEAKNESS: Due to the lack of traffic in space, wide and pedestrian roads, it is difficult for passers-by to reach the market.
		Height of floors (0.85%)	No description	The floor is usually raised 2 or 3 feet above ground level and is regularly raised towards the road with a seat. The first floor is always used for commercial purposes, while the second floor is used as the main warehouse or accounting office and private business meetings.	STRENGTH: Light load-bearing structure. OPPORTUNITY: It is economical and advantageous in terms of material usage during restoration.
		Soil strength (0.85%)	In adaptation, soil strength should be evaluated to determine land uses that are possible and physically compatible with the existing ground structure.	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Design complexity (0.85%)	This element consists of various geometries associated with the design and innovation of the building.	The main structure of the Bazaar consisted of covered passages with many shops on both sides. Each of the passages and corridors was devoted to the display of a particular commodity. For this reason, various sections of the Bazaar were named according to the items displayed one after the other. The largest area in the traditional market is Timcheh, which has the most ornate ceiling; decorations are usually made of brick or wood with geometric elements. These areas are generally safe areas where more valuable items, such as floor coverings, are stored and displayed, away from sun and wind damage.	OPPORTUNITY: Methods and materials can be used for future generations.
		Labor (0.85%)	It is related to the quality of workmanship applied to the structure and coatings of the building.	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.

Table 4b. Adaptive reuse model, physically

CRITERION		SUB-CRITERIA	DESCRIBING	RESEARCH CONTRIBUTIONS	CONCLUSION
ADAPTIVE REUSE MODEL CRITERIA	PHYSICAL (16.08%)	Prevailing climate (0.85%)	It deals with design according to changing climate conditions, determining appropriate solutions for hot or cold temperature zones.	Tabriz bazaar has a brick system and is more than one kilometer long. It is designed to be climate sensitive. The dome is used to heat the building during the very cold winter months and hot summer months. In general, the building material is mainly brick and stone, as the brick vault acts as a high thermal mass element for heat saving. The main advantage of this material is to produce a thermal "envelope" that helps control temperature.	STRENGTH: Durable materials and elements were used in the interior and exterior of the bazaar for thermal control and sustainability.
		Deconstruction (Efficient assurance and speed) (0.85%)	In the adaptation process of heritage buildings, the basis is related to the preservation of existing materials and main texture structure.	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Extensibility (0.85%)	Expanding the volume and capacity of the building.	As an exception, the Tabriz bazaar connected the northern and southern parts of the city by forming a Pol-Bazar that crossed the Mehran Road River along its main axes.	STRENGTH: The line plan shape, which is a backbone of the city, can be extended from the North and South. OPPORTUNITY: It can grow and spread into the surrounding area by providing new roads and access.
		Flexibility (space planning) (0.85%)	It focuses on the potential of an existing building with flexibility in planning for new uses during the adaptation process.	Construction type: Special high-flexibility moment-resisting frame construction system with high resistance to earthquakes, reinforced concrete complex structures and stone structures.	STRENGTH: The line plan shape, which is a backbone of the city, can be extended from the North and South. OPPORTUNITY: It can grow and spread into the surrounding area by providing new roads and access.
		Technological and convertibility (0.85%)	This element attempts to introduce adaptive reuse technology based on the recyclability potential of existing buildings.	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Sustainability (0.85%)	This element addresses issues of improving building performance throughout its life, where maintenance characteristics are defined as a building's ability to maintain operational resources.	The strategies written by the researchers will certainly help heritage conservation authorities move towards a context-driven sustainable conservation system for the Tabriz Bazaar world heritage site.	OPPORTUNITY: It will be useful for the future adaptation process.
		Dispute (0.85%)	Reusability/recyclability	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.

Table 5. Adaptive reuse model, Economic criteria

CRITERION		SUB-CRITERIA	DESCRIBING	RESEARCH CONTRIBUTIONS	RESULT
ADAPTIVE REUSE MODEL CRITERIA	ECONOMIC (13.04%)	Population density (1.44%)	"Population Density-location within major city, CBD, etc. Operational land use issues include density.	Shops have been established on both sides of the street and sidewalk with an excellent opportunity for population density residents and pedestrian traffic, and gradually an excellent opportunity has developed in some streets of the commercial boom and are shaped b passages. (Figure 5.22)	STRENGTH:Pedestrian design is designed according to population density.
		Occupational density (1.44%)	In addition to improving economic sustainability, it increases the density of the built environment to prevent erosion of green belt land within and around the existing area.	The two most important sources of changes in the old texture of the city of Tabriz are modernization and economic gains. The transition from tradition to modernity has led to a comprehensive urban transformation in the city center of Tabriz. Accordingly, the spatial structure of Tabriz city center has become a strong economic marke for traveler services. Later, a massive reconstruction project of downtown Tabriz began to detail such planning. According to this planning project, the surroundings of the Jame Mosque and its arc will be isolated with a green belt, and the rest of the old quarter will be converted into some modern shopping malls, hotels and residential towers.	WEAKNESS: This criterion presents a weak point that should be taken into account by experts and conservators in the adaptation process of Taberiz Bazzar.
		Productivity/Income (1.44%)	It focuses specifically on distinctiveness as a cultural value, through its historical or aesthetic significance and the cultural experiences it provides for the community.	In traditional markets, the light that enters the market through the skylights and follows it on the floor is meaningful to the traction an transport customers and encourages them to move forward. In the traditional bazaar, the light falling on the floor is indispensable for its rotation, which increases the visual appeal of the bazaar.	STRENGTH: The arcade benefits from natural light and ventilation from the skylight.
		Current value (1.44%)	It may be related to the current value of the heritage structure and contribute to the process of adaptive reuse.	The most moral and spiritual unity in Iranian history belonged to the Safavid period. Characteristic values of Eastern societies such as bravery, philanthropy, protecting the lower class, and sainthood are known as Craftsman culture. Tabriz is a place frequented by many people every year due to its historical values. The presence of a Cemevi mosque for Shiite Muslims in the city center of Tabriz is the main reason for the development of this city.	STRENGTH: Historical value still continues in the Bazaar due to certain characteristic aspects. Opportunity: Over time, through the process of reuse, historical values will be transferred to the nev generation.

Table 5a. Adaptive reuse model, Economic criteria

CRITERION		SUB-CRITERIA	DESCRIBING	RESEARCH CONTRIBUTIONS	RESULT
ADAPTIVE REUSE MODEL CRITERIA	ECONOMIC (13.04%)	Transportation and accessibility (1.44%)	Uyum sürecindeki ekonomik soruna bağlı olarak, diğer komşu binalarla olan bağlantı derecesi ve tarihi binaların ana caddeden sahaya erişim ile ilgilidir.	"FIGURE 5.21 In this Region, Most of the access roads are local and pedestrian-dominated main roads. ".	STRENGTH: The presence of some functional elements such as shortcuts and comforting items for customers and sellers in the Bazaar.
		Plot size and layout (1.44%)	Arsa boyutu – inşa edilen alan, mekansal oranlar, çevreleme vb.	The Bazaar has some stall areas such as platforms that help customers stop and relax during their short shopping; These spaces shorten the long journey to the market. Rates are also impressive things in a traditional market. Bazaar plans and manufacturing procedures are considered from the perspective of climate reaction. In the traditional Tabriz bazaar of Tabriz, the shops are only enough for the seller and only one person can fit in and display their produc easily. The buyer must stand outside the store, and at the same time, it will be difficult for pedestrians to cross the street if the store is full.	STRENGTH: The presence of some functional elements, such as shortcuts, that are comforting for customers and sellers in the Bazaar. OPPORTUNITY: Thanks to the construction of the market plan and production procedures based on climate reaction, it will be easy to adopt sustainability and recyclability. WEAKNESS: Lack of space for passers-by makes i difficult for them to cross the road, and sellers even lose a few customers because of it.
		Value increase after adaptation (1.44%)	Adaptasyon sürecinde tarihi değerin korunmasına yönelik hususlar içerir.	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Convertibility (1.44%)	Başka bir kullanıma dönüştürme kolaylığı ve dönüştürmeyle ilişkili maliyetler sağlar.	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Exposure (1.44%)	Riske maruz kalma, bir duyarlılık testi şeklidir. Her eskime oranı olası bir aralık olarak ifade edilir.	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.

Reason for Selection: Economic viability is essential for sustainable adaptive reuse. Parameters like population density, economic productivity, and market potential are critical for ensuring that the reused structure can generate economic benefits and support local development. For Tabriz Bazaar, understanding its economic impact helps in planning for a functional and financially sustainable future.

According to the Social criteria, which has only 14.37% at 100% of the ARM system, the lower values are given 1.1%. To use the adaptation potential of Tabriz bazaar, each sub-change was analyzed in the bazaar. As a result, the ARM criteria available in the Tabriz market were calculated as 1.1% and the total percentages were taken (Table 6).

Reason for Selection: The social value of a heritage building relates to its role in community identity, culture, and cohesion. Evaluating social criteria ensures that the reuse plan will enhance social benefits, including community engagement and cultural preservation. For Tabriz Bazaar, social criteria help in understanding its role in community identity and social interaction.

Looking at the Functional criterion, which has only 15.23% of the 100% rate of the ARM system, each sub-criteria is given 3.04%. To measure the adaptation potential of Tabriz bazaar, each sub-criteria was analyzed in the bazaar. As a result, the ARM criteria available in the Tabriz market were calculated as 3.04% and the total percentages were taken. (Table 7)

Reason for Selection: Functional adaptability is key to the successful reuse of heritage buildings. Parameters such as transformability, flexibility, and suitability for new functions are critical. For Tabriz Bazaar, assessing functional criteria ensures that the bazaar can accommodate new uses while preserving its historical essence.

Looking at the Technological criterion, which has only 14.85% of the 100% rate of the ARM system, each sub-criteria is given 2.47%. To measure the adaptation potential of Tabriz bazaar, each sub-criteria was analyzed in the bazaar. As a result, the ARM criteria available in the Tabriz market were calculated as 2.47% and the total percentages were taken (Table 8).

Reason for Selection: Technological advancements can enhance the usability and sustainability of heritage buildings. Parameters like technological infrastructure, energy efficiency, and modern amenities are important. For Tabriz Bazaar, technological criteria help in planning upgrades that respect historical integrity while meeting contemporary needs.

Looking at the Political criterion, which has only 12.79% of the 100% rate of the ARM system, each sub-criteria is given 2.13%. To measure the adaptation potential of Tabriz bazaar, each sub-criteria was analyzed in the bazaar. As a result, the ARM criteria available in the Tabriz market were calculated as 2.13% and the total percentages were taken (Table 9)

Table 6. Adaptive reuse model, Social criteria

CRITERION		SUB-CRITERIA	DESCRIBING	RESEARCH CONTRIBUTIONS	CONCLUSION
ADAPTIVE REUSE MODEL CRITERIA	**SOCIAL (14.37%)**	Community benefits – historical listing (1.1%)	Buildings must meet the needs of users and the wider community.	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Density of valuable cultural resources in the environment / Historical listing (%1.1.)	Typically, buildings or places must be of cultural or historical significance and/or be included on the Heritage Register and/or the World Heritage List.	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Image and identity/ Image and history (1.1%)	Social and cultural qualities, values, etc.	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Transport noise (1.1%)	In general, various types of noise can have disadvantages for the life cycle of historic buildings.	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Preservation of cultural past (1.1%)	Taking into account the past cultural history of heritage buildings is one of the key factors during adaptation.	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Aesthetics and landscape/City view (1.1%)	Aesthetics were important in adaptation and were evaluated based on mass, form, composition, use of materials, and so on.	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		History/ Authenticity (1.1%)	Original fabric, timelessness, socio-cultural traditions, practices, historic character or fabric, etc.	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.

Table 6a. Adaptive reuse model, Social criteria

CRITERION		SUB-CRITERIA	DESCRIBING	RESEARCH CONTRIBUTIONS	CONCLUSION
ADAPTIVE REUSE MODEL CRITERIA	**SOCIAL (14.37%)**	Urban transformation (1.1%)	Buildings occupying prime areas are considered ripe for urban renewal and redevelopment. Heritage capital adaptation can support urban regeneration in older areas.	The Tabriz bazaar has various components that serve different functions. Each component plays a specific economic and social role in an urban generation."	STRENGTH: The urban generation is influenced by the social and economic roles of the Tabriz market.
		Neighborhood and convenience (1.1%)	The transformability and expandability of individual buildings will help old neighborhoods modernize and adapt to new urban growth patterns with less social and economic disruption.	Residential neighborhoods are located in the spaces between the city gates and the markets.	STRENGTH: The strong bond between the bazaar and the surrounding neighbors. THREAT: Surrounding neighborhoods may be affected after improper renovation of the main center; Bazaar.
		Providing additional facilities/amenities (1.1%)	The building provides relevant amenities and facilities within its neighborhood that can add value to the local community.	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Proximity to hostile factors (1.1%)	Proximity to hostile factors or aesthetics includes noise, odor, pollution, proximity to power plant	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Stigma (1.1%)	Stigma	The bazaar lost its importance over time, was destroyed over time due to lack of restoration and mostly not being used by the public, and new activities could not be carried out in the bazaar. In order for the Tabriz bazaar to have a lively, dynamic and busy structure, it must be usable by everyone."	WEAKNESS: lack of restoration and useless to everyone. THE THREAT: losing one's worth and one's own identity.
		Age (1.1%)	Building Age	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.

Table 7. Adaptive reuse model, Functional criteria

	CRITERION		SUB-CRITERIA	DESCRIBING	RESEARCH CONTRIBUTIONS
ADAPTIVE REUSE MODEL CRITERIA	FUNCTIONAL (15.23%)	Flexibility and convertibility (3.04%)	Functionally and technologically, the building has the potential for internal flexibility and reversibility for future transformation.	The shape of an Islamic Iranian city offers the city's stability, protection, identity, originality and meaning. Arq and Baro (Fortress) - Jame Masjid (Mosque) Bazaar - Residential areas and neighborhoods - Historical heritage such as the street network, exterior views and commercial buildings in the Bazaar have created a coherent, interconnected and compact area in the city.	STRENGTH: The form and stable characteristic aspects of the Islamic bazaar can be durable in the transformation process. WEAKNESS: During the conversion process, the arcade is durable but lacks flexibility.
		Disassembly (3.04%)	It has reuse, recycling, disassembled systems and modularity options.	Her yıl, ülkenin kültürel miras organizasyonu, bu güzel eski kompleksin restorasyonu ve yeniden canlandırılması için devlet bütçesinden ve tüccarların mali yardımından önemli miktarda fon harcıyor. Yenileme için ise geri dönüşümlü inşaat malzemeleri restorasyon	STRENGTH: Savings in energy and material usage. OPPORTUNITY: Heritage durability due to restoration
		Spatial flow and atrium (3.04%)	Spatial flow – mobility, open plan, fluid and continuous 5 Convertibility – divisibility, flexibility, multifunctionality. Atria – open spaces, interior gardens etc.	Some historical Jame' mosques in the city take the form that part of their open space or courtyard is on the route of the cities, and people enter through the entrance and exit through the side door after passing the mosque's courtyard. A Rasteh is also found near manufacturing workshops and a number of workshops and shops, sometimes occurring in a lane or in an open area.	STRENGTH: The existence of open spaces and the interconnection of spaces provide ease of orientation and circulation.
		Structural grid (3.04%)	The ideal and economic spread is limited and liable to change completely.	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Service channels and corridors (3.04%)	Vertical circulation, service elements, raised floors, etc.	The first floor was always used for business and commercial purposes, while the second floor was the main warehouse or accounting office and a place for private business meetings. While the first floor rooms were used for daytime activities and storage at night, the upper rooms were for shelter, rental and heating with stoves. Some houses had stalls for caravans.	STRENGTH: The floors on the base are clearly separated, accurate and clear, and each unit has its own function.

Table 8. Adaptive reuse model, Technological criteria

	CRITERION		SUB-CRITERIA	DESCRIBING	RESEARCH CONTRIBUTIONS
ADAPTIVE REUSE MODEL CRITERIA	TECHNOLOGICAL (14.85%)	Orientation and sun access (2.47%)	Micro-climate siting, prevailing winds, sunlight and Solar access-measures for summer and winter sun	Heat control materials, structures and openings were used in the bazaar.	STRENGTH: Heat control materials and structures, openings were used in the bazaar.
		Glass and shading (2.47%)	Glazing: sunlight glare control, regulation of internal temperatures, etc. shading – thermal mass, sunshades, automated blinds, etc.	Bazaar domes are the light coming from the dome inside the bazaar. The application of light in most traditional monuments depends on components such as the spiritual dimension and sanctity of light, light adjustment and consistency, temperature control and energy storage in proportion to climatic conditions. In Persian architecture, the hierarchy of darkness and light	STRENGTH: Adequate thermal control elements such as domes and skylights on the roof. The presence of openings for ventilation and air circulation.
		Insulation and Acoustics (2.47%)	noise control, sound insulation, etc.	The lack of parking areas around the bazaar, which increases the risk of traffic accidents, also causes excessive air and noise pollution.	STRENGTH: Presence of noise and gas pollution control systems in the interior of the bazaar. WEAKNESS Lack of indoor noise and gas pollution control systems. THREAT: Lack of parking spaces in the surrounding area increases the risk of accidents.
		Natural lighting and ventilation (2.47%)	Natural lighting – inclusion for natural daylight, efficient lighting systems, etc. Natural ventilation – optimize airflow, quality fresh air, increase ambient air intake, etc.	"Natural light can penetrate the interior through skylights, which can also provide natural ventilation. Entrances and heights have been reduced and openings have been minimized to prevent heat wastage of the environment. Therefore, the structural system and scale of the Bazaar block were chosen according to the regional situation and local masonry to fulfill the spatial and architectural values.	STRENGTH: To provide energy saving and a healthy environment with a sustainable approach.
		Energy rating (2.47%)	Energy rating – environmental performance measures	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Feedback on building performance and usage (2.47%)	Taking feedback about the adaptation reuse from the projection users stakeholders, etc.	Tabriz Historical Bazaar has offered different functions to many stakeholders throughout history.	STRENGTH: Bazaar offers flexible options to capture feedback from stakeholders and conservators on the renovation process. OPPORTUNITY: Feedback from stakeholders and guardians can be updated according to future technology.

Table 9. Adaptive reuse model, political criteria

	CRITERION		SUB-CRITERIA	DESCRIBING	RESEARCH CONTRIBUTIONS
ADAPTIVE REUSE MODEL CRITERIA	POLITICAL (12.79%)	Ecological footprint and protection (2.13%)	Ecological footprint – human carrying capacity and conservation, including the principles, guidelines and conventions governing the conservation of tangible and intangible heritage	Government and military centres: The relationship of the bazaars with the government and power has always been full of contradictions; In fact, constant interaction and conflict have fostered this contradictory relationship, socio-political security and stability that are prerequisites for commercial and economic prosperity.	STRENGTH: The relationship between the bazaar and government and administrative power creates security and stability.
		Community interest/participation (2.13%)	Community interest/participation: stakeholder engagement and support	"The marketplace was a place that centralized the interconnected interests of different stakeholder groups. "As the center of international commercial and cultural exchange, bazaars have played an important role in the social and economic development of the region."	STRENGTH: Bazaar offers flexible options to capture feedback from stakeholders and conservators on the renovation process. OPPORTUNITY: Feedback from stakeholders and guardians can be updated according to future technology.
		Community Support and Ownership (2.13%)	Ownership – commitment to collaboration, sense of community or ownership, etc. Community support: stakeholder engagement and support	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Urban master plan and zoning / Urban transformation (2.13%)	Adapting buildings to urban regeneration projects provides social objectives such as affordable (or social) housing or employment opportunities in areas with high unemployment.	Standard negotiation with the legitimate Bazaar, trusted among other factions in the Bazaar. Capacity building in the education and advancement of young people working in Çarşı, (These young people, who are mostly relatives and sons of Çarşı, have owned commercial places in Çarşı for a long time.)	STRENGTH: Urban transformation had some kind of social and economic dynamic, so it has more impact on it.
		Redevelopment potential (2.13%)	No description	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Zoning (2.13%)	The municipal policy and zoning plan regarding the area where the building is located are taken into account.	During the Qajar period (1794–1924), the interaction of these dynastic rulers with Western countries and the inspiration they drew from the Industrial Revolution was the abandonment of old patterns and the use of new methods. With integration into the world economy, local markets disappeared and political and financial dependence on foreign governments began. All these components led to citywide functional zoning. The development of new functions such as roads and streets with different functions, a variety of architecture, modernism, government offices and the bourgeois class were characteristic of this period."	STRENGTH: The strong bond and connection between the bazaar and the state causes the development of the bazaar area to be seriously considered.

Reason for Selection: Political support and legal frameworks are crucial for the success of adaptive reuse projects. Parameters such as governmental policies, political stability, and legal protections influence the feasibility and implementation of reuse plans. For Tabriz Bazaar, political criteria ensure alignment with local and national heritage conservation policies.

Looking at the Legal/Zoning criterion, which has only 13.28% of the 100% rate of the ARM system, each sub-criteria is given 2.21%. To measure the adaptation potential of Tabriz bazaar, each sub-criteria was analyzed in the bazaar. As a result, the ARM criteria available in the Tabriz market were calculated as 2.21% and the total percentages were taken (Table 10).

Reason for Selection: Legal and zoning regulations directly affect the possibilities for adaptive reuse. Parameters like zoning laws, heritage protection regulations, and legal incentives are critical for compliance and feasibility. For Tabriz Bazaar, legal criteria ensure that the reuse plan adheres to relevant laws and maximizes legal benefits.

Based on the analysis of this study, the adaptation of the bazaar was made according to sustainability approaches, but sustainability criteria were not evaluated by the Adaptstar system. Considering the Environmental criterion, which has only 0.00% of the 100% rate of the ARM system, it is divided into 4 main sub-criteria, without each sub-criteria being in the ARM system. When the mentioned criteria were analyzed to measure the adaptation potential of Tabriz Bazaar, it was found that Tabriz Bazaar has a high degree of sustainability, which means that Tabriz Bazaar will adapt to sustainable adaptation. Therefore, it should be known as a missing criterion that should be taken into consideration for the upgraded version of new models (Table 11).

Table 10. Adaptive reuse model, Legal criteria

	CRITERION		SUB-CRITERIA	DESCRIBING	RESEARCH CONTRIBUTIONS
ADAPTIVE REUSE MODEL CRITERIA	LEGAL (%13.28)	Finishing standard (2.21%)	Standard of finish – ensuring a high standard of workmanship	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Fire protection and disabled access/Fire codes (2.21%)	Fire protection – provisions for fire safety	There is no quick access to outdoor parts of the bazaar in times of potential hazards such as a fire.	WEAKNESS: Encounter life-threatening THREAT: Encounter life-threatening
		Occupational health, IEQ, safety and Security (2.21%)	"Occupational health and safety – specific needs of building occupants, health and safety risks, building hazards and risk management plans. Non-hazardous materials, natural fabrics, etc. IEQ provisions for. Security - ensuring direct and passive surveillance designs"	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Convertibility (2.21%)	Convertibility – diversity, flexibility, multifunctionality	Most of the stores are used multifunctional and each floor has different functions. The caravanserais in the bazaar gave their current location to	STRENGTH: The existence of multifunctionality.
		Energy rating (2.21%)	Energy rating – environmental performance measures	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Acoustic (2.21%)	Acoustics – noise pollution control, sound insulation, etc.	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.

Table 11. Adaptive reuse model, environmental criteria

	CRITERION		SUB-CRITERIA	DESCRIBING	RESEARCH CONTRIBUTIONS
ADAPTIVE REUSE MODEL CRITERIA	ENVIRONMENTAL	"Indoor air quality	Indoor air quality should be considered as an ecological sustainability factor for the adaptation of historic buildings, as some ventilation devices may have a negative impact.	OPPORTUNITY: The method used may be useful for upcoming sustainable technology.	STRENGTH: Dome and roof openings are natural ventilation systems.
		"Indoor environmental quality	Indoor environmental quality requires special considerations in the adaptation of historical buildings in order to choose appropriate means not to destroy the HB valu	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		Presence of hazardous materials (asbestos)	This article addresses the specific concern for the types of hazardous materials present in HB and attempts to find a solution to eliminate asbestos.	MISSING CRITERIA	Missing criteria exist in adaptive reuse models that do not work in the marketplace research domain.
		sustainability issues	Buildings are inextricably linked to sustainability issues, and the construction environment as buildings contributes approximately half of all greenhouse gas emissions.	"The application of light depends on components such as spiritual dimension and light sanctity, light adjustment and consistency, temperature control and energy storage in proportion to climatic conditions. In Persian architecture, the hierarchy of darkness and light is used to coordinate and orient from one space to another and to indicate time. Courtyards are known as climate changers and allow indoor-outdoor activities to protect the building from dust, sun and wind. Courtyards serve as light sources in a building type that must limit exterior openings. "They also act as air gaps through absorbers of cold, dense night air, and fresh morning and post-rain air enters the building through large openings into the courtyards from the surrounding areas."	STRENGTH: All the elements and materials used in the bazaar are part of sustainability, and all these mentioned aspects help ventilate the environment and purify it from pollution.

Reason for Selection: Environmental sustainability is vital for the long-term success of adaptive reuse projects. Parameters such as energy efficiency, environmental impact, and sustainability practices are important. For Tabriz Bazaar, environmental criteria ensure that the reuse plan contributes to environmental sustainability.

The assessment of a building requires the evaluation of various criteria. These criteria include physical aspects such as the building's structure, materials, accessibility, and technological advancements. Additionally, the ecological status of the building is considered. Economic criteria include population density, diversity, productivity, and the design and exposure of the built environment. Social criteria involve the evaluation of factors such as stigma, age, neighborhood, identity, and culture. The

transformability, flexibility, and insulation of the building are evaluated in functional and technological criteria. Legal and political aspects, environmental sustainability, and energy rating are considered in the final chapters of the analysis. If the common features of the bazaar match with the sub-criteria of the ARM, the revival process for the bazaar harmony can be predicted. If the comparative livability study lacks sufficient criteria and sub-criteria, the bazaar must be revised according to interrelated features to ensure the continuity of the importance of the heritage. The preservation of heritage structures is achieved by integrating sustainable plans and preserving their historical values and originality.

4. Conclusion and Suggestions

In the field of Heritage Building (HB), the preservation, appropriate modification, and development of previous expressions are emphasized to identify cultural heritage values and transfer them to future generations. Therefore, determining the historical value is a crucial component of renewal processes, (Ashworth, 1997). Several studies and improvement systems for the sustainability of historical buildings have been proposed worldwide for the protection of historical monuments. This study focuses on the Tabriz Bazaar ARM method as a rehabilitation and revitalization method for one of the most important heritage structures in Tabriz City, (Table 12, 12a, 12b). To analyze the compatibility potential based on the ARM calculation system, the ARM system's evaluation was carried out to measure the adaptation potential of Tabriz Bazaar. The ARM system consists of criteria and sub-criteria, and each criterion is designed according to value percentages. The research applied and evaluated the ARM system's criteria percentages in Tabriz Bazaar by comparing the market's factors with the ARM criteria. The percentage of suitability is considered a positive side (Strength and Opportunity), and the percentage of defect is considered a negative side (Weakness and Danger). Based on the SWOT analysis, the Bazaar's success in the adaptation process is shown as strengths and opportunities with 53.8% and weaknesses and threats with 47%.

Strengths: Architectural significance, historical value, central location, community identity.

Weaknesses: Structural vulnerabilities, outdated infrastructure, economic challenges.

Opportunities: Potential for tourism, economic revitalization, and community engagement.

Threats: Political instability, legal restrictions, environmental degradation.

The concepts of globalization and modern architecture have influenced the architecture and urban planning of traditional bazaars, which were designed to reflect their local identity. Tabriz, one of the oldest cities on the historical Silk Road in Iran, has undergone cultural changes that have affected its Tabriz Bazaar, an objective symbol of traditional and semi-traditional architecture. While modern shopping malls have replaced some traditional bazaars, others can coexist in the same atmosphere. Yet, traditional bazaars in big cities do not meet people's psychological needs, shifting the architectural culture towards semi-modern and modern. To revitalize and rehabilitate Tabriz Bazaar, sub-criteria were reviewed based on age level and suitability to Tabriz Bazaar's identity. The main purpose of the rehabilitation process is to protect heritage buildings for future generations. ARM criteria and sub-criteria align with many of the arcade's features, providing an opportunity for adaptive reuse and revitalization. However, features that do not meet sufficient criteria will be considered suggestions, and a revitalization procedure with solutions for these inadequate features is essential. Traffic problems and lack of access points to the city center may cause a significant decrease in the number of visitors.

Table 12. SWOT Analysis extracted from ARM systems according to their suitability for Tabriz Bazaar identity

	CRITERIA		SUB-CRITERIA	MISSING SUB-CRITERIA
SWOT ANALYSIS OBTAINED FROM ARM SYSTEM	PHYSICALLY	STRENGTH	*PHYSICAL: STRUCTURE - 0.85% *PHYSICAL: STRUCTURAL INTEGRITY AND FOUNDATION - 0.85% *PHYSICAL: SERVICE BASIC LOCATION- 0.85% *PHYSICAL: FLEXIBILITY- 0.85% *PHYSICAL: MATERIAL DURABILITY AND WORKMANSHIP-0.85% *PHYSICAL: DEGREE OF CONNECTION TO OTHER BUILDINGS-0.85% *PHYSICAL: ACCESS TO THE BUILDING/ ACCESS TO THE SITE-0.85% *PHYSICAL: FLOOR HEIGHT - 0.85% *PHYSICAL: DOMINANT CLIMATE- 0.85% *PHYSICAL: EXPANDABILITY- 0.85% *PHYSICAL: FLEXIBILITY SPACE PLANNING- 0.85%	
	ECONOMIC		*ECONOMIC: POPULATION DENSITY - 1.44% *ECONOMIC: INCOME- 1.44% *ECONOMIC: CURRENT VALUE - 1.44% *ECONOMIC: TRANSPORTATION AND ACCESSIBILITY- 1.44% *ECONOMIC: PLOT SIZE AND SITE PLAN - 1.44%"	
	SOCIAL		*SOCIAL: URBAN TRANSFORMATION- 1.1% *SOCIAL: NEIGHBORHOOD AND BEAUTY- 1.1%	
	FUNCTIONAL		*FUNCTIONAL: FLEXIBILITY AND CONVERTIBILITY - 3.04% *FUNCTIONAL: DISASSEMBLY- 3.04% *FUNCTIONAL: SPATIAL FLOW AND ATRIA- 3.04% *FUNCTIONAL: SERVICE AND CORRIDORS- 3.04%	
	TECHNOLOGICAL		*TECHNOLOGICAL: ORIENTATION AND SOLAR ACCESS - 2.47% *TECHNOLOGICAL: INSULATION AND ACOUSTICS- 2.47% *TECHNOLOGICAL: NATURAL LIGHT AND VENTILATION- 2.47% *TECHNOLOGICAL: FEEDBACK ON BUILDING PERFORMANCE-2.47% *TECHNOLOGICAL: GLAZING AND SHADING - 2.47%	
	POLITICAL		*POLİTİK: EKOLOJİK AYAK İZİ VE KORUMA-**2.13%** *POLİTİK: TOPLUM ÇIKARLARI/ KATILIM- **2.13%** *POLİTİK: İMAR- **2.13%**	
	LEGAL		*LEGAL: CONVERTIBILITY - 2.22%	
	ENVIRONMENTAL		*ENVIRONMENT: INDOOR AIR QUALITY - NC* *ENVIRONMENT: SUSTAINABILITY ISSUES - NC*	

Table 12a. SWOT Analysis extracted from ARM systems according to their suitability for Tabriz Bazaar identity

	CRITERIA		SUB-CRITERIA	MISSING SUB-CRITERIA
SWOT ANALYSIS OBTAINED FROM ARM SYSTEM	PHYSICALLY	WEAKNESS	*PHYSICAL: STRUCTURAL INTEGRITY AND FOUNDATION* *PHYSICAL: FLOOR PLATE DIMENSION/ TYPICAL FLOOR AREA* *PHYSICAL: ACCESS TO THE BUILDING/ ACCESS TO THE SITE* *PHYSICAL: FLAT FLOOR- NA*	*PHYSICAL: WORKMANSHIP *PHYSICAL: RECONSTRUCTION (SAFE, EFFICIENT AND FAST) *PHYSICAL: TECHNOLOGICAL AND CHANGEABILITY *PHYSICAL: INCOMPATIBILITY*
	ECONOMIC		*ECONOMIC: VOCATIONAL INTENSITY - NA* *ECONOMIC: EFFICIENCY* *ECONOMIC: PLOT SIZE AND SITE PLAN*	*ECONOMIC: INCREASE IN VALUE AFTER ADAPTATION *ECONOMIC: CONVERBABILITY *ECONOMIC: EXPOSURE
	SOCIAL		*SOCIAL:STIGMA-NA*	*SOCIAL: SOCIETY BENEFITS / HISTORICAL LIST *SOCIAL: DENSITY OF VALUABLE CULTURAL RESOURCES IN THE SURROUNDING / HISTORICAL LISTING *SOCIAL: IMAGE AND IDENTITY / IMAGE IN HISTORY *SOCIAL: TRANSPORTATION NOISE *SOCIAL: ACQUISITION OF CULTURAL HISTORY *SOCIAL: AESTHETIC AND LANDSCAPE/ CITY VIEW *SOCIAL: PROVIDING ADDITIONAL FACILITIES
	FUNCTIONAL		*FUNCTIONAL: FLEXIBILITY AND CHANGEABILITY- NA*	*FUNCTIONAL: STRUCTURAL GRID
	TECHNOLOGICAL		*TECHNOLOGICAL: INSULATION AND ACOUSTICS*	*TECHNOLOGICAL: ENERGY ASSESSMENT
	POLITICAL		*COMMUNITY SUPPORT AND OWNERSHIP* *RECONSTRUCTION POTENTIAL-NA*	*POLITICS: COMMUNITY SUPPORT AND OWNERSHIP *POLITICS: ZONATION POTENTIAL
	LEGAL		*ACUSTIC-NA* *ENERGY RATING - NA* *OCCUPATIONAL HEALTH, IEQ, SAFETY AND SECURITY-NA* *FINISHING STANDARD* *LEGAL: FIRE PROTECTION AND DISABLED/FIRE CODES*	*LEGAL: FINISH STANDARD *LEGAL: OCCUPATIONAL HEALTH, IEQ, SAFETY AND SECURITY *LEGAL: ENERGY ASSESSMENT *LEGAL: ACOUSTIC
	ENVIRONMENTAL		*ENVIRONMENTAL: NONE	*ENVIRONMENTAL: INTERNAL ENVIRONMENTAL QUALITY *ENVIRONMENTAL: PRESENCE OF HAZARDOUS MATERIALS (ASBESTOS)

Table 12b. SWOT Analysis extracted from ARM systems according to their suitability for Tabriz Bazaar identity

	CRITERIA		SUB-CRITERIA	MISSING SUB-CRITERIA
SWOT ANALYSIS OBTAINED FROM ARM SYSTEM	PHYSICALLY	OPPORTUNITY	**PHYSICAL: STRUCTURE - 0.85% *PHYSICAL: SERVICE CORE LOCATION- 0.85% *PHYSICAL: DEGREE OF CONNECTION TO OTHER BUILDINGS - 0.85% *PHYSICAL: FLOOR HEIGHT - 0.85% *PHYSICAL: DESIGN COMPLEXITY- 0.85% *PHYSICAL: EXPANDABILITY- 0.85% *PHYSICAL: SUSTAINABILITY- 0.85%"	
	ECONOMIC		*ECONOMIC: CURRENT VALUE - 1.44% *ECONOMIC: PLOT SIZE AND SITE PLAN - 1.44%	
	SOCIAL		*SOCIAL: NONE	
	FUNCTIONAL		*FUNCTIONAL: NONE	
	TECHNOLOGICAL		*TECHNOLOGICAL: FEEDBACK ON BUILDING PERFORMANCE- 2.47%	
	POLITICAL		*POLITICAL: COMMUNITY INTERESTS/ PARTICIPATION - 2.13% *POLITICAL: URBAN MASTERPLAN AND ZONING/ URBAN TRANSFORMATION- 2.13%	
	LEGAL		*YASAL/ İMAR: YOK	
	ENVIRONMENTAL		*ENVIRONMENT: INDOOR AIR QUALITY	
	CRITERIA		SUB-CRITERIA	MISSING SUB-CRITERIA
	PHYSICALLY	THREAT	*PHYSICAL: STRUCTURAL INTEGRITY AND FOUNDATION* *PHYSICAL: FLEXIBILITY SPACE PLANNING*	
	ECONOMIC		*ECONOMIC: CURRENT VALUE*	
	SOCIAL		*SOCIAL: NEIGHBORHOOD AND SATISFACTION* *SOCIAL STIGMA-NA*	
	FUNCTIONAL		*FUNCTIONAL: NONE	
	TECHNOLOGICAL		*TECHNOLOGICAL: INSULATION AND ACOUSTICS - NA*	
	POLITICAL		*POLITICAL: NONE	
	LEGAL		*LEGAL: FIRE PROTECTION AND DISABLED/FIRE CODES*	
	ENVIRONMENTAL		*ENVIRONMENTAL: NONE	

First of all, the flooring material and roofing system of the bazaar should be restored in terms of visual and aesthetic quality. The bazaar needs to be arranged to ensure accessibility and ease of movement for disabled people. The parking and road problem needs to be solved, and the market and its surroundings need to use urban furniture such as benches, seats, garbage bins, and lighting. The functional quality of the new organization should be increased by providing a variety of goods, entertainment, and services instead of an abundance of eating and drinking places. Likewise, it is essential to provide green areas, vegetation, and sufficient space that add a special character and natural sustainability to the market. Some parts of the bazaar can be used as a museum or exhibition area with restoration and renovation works based on cultural sustainability. Social activity areas such as children's playgrounds and recreation areas should also include social sustainability to increase social quality. To increase economic sustainability, caravanserais and hotels close to the bazaar need to be restored to their original state. It is possible to develop some projects in the bazaar to maintain its commercial importance in the future. As far as is known, it is also known that the bazaar is an educational place like a madrasah. Some art students, vocational high school students, or uneducated talented young people can be introduced to these professions through training provided at chambers of commerce and bazaars. As a result, new generations can find employment opportunities and new traders can keep the market alive. Therefore, at least the traditional handicrafts of the city will be carried to the future.

Considering the result obtained from the SWOT analysis carried out from the research to the present, it should be taken into account that the modern form and standard content of Tabriz Bazaar should be revised in terms of missing criteria due to the influence of modernism on traditional architecture, Figure 4, Figure 4a. In this context, missing criteria should be discussed in future studies as listed below:

- Economic Criteria:

- Adaptability, convertibility, increase in value after display

● Physical Criteria:

- Workmanship, deconstruction (safe, efficient, and fast), technological and convertibility, and conflict.

● Social Criteria:

- Social benefits / historical listing, density of valuable cultural resources in the surrounding area / historical listing, image and identity/image in history, transportation noise, preservation of cultural past, aesthetics and landscape/city view, provision of additional facilities/amenities, proximity, contrast or age to the factors taken.

● Functional Criteria:

- Structural grid

● Technological Criteria:

- Energy rating

● Political Criteria:

- Community support, ownership, and rezoning potential

● Legal Criteria:

- Coating standards, occupational health, IEQ, safety and security, energy rating and acoustics

● Environmental:

- Internal environmental quality and the presence of hazardous substances (asbestos)

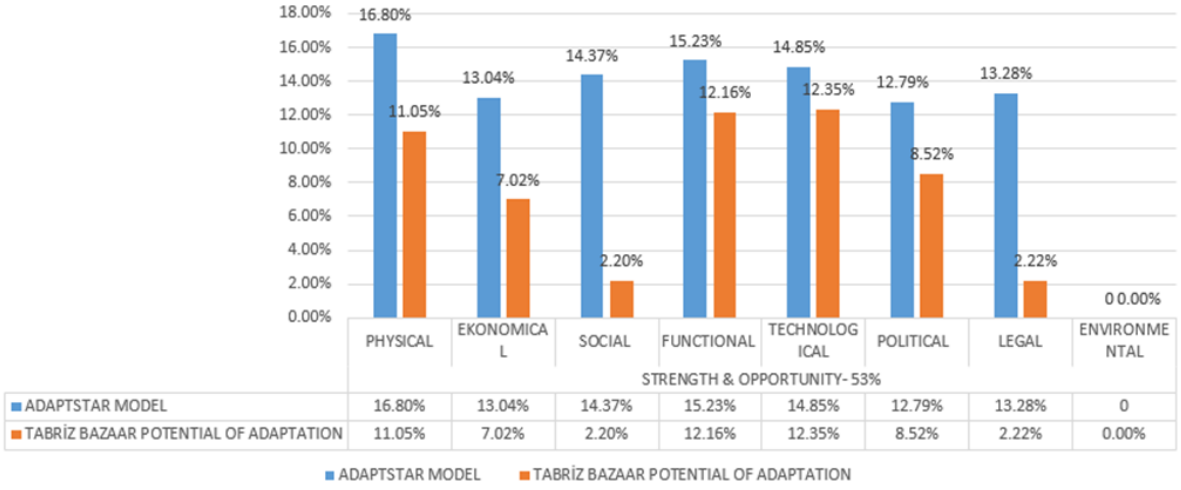


Figure 4. Tabriz Bazaar adaptation potential analysis (by authors).

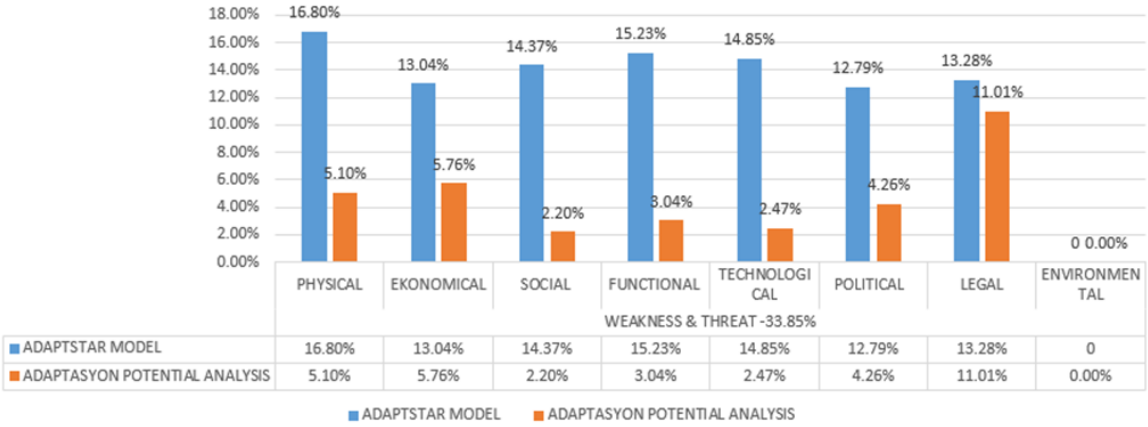


Figure 4a. Tabriz Bazaar adaptation potential analysis (by authors).

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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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Holistic Conservation Approach to Intangible Cultural Heritage and Places of Eyüp

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Abstract

Dating back to the Byzantine period, the province of Eyüp in Istanbul is home to a multi-layered structure that was sacred to Muslims during the Ottoman period and today, is an important settlement with both tangible and intangible cultural heritage. In this study, Eyüp's tangible and intangible cultural heritage and places are discussed regarding the idea of their joint protection in UNESCO's Convention for the Safeguarding of the Intangible Cultural Heritage. With this in mind, Eyüp's intangible cultural heritage was identified from the literature and area works; classified according to the categories in its contract; and associated buildings, spaces, textures, and regions were identified. As a result of these identifying factors, it has been observed that social practices related to religious belief continue in Eyüp, however, handicrafts have almost lost their importance and could disappear while some gastronomy remains. In parallel, it was understood that the intangible cultural heritage sites examined were also negatively affected and some were destroyed. As a result, suggestions have been presented to protect both the tangible and intangible cultural heritage together and in situ.

Keywords: *Eyüp, tangible cultural heritage, intangible cultural heritage (ICH), place.*

Bütüncül Koruma Yaklaşımı ve Eyüp'ün Somut Olmayan Kültürel Mirası ve Mekânları

Öz

Tarihi Bizanslılara kadar dayanan, Osmanlı Döneminde ve günümüzde de Müslümanlar için kutsaliyet içeren ve çok katmanlı bir yapıya sahip olan Eyüp, içerisinde barındırdığı somut ve somut olmayan kültürel mirası ile önemli bir yerleşim yeridir Bu çalışmada Eyüp'ün somut ve somut olmayan kültürel mirası ve mekanları, UNESCO'nun Somut Olmayan Kültürel Mirasın Korunması Sözleşmesi'nde ortak olarak korunması düşüncesi çerçevesinde ele alınmaktadır. Bu düşünceyle Eyüp'ün somut olmayan kültürel mirası literatür ve alan çalışmaları ile tespit edilmiş, sözleşmesindeki kategorilere göre sınıflandırılmış, bunlarla ilişkili yapılar, mekânlar, dokular ve bölgeler tespit edilmiştir. Tüm bunların sonucunda Eyüp'te dini inanca dair olan toplumsal uygulamaların devam ettirildiği, el sanarlarının neredeyse önemini yitirdiği ve kayboymaya yüz tuttuğu, gastronomi varlığının da bir kısmının devam ettiği görülmüştür. Bunlara paralel olarak da incelenen somut olmayan kültürel miras mekânlarının da olumsuz etkilendiği, bazılarının da yok olduğu anlaşılmıştır. Sonuç olarak hem somut hem de somut olmayan kültürel mirasın bir arada ve yerinde korunmasına yönelik öneriler sunulmuştur.

Anahtar kelimeler: *Eyüp, somut kültürel miras, somut olmayan kültürel miras, mekân.*

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1. Introduction

UNESCO states: “Heritage is our legacy from the past, what we experience today and what we will pass on to future generations”, and have classified cultural heritage into two categories: tangible and intangible (Figure 1). Tangible heritage includes buildings and historic places, monuments, and artefacts (eg, mosques, churches, churches, houses, fountains, and works of art), which are considered worthy of preservation for the future. Intangible cultural heritage (ICH) includes traditions or living expressions inherited from ancestors and passed on to their descendants, such as oral (Language and dialect) traditions, performing arts, social practices, rituals, festive events, knowledge, and practices concerning nature and the universe or the knowledge and skills to produce traditional crafts (UNESCO, 2003).

Figure 1. Classification of world heritage presented by UNESCO

Eyüp district of Istanbul, which has a multi-layered cultural structure, was chosen as the study area. The reason why the study area was chosen as Eyüp is that the tangible and ICH of Eyüp is intertwined within its multi-layered structure. The main problem in the study is that although tangible heritage areas are protected in Eyüp, ICH cannot be protected. To protect cultural heritage holistically, tangible and ICH must be protected together.

The values attributed to the Eyüp settlement (ie, the culture created by the society by settling in Eyüp) and the coexistence of different societies and the crafts performed by them to make a living, constitute the ICH of Eyüp. As such, the ICH is reflected in the architectural texture of the settlement and created spaces. There is a relationship between tangible cultural heritage and ICH sites. In the second article of the Convention for the Safeguarding of the Intangible Cultural Heritage published in 2003, the importance of cultural spaces and the practices that communities and individuals define as a part of cultural heritage is emphasized. Also in the statute, it is stated that natural areas and memory-related spaces necessary to express ICH should be protected. Oğuz (2007) emphasizes the importance of the place where people produce culture and that when the producer and the place of production disappear, the product also disappears. For this reason, the places where folklore originates become extremely important (Oğuz, 2007). Gülçayır (2011) states that ICH does not focus on creating awareness and results regarding the preservation of traditional architectural techniques. The master–apprentice relationship during the construction of the architectural structures in question is important in terms of the transfer of experience from generation to generation and the ICH of which the cultural and social structure of the architectural structure is a part (Gülçayır, 2011). Basat (2013) stated that ICH experiences a change–transformation parallel to the characteristics of time and place, which is important for the sustainability of culture. Based on these ideas, this article considers the ICH of Eyüp, heritage elements, heritage features, and places. As a result, Eyüp's intangible cultural heritage was documented through literature reviews and fieldwork, categorized per the contract’s specifications, and linked with relevant buildings, spaces, textures, and regions. The findings reveal that while religious social practices persist in Eyüp, traditional handicrafts have nearly vanished and risk extinction, although some gastronomic traditions still endure. Additionally, it was found that many of these intangible cultural heritage sites have suffered damage or have been destroyed.

1.1. History of the Eyüp settlement

The Eyüpsultan district is situated on the Çatalca Peninsula, which is located on the European side of Istanbul (Figure 2). Eyüp is adjacent to the Historical Peninsula and has managed to uphold its identity as a settlement throughout its history by its location, thereby providing a home to various buildings and communities. Eyüp, which has roots from the Byzantine period, became one of the significant

settlements outside the city walls after the Ottoman conquest of Istanbul. As a consequence, people migrated to Eyüp and the people under Ottoman protection settled there. The settlement of different communities in Eyüp contributed to the sociocultural and socioeconomic richness of the area. In parallel to this, the physical and social fabric of the settlement expanded and gave rise to unique places and traditions specific to Eyüp. Due to the religious characteristics attributed to Eyüp since its establishment, churches were constructed during the Byzantine period while mosques, social complexes, cemeteries, and mausoleums were built during the Ottoman period.

Figure 2. Location of Eyüpsultan (Yandex, 2024)

During the Roman and Byzantine periods, two main axes were formed from the city center of Constantinople surrounded by walls, to the entrance gates of these walls. One of these axes is the Victory Road parallel to the shores of the Marmara Sea, which includes the monument ceremonial gate through which the Emperor entered the city of Constantinople, which was the capital of the Mediterranean Basin in the 6th century. Another axis passes from the north outside the walls connecting the hills in Istanbul's topography, and through the Eyüpsultan district (Yenen, Akın & Yakar, 2000). The settlement called Eyüpsultan today (2024) was named Kozmidyon during the Byzantine period. The Byzantines saw the region as a hunting area and built a hunting palace and a monastery. During this period, interest in Kozmidiyon increased and palaces and churches were built in the settlement and on the shores of the Golden Horn. The palaces and churches were plundered by the Crusader armies from Bulgaria who wanted to conquer Constantinople. Before the conquest of Istanbul, the buildings in the settlement were in ruins (Haskan, 1996). One of the important sieges in the history of Istanbul was carried out by the troops under the command of Yazid, the son of the Umayyad caliph Muaviye (Ayvansarayı, 1864). What makes the siege important is Hz. Halid Bin Zeyd Ebû Eyyûb el-Ensari, the owner of the first house where Prophet Muhammad stayed in Medina after the Hijra, participated in this siege to support the army (Sevindik, 2010). During the siege, Ebû Eyyûb el-Ensari was martyred in front of the walls of Istanbul (Ayvansarayı, 1864). His body was taken to the farthest point they could reach by the Muslims in the siege army and buried, and his grave was lost over time (Artan, 1995). With the conquest of Istanbul by Sultan Mehmet the Conqueror in 1453, Ebû Eyyûb el-Ensari's grave was found, zoning and settlement policies were continued, and the city (which was surrounded by walls during the Byzantine period) was expanded beyond the walls and a Turkish–Islamic identity developed inside and outside of these walls (Ensari Kara, 2003). The settlement of Eyüp, which started with the discovery of the tomb of Eyüpsultan, became the center of spiritual symbolism over time with the spirituality of the region increased with the collection of holy relics of the Prophet Muhammad. In the same period, the Eyüpsultan district became the most important holy place of pilgrimage for Muslims after Mecca, Medina, and Jerusalem. For this reason, with the expectation of holiness, the Eyüpsultan settlement expanded with creating lodge buildings belonging to different sects and tombs and cemeteries belonging to scholars and palace members (Yenen et al., 2000). With the construction activities that gained momentum in the 16th century, mausoleums, social complexes, and madrasahs (religious education institute) were built, and after this century, monument building construction activities began to gradually decrease. In Eyüp, there are important buildings

from the Ottoman period, such as Eyüp Sultan Mosque, Zal Mahmut Pasha social complex, Mihrişah Sultan Imaret, Sultan Reşat Tomb, and Feshane. Since the settlement was first established, a religious feature has been attributed to the place. Although this feature has been preserved until today, some parts of Eyüp have undertaken different functions in terms of settlement that have changed over time. During the process, the function of the Golden Horn shores changed the most, and the coastal palaces were replaced by industrial buildings from the mid-19th century until the 1980s. After the 1980s, as a result of the construction activities around the Golden Horn, factories were demolished and these areas were converted into green areas and parking lots for example. According to the Istanbul Metropolitan Municipality Inventory (2017), there are 1193 registered buildings in Eyüp. These building include examples of civil architecture (eg, houses, mansions, and outbuildings), social complexes, mosques, soup kitchens, medrese, libraries, schools, lodges, churches, graves, cemeteries, water structures (eg, baths, fountains, wells, and public fountains), and industry buildings. Furthermore, there are other items, such as buildings, monument trees, and registered parcels that are registered. In the process, in addition to all its tangible cultural assets, Eyüp's ICH has also developed specifically.

1.2. Development of intangible cultural heritage

UNESCO's first initiative towards the protection of cultural heritage was the Convention and Protocol for the Protection of Cultural Heritage in the Event of Armed Conflict in 1954. This contract aimed to protect objects that are important in terms of art and history. The second document is the Convention on Measures to Prevent and Prohibit the Illegal Import, Export and Transfer of Ownership of Cultural Property dated 1970. The main goal of this contract was to prevent the smuggling of historical artefacts. On November 16, 1972, a contract was published under the title of the Convention on the Protection of the Cultural and Natural World Heritage, outside the scope of the earlier two conventions. This contract was object/object and building/architecture focused. Although these agreements were aimed to ensure protection in terms of objects and architecture, increased criticism resulted in, for the first time in the Bolivia Declaration, folklore being defined and accepted as a cultural heritage that should be protected (Oğuz, 2013). As stated by Oğuz (2013), folklore has been included in the concept of cultural heritage, which continues to develop. Following the 1973 Bolivia Declaration, it was understood that the definition of folklore was insufficient, and the Recommendation for the Protection of Traditional and Popular Culture was presented in 1989 (Oğuz, 2013). UNESCO reached a common opinion on the concept of ICH at its first conference in 2003. As a result of this meeting, the Convention for the Safeguarding of the Intangible Cultural Heritage was accepted on October 17, 2003. In the acceptance of the agreement, the concepts of cultural heritage and folklore were developed in the historical process and took their final form in this agreement.

In Türkiye, various institutions (especially universities), conduct ICH studies and provide suggestions for its preservation. The identified ICH items are evaluated as a result of the Ministry of Culture's applications to UNESCO, and the list is updated every year. The contract was accepted by the Council of Ministers in Türkiye in 2006. When Türkiye's representative list of humanity's ICH is examined, there were 30 elements registered by UNESCO (2023). Meddah (storytelling) tradition was first included in the list in 2008, and lastly, traditional knowledge and methods and practices regarding olive cultivation were included in the list in 2023.

2. Materials and methods

While conducting the study, the ICH of Eyüpsultan was researched in line with the ICH declaration published by UNESCO in 2003. Information about Eyüp was obtained from literature searches and Eyüp's ICH and ICH places were evaluated by on-site investigations.

Eyüp's ICH was discussed under five headings according to the classification determined for heritage in the UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage. These are: (a) oral traditions and expressions along with language that serve as a carrier in the transmission of ICH; (b) performing arts; (c) social practices, rituals, and festivals; (d) knowledge and practices related to nature and the universe; and (e) handicraft tradition.

The ICH elements identified in Eyüp were grouped under three main headings: social practices, handicrafts or production, and gastronomy (eating and drinking). While creating these headings, UNESCO's Convention for the Safeguarding of the Intangible Cultural Heritage was taken into account. In the case of Eyüp, beliefs and rituals are also discussed within the social practices element. In particular, the fact that Eyüp is a religious center, the practices based on Eyüp in this context, the presence of different religious groups here, and the fact that a Christian community lives in Eyüp and are buried here are reasons for this topic to be discussed separately. With the data obtained, Eyüp's ICH and places were identified, examined on site, and their condition evaluated. While evaluating, the breaking points of the ICH over time were discussed; the relationships between them were examined; and the common points of these relationships in terms of rituals, space, and material were tabulated.

3. Results

With the importance attached to the Eyüp district since the day it was founded, the social practices implemented in the district have differentiated and become specific to Eyüp. Most of these applications are focused on Eyüp Sultan El Ensari and Eyüp has many traditions of its own. Eyüp became an important center for Muslims after the conquest, with the discovery of the grave of Eyüp El Ensari and his tomb and social complex located there. In Eyüp, many traditions, customs, various crafts, and production activities have been formed along with religious beliefs. While all these were discussed within the scope of the study, UNESCO's Convention for the Safeguarding of the Intangible Cultural Heritage was discussed and Eyüp's ICH and places were examined within the scope of the social practices, rituals and feasts, knowledge and practices related to nature and the universe, and handicraft tradition items (Figure 3). Social practices was examined as two titles: religions and social practices in the context of Eyüp. Other headings are handicrafts and food-beverage-gastronomy.

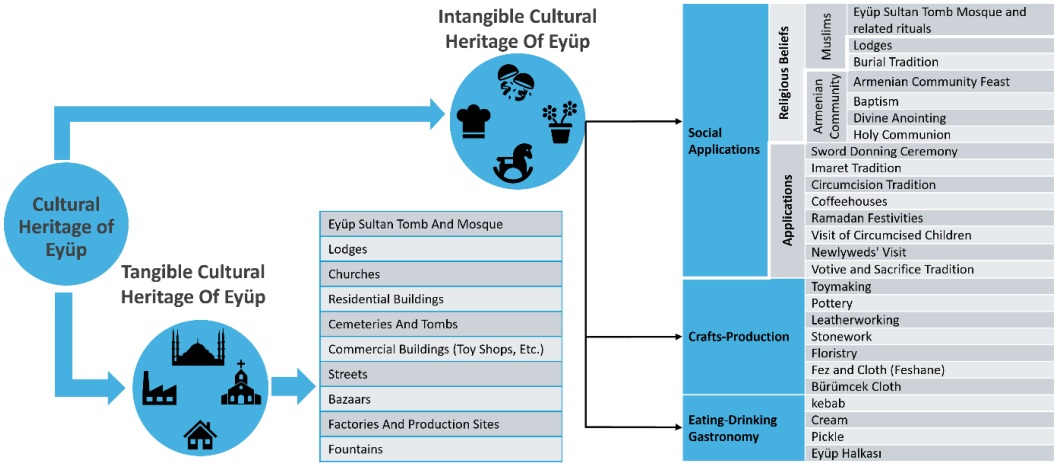


Figure 3. Tangible cultural heritage and ICH of Eyüp

3.1. Social practices, rituals and festivities

Social practices that are accepted throughout a country can vary by region. This diversity of practices reveals the unique identity of each region and ensures the cultural continuity of that region. Birth, death, holidays, weddings, and various life events constitute important building blocks of our culture by integrating them around a ritual (Isparta'nın Somut Olmayan Kültürel Mirası, 2019).

Many events are held on holy days in the district, which has become a religious center. Apart from these, one of the most important traditions is the Sword Girding Ceremony. After the abolition of the sultanate, urban traces of this tradition can be found in the district. The desire to be close to Eyüp Sultan and to be buried in Eyüp gave rise to the tomb tradition. With this tradition, many cemetery areas were created in Eyüp and many mausoleums were built. Another tradition that takes place within the scope of visiting Eyüp Sultan is bringing circumcised children to Eyüp. This tradition was reflected in the district as the toy seller's bazaar. Another practice conducted in the Eyüp district is the imaret tradition from the Ottoman period. Although this tradition, which disappeared with the proclamation of the Republic, is performed with different practices today, it continues in Eyüp Mihrişah Valide Sultan Imaret, preserving the original function of the building.

3.1.1. Religious rituals

While examining the ICH of Eyüp Sultan, development and stratification occurred around the Eyüp Sultan Mosque and tomb. Accordingly, mosques, lodges, madrassas, and cemeteries were built in Eyüp, which became a religious center. There are also churches in Eyüp as the province hosts different beliefs. Within the scope of ICH, Eyüp Sultan Mosque and tomb, lodges, and churches were discussed. The abundance of rituals performed by the public in the Eyüp Sultan Mosque and tomb, which is at the center of these, draws attention. The reason why lodges are included in the scope of this study is that it is thought that the rituals performed by the sects to which the lodges belong are related to the place. By examining the churches separately, it was aimed to determine the differences in the religious rituals of the Christian sects and how this difference is reflected in the church buildings.

3.1.1.1. Beliefs-rituals developed in Eyüp Sultan Mosque and tomb and its surroundings

Eyüp Sultan Mosque and tomb is the most important factor for the settlement and development of the Eyüpsultan district. The settlement policy in Eyüpsultan since the Ottoman period, the religious character of the district, and the preference of the district as a settlement place due to its location have enabled the district to grow gradually. The mosque and the tomb greatly contributed to the development of Eyüp and to the religious rituals and traditions of Eyüp. The reason why Eyüp Sultan Mosque and tomb are discussed separately is that many rituals and beliefs performed in the mosque and tomb are specifically intended for Eyüp Sultan (Figure 4).

Figure 4. Eyüpsultan Mosque and tomb (İBB Şehir Haritası, 2024)

Eyüp Sultan tomb is one of the most well-known and visited tombs in Istanbul. The Eyüp district is considered sacred and as important as Mecca by Muslims. People who come to Istanbul to visit include those who want to have children, those who will go on pilgrimage from Istanbul, newlyweds, children to be circumcised, and those who have various wishes will all pray in front of the prayer window (Göktaş, 1994). There are different practices and rituals developed in and around the Eyüp Sultan tomb. Kalafat (2008) identified rituals such as circumambulation around the tomb, sanctifying the rainwater accumulated around the tomb, and making vows (Kalafat, 2008). The importance attributed to Eyüp Sultan Tomb Mosque was perceived as very high by the sultans and society in the Ottoman Empire. Tomb visits were made by the sultan and the people. The sultans visited the tomb for sword-donning ceremonies and it was believed that visiting the tomb before going to war would boost morale and give strength to the sultan and the army. In the last periods of the Ottoman Empire, the tradition of visiting shrines before the war gradually came to an end, as the sultans did not participate in the war (Efendioğlu, 2011).

Figure 5. Eyüp Sultan Tomb visit and children who are to be circumcised visit Eyüp

Some of the traditions in Eyüp Sultan Mosque and tomb continue in and around the tomb, while some have ended. People who believe in the sanctity of Eyüp Sultan associate the beliefs and rituals in their customs and traditions with Eyüp Sultan and perform these rituals in the Eyüp Sultan Mosque, tomb, and places belonging to it. Many areas and features related to these spaces that can be associated with ICH have been identified in mosques and tombs. These places are related to the beliefs and rituals formed by the existence of tombs and mosques. Other places associated with mosques and tombs include the Çifte Gelinler Tomb, Eyüp Sultan Mosque place of sacrifice (sacrifice and offering), kismet fountains, water well in the northeast of Eyüpsultan Mosque, intention well in Gümüşsuyu, Cülus Road, and the toymaker's bazaar. The identified places and the elements belonging to the Eyüp Sultan Mosque and tomb were considered sacred by the believers, and this holiness significantly affected the way the rituals were performed. In this respect, the place has an effect on the ICH. Some places, such as the toymaker's bazaar have become important because of belief and values and are places of ICH.

3.1.1.2. Sword donning ceremonies-culus road

The word cülus was used in the Ottoman Empire to describe the accession of princes to the throne. The enthronement ceremony was held for the accession of princes to the throne in Muslim Turkish states (Figure 6). This enthronement ceremony varies by the states where they take place. In the Ottoman Empire, the prince's accession to the throne was held by various state officials and after the ceremonies in the palace, the new sultan would be taken to Eyüp Sultan and the sword-girding ceremony held. After the ceremony, the new sultan would visit Eyüp Sultan's tomb and the tombs of previous sultans (Özcan, 1993). The sultan would come to Eyüp Sultan by sea for the enthronement ceremony and after, they would use a land route to enter Divanyolu from Edirnekapı and return to the palace (Uyanıker, 2010). Sword girding ceremonies for religious and military ceremonies took place in two stages. In the ceremony performed as taklîd-i seyf, the first is the sword procession to and from the place where the ceremony is held, and the second is the donning of the sword brought from the sacred relics. The ceremony would start in the palace and continue in Eyüp. During the sultan's visit to the tomb, the Sheikh al-Islam (the head of religious affairs) prays and after the sultan prays, he girds himself with a sword. This ceremony could be either open or closed to the public. Then, a sacrifice (cow or sheep) was made in Eyüp (Özcan, 2002).

Cülus Road was called Sultan Reşat Dead End at the time the study was conducted (Figure 6). Hüsrev Pasha Library, Mihrişah Valide Sultan Fountain, Imaret, tomb, and a primary school can be found on the road. Until 1995, the Cülus Road was an axis extending from Bostan Pier to the Eyüpsultan Mosque and tomb. With the completion of the Golden Horn coastal road in 1996, Cülus Road was cut off from the sea.

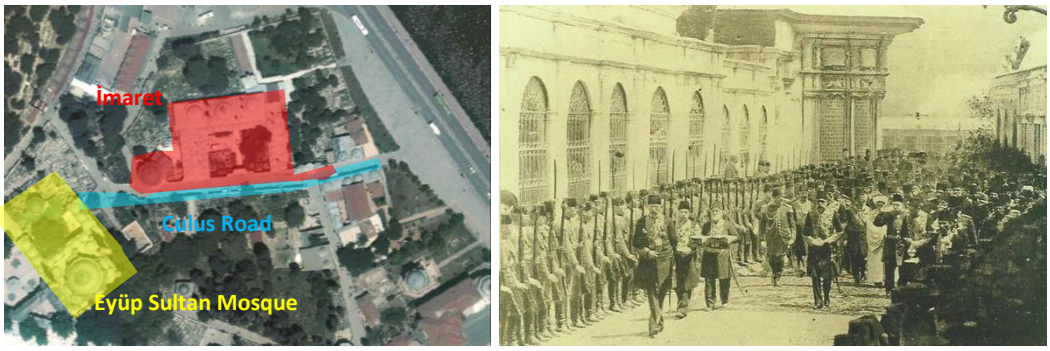


Figure 6. 2024 satellite image (İBB Şehir Haritası, 2024) and Sultan Mehmet V's sword donning ceremony from Cülus Road (Eyüpsultan Belediyesi, 2024)

The tradition of cülus was made for the last sultan of the Ottoman Empire, Sultan Vahdettin, and ended with the abolition of the sultanate in 1922. The fact that the tradition ended with the change of the ruling system does not cause this tradition in Eyüp to lose its significance. This ceremony, which was important in Ottoman political life, contributed to the development of the district. Although the name of the street where the ceremony was held has changed, the street is called Cülus Road and its remnants remain in the society, emphasizing its importance in terms of ICH value.

3.1.1.3. Visit of circumcision children, school children and newlyweds to Eyüp Sultan Tomb

It is common that children to be circumcised visit Eyüp Sultan Mosque and tomb (Figure 5). It is widely acknowledged that Eyüp El-Ensari loved children, so it has become a tradition for circumcised children and those starting school to visit Eyüp Sultan's tomb (Yalçın, 2004). Efendioğlu (2011) suggests that the tradition of bringing circumcised children to the shrine is that the child, after this stage of his life, depends on his religion, loves his homeland and nation, is well-behaved and moral, and believes in Hz Abu El Ansari. Hz Abu El Ansari was a companion of the Prophet Muhammad and children are expected to pray according to the Prophet (Efendioğlu, 2011). Bektaş (2001) states that circumcised children visit Eyüpsultan where the day is celebrated as a holiday with gifts and toys for the children. This tradition continues at the time of the study, and children visit the tomb and Eyüp wearing their circumcision clothes. Another tradition that has developed in Eyüp is the visit of school-aged children to the Eyüp Sultan tomb. This visit is called the Amin procession and Bed'i Besmele. Although the start date of this ceremony is unknown, the ceremony is performed on holy nights, Mondays, or Thursdays. A child going to school is mockingly taken away from home by his teacher and other children. During the procession, the children in the front sing hymns together, and the children in the back say amen in between. Children coming to school start by reciting the Bismillah prayer in front of their teachers. The part related to Eyüp is that before the ceremony, children come to the Eyüp Sultan tomb with their families and relatives and pray there for their success (Öcal, 1993). This tradition did not occur during the period in which the study was conducted. However, it is known that schoolchildren are still brought to Eyüp and pray here. Newlyweds also visit the tomb of Eyüp Sultan and pray.

3.1.1.4. Votive and sacrifice tradition

Istanbul is a settlement where votive places and traditions developed in votive places are rich. People have aspirations (attributed to wishes) and if these come true, they visit the place where a vow and sacrifice is made. Eyüp Sultan and its surroundings have an important place among the votive places in Istanbul and are where people come to make wishes (Koz, 1993). The tradition of sacrificing animals continued in Eyüp during the period when the study was conducted. Places sell various votive offerings and sacrificial animals in Eyüp. One of these is the center located to the north of Eyüp Sultan Mosque. The sacrificed animals here are used in the Mihrişah Valide Sultan imaret soup kitchen.

3.1.2. Lodges of Eyüp

After the Ottoman conquest of Istanbul, Eyüp became a religious center for Muslims and hosted sects of different beliefs. In the process, the sects built lodges for themselves and the lodge structures created an important physical character of Eyüp. Studies on lodges across Eyüp report 29 lodges and 13 sects to which some lodges belong were identified (Table 1).

Table 1. Lodges of Eyüp

	Building	The period in which it was built	Neighbourhood	Sect	Function in 2024
1	Evlice Baba Lodge	1453, 1481, 1892 Reconstruction	İslambey	Nakşibendi	Mosque
2	Alaca Tekke- Sultan Osman Lodge, Ahmet Efendi, Şeyh Seyyid Ahmet, Sıraserviler	1494, 1754 Reconstruction	Nişanca	Nakşibendi, Sadi, Rıfai	Dilapidation
3	Yavedud Lodge	1456	Defterdar	Kadiri	Mosque
4	Abdullah İl Huderi Lodge	15. century	Ayvansaray		
5	Emir Buhari Mosque- Lodge	1512, 1520	Could not be located	Nakşibendi	---
6	Baba Haydar Mosque- Lodge	1520, 1566	Nişanca	Nakşibendi	Mosque
7	İslambey Mosque- Lodge	1521	İslambey	Bedevi	Mosque
8	Yahyazade Tekkesi Saçlı Abdülkadir Efendi Mosque- Lodge	1537	Merkez	Kadiri, Sümbüli, Şemsi, Rıfai	Mosque
9	Karyağdı Tekkesi	1544	Merkez	Bektaşi	---
10	Davut Ağa Cami Sertarikazede Lodge	1555,2010 Reconstruction	Nişanca	Sivasi	Cultural Centre
11	Şah Sultan Mosque- Lodge	1555, 18.yy. Reconstruction	Merkez	Halveti Sümbüli	Mosque
12	Ümmî Sinan Lodge	1568,1839 Reconstruction	Düğmeciler	Sinani, Sadi, Rıfai	Cultural Centre
13	Cemalizade Lodge	1574, 1595	Defterdar	Halvetiyye, Kādiriyye, Sâ'diyye	Mosque
14	Cafer Paşa Lodge	1585	Merkez	Halveti, Kadiri, Sadi	Cultural Centre
15	Molla Çelebi Lodge	1590	Could not be located	Kadiri, Nakşibendi	----
16	Balçık Lodge	1591	Merkez	Sümbüli-Uşakki-Sadi	Dilapidation
17	Hacıhüsrev Mosque	1591	Defterdar		Mosque
18	Ferhat Paşa Tomb	1595	Merkez		Tomb
19	Cemalizade Lodge	1599	Defterdar	Halveti, Cemali, Sümbüli Şabani	Mosque
20	Sivasi Lodge	1639	Nişanca	Sivasi, Halveti	Tomb
21	Şeyh Murat Lodge	17. century, 1715	Nişanca	Nakşibendi	Masjid
22	Hatuniye Lodge	1732	Merkez	Nakşibendi	Masjid
23	Kalenderhane Lodge	1743	Merkez	Nakşibendi	Mosque
24	Şeyhülislam Lodge	1744, 1745	Merkez	Nakşibendi	Mosque
25	Kaşgari Lodge	1744, 1746	Merkez	Nakşibendi	Dilapidation
26	Özbekler Lodge	1752	Merkez		Public Building
27	Selami Efendi Lodge	1798	Nişanca	Rıfai	Cultural Centre
28	Afife Hatun Lodge	1844	Nişanca	Nakşibendi	Cultural Centre
29	Bahariye Mevlevihane	1877- Reconstruction	Merkez	Mevlevi	Cultural Centre

Tanman (2015) states that Istanbul lodges contain different architectural programs depending on the sect, and the places where worship services are held are named according to the sect. The places where the rituals take place are called semahane among Mevlevis (sect), square among Bektashis, and tevhithane among members of other sects. How the tevhidhane and semahane, which are the places of worship of the lodges in Istanbul, are shaped according to the worship choreography of the sect.

Apart from the squares of Bektashi lodges, the places of worship in other sects are designed according to the Islamic form of worship with features such as qibla direction (direction of prayer), mihrab (niche in a wall), pulpit, and congregation gathering place (Tanman, 2015).

Figure 7. Şeyh Murat Lodge and Selami Efendi Lodge

From the literature search conducted for Eyüp, 29 lodge structures were identified. The sects that used the searched lodges have changed occasionally. The rituals performed by Muslims in the lodge are important in terms of ICH. The main places of worship of the lodges mentioned in table 1 are square or polygonal in shape. When the users of the lodges are examined throughout the process, they had different sects, but had similar characteristics in terms of worship styles so their spaces are suitable for their needs.

3.1.3. Death and burial customs

According to Islamic belief, death and graves remind Muslims of the afterlife. The grave represents the place where the dead are buried in many celestial religions and beliefs. Grave-making in Turkish society dates back to before the invention of writing, and it has been determined that cemeteries have existed since the 11th century. Turkish people built cemeteries called kurgan with the belief that life would continue after death (afterlife). With the arrival of Islam in Türkiye, tombstones in the Ottoman Empire began to become classics (in terms of design) in the 15th century. There are tulipant (sarık) on male gravestones depending on the status of the deceased and there are flower motifs on female graves (Çetin, 2019).

With the discovery of the tomb of Ebû Eyyûb el-Ensari in the Eyüp district, the desire for people to be buried close to him led to the formation of the Eyüp Cemetery, with thousands of people buried around the tomb. Due to this demand, various charitable works such as mausoleums, soup kitchens, dervish lodges, and public fountains were built in Eyüp. Although not in terms of architectural design, these cemeteries clustered around the Eyüp Sultan complex have created an Islamic necropolis ie, a group of mausoleums and cemeteries that are unique to the Turkish–Islamic world (Tanman, 1994). The desire to be buried close to Eyüp Sultan stems from the belief that those who are close to the tomb will benefit from Eyüp Sultan's spirituality and will not suffer the torment of the grave (Efendioğlu, 2011). This belief was revealed by the tombstones of those buried in Eyüp after the conquest of Istanbul. The diversity of tombstones in Anatolia can be seen in Eyüp and information about the identity of the dead was given on the tombstones, each of which was a work of art (Yücel, 1994). Eyüp Cemetery, located to the north of Eyüp Sultan Mosque, is important in terms of settlement and believers. Other important cemetery areas in Eyüp are Edirnekapı and its surroundings. Edirnekapı Cemetery spans across both sides of the road leading from outside the city walls to Eyüp and Rami. This cemetery is the continuation of Tokmaktepe Cemetery. There are important Sheikh al-Islams buried in these cemeteries. There are also cemeteries belonging to non-Muslims in the areas close to the gates in the Eyüp district. Among these cemeteries are a Greek cemetery under the walls between Edirnekapı and Eğrikapı and a Jewish cemetery in Otakçılar (Kuşu, 2019).

In addition to the aforementioned cemeteries, there are also those belonging to lodges and social complexes in Eyüp that are of different sizes. Various rituals are performed in social life, from birth to death. As such, the cemeteries were created out of the desire to be close to Eyüp Sultan and that this has been a tradition since the conquest of Istanbul. The tradition that developed with this desire turned

into an ICH with the process of death and is unique to Eyüp. Death and the desire to be buried in Eyüp was effective in increasing the number of cemeteries throughout the district and was reflected in the district as urban spaces. Cemeteries in Eyüp are places where the relationship between burial rituals and ICH can be established.

3.1.4. Imaret tradition

Imaret is a charity house and soup kitchen that was established to distribute food to the poor and serve as a madrasah to students, residents of the kalenderhane, and travelers (Hasol, 2014). Although imaret is located within a complex, there are many building groups within the complexes, such as mosques, madrasahs, bimarhanes, temples, schools, caravanserais, libraries, hânkâhs, arastas, baths, and constitutional buildings. In Muslim–Turkish society, imaret was established to meet the food needs of madrasah students, poor and lonely people, travelers, and for charitable purposes based on the foundation system (Şeker, 1984). Guests, the poor, and the rich regardless of religion can benefit from imaret (Gelir Çelebi, 2017).

The tradition of imaret in Eyüp from the Ottoman period to the present day continues in the Mihrişah Sultan Complex (figure 8). The architectural program of the social complex, which was built by the Sultan Mihrişah in 1795, includes a mausoleum, imaret, public fountain, primary school, and cemeteries. The imaret served from the year it was built in 1795 until the law on the closure of imaret in Der Saadet was enacted in 1911 (Aydın, 1998). In 1950, the imaret was reopened for its original function by the General Directorate of Foundations (T.C. Vakıflar Genel Müdürlüğü, 2020). Gelir Çelebi (2017) states that among the soup kitchens in Türkiye, it was the only one retaining its original function is the Mihrişah Valide Sultan Almshouse. (Gelir Çelebi, 2017).

Figure 8. Mihrişah Valide Sultan complex (Eyüpsultan Belediyesi, 2024)

What is discussed in the study is the tradition of solidarity and cooperation in Mihrişah Valide Sultan Almshouse since 1795 (Figure 8) and the ICH of Türkiye and Eyüp. Mihrişah Valide Sultan imaret, which is a tangible example of solidarity and sharing, preserves its original function and continues the tradition. Eyüpsultan is one of the intangible examples where the ICH and place are preserved.

3.1.5. Ramadan festivities

Various events take place around Eyüp Sultan Mosque and tomb every year during Ramadan. These events are held in Eyüpsultan Square, Zal Mahmut Pasha social complex, and Mihrişah Valide Sultan imaret. Iftar (the time of breaking the fast) tables are set and various concerts and social practices are held to continue the ICH, such as Karagöz-Hacivat.

3.1.6. Armenian churches and church beliefs-rituals

Surp Asdvadzadzin and Yeghia churches, which form the physical layer of Eyüp, were made by Armenians. Armenians create an important sociocultural and ICH for Eyüp and their traditions, worship, handicrafts, and food and beverage culture enrich the ICH of Eyüp. Religious services continue in the Surp Asdvadzadzin Armenian Church (Figure 9). Tchilingirian (2019) states that there are sacraments that must be performed in Christianity including baptism, confirmation (strengthening and anointing), eucharist (holy communion and badarak -The last part of the Sunday ritual in Armenia, where holy bread and wine are presented to represent the body and blood of Jesus), repentance, marriage, holy ranks (clerical blessing and anointing of the sick), and holy communion (holy rite-

badarak) is the main sacrament. In Christianity, holy communion celebrates the death and resurrection of Christ (Tchilingirian, 2019). Although the Surp Asdvadzadzin Armenian Church is open for worship, there is no congregation and no rituals, such as baptisms, weddings, or funerals.

Figure 9. Eyüp Surp Asdvadzadzin Armenian Church

The Armenian community has holy days and holidays that they celebrate according to their own beliefs. Hançer (2005) found that in documents from the 20th century, the Eyüp Armenian Community held a religious ceremony in Surp Yeghya Armenian Church on the first Sunday of June for the feast of Prophet Elijah (Christian holiday). After this ceremony, a cow was slaughtered in the church garden and distributed to the poor. A mass was held again on the Monday and people from Eyüp and other districts attended this ceremony. Donations were offered at the table of love, and church and school expenses were covered. In church, the feast of the Virgin Mary is celebrated annually on the first Sunday of July (Hançer, 2005). Based on Hançer (2005)' findings, a practice that was once a tradition for the Armenian community has since become a ritual and continued by helping poor people after it was done collectively. This falls under the section of practices and rituals performed by societies within the scope of the Convention for the Safeguarding of Intangible Cultural Heritage. Some of these practices are continued in Surp Asdvadzadzin Church.

3.1.7. Coffeehouse tradition

Since the Ottoman period, coffeehouses have become important places for society. With the emergence of coffeehouses in the 16th century and their arrival in Istanbul, these have spread to a wider base and become a universal social feature. With the rapid increase in the number of coffeehouses, they have turned into public spaces where different cultures come together, are a place for developing cultural accumulation, and are a place for socializing and where political ideas are discussed (Yaşar, 2005). Yaşar (2004) identified 74 coffeehouses in Eyüp in the first half of the 18th century and 36 in the second half. According to Yaşar (2004)'s findings, these coffeehouses are small neighborhood coffeehouses. Kara (1994) states that Eyüp is a rich district in terms of coffeehouses and that there were coffeehouses between Ayvansaray Pier-Defterdar Pier-Eyüp Pier-Bahariye Pavilion in the early 19th century. The largest of these coffeehouses is the Bostan İskelesi Coffeehouse. It is also the most famous tulumbacı (fireman) coffeehouse in Istanbul in the Defterdar District. In this coffeehouse, instruments were played and entertainment provided during Ramadan. After the declaration of the Constitutional Monarchy, it became a boatman's coffeehouse. The last coffeehouses on this route were demolished during the coastal demolitions between 1984 and 1985 (Kara, 1994).

Figure 10. Pierre Loti coffeehouse (Eyüpsultan Belediyesi , 2024)

Within the scope of intangible cultural heritage, one of the places that have an important place in the social memory of those who live in Eyüp and those who visit Eyüp are coffeehouses. These coffeehouses, where various professional groups gathered, influenced social life and became places where economic income was earned. The coffeehouse tradition started with the arrival of coffee in Istanbul in the 16th century. In the process, coffeehouses were opened in Eyüp and continue today on Pierre Loti Hill in Eyüp (Figure 10).

3.2. Crafts and production

Handicrafts play an important role in transferring and continuing the lifestyle, traditions, and customs as they reflect the artistic tastes and cultural characteristics of the society in which they are made. These handcrafted products are made with materials obtained by traditional methods and techniques learned from ancestors (Isparta'nın Somut Olmayan Kültürel Mirası, 2019). In terms of traditional handicrafts in Eyüp, toy making, pottery and brick making, leather making, bürümcek fabric, fez (hat), and stone making have been identified. Over time, the handicrafts discovered in Eyüp have turned into both a tradition and economic gain for the people living in the Eyüp district. The tradition of floristry, which turns into an economic gain in production and handicrafts, is the ICH of Eyüp. At the time of the study, most of Eyüp's traditional handicrafts had no experts left, their places and production sites had disappeared, and were on the verge of being forgotten. Within the scope of the study, information about the development, locations, and current situation of handicrafts was discussed.

3.2.1. Eyüp toy making and toy making places

Dökmeci Hasan Ağa made the first Eyüp toy during the reign of Sultan Mahmud II. Later, shops were opened in Gümüşsuyu and toy art became widespread. Eyüp toys have been sold for centuries in Eyüp toy shops, attar (medicinal goods) shops in different districts of Istanbul, and street toy sellers. Evliya Çelebi recorded that there were 100 shops in Eyüp in the 17th century (Koçu, 1971). In Koçu (1971)'s study, it was stated that the old name of Camii Kebir Street was Toymaker's Bazaar and that there were 25–30 toy shops in this bazaar with no experts and sellers of Eyüp toys. While 25–30 toy shops were in operation at the beginning of the 19th century, many shops were burned down as a result of a fire in the bazaar in 1921, with only two shops surviving. In the interview with Kadir Şengöz in 1939, Şengöz stated that he had two shops of his own and another shop in the market, and that handmade toys did not attract attention compared with imported toys (Geleş, 2015). In the 20th century, with the industrialization of the toy industry, interest in handmade toys gradually decreased and interest in fabricated toys increased. The reason for this is that handmade toys could not improve themselves by processing and innovation (Ersoy İnci, 2006). Gürpınar (2014) states that the raw materials used in the production of Eyüp toys are obtained from recycling and these raw materials consist of leather, wood, tin, and clay. With these materials provided, the masters in the Toymaker's Bazaar were producing their toys in the workshop at the back of their shops and selling them in the shops at the front (Gürpınar, 2014) (Figure 11). In Eyüp, there are decks with mirrors on them, tambourines with tin cymbals, drums, wheeled cars, pilgrims, cradles, crop whistles, şak şak (sound toy),various animals, mosque minarets, Ferris wheels, and so on (Ersoy İnci, 2006).

Figure 11. Eyüp Toys and Toymakers' Bazaar (2023)

The toy-sellers' bazaar built on Camii Kebir Street in Eyüpsultan Central District, one of the most important axes leading to Eyüp Sultan Mosque and tomb (Figure 11), partially preserves its original function during the period when the study was conducted. In these shops, toys, religious materials, books, and clothing are sold at present. Apart from these commercially functional buildings, there are mausoleum structures and cemeteries. The fact that Camii Kebir Street was called Toymaker's Bazaar during the period when the study was carried out is a concrete reflection of the heritage of the district. With the development of the toy industry, toy production in the toy shops ended and the function of these shops changed and became sales places for religious materials. In the findings made within the scope of the study, it was determined that these shops were single spaces and that the setup of the toy workshops and shops mentioned by Gürpınar (2014) was disrupted and the buildings were used as single spaces. Eyüpsultan toy making, the ritual of bringing circumcision children to Eyüp, and buying toys for children from here are considered ICH in terms of the value of the toys manufactured in terms of traditional handicrafts, the value of the master–apprentice relationship, and the fact that they can be named as Eyüp toys within the borders of the country. Toy making contributed to Eyüp both economically and culturally. At the time of the study (2023), toy production continues in toy workshops in Kapatan Pasha Mosque (İskele Street) and Zal Mahmut Pasha social complex in Eyüp.

3.2.2. Pottery and brickwork

The market called Çömlekciler Çarşısı in Eyüp is located on Çömlekçiler Street in Nişanca District. In addition to the bazaars in Eyüp, this bazaar consists of shops staffed by pottery professionals. In the information compiled by Kuşu (2019), Evliya Çelebi, and Kömürciyan, the potters who gave their name to the bazaar consist of approximately 40 shops and state that these shops are lined up opposite each other throughout the bazaar. The raw material (clay) used to make pottery is provided from Kağıthane, Sarıyer streams and the Golden Horn, and this material reaches the bazaar from Balçık Pier, which is near the Potters' Bazaar. Along with pottery, bowls, glasses, pipes, bottles, bricks, and tiles were also produced in the bazaar (Kuşu, 2019) (Figure 12).

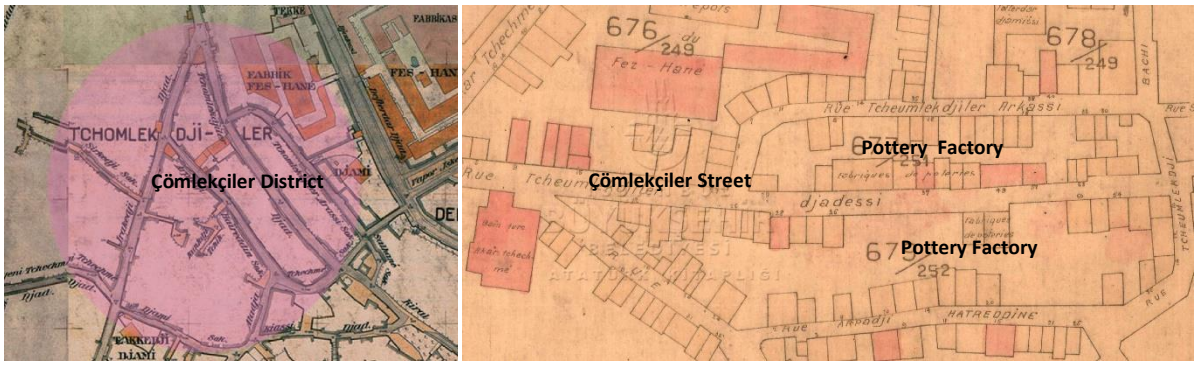


Figure 12. Eyüp Çömlekçiler District Alman Mavileri (1913–1914) (Atatürk Kitaplığı, 2020) and Pervititch Maps (Atatürk Kitaplığı, 2024)

Yenişehirlioğlu found pottery pieces during his archaeological excavations in the Eyüp Çömlekçiler District. The pottery pieces found during these excavations date back to the 19th century. It has been revealed that the rough Istanbul pottery of the 19th century is Eyüp pottery. In the 19th and 20th centuries, as a continuation of pottery production in Eyüp, brick and tile workshops were established especially around the Golden Horn, and the bricks and tiles produced during this period were used in the structures built in the surrounding area (Yenişehirlioğlu, 2005–06). Soyhan (1997) states that in the Ottoman period, pottery was used not only for cooking, but also for storing food ingredients and water, producing bowls, jars, glasses, jugs, pitchers, and water pipes. Additionally, pots were used to preserve flowers (Soyhan, 1997).

In the study, pottery and Eyüp pottery were examined in the field of handicrafts. In addition to the master–apprentice relationship, the importance of pottery for the people of the region is emphasized by the fact that the street where the potters are located is called Çömlekçiler Street, the pier where the raw materials are brought is called Balçık Pier, and the work of Mimar Sinan, Potter's Bath. The fact that the same professional group is gathered in this region has provided economic income to the

district and contributed to the development of handicrafts. After the end of pottery, the geographical and raw material opportunities of the region were taken advantage of and a fire brick factory was built on Çömlekciler Street. The construction date of the building, which was registered in 2009, is unknown. The factory built to use bricks in buildings is a derivative of pottery, and having a factory in the region making bricks from clay can be seen as a continuation of the pottery tradition. At the time of the study, there were no production areas or potters in the potter's bazaar. As a result, pottery was used in cooking and storing food in houses in Eyüp, in the production of toys, in storing flowers, in molds for shaping fezzes, and brick was used in the construction of residences and other architectural buildings. Pottery is an ICH value that affects Eyüp, but does not continue to exist today in the Eyüpsultan district.

3.2.3. Eyüp floristry

Floristry is among the income sources of Eyüp identified within the scope of the study. Koçu (1971) states that a flower market is held in the Toymaker's Bazaar on Fridays where roses, hyacinths, tulips, and jonquil flowers are sold. The flowers sold in the market were grown in fields on the hills of Gümüşsuyu, and the area where they were grown was called Fulya Field. In the 1950s, these flower fields were replaced by slums as a result of unplanned urbanization (Koçu, 1971) (figure 17). In his archive studies on Eyüp floristry, Kuşu (2019) determined that violets, tulips, hyacinths, and jonquils were grown in the fields on the Bahariye ridges in Eyüp and Bahariye gardens and that confectioners made desserts and sherbet from these flowers. In the same study, it was also mentioned that the importance of jonquil cultivation increased in Eyüp in the 18th century and who the tradesmen who grew and sold them were. In the study, it was determined that the soils of Eyüp and Kağıthane valleys are very fertile and these are the areas where the Lale-i Rumi tulip first grew.

Floristry has been practiced in Eyüp for a long time and has provided an economic contribution to the people undertaking this business in the region. Eyüp is associated with floristry and the flower market in the Toymaker's Bazaar has become traditional and Lale-i Rumi (known as the Ottoman Tulip), was first grown in Eyüp. It has become Eyüp's ICH. It was determined that this ICH could not be sustained as floristry was done in a few shops during the period of the study and the Eyüp flower fields disappeared.

3.2.4. Bürümcek cloth

The Turkish Language Association uses the word bürümcek or bürümcük to mean a thin fabric woven from raw silk and a headscarf made of raw silk (Türk Dİl Kurumu, 2023). Haskan (1996) states that a spring named Bürümcekli Ayazmana in Eyüp is located near the Surp Yeğya Church and that there are looms in this region where the bürümcek fabric is woven. It was determined that bürümcek fabric was not produced in Surp Yeghya Church and its surroundings at the time of the study. Bürümcek fabric is only mentioned in the literature, and it is thought that this handicraft tradition ended in Eyüp when the Armenians living in the region left.

3.2.5. Fez production and Feshane

Feshane is an industrial building built on Defterdar Street in Eyüp (Figure 13) in 1833 to meet the fez and fabric needs of the army. While the building was first built using cupboards turned by mules, in 1843, the production capacity was increased by introducing thread, weaving, and finishing machines powered by steam engines. The factory structure developed over time and became one of the most important production institutions. In 1895, a primary school attached to the factory was established to train workers and apprentices. All structures of the factory, which served various organizations after the Republic, were demolished in 1986 except for the large weaving hall (Dölen, 1994). Çalışlar Yenişehirlioğlu (2000) states in his study that the molds of the fezzes produced in Feshane might have been produced in the potter's bazaar.

Figure 13. Feshane (Mimarizm, 2020)

At the time of the study, Feshane (Figure 13) was used as a cultural center and served as a place where exhibitions, training, and workshops in different fields were held. Feshane considered a production place within the scope of ICH, played a major role in the production of fezzes, which were an important accessory of the period. In addition, the opening of a primary school within the factory and the work of those educated there in the factory is important in terms of the master–apprentice relationship, and thanks to this operation, fez production has been transferred from generation to generation and its ICH remains important. The use of pottery, an ICH element of Eyüp and the molds produced in the potter's bazaar for fez production show the relationship between these two cultural heritages. The building's current function and cultural activities contribute to the sociocultural richness of Eyüpsultan.

When discussing about tanneries in the Isparta Somut Olmayan Kültürel Miras Project, it states, "The tannery structures and each of the spaces they have are places, where people meet craft and craft meets space." The sentence emphasizes the importance of these structures. Within the scope of the study, the existence of this building group in Eyüp shows the presence of leatherworking and leather processing arts. For leatherworking and processing of leather, there must be workshops, tanneries, and candle shops. These building types were identified in Eyüp and gave their names to some streets. In the literature studies, it was determined that leather material was used for Eyüp toys. In this context, this shows that both ICH elements are related to each other. When all these determinations are examined, the leather industry has become an ICH element of Eyüp in the field of handicrafts and has taken its place in social memory by giving its name to both the economy of society and the streets. Leather has also contributed to ICH as it is used as the raw material of Eyüp toys.

3.2.7. Stonework

Another handicraft and professional group that is developing in Eyüp is stonework. Not much information about stonework could be found. However, as an ICH stonework handicrafts are present with their best examples in almost all monument buildings, residences, and cemeteries of Eyüp. The elements of Eyüp stonework that are reflected in the space as an ICH are stone and stonework. Although there is not enough information about the production places and locations, Kuşu (2019) stated that the quarries were built outside the land walls. In Eyüp, stonework can be seen in monument buildings, fountains, some examples of civil architecture, and especially tombstones.

3.3. Eating-drinking gastronomy

Türkiye's food and beverage culture, which has made a name for itself in the world, is an important ICH element. As an ICH, it reflects not only food, but also the preparation, cooking, and preservation of dishes passed down from generation to generation, and the tradition that develops along with it (Isparta'nın Somut Olmayan Kültürel Mirası, 2019).

Göktaş (1994) stated that visitors made their children happy by buying toys then eating Eyüp's famous kebab and baked goods (known as Eyüp halkası), while Eyüp cream were bought as gifts for neighbors after the visit to the Eyüp Sultan tomb.

Four foods stand out in the gastronomy of the Eyüp district. These are the Eyüp kebab, Eyüp cream, Eyüp ring, and Eyüp stew. In line with literature studies and observations made in the field, it has been

determined that among these four foods belonging to Eyüp, Eyüp ring and Eyüp casserole were present during the period when the study was conducted.

3.3.1. Eyüp halkası

This is the ring furnace in Eyüp that is still effective today. It is thought that the oven called the New Bakery during the last period of the Janissaries (infantry unit), was built in the mid-18th century and early 19th century (Kara, 1994). Although the production date of the Eyüp halkası is not known exactly, the production of halkası has continued in the bakery run by the Akmanoğlu family since 1883. The bakery has been in the same place since then. Halkası, which belongs to the times of poverty, is produced only from flour, water, salt, and oil, which has an important place in the memories of the people of the district. The Eyüp halkası also attracts the attention of those who visit Eyüp Sultan. Eyüp halkası was still being produced only in the Akmanoğlu kiln at the time of the study (figure 14). When the production space is considered, the space is divided into three parts. Although the contents of Eyüp ring and the first production phase maintain their originality, with the development of technology, the cooking is done with an electric oven.

Figure 14. Akmanoğlu Bakery and Eyüp halkası

3.3.2. Eyüp cream, yoghurt, pickle and kebab

Before the Ottoman Empire conquered Istanbul, the Eyüp settlement was a center that met the milk needs of Byzantium. During the Ottoman period, milk needs were met from this district with the dairies established in Eyüp (Kara, 1994). Yoghurt and cream are obtained from the milk produced in Eyüp, and the cream is famed as Eyüp Kaymakı. Eyüp cream shops, along with kebab shops, were located in the bazaar next to Mosque Kebir, and people who came to visit Eyüp bought cream from there. The cream makers in Eyüp were generally Bulgarian citizens (Koçu, 1971). After entertainment was held in the cream shops, complaints from the public increased and the cream shops were closed in the 1570s (Kara, 1994). The last two remaining cream shops were demolished during the expropriation between 1958 and 1960 (Koçu, 1971). Eyüp is also famous for its kebab and kebab shops. The two remaining kebab shops between 1935 and 1950 were eliminated with expropriation in 1956 (Kara, 1994). Koçu (1971) emphasized that Eyüp's tandoori kebab was famous and stated that Hacı Baba remained the last tandoori kebab restaurant between 1950 and 1958. During the period when the study was conducted (2022), Eyüpsultan cream shops, yoghurt shops, kebab shops, and the relevant production place and sales point could not be reached. Eyüp is famous for its gardens and flower growing. Vegetables produced in orchards are pickled and stored in Eyüp pots and the pickle festival is held in Kemerburgaz.

3.3.3. Eyüp güveci

Eyüp güveci emerged with the economic depression in the 1960s. Since the people living in Eyüp and those who came to visit were not able to afford the regular casserole, güveci was produced by placing it on dough. The food that has survived in Eyüp since the day it was produced is Eyüp's ICH in the field of gastronomy. Eyüp güveci, which was examined within the scope of Eyüp's ICH, continued to be produced in the bakeries around Eyüp Sultan at the time of the study (Figure 15). The ovens discussed do not have any similar features and the casseroles are produced in wood-burning ovens.

Figure 15. Eyüp güveci

3.4. Discussion

In the study, the ICH of Eyüpsultan was discussed and heritage places were evaluated together with the building groups and textures they formed. Eyüpsultan, a district with high spiritual value, has many religious building groups, cemeteries, examples of civil architecture, and bazaars where arts and crafts developed and where they were collected, from the time it was founded to the present day. No previous study has examined the intangible cultural heritage place, materials and rituals together of Eyüp.

Information about the ICH and places identified in Eyüp is given in table 2. The table includes information about whether the ICH continues or not and the existence of its location. While creating the table, Unesco's Convention for the Safeguarding of the Intangible Cultural Heritage was taken into consideration, and the ICH elements specific to Eyüp were examined under three main headings: social practice, handicrafts, and food and beverage gastronomy. Social practices have been examined under two headings: religion and practice. Eyüp is a settlement rich in religious beliefs. In this context, religious beliefs were divided as Muslims and Armenian Christians. Social practices are generally focused on Eyüp Sultan mosque and its surroundings. Under the title of handicraft production, the elements and spaces specific to Eyüp were examined. In the field of food and beverage gastronomy, in addition to foods specific to Eyüp, foods that contribute to the economy of the society were also discussed. In the columns of table 2, there are determinations about whether the ICH continues or not and the existence of the performance-production space.

It has been determined that some ICH is kept alive in Eyüp, while some are not preserved today. It is seen that the heritage considered as handicrafts has disappeared except for toy making. It is known that toy making continues in only a few workshops. The reason for this can be explained by the inability to keep up with the developing technology, changing production techniques, and the gradual decrease in interest of these handicrafts. Traditional toys are being replaced by factory-produced plastic toys, the interest in products such as pottery is gradually decreasing and being replaced by factory products, leather making is being replaced by modern factories in the clothing sector, flower fields are being replaced by slums and buildings, and modern construction materials are replacing stone with the development of construction techniques. The most important feature of ICH is transfer. With modernizing production, the biggest problem is that the master–apprentice relationship that will continue this legacy is lost and new experts are not trained. It is difficult to continue these arts today because apprentices cannot be found to train instead of traditional experts, hence why ICH studies are important. Documentation in ICH studies, which attach importance to the final product, production techniques and production sites is becoming increasingly important. For holistic protection, all these stages should be evaluated together with their spaces.

Table 2. ICH and places of Eyüp

Intangible cultural heritage				Currently practiced	Is the space available?	
Social Applications	**Religious Beliefs**	**Muslims**	Eyüp Sultan Mosque and Tomb related rituals	✓	Eyüp Sultan Mosque and Tomb	✓
			Lodges	-	29 lodge structures were identified	✓
			Burial Tradition	✓	Cemeteries	✓
		Armenian Community	Armenian Community Feast	✓	Surp Yeghia Armenian Church, Surp Asdvadzadzin Armenian church	✓
			Baptism	-	Surp Asdvadzadzin Church	✓
			Divine Anointing	-	Surp Asdvadzadzin Church	✓
			Holy Communion	✓	Surp Asdvadzadzin Church	✓
	Applications		Sword Donning Ceremony	-	Eyüp Sultan Tomb and Cülus Road	✓
			Imaret Tradition	✓	Mihrişah Valide Sultan Imaret	✓
			Circumcision Tradition	✓	Toymakers' Bazaar	✓
			Coffeehouses	✓	Pierre Loti Hill	✓
			Ramadan Festivities	✓	Eyüpsultan Mosque-Square	✓
			Visit of Circumcised Children	✓	Eyüp Sultan Tomb	✓
			Newlyweds' Visit	✓	Eyüp Sultan Tomb	✓
			Votive and Sacrifice Tradition	✓	Eyup Sultan Mosque	✓
Crafts-Production			Toymaking	✓	Kaptan Paşa Mosque – Zal Mahmut Paşa Complex	✓
			Pottery	-	Potters' Bazaar	-
			Leatherworking	-	-	-
			Stonework	-	-	-
			Floristry	-	Toymakers' Bazaar	✓
			Fez and Cloth (Feshane)	-	Feshane	✓
			Bürümcek Cloth	-	Nişanca-Armenian Settlement	-
Eating-Drinking Gastronomy			kebab	-	-	-
			Cream	-	-	-
			Pickle	✓	✓	-
			Eyüp Halkası	✓	Akmanoğlu Bakery	✓
			Eyüp Güveci	✓	Karadeniz Bakery	✓

Most of Rituals performed in Eyüp Sultan Mosque and tomb continue within the scope of religious belief. These rituals are developed specifically for mosques and tombs and performed according to the location. Almost all of these rituals can be interpreted as superstitious. However, in the definition of ICH in the convention on ICH; It is stated that it refers to the practices, representations, expressions, knowledge, skills and related tools, equipment, and cultural spaces that communities, groups and, in some cases, individuals define as part of their cultural heritage. These superstitions, practices, and representations fall within the scope of representations.

Regarding religious beliefs, lodges, zawiyas, and tombs belonging to sects in Eyüp and throughout Türkiye were closed by the law enacted on November 30, 1925. During this period, the closed lodges and mausoleum structures were not used in their original function and became idle and damaged. Some mausoleums were opened in 1950. In 1990, the law on opening tombs was changed and subject to the approval of the Ministry of Culture. There are many tombs throughout Eyüpsultan and with the opening of the tombs, visits to Eyüp Sultan have increased. Many lodge structures belong to sects in Eyüp. Some buildings have been refunctioned through restoration works, while others remain idle. In the field studies to be carried out, the function of the repurposed lodge structures and their harmony with their environment should be addressed.

It was determined that Armenians lived in Eyüp, and the rituals performed by Armenians in churches and the churches as places of ICH were discussed. Within the scope of the study, only holy communion

continues among the rituals practiced by the Armenian Christian community. Since few Armenians live in the region, other rituals cannot be performed.

Only Eyüp's halkası has survived Eyüp's eating and drinking culture. The Eyüp halkası is produced in only one kiln while Eyüp cream and yoghurt are no longer produced. This culture could not be continued due to changing economic earnings, production areas being replaced by buildings, and the lack of pastures to feed the animals used in milk production. The absence of experts making Eyüp kebab caused the kebab culture to cease. Almost all of the social practices carried out specifically for Eyüp have continued. The places of these practices, which continue with great interest in Eyüp, are also protected. The sword-girding ceremony, which was considered a social practice, ended with the abolition of the sultanate and the declaration of the Republic regime, but it maintained its place among the ICH values of Eyüp.

While evaluating the ICH of Eyüp within the scope of the study, the relationships between the ICH were determined (Figure 16). This relationship chart was created according to the definition of practices, representations, expressions, information, skills, tools, equipment and cultural spaces in the Convention for the Safeguarding of the Intangible Cultural Heritage. For example, children who will be circumcised are brought to visit Eyüp Sultan Mosque and tomb before they are circumcised. With the children being brought here, toy production started in Eyüp, and as a result of the increased interest in toys, a market with toy shops was established on Cami Kebir Street. These and similar relationships are shown in Figure 16.

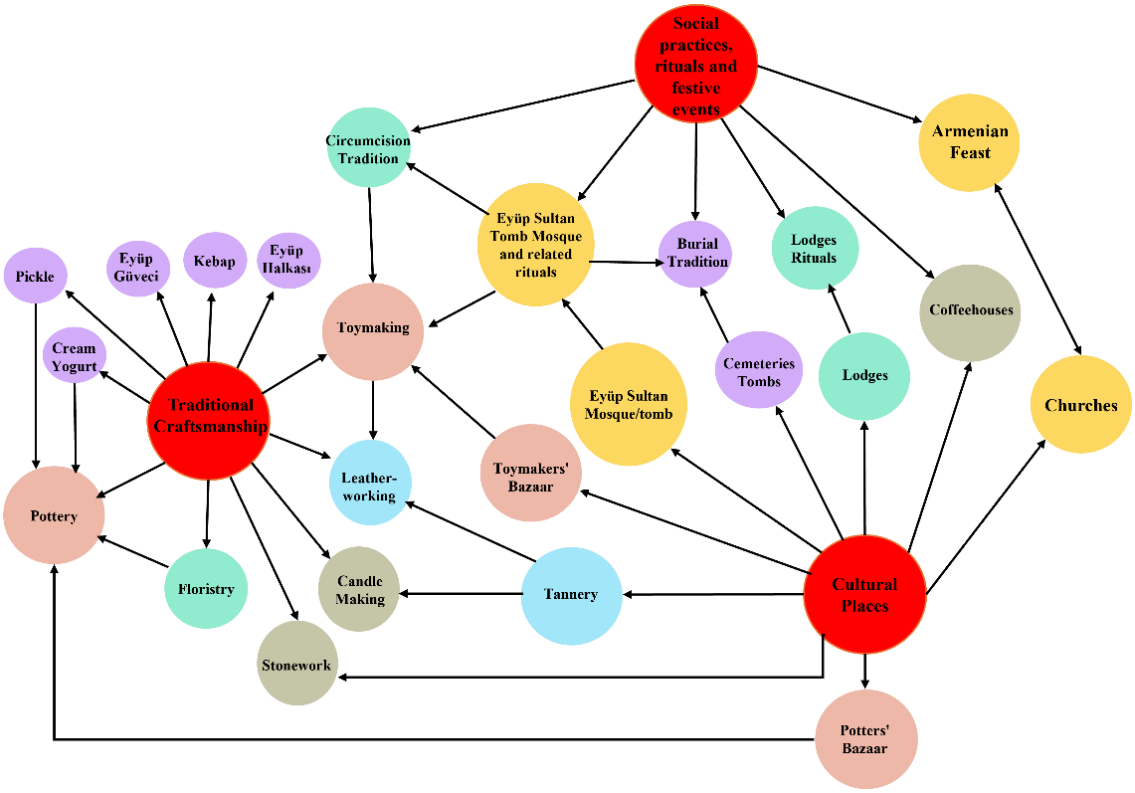
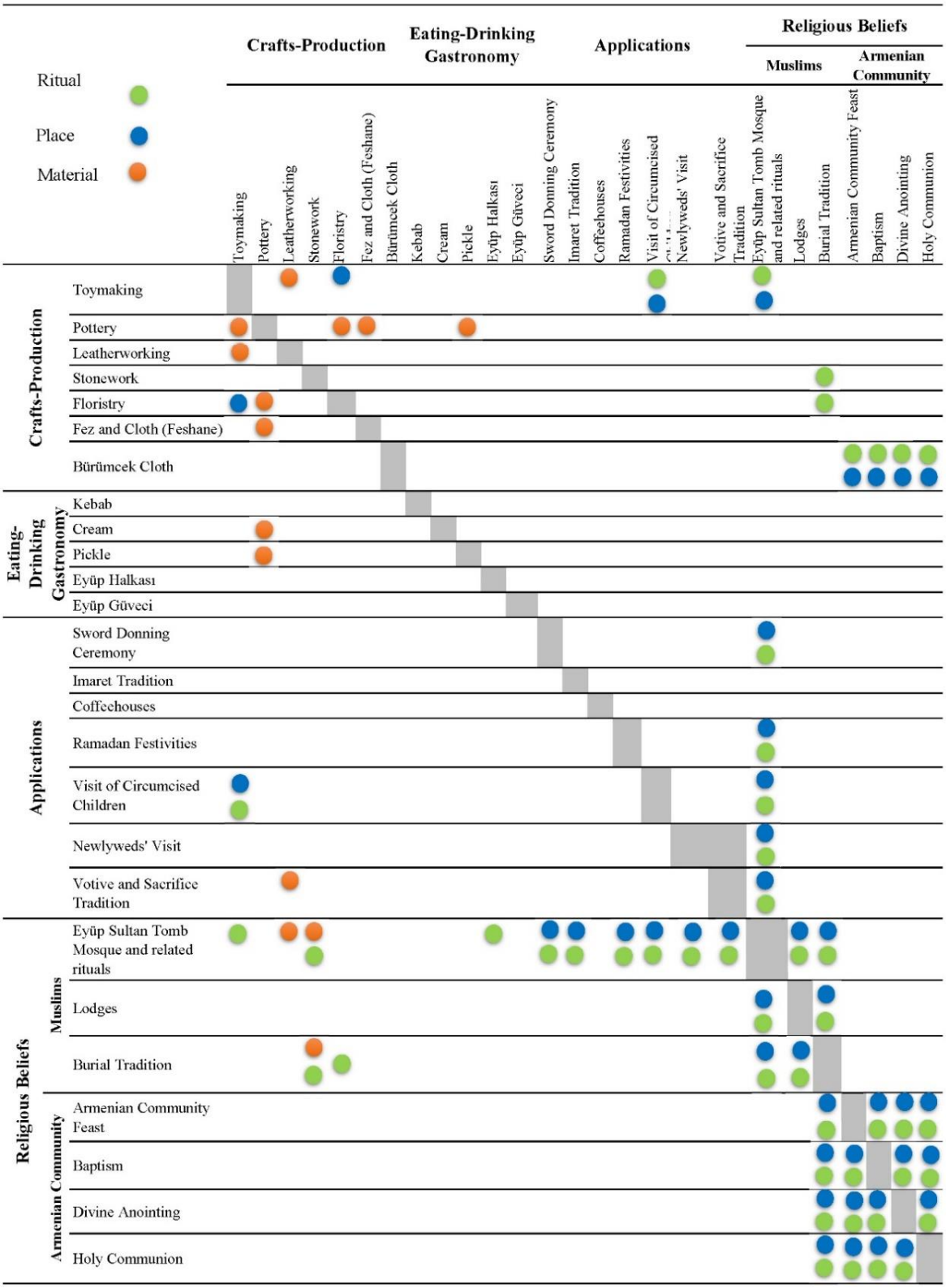


Figure 16. The network of relationships between the ICH of Eyüp

Figure 16 shows that the ICH elements are not a single element and affect each other, and this interaction has effects on the development, continuation, and termination of the heritage. As a result of this analysis and synthesis, it was seen that the elements affecting each other could be discussed in terms of ritual, space, and material within the scope of the study, and their relationships were detailed by creating a relationship matrix in Table 3. While some ICH elements are affected by only one feature, some are affected by two features. The created matrix is discussed in four sections: handicrafts and production, eating and beverage gastronomy, social practices, and religious beliefs. In the matrix, the sub-elements of these four ICH elements are specified. In the table, the common features of ICH elements are indicated as ritual (green), space (blue), and material (orange). ICH elements that have common features in terms of ritual, space, and material intersect are marked.

Table 3. Intangible cultural heritage relations matrix of Eyüp



For example (Table 3), toy making and Eyüp toy makers developed around the Eyüp Sultan Mosque and tomb, which was formed as part of the visit of circumcised children coming to Eyüp. Leather is among the materials used in toys, and leather produced in Eyüp tanneries was used. In terms of this feature, as determined by Gürpınar (2014), toy making and leather manufacturing were associated with Eyüp in terms of materials and sustainability and their production locations were identified within the scope of the study. This tradition affected Eyüp both in terms of material, ritual, and as a place. A

flower market was also established in the bazaar, which was formed by toy making, and floristry and toy making came together as a venue. In this context, materials associated with leather and toy making, the place associated with the toy seller's bazaar and floristry, ritual and place associated with the visit of circumcised children and the mosque and tomb, and ritual and place associated with toy making and the Eyüp Sultan Mosque are marked by similarity.

Within the scope of the study, ICH elements and locations were identified and ICH maps were processed on Alman Mavileri Maps (1913–14) (Atatürk Kitaplığı, 2020) and satellite photographs (Google Earth, 2024) (Figure 17). A 100-year change can be seen on the two maps, and some lost places, existing streets named after ICH, and lost streets have been identified. It has been determined that some ritual production spaces and textures have been lost due to the change of the settlement in the process. Tanman (1994) stated that Eyüp was an Islamic necropolis, but It was seen that the cemetery areas have largely disappeared, especially between the two maps. The jonquil fields identified by Koçu (1971) have also survived to the present day. Traces of the Armenian neighborhood in Eyüp mentioned by Hançer have not survived to the present day. It has been determined that although the spaces considered as ICH spaces are protected on a structure-specific basis, they are not protected on a texture basis.

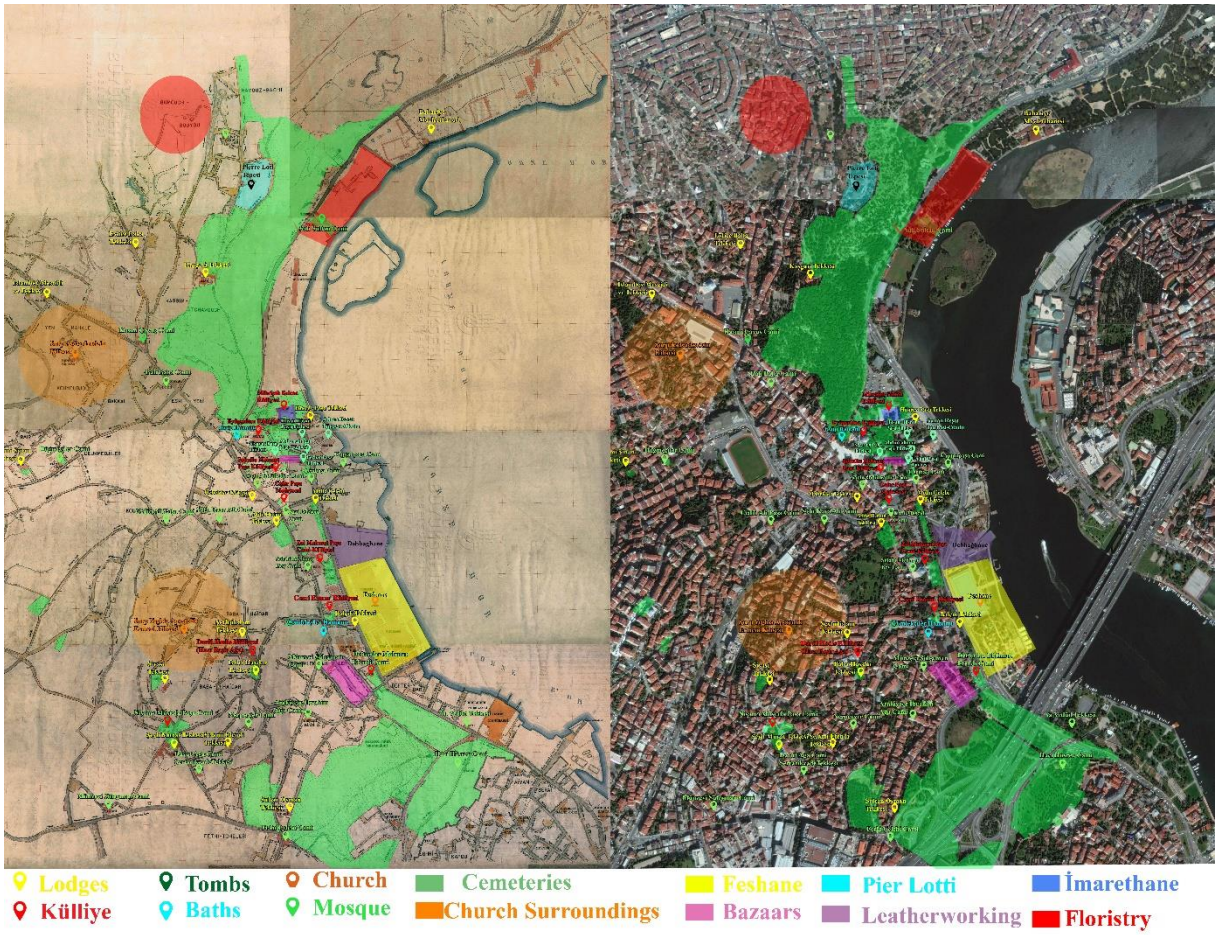


Figure 17. ICH map of Eyüp– Alman Mavileri (1913-1914) (Atatürk Kitaplığı, 2020)- 2024 (Google Earth, 2024)

4. Conclusion and suggestions

In the protection of cultural heritage, firstly, the concepts of site in which the natural environment, structures, and building groups are examined, were discussed with these concepts and the cultural heritage, which we describe as tangible, began to be protected. In the process, the concept of intangible heritage has emerged, and people, production, and even production stages have gained importance. Along with the concept of intangible heritage of production and production stages, practices and rituals performed by communities, the idea of protecting the tangible cultural heritage along with its space, buildings, environment, and texture of buildings has emerged. With the use of

these two heritage concepts, a holistic understanding of conservation has developed. When the concepts of tangible and intangible heritage are not protected or evaluated together, it is seen that some values are lost, moving away from the holistic conservation approach. Based on this understanding, Eyüp's ICH and ICH venues are discussed in the article. For Eyüp, 27 elements and their places were identified among the headings evaluated within the scope of the UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage, and the present-day continuity of ICH elements and places were questioned. Among the social practices evaluated within the scope of the study, almost all the rituals identified (except for the rituals performed in the lodge) are still taking place and have been preserved along with their places. In terms of religious belief, some of the worship performed by Armenian Christians is not implemented because there are few Armenians left in Eyüp and the churches no longer have a congregation. It is seen that almost all of the ICH elements examined under the heading of social implementation are implemented and their spaces are protected.

In the study, most of the ICH elements identified under the title of handicrafts and production in Eyüp were lost. The main reasons for the disappearance of handicrafts in Eyüp are based on the determinations made in the literature and field studies that handicrafts were negatively affected by technology and the interest in them gradually decreased, the master–apprentice relationship disappeared and the art and craft could be transferred, and some of them lose their current appeal. With the disappearance of these arts and crafts, it has been determined that some of the spaces belonging to them changed their functions and most of them disappeared. Some of the ICH elements identified in the study under the heading of food and beverage gastronomy in Eyüp have also been lost while some continue to exist. It is thought that the reason why some elements did not continue is that the production areas and spaces disappeared over time. The most important factor in keeping the social practices identified (specifically in Eyüp) alive is to correctly identify and convey the execution of the ICH. Since some of these practices do not have continuity today, it is thought that their spaces can be refunctioned and the ICH can be preserved in situ. When refunctioning, performance and space should be taken into consideration and should be protected together, and rituals should be explained physically or digitally by selecting appropriate infrastructures for the ritual and space. The handicraft production elements identified for Eyüp are on the verge of disappearing and the artisans and craftsmen who produce them need to be supported, encouraged, and protected in a commercial sense. For handicrafts to continue, these elements must be transferred from generation to generation and apprentices must be supported with training in this field. It should be possible to show the execution of handicraft products on different platforms and to promote them in various exhibitions and fairs.

There has been no previous study examining the intangible cultural heritage spaces, materials and rituals for Eyüp. As a result of all these determinations made within the scope of the study, it is seen that ICH and places are directly related. It is understood that even if the existence of the intangible heritage space lost in these relationships is preserved, the space loses its meaning and function and the place loses its originality. It is thought that the preservation of tangible cultural heritage and ICH together on-site can make the heritage easier to understand. Understandable heritage can be transferred from generation to generation and will be protected by local people and visitors.

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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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Sarayköy Halkevi Building According to Presidential State Archive Documents

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Abstract

With this article, the Sarayköy Halkevi Building, which has not survived to the present day, has been included in the art and architectural history inventory for the first time based on the documents of the Presidential State Archives. The text of the article consists of five sections in general terms. In the introduction section, information about the general course and sections of the article is given, and in the second section, the phenomenon of public houses in general and the establishment process of public houses are mentioned. In the third section, which can also be considered as a catalog, the establishment of Sarayköy Halkevi and the architectural features of the Halkevi building are mentioned. In the fourth section, comparisons are made with other public house buildings that have survived / not survived to the present day, and in the conclusion section, the original value of the study is mentioned.

Keywords: *Republic, architecture, halkevi, Sarayköy.*

Cumhurbaşkanlığı Devlet Arşiv Belgeleri Işığında Sarayköy Halkevi Binası

Öz

Bu çalışmanın temel amacı; bir Cumhuriyet kurumu olan Halkevlerinin sanat tarihinin bir çalışma alanı olarak belirlenmesine katkı sağlamak ve günümüze gelememiş bir Halkevi binasının sanat tarihi literatürüne kazandırmaktadır. Bu makale ile günümüze gelememiş olan Sarayköy Halkevi Binası, Cumhurbaşkanlığı Devlet Arşivleri belgelerinden hareketle ilk kez sanat ve mimarlık tarihi envanterine kazandırılmıştır. Makale metni genel hatlarıyla beş kısımdan müteşekkildir. Giriş kısmında makalenin genel seyri ve bölümleri hakkında bilgi verilmekte, ikinci kısımda genel olarak Halkevi olgusundan ve Halkevlerinin kuruluş sürecinden bahsedilmektedir. Katalog olarak da kabul edilebilecek olan üçüncü kısımda, Sarayköy Halkevi'nin kuruluşu ve Halkevi binasının mimari özelliklerinden bahsedilmiş, dördüncü bölüm olan değerlendirme kısmında günümüze ulaşan/ulaşmayan diğer Halkevi binaları ile karşılaştırmalar yapılmış, sonuç kısmında ise çalışmanın özgün değerinden bahsedilmiştir.

Anahtar Kelimeler: *Cumhuriyet, mimari, halkevi, Sarayköy.*

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1. Introduction

This study was prepared based on the data obtained from research conducted on the State Archives of the Presidency of the Republic of Türkiye, Sarayköy Halkevi Building. The study has a descriptive methodology and follows a course centered on the stages of introduction, identification, analysis, comparison-evaluation and conclusion stages. In general terms, the article consists of four sections. The introduction gives information about the course and sections of the article. The next section following the introduction deals with the phenomenon of the Halkevi (people's house) and the establishment and expansion processes of Halkevi in the late Ottoman and Republican Türkiye. In the section that follows, which can also be considered as the catalog section of the article, the architectural analysis of the Sarayköy Halkevi Building was made based on the archival documents in the Presidency of the State Archives. A descriptive methodology was preferred in this analysis. In the evaluation section, Saraykoy Halkevi Building was compared to other Halkevi in Anatolia in terms of its architectural features. Many visuals were used for the comparisons in this section. Due to the large number of images, these were collected into a table. In the conclusion section, general conclusions are mentioned. With this article, Saraykoy Halkevi Building, which has not survived to the present day, has been added to the art and architectural history inventory for the first time as a building type in the First and Second National Architecture movement based on official state archive documents.

2. Material and Method

The subject of this study is the Sarayköy Halkevi Building. Saraykoy Halkevi Building was one of the Halkevi buildings built as a part of the First and Second National Architecture movement. However, the building has not survived to the present day. Therefore, the main basis as a resource is the Documents of the State Archive of the Presidency of the Republic of Türkiye. In this article, CDA was used as the abbreviation of the State Archives of the Presidency of the Republic of Türkiye. In addition to these, the Sarayköy Municipality Archive was also examined within the scope of the study. In addition, an on-site examination was made in Denizli/Sarayköy. In this study, a descriptive methodology was preferred. In the field of art and architectural history, two methodologies were used: descriptive and hermeneutic. Hermeneutics is mostly preferred in iconographic studies. The descriptive method was preferred in identification and description. Accordingly, all data related to the building were collected. Then, in light of the data obtained (photographs, drawings, archive documents), the architectural description of the building was made. Its drawing was renewed. Based on this description, the building was compared with other contemporary public buildings. The comparison was made in terms of typology and architectural features (especially the facade design). Therefore, the descriptive method was also preferred in the evaluation part. For this comparison, drawings and photographs of similar buildings were accessed. The source of all images taken from different sources was indicated under the images.

3. Research Findings

3.1. An Overview of the Establishment of Halkevi Buildings

The 18th-19th century westernization process, which started to increase as of the 19th century, necessitated a change in Ottoman architecture. Building types and styles with different functions started to be imported in this period (Kuyulu, 1992, p.47,48). Sultan Abdülmecid and Abdülaziz periods are important in this respect. With the Abdülhamid II period, the construction of public buildings mostly related to education increased (Can, 2011, p.27). It should not be forgotten that the reign of Abdülhamid II was a continuation of the Westernization process that preceded it. However, the organizational structure has changed (Duymaz, 2003, p.42). In this context, the proclamation of the Tanzimat Edict and the Constitutional Monarchy should also be mentioned. These two events directly influenced late Ottoman and Republican architecture in terms of democratization and the importance of the public sphere, as well as influencing the development of nationalist and national movements that would develop later, and the dominance of many styles in art (Bozdoğan, 2012, p.41).

Tanzimat, which is derived *from tanzim*, meaning putting in order / to bring order; was used to define all the measures taken and the practices envisaged to be realized in order for the administrative functioning to continue with corrections. With the Tanzimat Edict and the subsequent Tanzimat Period, radical changes were experienced in the Ottoman state structure and social life. With this new process, public buildings such as government mansions, hospitals, banks, schools and municipalities, which had not been built before, entered the Ottoman architectural repertoire (Yazıcı, 2007, p.117).

One of the outcomes of the Tanzimat Period and the process that followed was the proclamation of the Constitutional Monarchy. Although at first it was perceived as an attempt to reconstitute the constitutional process (the 1876 constitution), a much more radical transformation was aimed with the re-proclamation of the Constitutional Monarchy (Kansu, 2016, p.2). With the Second Constitutional Monarchy, the dominant political trend was Turkism (Tunaya, 1988, p.414). In this process, it was possible to talk about many different factions centered on Turkism. Among these, the Turkish Quarry, which was organized among the students of the Military Medical School, was quite important. Officially established on March 25, 1912, the declaration of the Turkish Hearth was written on May 11, 1911 (Sarınay, 1994, p.127).

After its foundation, the Turkish Hearths established branches in many Anatolian cities, especially in Istanbul. The number of branches reached 16 in 1914, 25 in 1916, 35 in 1918, 71 in 1927, 135 in 1925, 260 in 1928 and 267 in 1931 (Bozdağ, 2013, p.19).

Both having a nationalist ideology and being an institution inherited from the Ottoman Empire, the Turkish Hearths failed to harmonize with the general ideology of Republican Türkiye. Therefore, at the April 10, 1931 congress of the Ankara Turkish Hearths Headquarters, it was decided to close down the Turkish Hearths and transfer all its assets to the CHF (Toksoy, 2007, p.26). Following this transfer decision, Halkevi was officially established on February 19, 1932 (Çeçen, 2018, p.111). In 1932, Ankara, Afyon, Aydın, Bolu, Bursa, Çanakkale, Denizli, Diyarbakır, Eskişehir, İstanbul, İzmir, Konya, Malatya, Samsun; in 1932, Antalya, Bilecik, Edirne, Gaziantep, Silifke, Giresun, Kastamonu, Kayseri, Kırıkkale, Kocaeli, Kütahya, Ordu, Rize, Sinop, Şebinkarahisar, Tekirdağ, Trabzon, Van and Yozgat Halkevi entered into service (Toksoy, 2007, p.42). A total of 479 Halkevi was opened between 1932 and 1946, including 21 in 1933, 25 in 1934, 23 in 1935, 33 in 1936, 31 in 1937, 43 in 1938, 163 in 1939, 6 in 1940, 2 in 1941, 3 in 1942, 4 in 1943, 3 in 1944, 17 in 1945 and 1 in 1946 (Zeyrek, 2006, p.24, 25).

The institutional framework of the Halkevi, whose number of branches rapidly reached five hundred after their establishment, was shaped according to the CHF (CHP) Halkevi Instructions.

> *The foundations of our party's program are republicanism, nationalism, populism, statism, secularism and revolutionism. In order for these main and fundamental principles to prevail and become eternal, our program identifies and points to raising strong citizens with these qualities, raising the national character to the levels inspired by Turkish history, raising fine arts, strengthening national culture and scientific movements and activities as important means. All of these principles and means together aim to raise generations that will regain the long-lost years of Turkishness on the road to civilization with courageous, assertive and tireless moves, and to restore the Turkish position of honor in the field of civilization commensurate with its natural virtues and abilities. The aim of the Halkevi is to be gathering and unifying dormitories for ambitious citizens who will work for this cause* (Cumhuriyet Halk Fırkası, 1932, p.5).

The directive also specified how the buildings of the Halkevi would be selected, how they would be constructed and what kind of features they would have.

Facility conditions

In the establishment and organization of Halkevi, first of all, the elements that will ensure the activities of the branches listed in the third article and the building, money and other material means suitable for their work are sought. If there are no working elements sufficient for the organization of all branches at the same time, Halkevi may be opened, provided that the activities of at least three branches are

ensured. And other branches shall be completed gradually.

Building Supply and Arrangement

8) The buildings of the Halkevi shall be provided, designed and furnished by the administrative committees of the Republican People's Party.

If One Building is Not Enough

10) If there is not a building large enough for all the working branches, it is permissible for some branches to work in another building.

What is forbidden and what is allowed?

12) Places shall be allocated for billiards, indoor tennis and other indoor gymnastics in Halkevi. Alcoholic beverages and games are not permitted.

Utilization of Radio and Cinemas

13) The manner of utilization of radios and cinemas in Halkevi buildings will be separately arranged and determined by the center and will be notified.

Monthly Plays

14) Public events with a regular program for the whole public are organized at least once a month in Halkevi. Conference, accounting and music evenings are separate from these (Cumhuriyet Halk Fırkası, 1932, p.6,7).

Based on the directive, it could be argued that the reason for the freedom in the choice of buildings was to branch out rapidly and to pursue an active expansion policy. Therefore, in many cities, especially in Anatolia, buildings of different types, most of which were either civil or public buildings, were converted into Halkevi buildings.

The Halkevi, which developed rapidly in approximately twenty years until the mid- 1940s, began to experience institutional problems after the transition to multi-party life. Especially after the multi-party period, Halkevi began to be seen more as a political institution belonging to the Republican People's Party and as a result of the frequent statements that they had gone beyond their founding principle, Halkevi was closed down with the TBMM's law dated August 8, 1951 and numbered 5830 (Arıkan, 1999, p.279).

3.2. Saraykoy Halkevi Building

3.2.1. Establishment Process

As mentioned earlier, at the 1931 (April 10) congress of the Turkish Hearths Headquarters, it was decided to close down the Turkish Hearths and transfer all its assets to the CHF (Toksoy, 2007, p.26). Following this decision, Halkevi across the country experienced a rapid establishment process as a public institution and branched out. In this process, in many provinces and districts, the buildings belonging to the Turkish Hearths were transferred to the Halkevi by local administrations, and in places where there were no buildings under the Turkish Hearths, Halkevi were established by renting or purchasing. In most settlements, Halkevi were planned to operate in CHP party buildings.

One of the Halkevi thus formed was the Denizli Saraykoy Halkevi Building. In a document dated 1937 in the State Archives Department of the Presidency of the Republic of Türkiye and dedicated to the CHP Presidency, it is mentioned that there was a building and a sports field in Saraykoy District that was transferred to the CHP from the disbanded Turkish Quarry (CDA. 1691 - 876 - 1 / 00.00.1943-16.05.1945 / no: 29, 1945b). Based on this official document, it was understood that the Sarayköy Halkevi District started its service in 1937 in a building transferred from the Turkish Quarry. According to another document dated 1939 in the State Archives of the Presidency of the Republic, it was understood that the sports field that was transferred to the party was later transferred to the General Directorate of

Physical Education free of charge (CDA. 1691 - 876 - 1 / 00.00.1943-16.05.1945 / no: 20, 1945a).

3.2.2. Architectural Features

In a document dated 1945 in the State Archives of the Presidency of the Republic of Türkiye, many features of the building can be found in the inventory receipt and the accompanying drawings, which were prepared by the CHP and based on a template applied to all Halkevi across the country (Figure 1-2). The architectural and plan features of the Sarayköy Halkevi Building were be made according to these official documents.

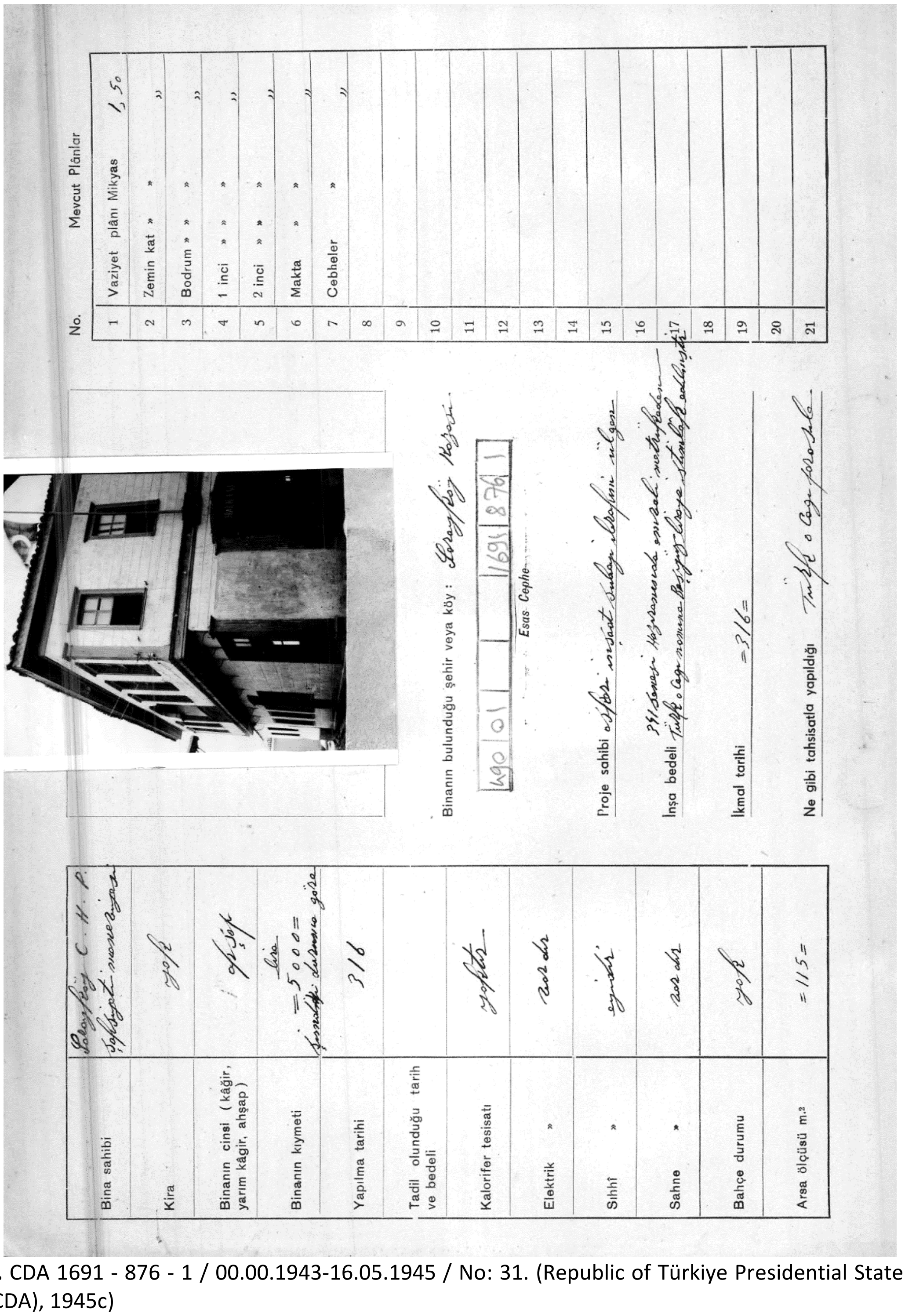


Figure 1. CDA 1691 - 876 - 1 / 00.00.1943-16.05.1945 / No: 31. (Republic of Türkiye Presidential State Archive (CDA), 1945c)

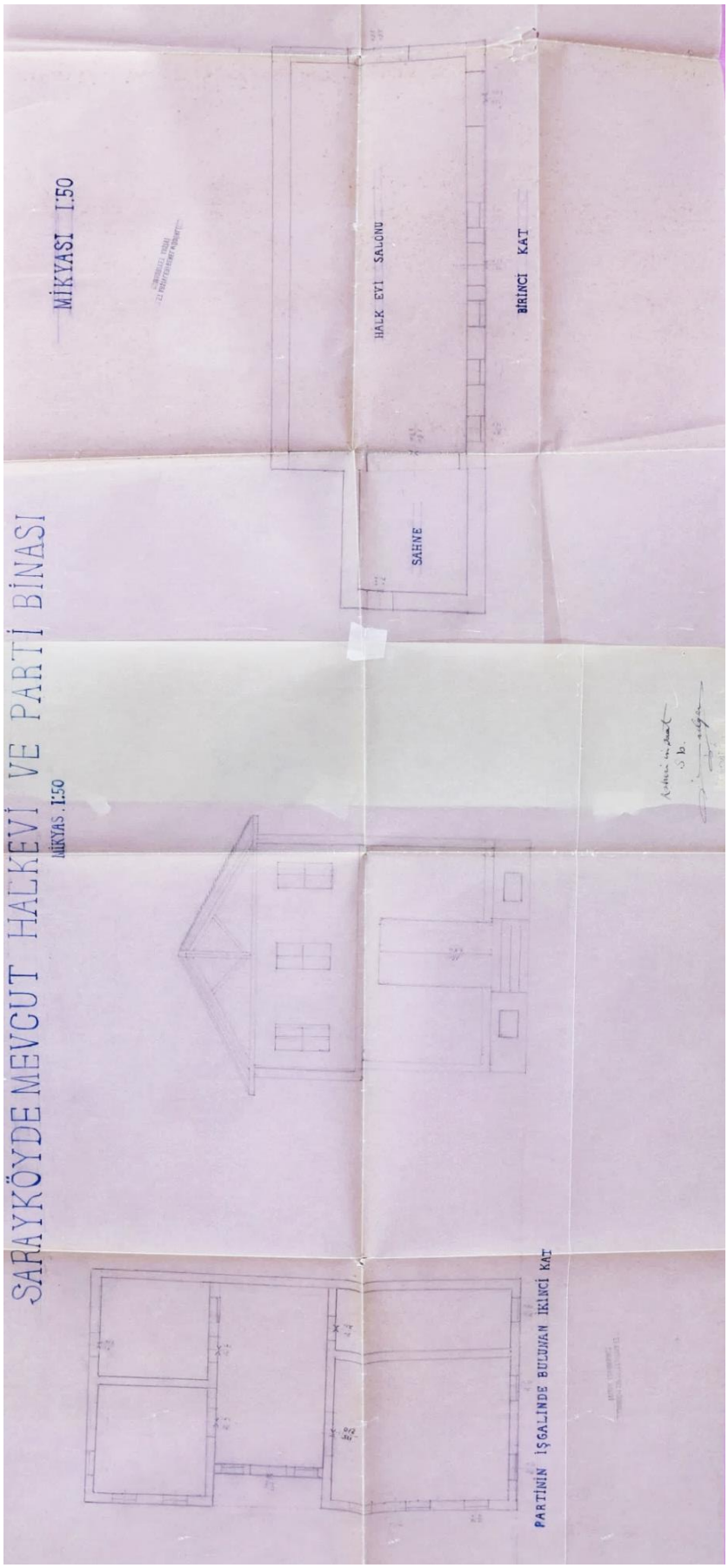
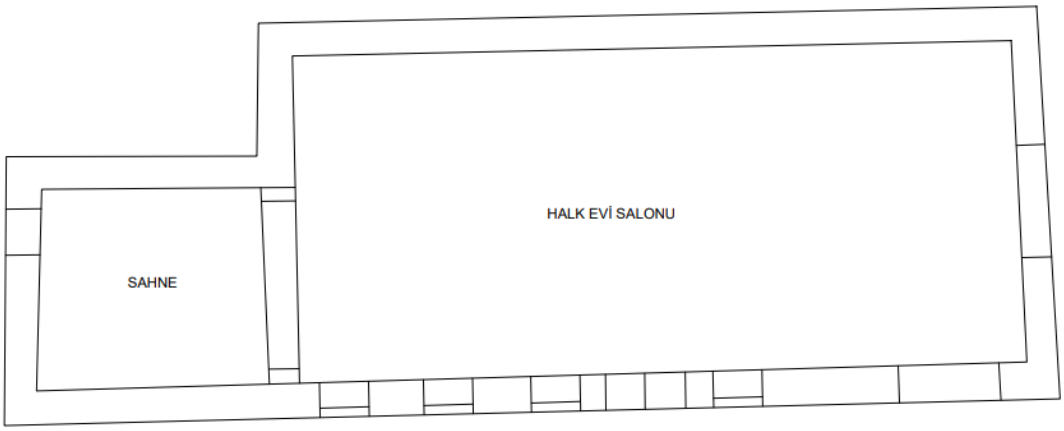


Figure 2. CDA 1691 - 876 - 1 / 00.00.1943-16.05.1945 / No: 32. (Republic of Türkiye Presidential State Archive (CDA), 1945d)

According to this:

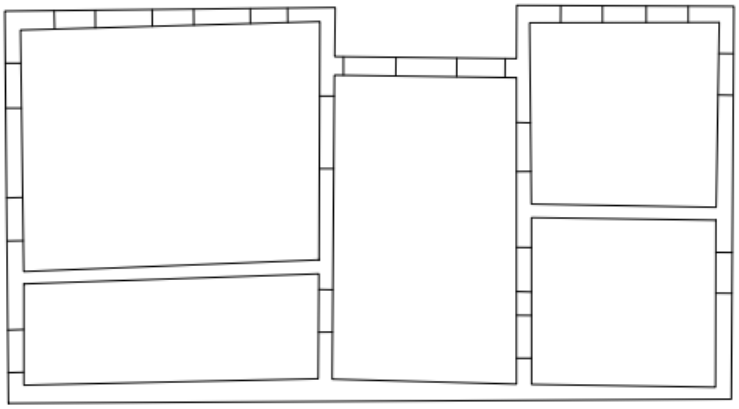
Sitting on a 115 square meter land share and built as a two-storey building made of wooden material, Sarayköy Halkevi Building, in addition to having the appearance of a mansion (partially), also resembled the commercial buildings encountered in late Ottoman architecture, whose lower floors served as shops, had two-stories and a product of civil architecture. It was understood from the existing building photograph in the inventory receipt that the Sarayköy Halkevi Building had at least two facades. The fact that the ground floor of the north façade of the building was deaf on the plan suggested that this façade was blind. When the existing building photograph and the plan were compared, it was understood that the photograph belonged to the southeast façade of the building. Based on the plan, it was understood that the ground floor of the building consisted of a single volume with a vertical rectangular plan, that the ground floor was entered through a wide door on the east façade and that there were four windows and two more entrance doors on the south façade of the unit that was used as a hall. To the west of this hall, there was a square planned stage section connected to the hall with another door on the west wall that provided contact with the outside (Figure 3).



Scale 1/50

Figure 3. Sarayköy Halkevi Building ground floor drawing (Yılmaz, 2024)

The first floor of the building was in the plan type of a house with an inner living room. In general, the first floor consisted of four spaces, one of which was square and rectangular and the other two were rectangular, located around a rectangular central area complemented by a balcony. The upper floor units had a total of twelve windows for lighting purposes, two of which were located on the balcony (Figure 4).



Scale 1/50

Figure 4. Sarayköy Halkevi Building first floor drawing ((Yılmaz, 2024)

Based on the available archival documents, it was understood that the Sarayköy Halkevi Building had electricity and a stage, but not a heating system or a garden.

As a result of the evaluations made on the archival documents, it was also determined that there were some inconsistencies between the plan of the building and the photograph. One of these was the roof condition of the building. Although it was understood from both the façade drawing and the photograph that there was a roof arrangement covered with Marseille type tiles, it was understood that the Halkevi had a gable roof in the façade drawing of the building, but the upper cover was not perceived as such in the photograph. In addition, the basement floor windows in the façade drawing of the building could not be selected in the photograph of the building. It was considered that this situation could be related to the angle of the photograph. In particular, it was considered that this roof discrepancy was related to the fact that the plan of the building was older and reflected the original state of the building, while the visual was dated later. Unfortunately, no source or official document related to this process and the possible change in the building could be found.

In the archive document, it is stated that the building, which started to be used as a Halkevi, was built as the Turkish Quarry in 1899. Regarding the current status of the building, the building was not found in the observations made in Sarayköy. Denizli Museum Directorate was contacted regarding the current status of the building, but no information or registration record of the building was found. Later, as a result of the examinations made in the archive of Sarayköy Municipality Zoning Affairs Department the investigations made in Sarayköy and the interviews with the residents of the city who were over eighty years old, the location of the building was largely determined (According to archival records, the area where the building was located was expropriated in the 1970s. It is thought that the Sarayköy Halkevi Building was demolished in this process. At this point, I would like to thank Murat Mustafa Ayhan, Director of Sarayköy Municipality Zoning and Urbanization Unit, for his great contributions). There is a square in its place today (Figure 5).

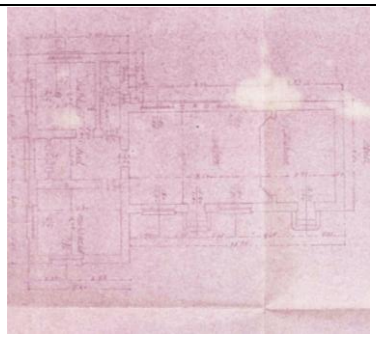
Figure 5. The area where Sarayköy Halkevi Building was located: Sarayköy Atatürk Square

4. Conclusion and Suggestions

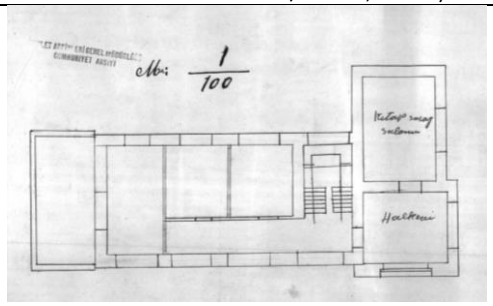
In her doctoral dissertation (Durukan, 2006: p.146), Ayşe Durukan examined the Halkevi built between 1930 and 1940 and created a typology for Halkevi by focusing on the hall, administration department, library and classrooms. Accordingly, Durukan categorized the Halkevi as I, L, T and U. Neşe Gürallar Yeşilkaya, on the other hand, stated that Halkevi had similar plan features and that T, L and I types were seen in the buildings (Yesilkaya, 1999, p.165). The findings of both researchers are in fact valid for the buildings built as Halkevi within a specific program in big cities. Because the Halkevi buildings in Denizli and its surroundings did not form a common typology and did not have similar architectural features (In this context, two architectural elements that were essential for Halkevi could be mentioned: The hall and the stage). Therefore, making evaluations and determinations based on the approaches of both Durukan and Yeşilkaya would be an extremely forced choice for the Sarayköy Halkevi Building (Yeşilkaya, who does not make a complete typological grouping, states that the L-plan

types are mostly associated with small-sized Halkevi and that this situation is directly related to the garden space). This situation is also clearly seen in the plans and photographs of Kızılcabölük, Honaz, Akalan and Kale Halkevi-party buildings in and around Denizli, which are available in the State Archives of the Presidency (In fact, this grouping is not a new approach in the case of Halkevi but is a classification that applies to all public buildings of the Republican period) (Figure 6a-b-c-d-e-f-g).

a. Kızılca Halkevi Building (Republic of Türkiye Presidential State Archive (CDA) 1691 - 876 - 1 / 00.00.1943-16.05.1945 / no: 33, 1945e)

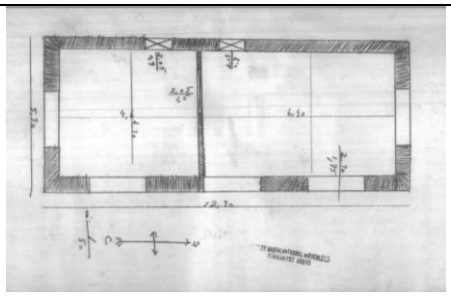


b.Kızılca Halkevi Building Plan (Republic of Türkiye Presidential State Archive (CDA) 1691 - 876 - 1 / 00.00.1943-16.05.1945 / no: 34, 1945f)

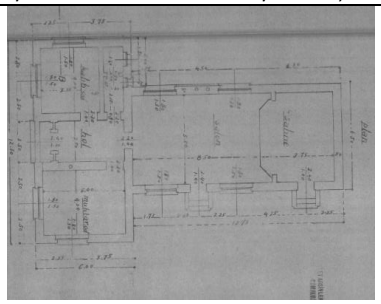


c. Honaz Halkevi Building Plan (Republic of Türkiye Presidential State Archive (CDA) 1691 - 876 - 1 / 00.00.1943-16.05.1945 / no: 36, 1945h)

d. Akalan Halkevi Building (Republic of Türkiye Presidential State Archive (CDA) 1691 - 876 - 1 / 00.00.1943-16.05.1945 / no: 37, 1945i)



e. Akalan Halkevi Building Plan (Republic of Türkiye Presidential State Archive (CDA) 1691 - 876 - 1 / 00.00.1943-16.05.1945 / no: 38, 1945j)



f. Nikfer Halkevi Building Plan (Republic of Türkiye Presidential State Archive (CDA) 1691 - 876-1 00.00.1943-16.05.1945 / no: 40, 194k)

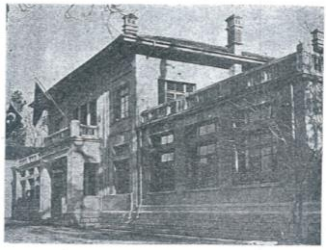
g. Kale Halkevi Building Plan (Republic of Türkiye Presidential State Archive (CDA) 1691 - 876 - 1 / 00.00.1943-16.05.1945 / no: 41, 1945l)

Figure 6a-b-c-d-e-f-g. Plans and photographs of Halkevi around Denizli

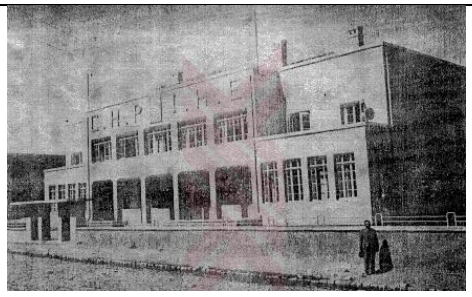
In fact, this is the case for all Halkevi buildings (not located in major centers) built or converted

throughout the country (Figure 7a-b-c-d-e-f-g-h).

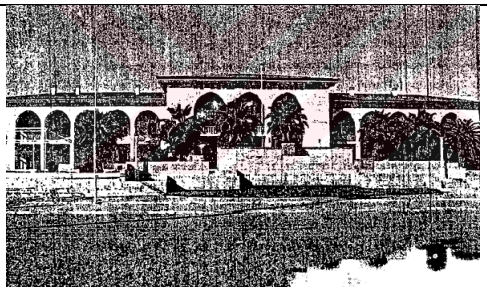
a. Bursa Halkevi 1932 (Akkuş, 2020)



b. Antalya Halkevi 1932 (Kapusuzoğlu, 2020)



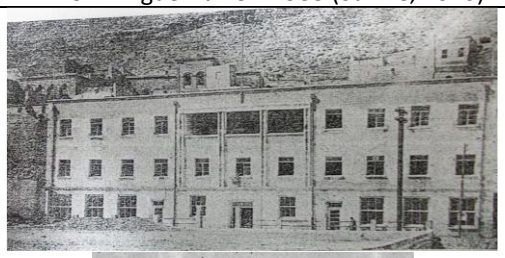
c. Isparta Halkevi 1933 (Turan, 2020)

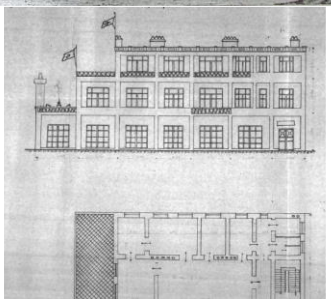


d. Mersin Halkevi 1946 (Yiğit, 2020)

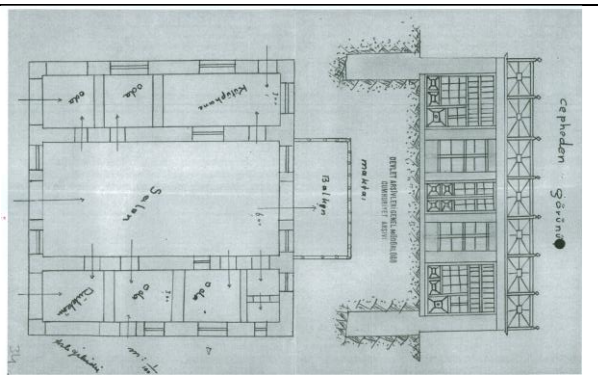
e. Niğde Halkevi 1933 (Sürme, 2020)

f. Maraş Halkevi 1934 (Doğan, 2020)





g. Mardin Halkevi 1934 (Dilek, 2020)



h. Cizre Halkevi 1938 (Altan, 2020)

Figure 7a-b-c-d-e-f-g-h. Photographs and Plans of Different Halkevi from Anatolia

The fact that the twelve Halkevi buildings in the city center and districts of Aydın, which is neighboring and quite close to Denizli, had dissimilar plans and architectural features could be presented as a proof of this situation (Yılmaz, 2019, p.39-107). This difference in plan type and architectural features was undoubtedly the same for materials and techniques. With its current appearance, the building was not very similar to the registered civil architecture buildings in Sarayköy (Figure 8). The only difference between these examples and Sarayköy Halkevi Building was the use of materials.

Figure 8. Saraykoy Hisar Neighborhood General View. (Denizli Kültür Envanteri, 2020)

However, it was similar in terms of stylistic features to the two-storey civil architecture examples in the city center of Aydın, some of which were designed to have shops on the lower floors (Figure 9).

a. An Example of Trade Architecture from Aydın

b. A Hotel Building Demolished in Aydın

c. An Example of Civil Architecture from Aydın

d. An Example of Civil Architecture from Aydın

e. An Example of Civil Architecture from Aydın

f. An Example of Civil Architecture from Aydın

g. An Example of Civil Architecture from Aydın

Figure 9a-b-c-d-e-f-g. Registered civil architecture examples in Aydin City Center (All images belong to the author)

Therefore, the Sarayköy Halkevi Building was built on the basis of functionality as a product of a local architectural tradition in the provinces. It cannot contain the hall and stage, which are the minimum conditions of a Halkevi, and it is a Halkevi building with an individual plan that was taken over from a Turkish hearth building and built to serve similar purposes.

Halkevi is public, official and political buildings in terms of their founding principles. They emerged as a product of the official understanding of a period. They were also the architectural products of an ideology. In this respect, they can be considered as the last great experiment of Turkish architecture in terms of the influence of ideology on architecture. Despite this, unfortunately, Halkevi buildings have not managed to become a focus of art and architectural historians. Halkevi buildings, especially in the provinces, were institutions organized on the basis of functionality. This form of organization was directly reflected in architecture.

Therefore, the People's Houses were sometimes converted from a Turkish Quarry, sometimes from a mansion, and sometimes from a commercial building. Halkevi buildings served a specific purpose in the region in which they were located. In this respect, although the buildings were not originally built

as public houses and thus did not reflect a certain typology and architectural characteristic, these public houses operating in different buildings are the most important ideological-public architectural phenomena of Republican Turkey. Therefore, this subject is worthy of research in itself.

This study is a research on a public house building that has never been published before and was published as a result of the research conducted in the State Archives of the Presidency of the Republic of Türkiye. In this respect, it is hoped that the study will accelerate the studies on the subject and contribute to those who will conduct research on similar issues.

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Author Contribution and Conflict of Interest Declaration Information

There is no conflict of interest in this single-author article.

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