INNOVATIVE APPROACHES IN PLANNING AND DESIGN

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PREFACE

Using innovative approaches in planning and design processes requires addressing problems in a different way, finding extraordinary solutions and pushing boundaries. Innovative approaches also enable interdisciplinary collaboration and benefit from different perspectives. It is an approach to closely follow technological developments and integrate them into planning and design processes.

This book aims to provide an example of innovative approaches in planning and design. This study, prepared by a team of experts from different disciplines, includes examples and case studies in various fields, from urban planning to architecture, from product design to planning strategies.

I would like to thank the authors who contributed to the realization of this study with their chapter articles and made us use of their valuable ideas and research. I would also like to thank Assoc. Prof. Dr. Seyithan SEYDOŞOĞLU and IKSAD Publishing staff for their support and knowledge during the formation and publication stages of the book. I hope the book will be useful for the scientific world and anyone interested in this subject.

Sincerely yours

Assoc. Prof. Dr. Arzu ALTUNTAŞ

December, 2023 – Siirt

CHAPTER 1

MONITORING TO SPATIO-TEMPORAL VARIATION OF DROUGHT BASED ON VEGETATION CONDITION INDEX AT THE BASIN SCALE

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INTRODUCTION

Climate changes due to the greenhouse effect caused by the increase of heat-trapping gases in the atmosphere are expressed as global warming (Zheng et al., 2019). Droughts, storms and floods caused by global warming cause both loss of life and property (Ebi et al., 2021). The negative impact of rising temperatures in recent years, especially on living standards and agricultural production, encourages policy makers to tackle climate change and its devastating effects worldwide (Mate et al., 2021; Forzieri et al., 2017). Climate change has increased the frequency and severity of droughts worldwide (Pokhrel et al., 2021; Wu et al., 2022). Drought, which is a natural climatic event, is expressed as a water imbalance caused by the lack of precipitation and periodically recurring climatic features (Liu et al., 2021). Generally, drought can occur in regions where precipitation is below the average in the long term (Haile et al., 2020). Drought, which can be considered as a long-term natural disaster, may not be over immediately after it affects a region. For this reason, it is very difficult to quantify drought in agricultural areas (Kim et al., 2020).

Understanding the response of vegetation to drought is of paramount importance for the conservation of terrestrial ecosystem biodiversity (Li et al., 2022). Various approaches have been developed to determine the effects of drought on vegetation. These can be classified as phenological studies, yield analyses, analysis of hydraulic properties of vegetation and the use of remote sensing technology (Páscoa et al., 2020). It is essential to track and evaluate drought using scientific instruments in order to reduce further risk and potential consequences. Observations of meteorological and hydrological data, such as temperature, precipitation, soil moisture, evapotranspiration, and surface runoff, are the mainstay of traditional drought monitoring techniques. Several drought indices, including the standardized precipitation index (Tirivarombo et al., 2018), the Palmer drought severity index (Zhu et al., 2018), the crop moisture index (Palmer, 1968), the soil moisture drought

index (Ajaz et al., 2019), and the crop-specific drought index (Meyer and Hubbard, 1995) have been developed in recent decades based on this point data. Due to the restricted spatial density and dispersion of the observation stations, interpolation of data points when using these approaches makes it challenging to ensure dependability (Mendicino et al., 2008; Baniya et al., 2019).

A sophisticated and practical tool for tracking drought is remote sensing. The normalized difference vegetation index (NDVI), temperature vegetation drought index (TVDI), and vegetation condition index (VCI) are only a few of the drought indices that have been developed using remote sensing of vegetation (Baniya et al., 2019; Yihdego et al., 2019; Liu et al., 2020). In comparison to NDVI and TVDI, which can lessen the effects of geographic location, ecological system, and soil condition, the sensitivity of VCI for monitoring drought is substantially higher (Liu et al., 1996; Sha et al., 2013). Because VCI isolates climate signals from long-term biological signals, it is also a better indication of moisture deficiency than NDVI (Jain et al., 2010). So, compared to other remote sensing-based indices, VCI can be utilized in non-homogeneous areas to monitor and analyze drought more precisely. Due to this, VCI has been extensively utilized in drought monitoring and analysis (Qian et al., 2016; Liang et al., 2017) and numerous studies have confirmed its dependability.

In this study, it was aimed to determine the vegetation condition between 2014-2022 in a sub-basin of the Western Mediterranean basin. In this context, analyzes were carried out with the NDVI and VCI using Landsat satellite images. The VCI maps obtained from this study, which reveal the intensity, time and dynamics of drought, will contribute to the determination of the effects of drought on land cover/land use and especially vegetation.

1. MATERIAL AND METHOD

1.1. Study Area

The study was carried out in one of the sub-basins of the Western Mediterranean Basin. This sub-basin includes some parts of Kumluca and Finike districts (30°14' E, 36°28' N). The study area is 96933.78 hectares in total and consists of basic land use/land cover, forest areas, agricultural areas, settlements and water bodies (Figure 1).

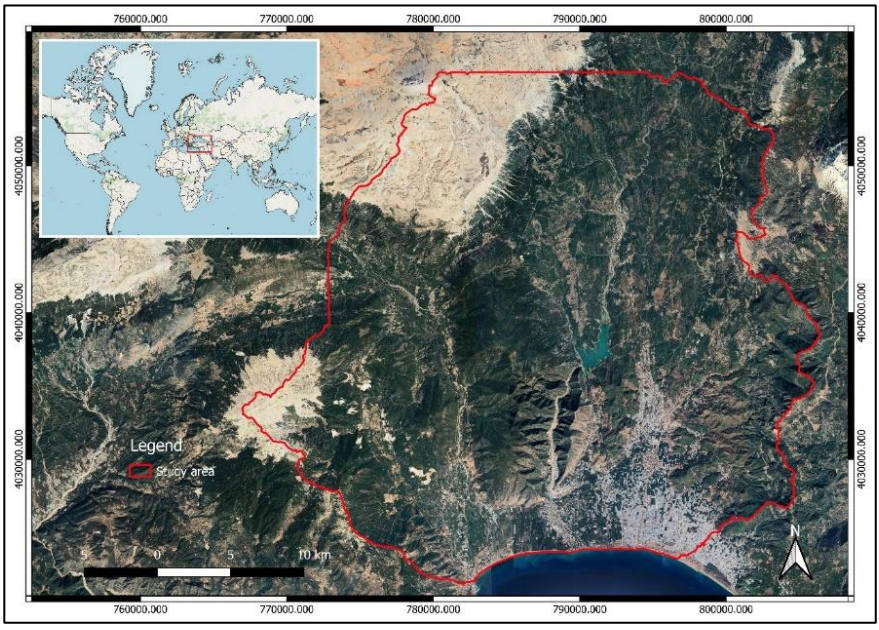

Figure 1: Study Area

1.2. Data Sets

Palsar digital elevation model (DEM) data, one of the 3 sensors on the Alos satellite, was used to determine the boundaries of the study area. This Alos Palsar DEM data provided by JAXA (Japanese Space Agency) has a spatial resolution of 12.5 m. The main dataset used in the study is Landsat satellite data. In this context, Landsat satellite data of 3 different dates were downloaded, taking into account the condition of the vegetation in the study area (Table 1).

Table 1: Datasets Used In The Study

Date	Satellite	Spatial Resolution*	Wavelenth (micrometers)
03 July 2014	Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS)	30	Blue: 0.45-0.51 Green: 0.53-0.59 Red: 0.64-0.67 NIR: 0.85-0.88
11 July 2017	Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS)	30	
17 July 2022	Landsat 9 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS)	30	

** For the blue, green, red and near infrared bands used in the study*

1.3. Method

Hydrology analysis was carried out to determine the study area. The hydrology analysis tools used in this study were used to model water flow across a surface. With hydrology analysis, it is mainly aimed to find where the water comes from and where it goes, while the flow of water can also be modeled. In this study, hydrology tools in ArcGIS (ESRI, California, USA) software were used to determine the study area. Three processing steps are typically used to create a raster that identifies all drainage basins in the study area with hydrology tools. These are fill, flow direction and basin (Figure 2). During the fill phase, the sinks in a surface raster are filled to remove minor imperfections in the data. In the flow direction phase, a flow direction raster is created from each cell to its steepest downslope neighbor. Finally, at the basin stage, a raster data is created by delimiting all drainage basins (ESRI, 2020). Then, the extracted basin boundaries raster data is converted to polygon data format.

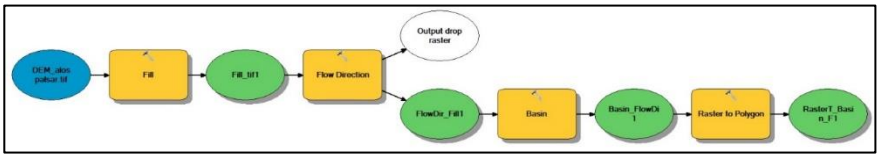

Figure 2: The Model Used To Extract The Basin Boundaries

In the study, blue, green, red and near infrared bands of all satellite data were combined with band aggregation for visualization of the area within the scope of preprocessing. The merged images were then clipped according to the study area boundaries. In the study, within the scope of image enhancement process, NDVI was calculated by using the Red and NIR bands of the data sets and Equation 1.

$$\mathrm{NDVI} = \frac{(\mathrm{NIR}-\mathrm{Red})}{(\mathrm{NIR}+\mathrm{Red})} \quad (1)$$

The vegetation condition index (VCI) serves to reveal how drought affects vegetation. Values between 0 and 100 reflect the relative variability in vegetation conditions. A value close to 0 indicates severe drought conditions, and close to 100 indicates optimum humidity (Vallejo-Villalta, 2019). In this study, VCI calculated for all dates was reclassified and 5 new classes were created (Table 2).

$$\mathrm{VCI} = \frac{(\mathrm{NDVI}-\mathrm{NDVI}_{\mathrm{min}})}{(\mathrm{NDVI}_{\mathrm{max}}+\mathrm{NDVI}_{\mathrm{min}})} \times 100 \quad (2)$$

where vegetation condition index; NDVI normalized difference vegetation index; $\mathrm{NDVI}_{\mathrm{min}}$ is the index of minimum NDVI from the 2014-2022 period and $\mathrm{NDVI}_{\mathrm{max}}$ is the index of maximum NDVI from the 2014-2022 period.

Table 2: Classification Of The VCI (Vallejo-Villalta, 2019)

VCI Range	Drought Level
0–20	Extreme
20–40	Severe
40–60	Moderate
60–80	Light
80–100	Very light

2. RESULTS AND DISCUSSION

The maps created from the NDVI values calculated for 3 different dates (2014-2022) in the study are as seen in Figure 3. When these NDVI maps are examined, it has been determined that NDVI values for all dates have the lowest values especially in the bare mountainous region and settlements located in the north of the study area. The highest NDVI values were determined in forest areas and agricultural areas as expected. According to the NDVI maps obtained, the minimum NDVI value was -0.13, the maximum NDVI value was 0.51 in 2014, the minimum NDVI value was -0.19, the maximum NDVI value was 0.57 in 2017, and the minimum NDVI value was -0.19 and the maximum NDVI value was 0.62 in 2022.

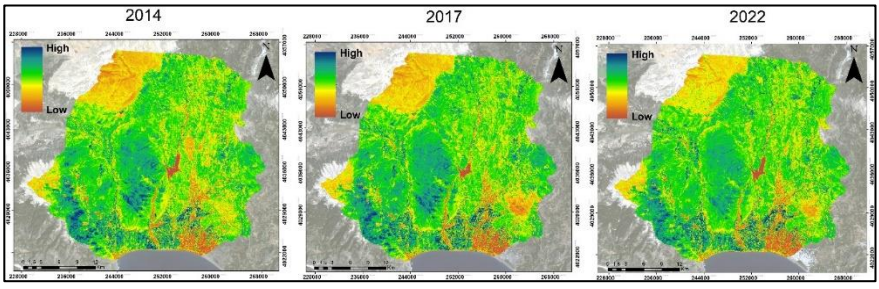

Figure 3: NDVI (2014-2017-2022)

VCI maps created from NDVI values are as seen in Figure 4. The VCI maps created here are classified according to the intervals given in Table 2. When Figure 4 is examined, it is seen that the drought was more intense in 2014 and less in 2022 compared to other years.

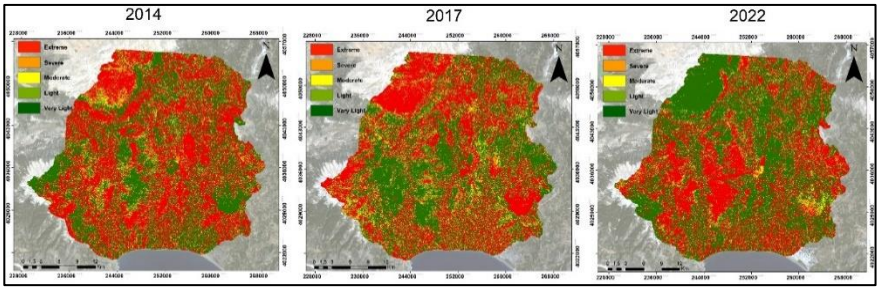

Figure 4: VCI (2014-2017-2022)

The areal values of these classes were calculated using the classification of VCI maps and the pixel values in the GIS environment (Table 3). In the study area, from 2014 to 2022, it was determined that extremely dry areas decreased and very light areas increased. In a study by Pei et al. (2018), vegetation stress was defined using VCI (0-40) as an indicator. Accordingly, while 52% of the vegetation in our study area was under drought stress in 2014, this rate is only 41% for 2022.

Table 3: Areas By Drought Levels (ha)

	2014	**2017**	**2022**
Extreme	43795.08	37584.54	34506.00
Severe	7068.96	7992.63	5585.58
Moderate	6715.8	8324.82	5720.04
Light	6103.71	7709.40	5443.83
Very light	33250.23	35322.39	45678.33
Total area	96933.78	96933.78	96933.78

According to the drought levels time series, it was determined that there was no significant change in the severe, moderate and light drought levels in the study area in 2014, 2017 and 2022 (Figure 5). However, it was determined that there were changes in extreme and very light drought levels for these dates. While extreme drought level was higher

in 2014, very light drought level was found to be high in 2022. For both drought levels, areal values very close to each other were calculated in 2017.

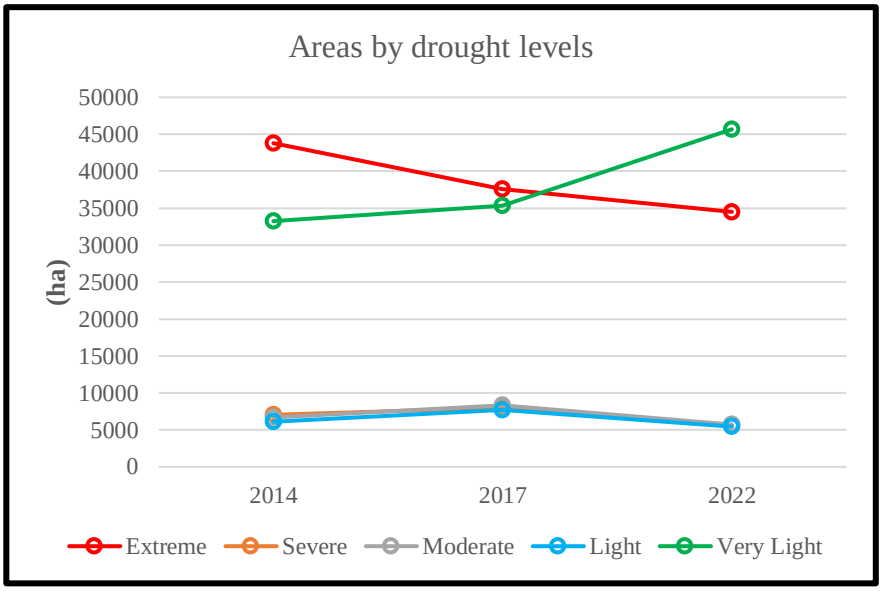

Figure 5. Drought Levels Time Series

3. CONCLUSION

As is known, drought is a very important problem today. Especially in agricultural practices, with the effect of drought, significant damage occurs in plant production, and serious economic and social problems arise. Drought is a global problem that affects not only certain regions but the whole world. With today's remote sensing technology, it is possible to detect areas exposed to drought and to reveal its severity. In this way, it is possible to manage the danger and impact of drought, and to take precautionary measures at the regional and country level with appropriate planning.

In this study, it was aimed to monitor drought for many years with VCI in a sub-basin on a basin-scale. The study was carried out in a sub-basin of the Western Mediterranean basin. Study area boundaries were

extracted from Alos Palsar DEM data. The NDVI and VCI used in the study to determine the vegetation status were created from the Landsat satellite data. According to the findings obtained as a result of monitoring the drought in the study area with VCI in the short term, it has been determined that the drought has decreased since 2014. While 45% of the total area was extremely drought in 2014, this rate decreased to 36% in 2022. From the results obtained from the study, it was determined that the very light drought areas, which were 34% in 2014, increased to 47% in 2022.

According to these results, it has been revealed that over a 10-year period extreme, severe, moderate and mild drought levels are not very effective in the area, but global warming has also gradually manifested itself in the Mediterranean region and there has been a significant increase in the level of mild drought. In this context, it is necessary to take some measures in order to prevent serious problems due to the increase caused by drought in the study area, which is the most important agricultural activity area of the Mediterranean region, and to manage the drought problem in a healthy way. Some of these measures are; establishing an up-to-date climate database on the basis of geographic information system in basins and sub-basins, conducting more detailed studies in the field, establishing or increasing the number of meteorological stations that provide continuous data, increasing green vegetation in all areas, developing and promoting drought-resistant varieties in agricultural areas, if possible, and the preparation of ideal land management plans at the basin and sub-basin levels, and the protection of nature by applying them in a planned manner.

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CHAPTER 2

RISK MANAGEMENT PLANS AS A NEW APPROACH IN PLANNING FOR RESILIENT CITIES

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INTRODUCTION

In an era marked by rapid urbanization and the ever-growing challenges posed by climate change, natural disasters, and socio-economic uncertainties, the concept of urban resilience has emerged as a crucial paradigm for sustainable urban development. Urban resilience refers to a city's ability to withstand, adapt to, and recover from shocks and stresses while maintaining essential functions and minimizing long-term negative impacts on its residents and infrastructure.

At the heart of urban resilience lies effective risk management planning, a proactive and strategic approach to identify, assess, and mitigate potential threats. These threats encompass a wide spectrum, ranging from natural disasters like earthquakes, floods, and storms to human-induced challenges such as economic crises, pandemics, and social unrest. Urban areas are dynamic, complex systems where interconnectedness and interdependence require comprehensive strategies to enhance their capacity to bounce back and thrive in the face of adversity.

This paper delves into the significance of urban resilience and the pivotal role of risk management plans in safeguarding cities against various hazards. As we navigate an increasingly uncertain future, the need for resilient urban environments becomes imperative for ensuring the well-being of communities, preserving critical infrastructure, and fostering sustainable growth. This exploration will delve into key principles, challenges, and successful strategies in the realm of urban resilience and risk management, shedding light on how cities can build a robust foundation to withstand and recover from the inevitable shocks of the 21st century.

In this study, the concept of urban resilience is first introduced. Afterwards, risk management plans, which are a tool for ensuring urban resilience, are mentioned. In addition to the 4 types of risk management plans existing in the literature, world examples that will set good examples for these risk management plans are included.

1. CONCEPT OF URBAN RESILIENCE

While the concept of resilience is used in disciplines such as engineering and psychology, it gained a different dimension with the study published by C. S. Holling in 1973 on the resilience of ecological systems (Folke, 2006). In general terms, resilience is the ability of a system to protect and maintain its current structure against internal and external threats (Boonstra, 2016; Allenby & Fink, 2005). The concept of urban resilience is defined in different ways by theorists. Alberti et al. (2003) define urban resilience as "the degree to which cities tolerate change before reorganizing around a new set of structures and processes". Campanella (2006) defines urban resilience as "the capacity of a city to recover from destruction". In order to ensure the resilience of the system, identifying its vulnerabilities constitutes an important stage.

The "socio-ecological resilience theory", which forms the basis of the concept of resilience, emphasizes the continuous changeability of systems. Therefore, this theory is an appropriate approach to deal with future climate uncertainties and their consequences (Rodin, 2014). The fact that cities continue to grow rapidly and global climate change triggers various risks such as disasters in urban areas increases the importance of the concept of urban resilience. This is because the complex and dynamic character of urban systems makes it very difficult to return to the past after they have been disrupted. Therefore, building resilient urban systems requires transforming and adapting to future possibilities in order to sustain the current functioning systems (Klein et al., 2003). As a result of this approach, the concept of risk management plans has emerged within urban planning approaches. The planning process for resilient cities is not only about making physical decisions about the city, but also about collaborating with the public, private sector and NGOs through a deliberative approach (Pelling, 2011).

Looking at the concept of urban resilience from a risk management framework, Wamsler et al. (2013) argue that in order for a city to be resilient to disasters, it should reduce its susceptibility to current disasters

as well as current and future hazards, and create functioning mechanisms for disaster response. Henstra (2012) combines the concept of urban resilience with climate resilience and states that a climate resilient city can survive climate-related hazards and risks by being resilient to climate change stresses.

The main characteristics of urban resilience are defined by the concepts of redundancy, diversity, efficiency, robustness, connectivity, adaptation, resources, independence, innovation, inclusion and integration. Redundancy and diversity emphasize that having several functionally similar components is important for ensuring the system's functionality. Robustness is defined as the ability to resist external threats. Independence refers to the ability to manage the post-disaster process without the need for external intervention (Godschalk, 2003; Alland and Bryant, 2011; Wardekker et al., 2010; McLellan et al., 2012; Kim and Lim, 2016; Spaans and Waterhout, 2017). Among these concepts, redundancy, diversity, robustness, adaptation, and independence constitute the main objectives and inputs of risk management plans for increasing urban resilience.

2. RISK MANAGEMENT PLANS IN CITIES

Risk Management Plans are an approach that has emerged to increase urban resilience and integrated into the urban planning system. They are plans developed to be resilient against global climate change and related risks (floods, droughts, fires, etc.) as well as risks that may arise from the existing natural structure such as earthquakes. The aim of Risk Management Plans is to increase resilience by revealing the vulnerabilities of cities, regions or countries at different scales. In other words, it is to ensure that cities, regions or countries are prepared for the risks they may experience.

Risk Management Plans are the product of a process that should be carried out in cooperation with the public and private sectors in cities and

that concerns all groups. The production of Risk Management Plans generally consists of 3 stages. These stages are given in Figure 1.

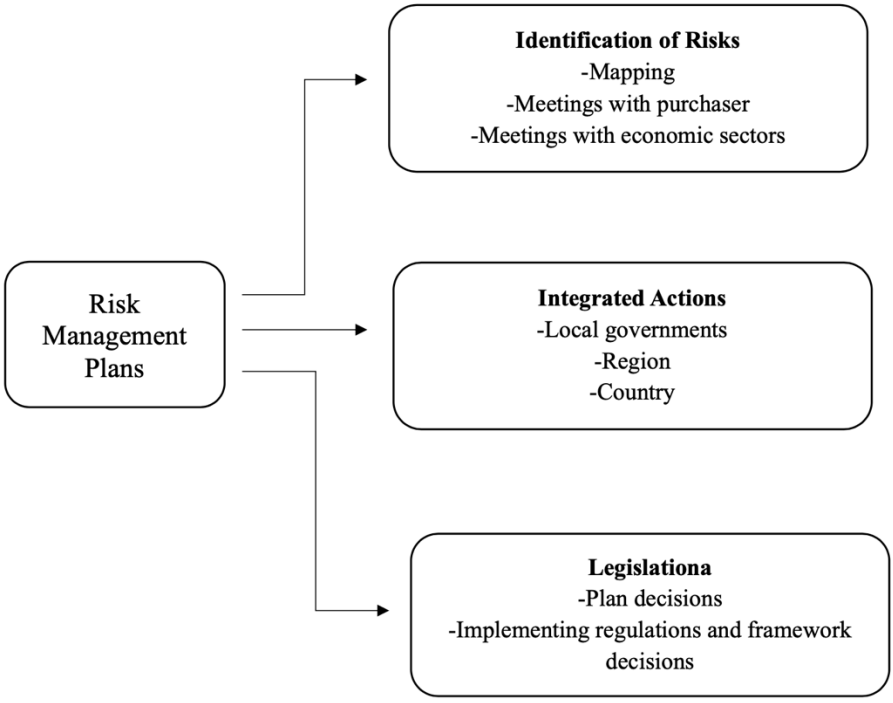

Figure 1. Risk Management Plans (Inspired by Young, 2016)

Risk Management Plans are categorized under 4 headings: i) flood risk management plans, ii) earthquake risk management plans, iii) fire risk management plans, iv) climate change adaptation plans. In the rest of the study, important parameters and examples of these plans are given.

2.1 Flood Risk Management Plans

With the impact of climate change, the rate of flooding in cities and the destructive impact of floods are increasing. Not only physical interventions but also non-structural interventions are required to combat the floods that have occurred and are likely to occur. Although the first thing that comes to mind when we say structural or physical

interventions is the improvement of infrastructure, it is known that this is not enough. In addition, land use planning is also a good intervention tool to prevent or mitigate floods (Wheater and Evans, 2009; White, 2010). The most important non-structural intervention is to support risk management plans with policies and to ensure public-private sector cooperation in the process. A good example of this is The Flood Risk Management Directive (FRMD) introduced by the European Union in 2007. The member countries of the European Union have adapted the directive for their own countries.

Flood Risk Management Plans are more long-term and complex than many other planning issues. Therefore, although it may seem difficult to integrate such plans into the planning process of cities, it is not impossible. First, however, the planning system needs to be transformed from vertically institutional to horizontally interactive. With this, the planning process will evolve from a system where a single group is active in the planning process to a multi-actor system. In this way, the complex planning process will enable the production of plans that can be implemented in the longer term within the framework of legitimacy (Geldof, 2007; Hamin and Gurran, 2009; White, 2010).

2.1.1 The Case of Arnsberg, Germany

In Arnsberg Regierungbezirk in Germany, it is aimed to prevent flood risk by assigning tasks related to water management to local government and industrial companies. For this purpose, firstly, an inter-institutional cooperation agreement was signed and the process of creating a data set was initiated. In this context, hazards and risks in the area are determined together with model simulations to identify risk waters and flood plains. The created data pool and risk simulations provide the necessary infrastructure for the preparation of a flood risk management plan (Johann and Leismann, 2017).

In the Seseke area of Arnsberg city, there are depressed areas in the land due to coal mining. Considering the density of buildings, these

depressed areas pose a flood risk. Hydrological calculations were made to determine the impact area and extent of the risk, and the flood area and impact area of each watercourse were calculated individually. Flood flows and flood plains were identified and flood hazard and flood risk maps were prepared. It was concluded that there is a risk of floods up to 4 meters deep from the flood plains formed by subsidence towards the densely populated areas. This was followed by the preparation of a flood risk management plan. The mission of the FRMD is "To evaluate and manage flood risks with a view to reducing the risk of adverse flood-related consequences for human health and life, the environment, cultural heritage and economic activity". Under this, the objectives of the large-scale flood risk management plan, including the Seseke region, are "to avoid new risks, to reduce existing risks, to reduce adverse consequences during a flood event, to reduce adverse consequences after a flood event" (Johann and Leismann, 2017).

2.1.2 The Case of Netherland

In the Netherlands, the "Dutch Water Act" came into force in 2009. With this law, it was decided to raise the ground level of all new development areas in the region. Thus, the "Dutch Water Act" forms the basis of the decisions taken to prevent flood risk in coastal areas throughout the country. In the analysis processes of all plans made within this scope, flood mapping including water levels and flow velocity, ground level analysis, vulnerability analysis of buildings, infrastructure, public space and critical assests, climate change scenario analysis were carried out (Herk et al., 2011).

In "Room for the River", which is one of the projects implemented in the Netherlands in line with the "Dutch Water Act", it is aimed both to increase the spatial quality in the city and to prevent flood damages in

the city (Schut et al., 2010). Firstly, it was decided to raise the area to 4 meters above sea level, but this decision received many objections. The proposed plan includes safe shelters for evacuation, elevated escape routes and infrastructure inputs. In the implementation phase, the first idea was to build flood-resistant housing (Herk et al., 2011).

In 2006, a series of spatial decisions were taken to prevent flood risk in a larger area including the airport in the Westflank Haarlemmermeer region of the Netherlands, which will be realized with private-public cooperation. These include the production of 10,000 flood-resistant housing units and 900 hectares of recreational green space with floodwater retention and storage capacity (Herk et al., 2011).

2.2 Earthquake Risk Management Plans

The tectonic structure of the regions enables predictions to be made about the seismicity and disaster risk of the region. With increasing urbanization rates, urban planning processes have lagged behind in some regions and rules and regulations for construction have not been provided. This situation constitutes one of the vulnerabilities in cities with earthquake risk.

2.2.1 The Case of Tehran, Iran

Tehran Disaster Management Master Plan has 3 objectives: "ensuring the safety of life and property of citizens, protecting the lives of citizens after the event, and preparing rehabilitation and reconstruction plans". All policies and actions developed afterwards were aimed at achieving these 3 objectives in 12 years (Hosseini and Hosseini, 2008).

First, earthquake scenarios that could occur in Tehran were prepared. Then the seismic resilience of all buildings in Tehran was analyzed. Then, earthquake-related vulnerabilities in the urban space were

identified. For this purpose, the ratio of buildings to all buildings that would collapse in a possible earthquake as a result of seismic resilience calculation, the adequacy of available spaces for evacuation (amount of open spaces, narrow road ratios, etc.) and factors that may cause secondary damage (hazardous facilities, gas pipelines, etc.) were analyzed. Once vulnerabilities were identified, various decisions were developed to reduce vulnerability, including urban redevelopment, reinforcement of buildings, road and urban infrastructure improvements.

In addition to physical and spatial decisions, trainings were organized to increase social and institutional awareness. Emergency response system was improved by establishing a disaster management organization. An emergency response plan was developed for this purpose. After a possible earthquake is overcome with minimum damage through awareness raising trainings and disaster management organization, a reconstruction and rehabilitation procedure has been established for the process after the earthquake. At this stage, it was explained in detail what would be done about the damaged structures and regions after the disaster and which institutions would be in charge of the duties and responsibilities (Hosseini and Hosseini, 2008).

2.2.2 The Case of Kathmandu Valley, Nepal

Kathmandu Valley is located in Nepal. Nepal is one of the least developed countries in the world. It is also one of the poorest countries in the world. This has a negative impact on the earthquake risk management process due to lack of resources and scarcity of government funds. However, when the economic burden caused by earthquake disasters in the region is calculated, it is concluded that raising funds for the preparation of a holistic risk management plan is less costly than this economic burden (Dixit et al., 2000).

The Kathmandu Valley has experienced many earthquakes in the historical process and suffered heavy losses. Especially with the earthquake in 1934, 20% of the building stock in the Kathmandu Valley

was completely destroyed and 40% was damaged. In addition, many historical buildings were completely destroyed or damaged in this earthquake. When the earthquake history of Kathmandu is analyzed, it is seen that a major earthquake occurs approximately once every 75 years. Therefore, one of the most important vulnerabilities of Kathmandu Valley is the earthquake risk. Therefore, a risk management plan has been prepared for Kathmandu Valley. This plan consists of policies and practices to realize the 4 objectives established in the first stage. These 4 objectives can be listed as follows;

- To identify the earthquake risk of Kathmandu Valley and create an action plan to reduce the risk,
- Reducing earthquake vulnerability of educational facilities,
- Raising awareness of all individuals, institutions and organizations living in the Valley,
- Establishment of local institutions that can carry out the necessary work within the scope of the risk management plan to be created.

In this context, firstly, scenarios for future earthquakes were created and vulnerable regions were identified. In addition, loss estimates were made for possible earthquakes. Afterwards, a risk management action plan was prepared. Within the scope of the plan, short, medium and long term actions were identified. The actions are generally related to ensuring earthquake safety in educational facilities, raising public awareness and strengthening the institutional structure. The institutions and organizations that will carry out these actions are also included in the plan (Dixit et al., 2000).

In general, the Kathmandu Valley example is important in terms of raising awareness of the risk management plan despite being a country with a high poverty rate and few state resources.

2.3 Fire Risk Management Plans

Fire is one of the most important disasters that negatively affect the ecosystem and living life. Especially with climate change, the risk of fire increases in parallel. Especially in hot and dry climate regions, the probability of fire in forested areas increases even more with the effect of climate change (Bovio et al, 2017; Rego et al, 2018). The increased risk of fire due to global climate change also depends on the vulnerabilities of the region and land management models (IPCC, 2019). In this context, when the literature is reviewed, it is concluded that researchers have adopted different approaches in fire risk management processes. Socio-ecological system, integrated fire management, fire resilience are some of these approaches. Chapin et al. (2006), in the socio-ecological system approach, determined the strategies that will provide targets and transformation based on global climate change. According to Chapin et al. the main goal for fire risk management is to determine policy strategies. Strategies for transformation are human adaptation, increasing resilience and reducing vulnerability. Moritz et al (2014) set sustainable coexistence as the main goal based on global climate change and the expansion of urban areas into natural areas within the framework of the socio-ecological systems approach. In order to achieve this goal, it is necessary to develop context-specific knowledge and place-based approaches, conduct research and planning to support the use of buffer zones, and improve risk perception in society (Moritz et al., 2014). Unlike Moritz and Chapin, Tedim et al (2016) define land use changes and global climate change as a problem with an integrated fire management system approach. The main objective is to minimize damage and maximize benefits. What needs to be done for this is to reveal the history and causes of the fire, to be ready to fight the fire, and

to organize the rapid recovery process after the fire. Smith et al (2016) define global warming and the expansion of the urban area over the natural environment as a problem with the fire resilience approach. In this context, the main goal is to build a resilient society that provides information about fire. Strategies are identified as holistic characterization of fire risk areas and identification of vulnerabilities, identification of vulnerabilities, preparation of adaptation planning, identification of barriers and increasing resilience capacities.

2.4 Climate Change Adaptation Plans

Disasters caused by climate change have become more common in recent years. Especially developing countries are the most affected by these disasters. For this reason, frameworks have been prepared by organizing meetings on this issue in various countries. In 2005, the World Conference on Disaster Reduction was held in Japan. Another important development that followed was the United Nations Framework Convention on Climate Change in Copenhagen in 2009. The Intergovernmental Panel on Climate Change (IPCC) published a report bringing together the issues of climate change and disaster reduction (IPCC, 2012; Few et al., 2006; UNISDR, 2005).

Disaster risk increases in line with the vulnerability of cities. This situation triggers migration in some regions and the population concentrated in certain regions increases the impact of the disaster. When urban development triggered by increasing population is realized without taking risks into consideration, it also increases the risk of disasters. In other words, if urban planning processes are not integrated with disaster risk reduction and climate change adaptation, they increase the risk by increasing existing vulnerabilities.

2.4.1 The Case of Nikaragua

Nicaragua is one of the largest countries in Central America. Since 1885, Nicaragua has suffered serious damage and large-scale losses due to natural disasters such as earthquakes and floods. Finally, with Hurricane Mitch in 1998, the government took action on disaster mitigation. Nicaragua is a good example for the integration of disaster mitigation, risk management, adaptation to global climate change and urban planning processes.

In summary, the process in Nicaragua consists of adaptation to climate change, a process that aims to reduce the vulnerability of cities to the negative impacts of expected climate change, and related actions. Three reports have been prepared to form the basis for the formulation of national policies and practices: "Mapping of Risks, Processes, Public Policies and Actors Related to Climate Change in Nicaragua", "Policies, Programs and Case Study About Climate Change in Nicaragua" and "Nicaragua Toward Climate Change" (Campos et al., 2011; Suswatch, 2011; Hermandez and Viteri, 2003).

Looking at Nicaragua's policies and actions in the historical process; it is seen that environmental policies were first started to be developed in 1991. Then, in 1996, the "Institute of Natural Resources (IRENA)" was established and later this organization was updated as a ministry (MARENA). In the same year, the "General Law of environment and natural resources" came into force. In 1999, Nicaragua acceded to the Kyoto Protocol and committed to implement the "Regional Strategy for Climate Change" in 2008. At the end of all these processes, MARENA proposed actions for mitigation and adaptation to global climate change. Subsequently, the "National Environmental Strategy and Climate Change Action Plan 2010-2015" was prepared. This action plan describes integrated actions for disaster risk reduction and climate change adaptation. All of Nicaragua's environmental policies address the vulnerability of its natural resources, as well as mitigation

and adaptation to global climate change and international framework conventions.

3. DISCUSSION

In the face of a rapidly changing world, urban resilience and effective risk management plans stand as linchpins in the pursuit of sustainable, adaptable, and thriving cities. The journey towards resilience is an acknowledgment that urban areas are not immune to shocks and stresses but rather dynamic systems that demand proactive strategies to navigate the complexities of the modern era.

As our cities continue to grow and face an array of challenges, from the escalating impacts of climate change to the unpredictability of global events, the imperative for resilient urban development becomes more evident than ever. The importance of risk management plans cannot be overstated; they serve as the blueprint for cities to identify vulnerabilities, assess potential threats, and implement measures that not only mitigate risks but also enhance overall urban capabilities.

The experiences of resilient cities worldwide underscore the transformative power of foresight, collaboration, and innovative thinking. The synergies between government bodies, communities, businesses, and academia are critical in crafting holistic approaches that address the multidimensional nature of urban challenges. The adoption of sustainable infrastructure, smart technologies, and community engagement fosters a culture of preparedness and adaptability, positioning cities to not only survive but thrive in the face of adversity.

In conclusion, the journey towards urban resilience is an ongoing commitment to creating cities that are not just robust in the face of adversity but also compassionate and inclusive. The integration of risk management plans into urban governance ensures that the lessons learned from past experiences and emerging threats contribute to the continuous evolution of cities as resilient, dynamic ecosystems. As we

move forward, the collective efforts invested in building urban resilience and effective risk management plans will play a pivotal role in shaping cities that can weather storms, embrace change, and provide sustainable havens for generations to come.

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CHAPTER 3

MICROCLIMATIC BENEFITS OF URBAN GREEN

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INTRODUCTION

As a result of rapid urbanisation, problems such as destruction of urban green areas, decrease in quality of life, stress, environmental air-noise pollution, significant changes in surface and air temperatures are emerging. With urbanisation, some changes occur in land cover. Natural landscapes in and around the city are replaced by concrete surfaces, thus creating climatic differences between urban and rural areas and leading to "urban heat island", which is the most obvious climatic indicator of urbanisation (Yüksel and Yılmaz, 2008; Alpaslan, 2019).

High temperatures in cities increase energy use for landscape irrigation, cooling and water demand. Increased cooling energy use increases electricity demand, requiring more electrical energy production, and more greenhouse gases are released due to the combustion of fossil fuels. Greenhouse gases also contribute to global warming. Shifting seasons, extreme cold or high temperatures due to climate change also increase health risks (Yu and Hien, 2006). While cities constitute one of the main drivers of global warming, climatic changes caused by global warming also put pressure on cities (Şimşek and Şengezer, 2012). When we compare the climate of urban areas with rural areas; urban environments are, in general, 1-2 ^{o}C warmer than rural areas in terms of annual average temperature. In some areas, this temperature difference goes up to 6-12 ^{o}C (Yüksel, 2005). Although cities cover less than 2 per cent of the earth's surface, they consume 78 per cent of the world's energy and produce more than 60 per cent of all carbon dioxide, accelerating climate change. Cities are also among the areas most affected by this climate change (Alpaslan, 2019).

The climate has changed at all times since the formation of the Earth and the living life on earth has continued to survive by adapting to this change. However, especially after the Industrial Revolution, the effects of human activities have reached continental and even global scale with urbanisation (Yüksel, 2005). Man and climate have a reciprocal relationship that responds to climatic change, such as the

heating and air conditioning of buildings and the provision of climatic comfort by open green spaces (Alaigba, Fabiyi and Akinnawo, 2017).

Researches show that one of the reasons of the climate difference between rural and urban areas is the decrease in green areas and the destruction of urban vegetation. Green areas can reduce temperatures especially in summer months by creating a microclimatic effect. They provide thermal comfort to city dwellers. Therefore, the integration of green areas in urban planning and building design is necessary to mitigate the effects of both local and global warming (Feyisa, Dons and Meilby, 2014).

Parks within the city are cooler in the summer months compared to the surrounding urban built environment. Various factors such as the land cover composition of the park play a role in this differentiation (Yan and Dong, 2015). The most important determinant of the cooling potential of the park is the vegetation. In addition to the shade, evapotranspiration and regulation of atmospheric movement provided by vegetation, the shape and size of the green area, the wind environment around it and the presence of water bodies contribute to the cooling effect (Xiao, Dond, Yan, Yang and Xiong, 2018).

Green areas are of great importance for human life and needs in urban spaces. These areas have many physical and ecological functions such as providing circulation and physical comfort between different urban uses, providing aesthetic value to the city, providing recreation opportunities, reducing noise and pollution. In order to fully fulfil these functions, they should be planned within a system in urban planning, in accordance with certain standards and in sufficient size and should have a regular distribution within the urban texture. Open and green areas play an important role in shaping a city as well as the opportunities they provide to the urbanites (Karagüzel, Ortaçeşme and Atik, 2000).

The demand for open spaces to meet the social, cultural and comfort needs of the growing urban population is increasing day by day. Green spaces can provide many environmental services such as sinkink

carbon, reducing air pollution and creating habitats for urban biodiversity, while increasing outdoor comfort. Thanks to the recreational opportunities they provide, they increase the comfort levels of people by enabling them to contact with nature.

Antalya, located in the Mediterranean region of Türkiye and experiencing a very rapid urbanisation process, is among the cities that feel the effects of global warming quite severely. Due to the high temperature and humidity in the long summer months, there is an intense heat stress on people outdoors and therefore people have to prefer indoor spaces in certain parts of the year. The presence of green areas in Antalya, where the hot climate is prevailing, has a special importance in terms of breathing and livability of the city. Parks and green areas in the city play an important role in reducing the effects of sweltering heat especially in summer, meeting the recreation and leisure needs of urban residents, reducing air pollution caused by urbanisation, ensuring people's contact with nature and generally increasing the comfort of urban life. Green areas also contribute to the mitigation of the urban heat island effect in Antalya with the microclimatic effects they create. In this study, it is aimed to determine the microclimatic benefits provided by urban green in Antalya city.

1. STUDY AREA AND METHOD

The study area is Aydın Kanza Park located in Muratpaşa District, one of the central districts of Antalya. With approimately 11.000 m^2 in size, the park is bordered by Yüzüncü Yıl Boulevard to the south, Anafartalar Street to the east, and residential areas to the north and west (Figure 1.1).

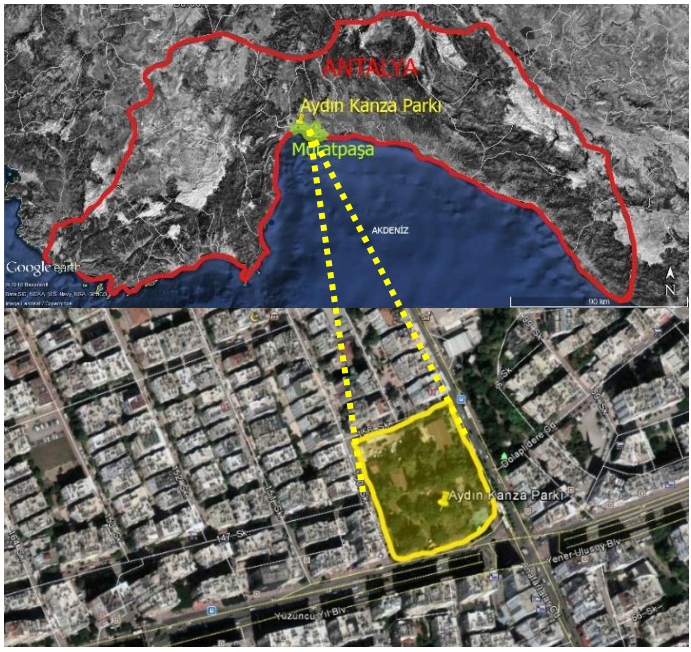

Figure 1.1. Location of Aydin Kanza Park (Google earth 2019)

The temperature, humidity and wind speed measurements were made in the park and its immediate vicinity. Extech 45160 - Wind Speed, Temperature and Humidity Measurement Device was used for this purpose. The measurements were made once a week and three times a day in the morning (07:00-08:00), noon (13:00-14:00) and evening (20:00-21:00) for one year starting from January 2019, at a height of approximately 2 m. from the ground. Measurements within the park were made in four different areas in accordance with three replicate split-plot experimental design within the time-series basic experiment approach: 1) Tree covered areas (Fig. 1.2), 2) Grass covered areas (Fig. 1.3), 3) Hard grounds (Fig. 1.4), 4) Pool area (Fig. 1.5). In addition, in order to determine the cooling effect of the park on the immediate surroundings, measurements were made in 3 iterations at 50, 100 and 300 metres from the park boundary. The location of the measurement points in and around the park is shown in Figure 1.6.

Figure 1.2. Tree covered areas

Figure 1.3. Grass covered areas

Figure 1.4. Hard grounds

Figure 1.5. Pool area

A variance analysis was applied to the data by using SPSS 22 software and the parameters that were statistically different were compared using Duncan multiple comparison test at 5% significance level. The results of the analyses were interpreted in the context of the year-round microclimatic contributions of the parks.

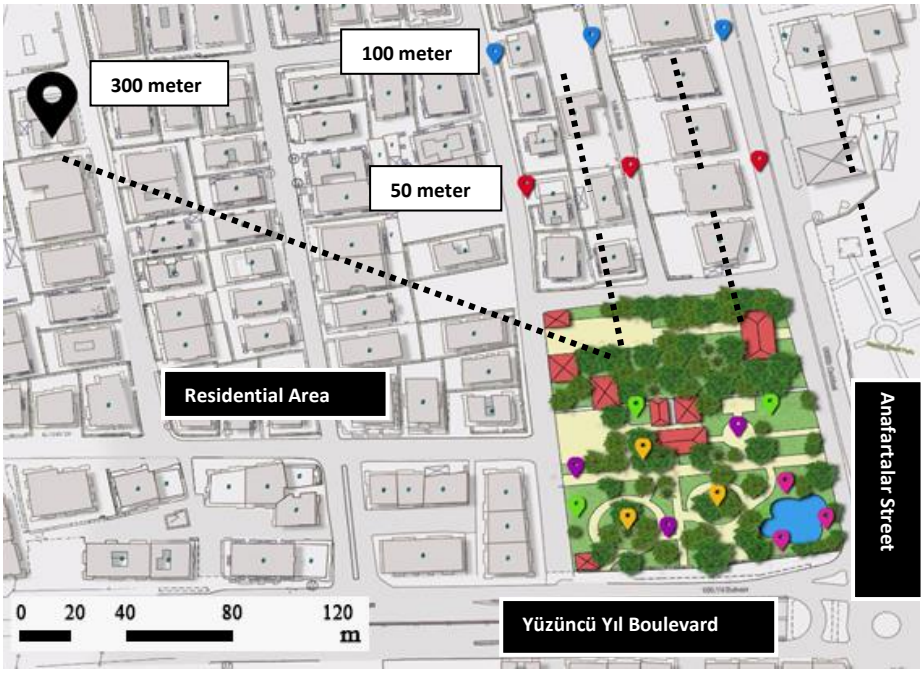

Figure 1.6. Measurement points in and around Aydın Kanza Park

- Measurement points in tree covered areas
- Measurement points in grass covered areas
- Measurement points on hard grounds
- Measurement points around the pool
- Measurement points 50 m from the park
- Measurement points 100 m from the park
- Control measurement point 300 m from the park

2. FINDINGS AND DISCUSSION

Data obtained from the measurements from 4 different areas inside and 3 different points outside Aydın Kanza Park for one year were first handled separately as in-park and out-of-park data, and then all data were analysed.

2.1. Climatic Data and Analysis within the Park

The average values obtained from the measurements in the park, were first recorded separately for each area. By averaging the values of

the four measurement points, the temperature, humidity and wind speed values of the whole park were found. In order to determine whether there is a difference in terms of climatic comfort in different parts of the park, the average temperature, humidity and wind speed values measured in four different areas of the Park were subjected to statistical analysis.

2.1.1. Analysis of in-park temperature data

When different measurement points within the park were compared in terms of temperature, it was observed that the differences in temperature values between months (P<0,001), the differences in temperature values between measurement hours in each month (P<0,001) and the differences in temperature values of different measurement points within the park (P<0,027) were statistically significant.

When the results were evaluated in terms of binary interactions, it was seen that the values of the interaction of month and measurement hour (P<0,001), the interaction of month and measurement point (P<0,542) and the interaction of measurement hour and measurement point (P<0,001) were statistically significant.

When the monthly averages of all temperature measurements made at different measurement points and hours within the park are analysed, it is seen that the monthly average temperatures vary between 13 ^{o}C and 32 ^{o}C. The highest monthly mean values occurred in July (31.9 ^{o}C) and August (32 ^{o}C), and the lowest value occurred in January (13 ^{o}C), with no statistical difference between them.

When the averages of the temperature measurements made in the park according to hour zones were analysed, it was observed that the differences between the morning, noon and evening temperature values were statistically significant in all months except June; the noon values were the highest and the morning values were the lowest. In June, the difference between morning and evening temperature values was not statistically significant, but it was lower than the noon temperature value.

Again, when the average of the temperature values in the park was analysed, it was observed that the lowest temperature was in the morning hours of January (8.4 ^{o}C) and the highest temperature was in the noon hours of August (35.3 ^{o}C).

When the annual averages of all temperature measurements made at different measurement hours within the park are analysed, it is seen that there is a statistical difference between the temperature values, with the noon hours having the highest values (27.8 ^{o}C) and the morning hours having the lowest values (20.3 ^{o}C).

Looking at the annual average of the temperature measurements made from each of the different measurement points in the park, it was observed that there was no significant difference between the measurement points and the values ranged between 23.5 ^{o}C and 23.7 ^{o}C.

When the monthly temperature averages of different measurement points in the park were compared, it was observed that the highest temperature value was in August (32.2 ^{o}C) in the area covered with hard ground and the lowest temperature value was in January (12.8 ^{o}C) in the area covered with hard ground, although there was no statistically significant difference between them. These values show that the areas covered with hard ground in the park have the highest temperature in summer and the lowest temperature in winter.

2.1.2. Analysis of in-park humidity data

When different measurement points within the park were compared in terms of humidity, it was observed that the differences in humidity between month ($P<0,001$), measurement hour ($P<0,001$) and measurement point ($P<0,001$) were statistically significant. When the results were evaluated in terms of binary interactions, it was seen that the binary interaction of month and measurement hour ($P<0,001$) and the binary interaction of measurement hour and measurement point ($P<0,004$) were statistically significant.

When the monthly averages of all humidity measurements made at different measurement points and hours within the park are examined, it is seen that the monthly humidity values vary between 42.3% and 54%. The highest monthly humidity was recorded in February (54%) and the lowest monthly humidity was recorded in July (42.3%).

When the annual averages of the humidity measurements made at different measurement hours in the park are analysed, it is seen that there is a statistical difference between the humidity values, with the noon hours having the lowest (42%) and the evening hours having the highest (56.3%) values.

When the averages of the humidity measurements made in the park were examined according to the hour periods, it was observed that the differences between the morning, noon and evening humidity values were statistically significant in January, March, April, May, June, September, November and December; the evening values were the highest and the noon values were the lowest. In July, August and October, the differences between morning and noon humidity values were not statistically significant, but the evening values were lower than the humidity values. In February, the difference between morning and evening humidity values was not statistically significant, but it was higher than the humidity value at noon. According to the measurement hour averages of humidity values, the lowest value was observed at noon in January (30.7%) and the highest value was observed in the evening hours of December (62.8%).

Looking at the annual average of the humidity measurements made from each of the different measurement points in the park, it was observed that there was not much difference between the areas. The grass area had the lowest value (49.3%), while the pool side had the highest value (50%). When the monthly averages of the humidity measurements made from each of the different measurement points in the park are compared, although there is no statistically significant difference between them, the highest humidity value was observed in February

(54.4%) in the hard ground area and the lowest humidity value was observed in July (41.5%) in the grass area.

When the triple interactions of months, measurement points and measurement hours in the park are analysed in terms of humidity values, it is seen that the highest value (63%) was obtained around the pool in the evening hours of January (20.00-21.00) and the hard ground area in the evening hours of December (20.00-21.00). The lowest value (29.3%) was obtained in the grass area at noon (13.00-14.00) in January.

2.1.3. Analysis of in-park wind speed data

When different measurement points within the park were compared in terms of wind speed, it was observed that the differences in wind speed between month ($P<0.001$), measurement hour ($P<0.001$) and measurement point ($P<0.001$) were statistically significant. When the results were analysed in terms of binary interactions, the binary interaction of month and measurement hour ($P<0001$) was found to be statistically significant.

When the monthly averages of all wind speed measurements made at different measurement points and hours within the park are examined, it is seen that the values vary between 0.1 m/sec and 0.6 m/sec. The highest monthly average value was in June (0.6 m/sec) and the lowest monthly average value was in December (0.1 m/sec).

When the annual averages of all wind speed measurements made at different measurement hours in the park are examined, it is seen that there is no statistically significant difference between the morning and evening wind speeds, and these values are lower than the value at noon. The highest values (1 m/sec) were observed at noon and the lowest values (0.1 m/sec) were observed in the morning and evening hours.

When the wind speed values were analysed in terms of the average of the measurement hours, the difference between the morning and evening values was not statistically significant and was lower than the noon value in all months except September. In September, the difference

between morning-afternoon-evening wind speed values was statistically significant and the highest value (0.8 m/sec) was found at noon and the lowest value (0 m/sec) was found in the morning. According to the measurement hour average of wind speed values, the lowest value (0 m/sec) was measured in the evening hours in January, April and May; in the morning and evening hours in February, March, October and November; and only in the morning hours in September. The highest value was observed in June at noon (1.4 m/sec).

When the annual average of the wind speed measurements made from each of the different measurement points in the park is examined, it is seen that there is an insignificant difference between the areas. When the monthly averages of the wind speed measurements made from each of the different measurement points in the park are compared, it is seen that there is no statistically significant difference between the values in all months. The highest wind speed value (0.8 m/sec) was observed around the pool in June, the lowest wind speed value (0.1 m/sec) was observed in October in the wooded area and in December in the wooded area, grass area and hard ground.

When the triple interactions of months, measurement points inside and outside the park and measurement hour were analysed in terms of wind speed values, the highest value (1.6 m/sec) was observed in the grass area at noon (13.00-14.00) in March and April and around the pool at noon (13.00-14.00) in June. The lowest value (0 m/sec) was observed in the evening hours in the wooded area for 12 months.

2.2. Analysis of Climatic Data for the Whole Park and Outside the Park

In order to determine the microclimatic effects of Aydın Kanza Park, the differences between the temperature, humidity and wind speed values measured inside the park and the temperature, humidity and wind speed values measured at points outside the park were examined. For this purpose, the "whole park" measurement data, which was formed by

averaging all the values obtained from four different measurement points within the park, and the measurement data of three points outside the park were collected in the same charts and graphs and subjected to statistical analysis.

2.2.1. Analysis of temperature data for the whole park and outside the park

According to the data, the expected microclimatic effects of Aydın Kanza Park are mostly provided at noon. In December, it was observed that the temperature values measured at the control point were balanced with the temperature values of the whole park. In the four months following the interval (January, February, March, April), the noon temperatures in the park were higher than those outside the park. According to both the general climatic data of Antalya and the data measured in this study, the noon temperature difference between the whole park and the control point was determined as 3.2 ^{o}C in January, the coldest month. In other words, Aydın Kanza Park provided a 3.2 ^{o}C warmer environment in the coldest month of the year. The park was 2.6 ^{o}C warmer than the control point in February, 2.0 ^{o}C warmer in March and 1.9 ^{o}C warmer in April. The temperature values show that the Park is cooler from May onwards.

The results obtained from January to April show that the heating effect of the park is realised in relatively cold and cool months. In seven months of the year (May, June, July, July, August, September, September, October, November), it is observed that the temperature values in the park are lower than the temperature values outside the park at noon. According to both the general climatic data of Antalya and the data measured in this study, the temperature difference between the whole park and the control point was determined as 3.6 ^{o}C in August, the hottest month. In other words, Aydın Kanza Park provides a 3.6 ^{o}C cooler environment in the hottest month of the year.

The temperature measurement results show that the microclimatic effects of the park (heating and cooling) do not occur gradually as expected at 50 and 100 metres from the park. In the months when the heating effect of the park is detected (January, February, March, April), the measurement results obtained from 50 metres are expected to be higher than 100 metres; in the months when the cooling effect is detected (May, June, July, August, September, October, November), the measurement results obtained from 50 metres are expected to be lower than 100 metres, but the results did not support this expectation. This situation is considered to be related to the local conditions of the measurement points at 50 and 100 metres (such as the presence of a street that affects 100 metres and functions as an air corridor) and other climatic data (humidity and wind speed).

When in-park and out-of-park areas were compared in terms of temperature, it was observed that the differences in temperature values of month ($P<0.001$), measurement hour ($P<0.001$) and measurement point ($P<0.001$) were statistically significant. When the results were evaluated in terms of binary interactions, it was determined that the binary interaction of month and measurement hour ($P<0,001$), the binary interaction of measurement hour and measurement point ($P<0,001$) and the binary interaction of month and measurement point ($P<0,001$) were statistically significant. The triple interaction of month, measurement hour and measurement point ($P<0,001$) was also found to be statistically significant.

When the temperature data were analysed in terms of hourly averages, it was observed that the lowest value occurred in the morning hours of January (8.3 ^{o}C) and the highest value occurred in the noon hours of August (36.7 ^{o}C). Except for June and October, the difference between morning-afternoon-evening temperature values in the other months was statistically significant, and it was observed that the noon value was the highest and the morning value was the lowest. In June and October, the difference between morning and evening temperature

values was not statistically significant, but it was lower than the noon temperature value.

When the temperature data were analysed in terms of the annual average of the measurement hours, it was observed that there was a statistical difference between the temperature values at different measurement hours, with the highest values at noon (27.7 ^{o}C) and the lowest values in the morning (20.8 ^{o}C).

When the temperature data were analysed in terms of the annual averages of the measurement points, the control point (24.4 ^{o}C) had the highest value, while the lowest values were obtained at 100 metres outside the park (23.7 ^{o}C), 50 metres outside the park (23.7 ^{o}C) and the whole park (23.6 ^{o}C), with no statistical difference between them.

When the triple interaction of months, measurement points and measurement hour is analysed in terms of temperature values, it is seen that the highest value (38.9^{o}C) was taken by the measurement point at the control point at noon (13.00-14.00) in August. The lowest value (8.2 ^{o}C) was taken by the measurement point at 100 metres outside the park in the morning hours (07.00-08.00) in January.

When the monthly averages of the whole park and non-park measurement points were compared, it was observed that there was no statistically significant difference between the values of the other months except October, the highest temperature value occurred in August (33.8 ^{o}C) at the control point and the lowest temperature value occurred in January (12.2 ^{o}C) at the control point.

The graphs of the temperature data of the whole Aydın Kanza Park and three measurement points outside the park were created and interpreted separately for January, the coldest month, and August, the hottest month. The graph of average temperature values in January is given in Figure 2.1. According to the average temperature values in January, it is seen that there is almost no difference (8.2 ^{o}C to 8.4 ^{o}C) between the measurement points inside and outside the park in the morning hours. The temperature difference increases significantly in

favour of the whole park at noon and reaches 19.7 ºC. Between the control point and the whole park, there is a temperature difference of + 3.2 ºC in favour of the whole park. In the evening hours, it is observed that the areas outside the park are warmer. Between the whole park and the control point, there is a temperature difference of +1 ºC in favour of the control point.

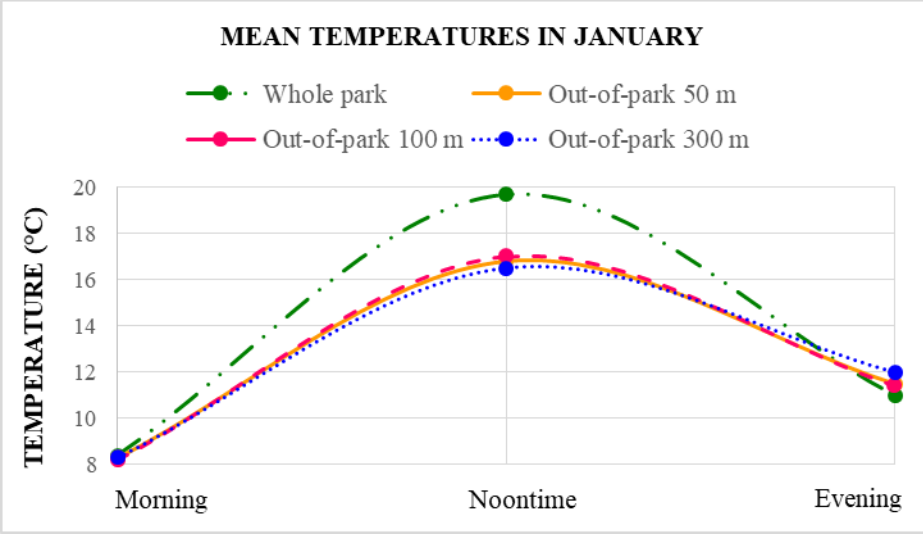

Figure 2.1. Graph of average temperature values in January

The graph of average temperature values in August is given in Figure 2.2. According to the average temperature values of August, there is a temperature difference of + 0.9 ºC between the whole park and the control point in the morning hours in favour of the control point. In addition, the temperature values gradually increased from the park. The temperature difference increases significantly in favour of the control point at noon and there is a temperature difference of + 3.6 ºC between the whole park and the control point in favour of the control point. In the evening hours, as in the morning hours, the temperature values gradually increased from the park and there was a temperature difference of + 0.7 ºC between the whole park and the control point in favour of the control point.

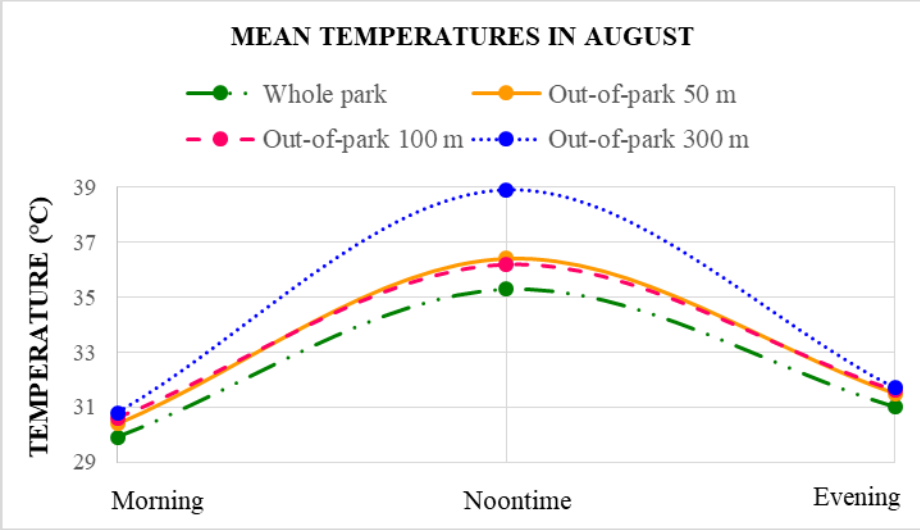

Figure 2.2. Graph of average temperature values in August

2.2.2. Analysis of humidity data for the whole park and outside the park

According to the humidiy data, in the first four months of the year (January, February, March, April), the humidity values in the whole park are lower than those outside the park. According to both the general climatic data of Antalya and the data measured in this study, the noon humidity difference between the whole park and the control point in January, which is the coldest month, was determined as 4.1%. In other words, in the coldest month of the year, the park provides a 4.1% less humid environment and softens the cold air inside the park. This result shows that the humidity value of the park is low in relatively cold and cool months, which reduces the effect of cold. In the eight months between May and December, it is seen that the humidity values in the whole park are higher than the humidity values outside the park. According to both the general climatic data of Antalya and the data measured in this study, the humidity difference between the whole park and the control point was determined as 7.8% in August, the hottest month.

The humidity measurement results show that the humidity effect created by the park around the park does not occur gradually as expected at 50 and 100 metres from the park. In the months when the heating effect of the park is detected (January, February, March, April), the measurement results obtained from 50 metres are expected to be higher than 100 metres; in the months when the cooling effect is detected (May, June, July, August, September, October, November), the measurement results obtained from 50 metres are expected to be lower than 100 metres, but the results did not support this expectation. This situation is considered to be related to the local conditions of the measurement points at 50 and 100 metres (such as the presence of a street that affects 100 metres and functions as an air corridor) and other climatic data (temperature and wind speed).

When the humidity measurement data of the whole park and the areas outside the park were compared, it was observed that the differences in the temperature values of the month ($P<0.001$), measurement hour ($P<0.001$) and measurement point ($P<0.001$) were statistically significant. When the results were analysed in terms of binary interactions, it was determined that the binary interaction of month and measurement hour ($P<0,001$), the binary interaction of measurement hour and measurement point ($P<0,004$) and the binary interaction of month and measurement point ($P<0,001$) were statistically significant. It was also determined that the triple interaction of months, measurement hour and measurement point ($P<0,001$) was statistically significant.

When the humidity data are analysed in terms of monthly averages, it is seen that the values vary between 40.3% and 54.4%. The highest value occurred in February (54.4%) and the lowest value occurred in July (40.3%). When the humidity data were analysed in terms of hourly averages, it was observed that the lowest value occurred at noon in January (33.3%) and the highest value occurred in the evening hours in October and December (61.4%). In February, March, April, May, June,

August, September, September, November and December, the difference between morning, noon and evening humidity values was statistically significant and it was observed that the evening value was the highest and the noon value was the lowest. In July and October, the difference between morning and noon humidity values was not statistically significant, but it was lower than the evening humidity value. In January, the difference between morning and evening humidity values was not statistically significant, but it was higher than the noon humidity value.

When the humidity data were analysed in terms of the annual averages of the measurement hours, it was observed that there was a statistical difference between the humidity values at different measurement hours, with the lowest value at noon (41.2%) and the highest value in the evening (55.8%). When the humidity data were analysed in terms of the annual averages of the measurement points, the control point (48,1%) had the lowest value, while the average inside the park (49,8%) had the highest value.

When the triple interaction of months, measurement points and measurement hour was analysed in terms of humidity values, the highest value (62.8%) was obtained in the whole park in the evening (20.00-21.00) in December, and the lowest value (30.7%) was obtained in the whole park at noon (13.00-14.00) in January.

When the monthly averages of the whole park and non-park measurement points are compared, although there is no statistically significant difference between them, the highest humidity value was observed in February (54.9%) at 100 metres outside the park and the lowest humidity value was observed in July (39.3%) at 50 metres outside the park.

The graphs of the humidity data of the whole Aydın Kanza Park and three measurement points outside the park were created and interpreted separately for the coldest month of January and the hottest month of August. The graph of average humidity values in January is given in Figure 2.3. According to the average humidity values in January,

the humidity value of the whole park in the morning hours was higher than the humidity values at the control point and 50 metres outside the park and lower than the humidity value at 100 metres outside the park. When the whole park and the control point are compared, it is seen that the humidity difference is + 0.8% in favour of the whole park. At noon, the humidity difference increases significantly in favour of the control point and the humidity difference between the control point and the whole park is + 4.1%. In the evening hours, the opposite is the case, the humidity value decreases gradually from the park, and the humidity difference between the whole park and the control point is + 3.5% in favour of the whole park.

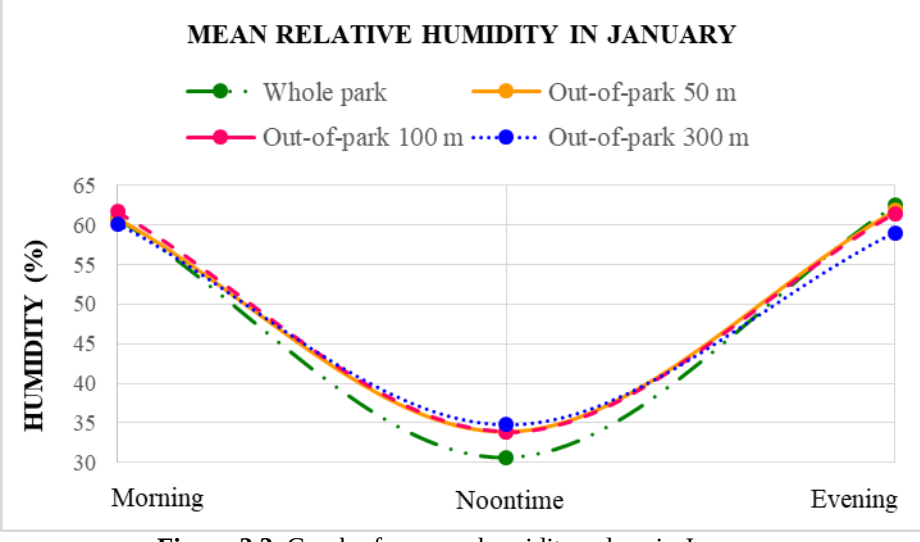

Figure 2.3. Graph of average humidity values in January

The graph of average humidity values in August is given in Figure 2.4. Accordingly, it is observed that the whole park is more humid in the morning, noon and evening hours. The difference between the 100th meter outside the park with the lowest humidity in the morning hours and the park as a whole is + 1.7%; the difference between the control point with the lowest humidity in the noon and evening hours is + 7.8% at noon and + 4.3% in the evening, all in favour of the park as a whole.

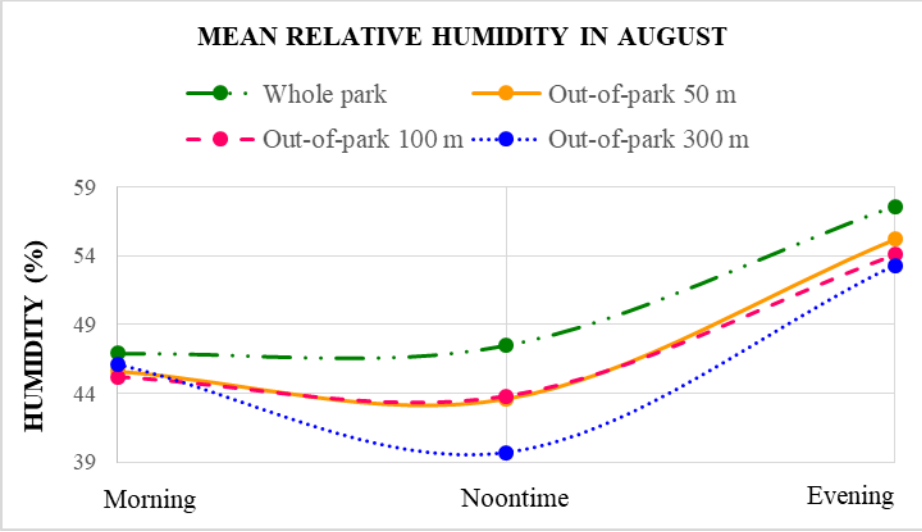

Figure 2.4. Graph of average humidity values in August

2.2.3. Analysis of wind speed data for the whole park and outside the park

In Aydın Kanza Park in the first three months of the year (January, February, March), wind speed values were highest at 100 metres outside the park except in the morning hours. In January, the wind speed difference between the whole park and the 100th metre at noon is up to 0.5 m/sec. In June and July, wind speed values are highest at 100 metres outside the park and lowest at the control point, except in the evening hours. Especially in June, the wind speed difference between the whole park and the 100th metre at noon was up to 0.4 m/sec. In August, wind speed values were highest at 50 metres outside the park and lowest at the control point. In April, May, September, October, November, October, November and December, wind speed values are highest at 100 metres outside the park and lowest at the control point. Especially in September, the wind speed difference between the whole park and the 100th metre at noon is up to 0.6 m/sec. These measured values show that the wind speed is generally higher outside the park.

When the wind speed measurement data of the whole park and non-park areas were compared, it was observed that the differences between the month (P<0.001), measurement hour (P<0.001) and measurement point (P<0.001) wind speed values were statistically significant. When the results were analysed in terms of binary interactions, it was determined that the binary interaction of month and measurement hour (P<0,001) and the binary interaction of measurement hour and measurement point (P<0,001) were statistically significant, while the binary interaction of month and measurement point (P<0,151) was statistically insignificant. In addition, the triple interaction of months, measurement hour and measurement point (P<1) was not statistically significant.

When the wind speed data are analysed in terms of monthly averages, it is seen that the values vary between 0.2 m/sec and 0.6 m/sec. The highest monthly average value was in June (0.6 m/sec) and the lowest monthly average value was in December (0.2 m/sec).

When the wind speed data were analysed in terms of hourly averages, the lowest value was observed in the evening hours of January (0 m/sec) and the highest value was observed in the midday hours of March and June (1.3 m/sec) without any statistical difference between them. Except for January and September, the differences between the morning and evening values are not statistically significant and are lower than the noon values. The differences between the morning, noon and evening wind speed values in January and September were statistically significant and the highest values were obtained at noon, the lowest values were obtained in the evening in January and in the morning in September.

When the wind speed data are analysed in terms of the annual average of the measurement hours, it is seen that there is no statistically significant difference between the values of the morning and evening measurement hours, and these values are lower than the values at noon. The highest value was measured at noon (0.9 m/sec) and the lowest

values were measured in the morning and evening hours (0.2 m/sec), although there was no statistically significant difference between them.

When the wind speed data were analysed in terms of the annual averages of the measurement points, the control point (0.2 m/sec) had the lowest value, while the highest value was obtained at 50 and 100 metres outside the park (0.6 m/sec) without any statistical difference between them.

When the triple interactions of months, measurement points inside and outside the park and measurement hour were analysed in terms of wind speed values, the highest value (1.8 m/sec) was obtained at 100 metres outside the park at noon (13.00-14.00) in April and June. The lowest value (0 m/sec) was obtained in January and December in the evening hours (20.00-21.00) in the whole park and control point. In February, March, October and November, the lowest value (0 m/sec) was obtained in the morning (07.00-08.00) and evening (20.00-21.00) hours. In April and May, in the evening hours (20.00-21.00), the park as a whole and the control point, and in the morning hours (07.00-08.00), only the control point received the lowest value (0 m/sec). The lowest value (0 m/sec) was obtained at the control point in the morning hours (07.00-08.00) in June and July, only at the control point in the evening hours (20.00-21.00) in August and only in the whole park in the morning hours (07.00-08.00) in September. The lowest value (0 m/sec) was generally taken by the control point in the evening hours (20.00-21.00) in all months except September.

When the monthly averages of the whole park and non-park measurement points are compared, it is seen that there is no statistically significant difference between the values in January, February, March, May and November. In April, September, October and December, there was no statistical difference between the average wind speed measurement values inside the park, 50th metre outside the park and the control point wind speed measurement values, and it was observed that it was lower than the 100th metre wind speed measurement value inside

the park. In the months of June, July and August, it was observed that the measurement value of the whole park and the control point, which had no significant statistical difference between them, was lower than the whole park and the 50th and 100th metre wind speed values, which also had no significant statistical difference between them. The highest wind speed value (1 m/sec) was observed at 50 metres outside the park in August and the lowest wind speed value (0.1 m/sec) was observed at the control point in April, May, July, October, November and both at the control point and inside the park in December.

Graphs of wind speed data for the whole of Aydın Kanza Park and three measurement points outside the park were created and interpreted separately for January, the coldest month, and August, the hottest month. The graph of average wind speed values for January is given in Figure 2.5.

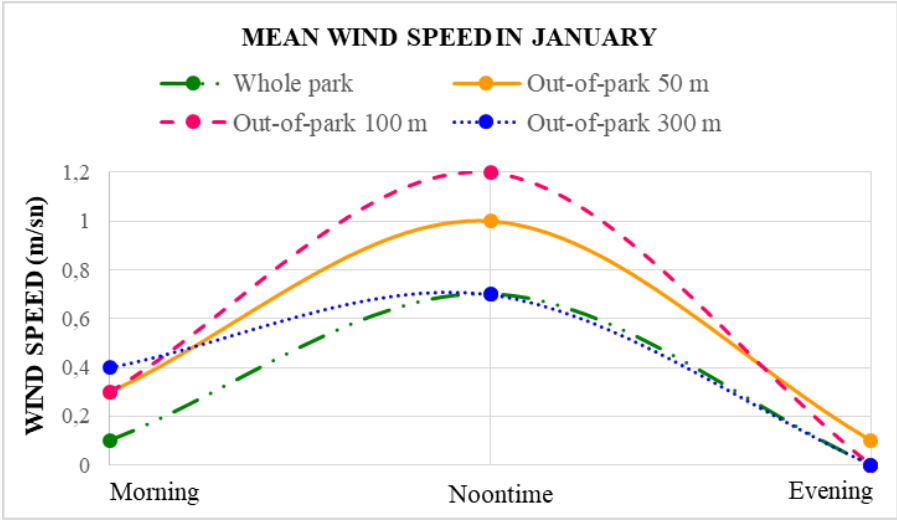

Figure 2.5. Graph of average wind speed values in January

According to the average wind speed values in January, it was observed that the whole park had the lowest wind speed in the morning, midday and evening hours. In the morning hours, there is a wind speed difference of + 0.3 m/sec between the whole park and the control point

in favour of the control point. Although there is no wind speed difference between the whole park and the control point at noon and evening hours, the wind speeds measured at other points are higher than these two areas. At noon, there is a wind speed difference of + 0.5 m/sec between the park as a whole and the 100th meter, which has the highest wind speed value outside the park, in favour of the 100th meter.

The graph of average wind speed values in August is given in Figure 2.6. In August, the 50th metre had the highest value from all measurement hours, followed by the 100th metre, the whole park and the control point, respectively. The difference between the whole park and 50th metre is +0.7 m/sec in the morning, +0.4 m/sec in the afternoon and +0.5 m/sec in the evening.

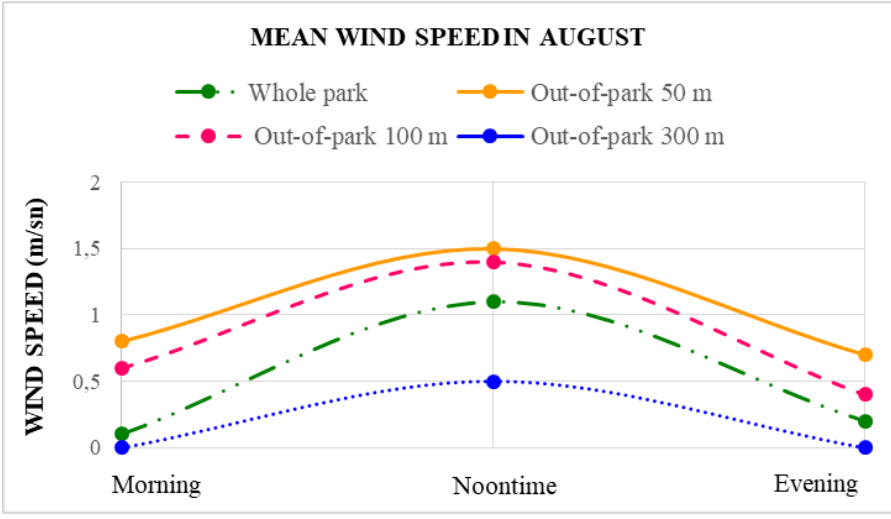

Figure 2.6. Graph of average wind speed values in August

2.3. Evaluation of Research Findings in terms of Bioclimatic Comfort

When the data obtained from the research are evaluated within the framework of Olgyay's (1973) bioclimatic comfort values (Table 2.1), it is seen that in January, both inside and outside the park are cold, in other words, not suitable in terms of bioclimatic comfort. In February, it is seen that the inside of the park is comfortable in terms of bioclimatic comfort

and the outside of the park is cold, in other words, uncomfortable in terms of bioclimatic comfort. In March and April, both inside and outside the park are bioclimatically comfortable; in the period starting from May until the end of October, both inside and outside the park are hot, i.e. bioclimatically uncomfortable. When the November values are analysed, it is seen that except for the control point outside the park, the other measurement points are bioclimatically comfortable, while the control point is hot, i.e. bioclimatically uncomfortable (Table 2.2).

Table 2.1. Bioclimatic comfort values of Olgyay (1973)

PERCEIVED TEMPERATURE (^{O}C)	COMFORT CLASS	COLOUR
27,5<	Comfort deteriorates (warm)	
21-27,5	Comfortable	
21>	Comfort deteriorates (cold)	

Here, it is seen that the microclimatic effect of the park continues until 50 m and 100 m outside the park, but loses its effect at the control point at 300 m. Looking at the December values, it is seen that the measurement points inside the park and the control point measurement point are bioclimatically comfortable, while the measurement points 50. m and 100. m outside the park are cold, that is, bioclimatically uncomfortable. Here, different wind values caused by the wind corridor and building orientations affected the bioclimatic comfort.

Table 2.2. Bioclimatic comfort periods inside and outside the park

MONTH	CLIMATE DATA	MEASUREMENT POINTS						
		Wooded area	Grass area	Hard ground area	Poolside	50m outside the park	100m outside the park	Control point
01	Temperature (^{O}C)	19,3	20	19,5	20	16,8	17	16,5
	Humidity (%)	31,3	29,	31,4	30,	33,9	33,9	34,8
	Wind speed	0,6	1	0,7	0,4	1	1,2	0,7
02	Temperature (^{O}C)	21,4	21,	21,3	22,	18,9	19,7	19
	Humidity (%)	42	41,	43,7	42	44,7	44,8	43,2

	Wind speed	1,3	1,2	1,4	1,3	1,4	1,6	0,5
03	Temperature (^{O}C)	23,7	24,	23,7	24	22,5	22,7	21,9
	Humidity (%)	34,4	34	35,4	33,	37,1	37,6	35,9
	Wind speed	1,1	1,6	1	1,1	1,5	1,6	0,9
04	Temperature (^{O}C)	25,7	26,	25,8	26	24,9	25,5	24,1
	Humidity (%)	34,5	34,	36	33,	33,5	34,6	37,8
	Wind speed	1	1,6	1,4	1	1,1	1,8	0,3
05	Temperature (^{O}C)	30,3	30,	30,2	30,	31,7	32	31,5
	Humidity (%)	42,5	42,	43,2	42,	38,8	38,1	37,5
	Wind speed	0,8	1	1,4	1,3	1,2	1,3	0,3
06	Temperature (^{O}C)	32	32,	32,5	31,	33,2	33	35,7
	Humidity (%)	48,6	46,	47,6	50,	47,5	48,3	42,7
	Wind speed	1,2	1,3	1,3	1,6	1,6	1,8	0,5
07	Temperature (^{O}C)	35	34,	34,8	34,	37	35,8	36,6
	Humidity (%)	40,1	40,	40,4	41,	36,2	37,5	36,9
	Wind speed	0,9	1,2	1,5	1,4	1,1	1,2	0,2
08	Temperature (^{O}C)	35,5	34,	35,4	35,	36,4	36,2	38,9
	Humidity (%)	47,6	48,	47	47,	43,6	43,8	39,7
	Wind speed	0,7	1,3	1,2	1,2	1,5	1,4	0,5
09	Temperature (^{O}C)	31,8	31	31,3	32	31,9	31,7	32,5
	Humidity (%)	49,6	50,	49,9	49,	47	47,2	45,4
	Wind speed	0,7	0,8	0,8	0,7	0,9	1,3	0,3
10	Temperature (^{O}C)	28,9	29,	29,1	28,	29	28,9	30,9
	Humidity (%)	47,8	47,	47,1	48,	47,3	47,5	45
	Wind speed	0,3	0,5	1	1	0,9	1,2	0,2
11	Temperature (^{O}C)	26,8	27,	26,9	27,	26,9	27,1	28,7
	Humidity (%)	45	44,	45,3	43,	43,7	44	41,3
	Wind speed	0,6	0,5	0,7	0,3	0,7	0,8	0,3
12	Temperature (^{O}C)	22	21,	21,3	21,	20,6	20,4	21,5
	Humidity (%)	39,8	39,	40,3	40,	40,4	39,8	41,1
	Wind speed (m/sec)	0,2	0,2	0,2	0,3	0,4	0,7	0,1

3. RESULTS

The results obtained from this study, which aims to determine the microclimatic benefits provided by parks in the case of Aydın Kanza Park, support previous scientific studies on this subject. With its 10.942 m2 surface area, Aydın Kanza Park is a small urban park on an international scale, and when the average size of urban parks in Antalya and Turkey is taken into consideration, it can be described as a medium-sized urban park, which provides a cool environment in summer and a warm environment in winter.

According to the results obtained from the measurements, Aydın Kanza Park is warmer than the surrounding built-up areas in 4 months of the year (between January and April) and colder than the surrounding built-up areas in 7 months of the year (between May and November). There is a stabilisation in December. In January, the coldest month of Antalya, the park provides a 3.2 ^{o}C warmer environment at noon. In the noon hours of August, the hottest month, the park contributes to the climatic comfort of the city dwellers by providing a cooler environment by 1.1 ^{o}C compared to 50 metres, 0.9 ^{o}C compared to 100 metres and 3.6 ^{o}C compared to 300 metres (Figure 3.1). The heating effect provided by the park in the 4-month period varies between 1.9 ^{o}C and 3.2 ^{o}C; the cooling effect provided in the 7-month period varies between 1 ^{o}C and 3.6 ^{o}C.

The results show that the heating and cooling effect provided by the park continues at a certain distance from the park. When the temperature differences between 100 m from the park and the control point at 300 m, which is assumed that the microclimatic effect of the park is no longer observed, it is seen that the measurement point at 100 m is warmer in 5 months of the year (January-May period) and cooler in 7 months of the year (June-December period). As a result of the microclimatic effect provided by the park, the point at 100 metres is warmer between 0.5 ^{o}C and 1.4 ^{o}C in 5 months and cooler between 0.8 ^{o}C and 2.7 ^{o}C in 7 months.

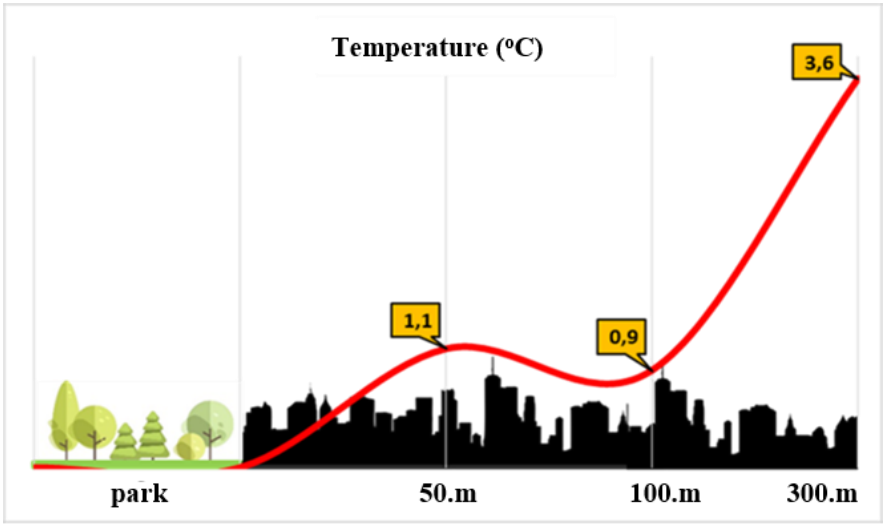

Figure 3.1. Graph of temperature difference between Aydın Kanza Park and outside the park (August)

When we look at the measurement average of August, which is the hottest month in Antalya, it is seen that the temperature values of the measurement points other than the hard ground area are equal between the areas within the park. There was a temperature difference of 0.2 oC between them and the hard ground area. The reason for this is thought to be that the distance between different structural areas in the park is quite small and not homogeneously distributed. Because when the general temperature values of the park are considered, the cooling effect is clearly seen compared to its surroundings. The fact that some of the fountains in the pool and some of the measurement points around the pool are located very close to Anafartalar Street, which descends uninterruptedly to the sea parallel to the dominant wind direction, has been effective in the fact that the temperature values in the wooded area and the temperature values around the pool take the same values. A similar situation is observed in the fact that the grass area temperature values are the same as the wooded area temperature values. The fact that some of the grass area measurement points are located very close to Anafartalar Street, which descends continuously to the sea parallel to the

prevailing wind direction, and that another grass area measurement point is located right next to the wind corridor in the park have been effective.

In order to clearly distinguish the cooling effect of different design areas within the park in hot climate character, these areas should be designed without too much fragmentation. Although the wooded areas are particularly effective in the climatic comfort of the park, it is seen that the grass area, the water edge and the hard ground area provide cooling, respectively, when designed considering the above-mentioned criteria. In addition, the diameter of the trees in the park, the leaf density, the distance of the branching to the ground also play a role in the cooling effect of the park in summer.

When the measurement points inside and outside the park are analysed in terms of bioclimatic comfort values, it is seen that February is the month when inside the park is more comfortable than outside the park. In November, except for the control point outside the park, the other measurement points are comfortable in terms of bioclimatic comfort, while the control point is uncomfortable. Here, it is concluded that the microclimatic effect of the park continues until 50 m and 100 m outside the park, but loses its effect at the control point at 300 m. In December, it was observed that the measurement points inside the park and the control point measurement point were bioclimatically comfortable, while the 50 m and 100 m measurement points outside the park were cold, that is, bioclimatically uncomfortable. Here again, it is concluded that corridors and building orientations affect the wind values and affect the bioclimatic comfort.

The results obtained from the study are important in terms of revealing how important urban green spaces can play an important role in mitigating the effects of urban heat islands, which are among the important urban environmental problems of recent years, which have emerged as a result of urbanisation and global warming. The climatic comfort provided by urban parks and other green areas is more important in regions of our country with Mediterranean climate, including Antalya.

The results of the study contribute to the application dimension of the discipline of Landscape Architecture. The results contribute to the professional discipline of Landscape Architecture, whose main field of action is open and green space planning and design, both in the context of urban landscape planning and urban landscape design and applications. Within the scope of urban landscape planning, it contributes to open and green space planning in the zoning planning process of cities; within the scope of urban landscape design, it contributes to the preparation of landscape projects of parks by revealing which type of areas provide more climatic comfort.

Within the framework of the results obtained from the study, it is necessary to give special importance to open and green area planning during the preparation of zoning plans, especially in cities located in hot climate zones such as Antalya. It should be known that small, isolated green areas, which are a product of the current planning practice and which are not regularly distributed in the urban texture, will not fulfil the functions expected from them, especially in terms of climatic comfort. In order for parks and other green areas to fully fulfil the social, cultural, ecological and climatic functions expected from them, they should be planned in accordance with certain standards and in sufficient size within a system in urban planning and their regular distribution in the urban texture should be ensured.

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CHAPTER 4

DETERMINATION OF PRECIPITATION DISTRIBUTION BY SCHREIBER METHOD AND DIFFERENT INTERPOLATION TECHNIQUES

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INTRODUCTION

The condensation of water vapor in the atmosphere and falling to the earth in solid or liquid form is called precipitation (Agirbas et al., 2019). Precipitation can be seen in various forms according to the temperature value of the environment. These are rain, snow, hail, frost, and drizzle. Precipitation is vital for humans and other living things. While excessive precipitation endangers life and property; insufficient precipitation can affect agriculture and lead to hunger problems (Kidd et al., 2011). Although precipitation has many benefits for life, natural disasters such as floods may occur if the water mass formed in regions with continuous and excessive rainfall cannot be discharged. Geographical regions that drain water bodies are called precipitation basins. Precipitation basins are geographical areas that deliver water, sediments, dissolved substances, and drainage waters to an outlet or from an area to a lake, dam, sea, and ocean waters (Anderson, 1999).

If the annual precipitation received by a basin is not sufficient for the survival of the living beings in that area, it may cause a drought problem. Drought occurs when the amount of precipitation falling on the earth falls below the average within a certain time interval (Sarış et al., 2021). If we can predict the drought, we can take the measures of this devastating event before it's too late. Therefore, it is extremely important to determine the amount of precipitation in a region. The amount of precipitation is measured by the automatic meteorological observing stations (AMOS) by means of a pluviometer (Ünel et al., 2023). However, the absence of AMOS in every residential area means that the amount of precipitation in that region cannot be measured. In the calculation of the precipitation amount of the non-station settlements, the data of the stations adjacent to the selected area are used and the precipitation amount is estimated by various interpolation methods. The main interpolation methods used for precipitation distribution in the literature are inverse distance weighted (IDW), kriging method and radial basis function (RBF) method. Since its discovery, IDW is one of

the most used algorithms for spatial interpolation (Chiocchini et al., 2016; Şerban et al., 2021). In this method, the effect of the distance of other points to the reference point with respect to the reference point is revealed with an exponential expression. Thus, it is possible to calculate the effects of the points only with their distances, without the need for any other parameters. It has been determined that the IDW method gives more successful results than other methods in precipitation data (Jo et al., 2018). Kriging interpolation method is an interpolation method that estimates the optimum values of data at other points by using data from known close points (Inal, 2002). It is one of the widely used spatial interpolation methods (Jo et al., 2018). What makes this method important is that the correlation of a point with respect to other points is calculated and assigned to new points in this way and its variance can be calculated. The RBF method is one of the first-choice methods for interpolating scattered data (Grady, 2003). It fits the most appropriate curve according to the sample points given in multidimensional space. It repeats this process until it finds the best fit curve and outputs a surface that passes through these points. A few precise interpolation techniques are used, in which the interpolated surface must pass through each measured point value (Alaboz et al., 2020).

All three methods used in spatial interpolation use the station data of the desired area as a data set. If there is no station data in our study area, a precipitation value of those stations can be found by various methods by assigning fake station points to our study area and using station data close to the actual area. The Schreiber method is the widely preferred method in the literature in this process. The annual precipitation values of the fake stations assigned with this method are calculated according to the altitudes of the stations above sea level. The formula of the Schreiber method is given as $P_h = P_0 \pm 54h$. (Ardel et al., 1969; Doğru et al., 2022).

In this study, it is aimed to determine and map the amount of precipitation with different interpolation techniques in one of the sub-

basins of the Antalya basin. For this purpose, altitude values obtained from the digital elevation model (DEM) data and precipitation data from meteorology stations were used. The precipitation distribution of the study area was created according to the IDW, Kriging and RBF interpolation methods using the precipitation amounts calculated according to the Schreiber formula. As a result of the study, the precipitation amounts produced from the weighted values of the data of 10 meteorology stations were calculated using different interpolation methods. Then, the success of the interpolation methods was evaluated by statistical analyses.

1. MATERIAL AND METHOD

1.1. Study Area

This study was carried out in a sub-basin of the Antalya basin (31°34' E, 37°04 N). The study area covers a part of Manavgat, Akseki, İbradı and Gündoğmuş districts of Antalya province with a size of 2402.69 km^2. Although a large part of the study area, especially in the north, is covered with forest areas, there are mostly agricultural areas and residential areas in the south. In addition, as a water source in the study area, there are the Manavgat River, which is approximately 93 km long, originating from the Taurus Mountains and passing through the area in the north-south direction and pouring into the Mediterranean Sea, and the Oymapınar and Manavgat Dams built on it (Figure 1).

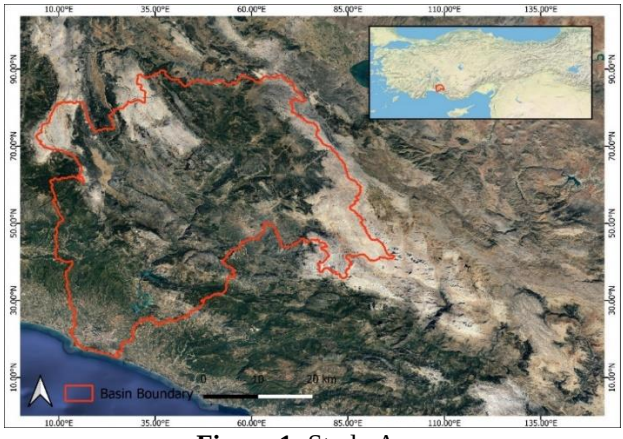

Figure 1: Study Area

1.2. Material

The basic data sets used in the study are DEM data with 12.5 m spatial resolution obtained from ALOS Palsar satellite and precipitation data of meteorology stations (Table 1). ALOS (Advanced Land Observing Satellite) is a mission of the Japan Aerospace Exploration Agency (JAXA) and the PALSAR sensor on it is one of three tools developed to contribute to the fields of mapping, field observations, disaster monitoring and resource research. The L-band synthetic aperture radar (SAR) on PALSAR provided detailed day and night observation as well as repeat-pass interferometric data in all weather conditions from 2006 to 2011. PALSAR data were acquired in multiple observation modes with varying polarization, resolution, band width and uncommon angle (ASF 2023). Precipitation data were obtained from a total of 10 meteorology stations within the scope of the study area. The hydrology tool was used to determine the boundaries of the study area and the Schreiber formula and IDW, Kriging, and RBF interpolation methods were used to obtain the precipitation distribution maps. Remote sensing and GIS operations of the study were performed with ArcGIS 10.5 (ESRI, California, USA) and QGIS 3.28.0 software.

1.3. Method

In the study, first, the basin boundaries were determined. For this purpose, the hydrology tool in ArcGIS software was used. Using this tool, water flow across the surface in the study area is modeled. DEM data was used as surface data in the creation of these models. Using the hydrology tool and DEM data, the determination of the basin boundaries was carried out in three stages: fill, flow direction and basin. Gaps that may occur in the DEM data can cause a discontinuous drainage network (ESRI 2023a). In this context, these gaps, which may occur due to the resolution of the data, or the errors caused by rounding the heights to the nearest integer value, are filled during the filling phase (Figure 2).

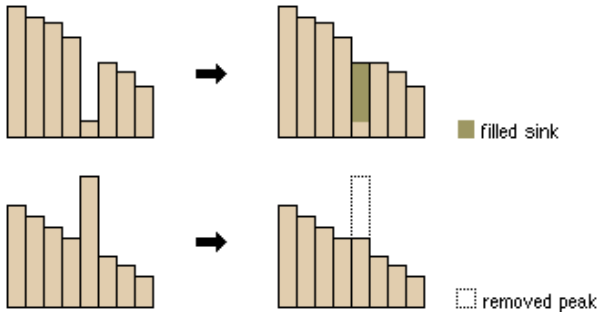

Figure 2: Fill (ESRI 2023)

In the flow direction stage, the flow direction from the surface is determined using a raster data in order to obtain the hydrological properties of the surface. According to this method, there are eight valid outlet directions for eight adjacent cells through which the flow can travel (Figure 3). This approach is often referred to as the eight-way (D8) flow model (ESRI 2023b; Jenson and Domingue 1988).

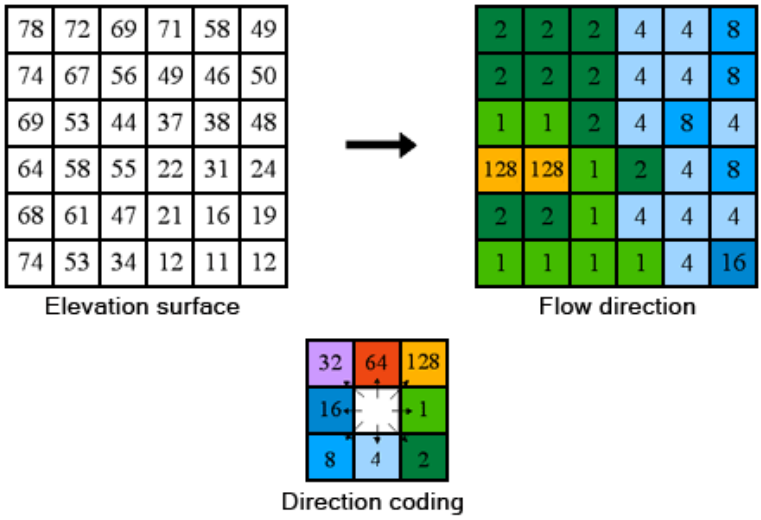

Figure 3: Flow Direction (ESRI 2023)

In the basin stage, which is the last stage of the hydrological analysis, the basin boundaries were determined by using the flow direction data. Then, the raster data showing the basin boundaries were converted to vector data format and saved as polygon data. Determination of the basin center of gravity of

(BCG), which is the mean center point of the basin, was performed with the mean center tool in ArcGIS software. The coordinates, which were taken from the General Directorate of Meteorology (MGM) and showing the location information of the stations, were recorded, and transferred to the GIS environment. Thus, a point vector set showing the positions of both these stations and the BCG was obtained (Figure 4).

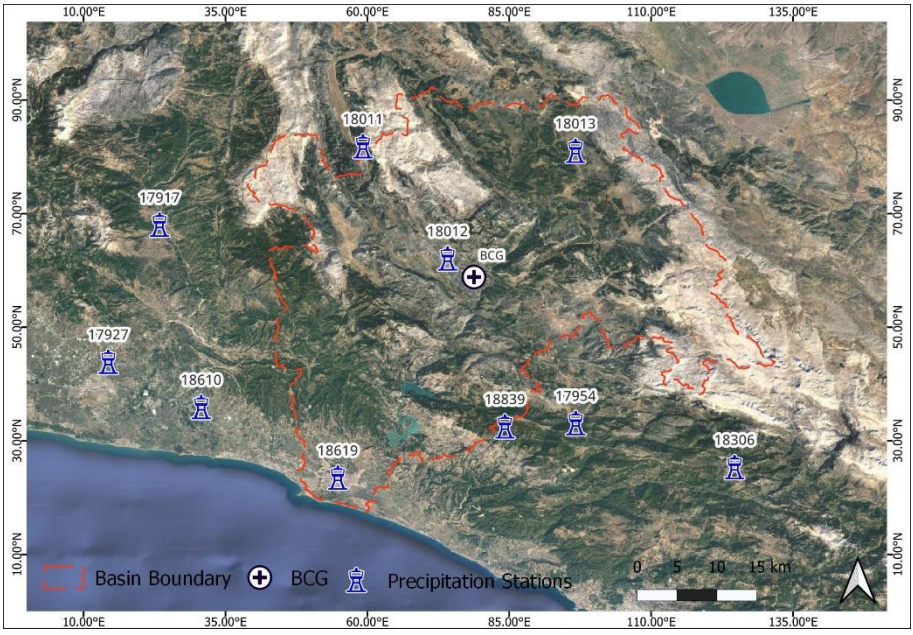

Figure 4: Locations of Stations and BCG

When the distances of the meteorology stations included in the study to BCG are examined, the closest is İbradı Centre Station and the farthest one is Serik Centre Station (Table 1). In addition, at this stage, the ALOS Palsar DEM data used in the study was cut according to the basin boundaries extracted in the previous stage.

Table 1: Stations and Annual Precipitation Values

Station Nu.	Station name	X coordinate	Y coordinate	Total annual precipitation (mm)	Distance to BCG (m)
18012	İbradı Centre	375161.81	4106535.02	1237.60	4332
18013	Akseki Cevizli	391328.25	4123067.24	838.90	23308
18839	Manavgat Forest	381945.43	4080312.06	1037.70	23620
18011	İbradı Gembos Plain	364885.63	4124156.23	2273.50	24552
18619	Manavgat Centre	360901.08	407654.72	641.80	35612
18610	Taşağıl	344003.48	4083942.28	659.90	39658
17917	Beşkonak	339332.33	4112397.918	1137.00	40041
18306	Gündoğmuş F.W.	410607.75	4073631.54	858.00	44032
17927	Serik Centre	332516.74	4091201.94	788.00	47554
17954	Murtiçi Forest New	390809.47	40800707.39	1116.10	26093

The method used for weighting is the Inverse Distance Weighted (IDW) method. This method is based on the principle of estimating an unknown point directly with the help of neighboring points with known values (Burrough et al., 2015). The formula used is given below (Equation 1).

$$\check{z}(\mathbf{x_0}) = \frac{\sum_{i=1}^{n} \mathbf{z(x_i)} \mathbf{d_{ij}^{-r}}}{\sum_{i=1}^{n} \mathbf{d_{ij}^{-r}}} \quad (1)$$

where, x_0 is the prediction point, x_i is each of the neighboring points, d_{ij} is the difference between the prediction point and the distance between the neighboring points, and r is the weight of this difference.

The Schreiber formula used in the study is given below (Equation 2). In this formula, Ph indicates the precipitation amount to be found at a point with a known height (mm), P_0 indicates the precipitation amount received from the station (mm), and the constant value of 54 indicates that the precipitation changes annually as 54 mm per 100 meters. Finally, h in the equation shows the height difference of a real station and the point where the precipitation amount is desired to be learned in hectometers (Ardel et al., 1969).

$$P_h = P_0 \pm 54h \quad (2)$$

Schreiber formula and IDW, Kriging and RBF interpolation techniques were used to determine and map the precipitation distribution of the basin. For this purpose, 500 random point data was created with the create random points tool in the study area. Then, the precipitation amounts of these points were calculated using Equation 2.

IDW, which is one of the three different interpolation methods evaluated within the scope of the study, and which is based on the determination of other unknown points with a non-linear interpolation method, considering the values measured at neighboring points, is a technique that is frequently used for this purpose and is very popular in this sense. In the IDW method, a neighborhood is determined around the interpolated point and the weighted average of the observation values in this neighborhood is taken (Caloiero et al. 2021; Usowicz et al. 2021). Kriging, another interpolation method used in the study, is different from other interpolation methods, and the quality of the interpolation can also be determined by the size of the error in estimating the values. The Kriging method uses a semi-variogram to measure the correlation of the spatially relevant component (Aalijahan and Khosravichenar 2021). RBF, which is the third interpolation method used in mapping the rainfall of the basin and one of the leading tools in the interpolation of multidimensional scattered data, uses a general function based on the distance between interpolation and sampling points (Yang and Xing 2021; Aalijahan and Khosravichenar 2021).

Precipitation distribution maps were obtained with these three interpolation methods. Before evaluating the precipitation distribution in the basin, which was determined by different interpolation methods, statistical analyses were made. For this purpose, 100 random points were created in the study area with the create random points tool. Then, the precipitation values of these points were recorded in the attribute table according to three different interpolation methods. After these precipitation values were exported, normality tests were performed with SPSS 23 software. Pearson correlation coefficients were calculated again in SPSS 23 software for the precipitation data showing normal distribution, and accordingly, the relationships between different interpolation methods were evaluated according to the precipitation values obtained from the stations within the study area.

2. RESULTS AND DISCUSSION

According to the basin boundary deduced as a result of the hydrological analysis, the study area is 2402.69 km2 and its circumference is 359.68 km. The minimum elevation in this basin is 18 m, the maximum elevation is 2775 m, and the average elevation is 886.37 m (Figure 5).

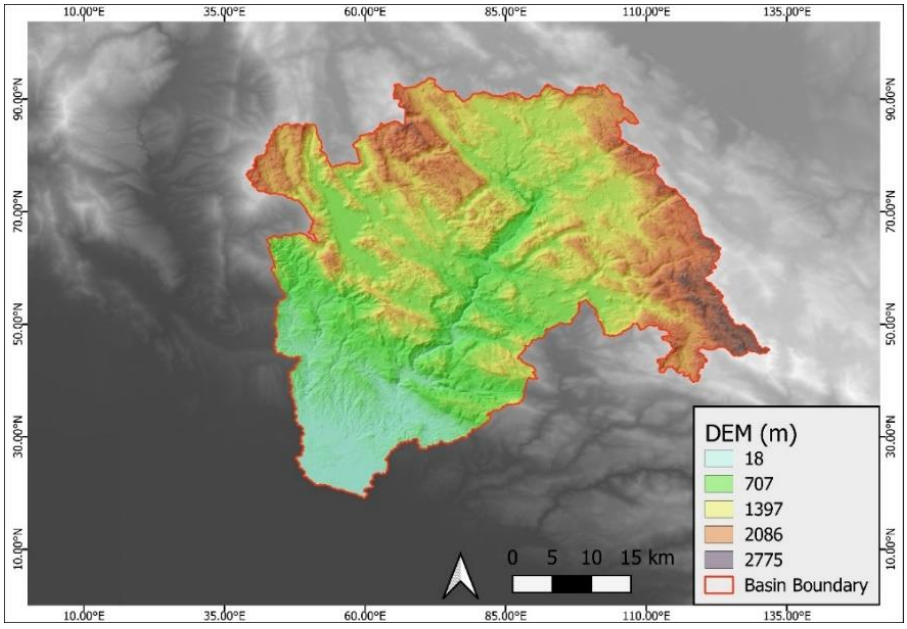

Figure 5: DEM

The weighting process was applied to the stations based on their distance from the BCG point. As a result, the new annual precipitation values of the stations were calculated and the sum of these values, 1160.4 mm of annual precipitation, was assigned to the BCG point (Table 2).

Table 2: Stations and New Annual Precipitation Values

Station Nu.	Station name	Total annual precipitation (mm)	Distance to BCG (m)
18012	İbradı Centre	552.43	4332
18013	Akseki Cevizli	69.60	23308
18839	Manavgat Forest	84.95	23620
18011	İbradı Gembos Plain	179.06	24552
18619	Manavgat Centre	34.85	35612
18610	Taşağıl	32.18	39658
17917	Beşkonak	54.91	40041
18306	Gündoğmuş F.W.	37.68	44032
17927	Serik Centre	32.04	47554
17954	Murtiçi Forest New	82.71	26093

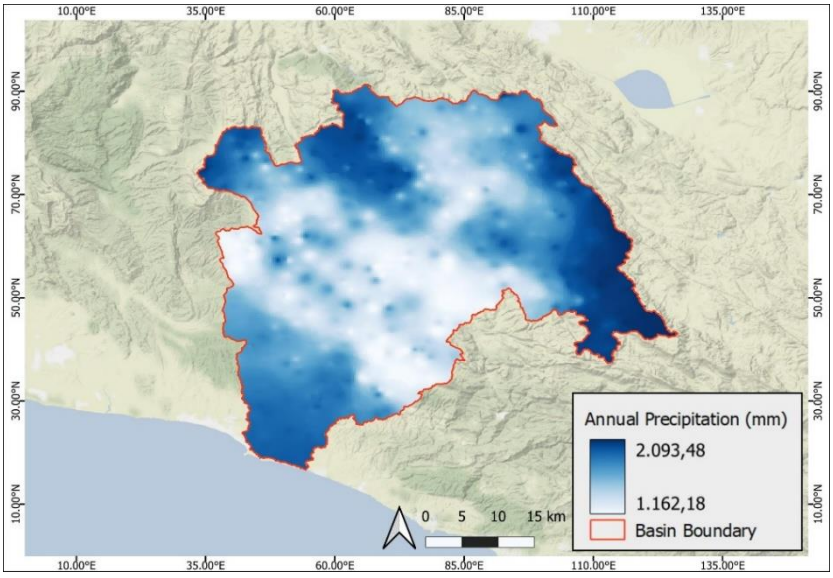

Figure 6: IDW Result Map

The minimum annual precipitation value is 1162.1 mm and the maximum annual precipitation value is 2093.4 mm, according to the precipitation distribution map obtained by the meteorology station data,

Schreiber formula and IDW interpolation method within the scope of the study (Figure 6).

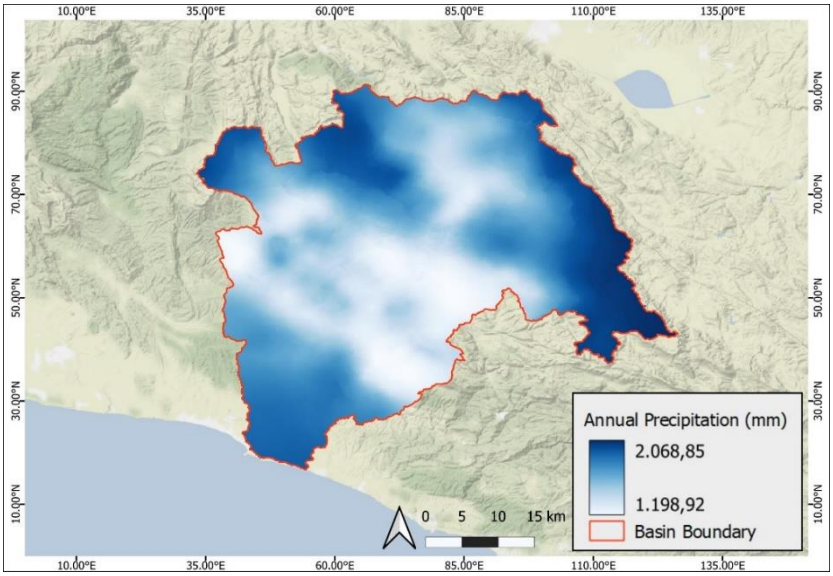

Figure 7: Kriging Result Map

The minimum annual precipitation value is 1198.9 mm and the maximum annual precipitation value is 2068.8 mm according to the meteorology station data included in the study, the precipitation distribution map obtained by the Schreiber formula and Kriging interpolation method (Figure 7).

The minimum annual precipitation value is 1095.8 mm and the maximum annual precipitation value is 2096.7 mm according to the precipitation distribution map obtained by the meteorological station data, Schreiber formula and RBF interpolation method within the scope of the study (Figure 8).

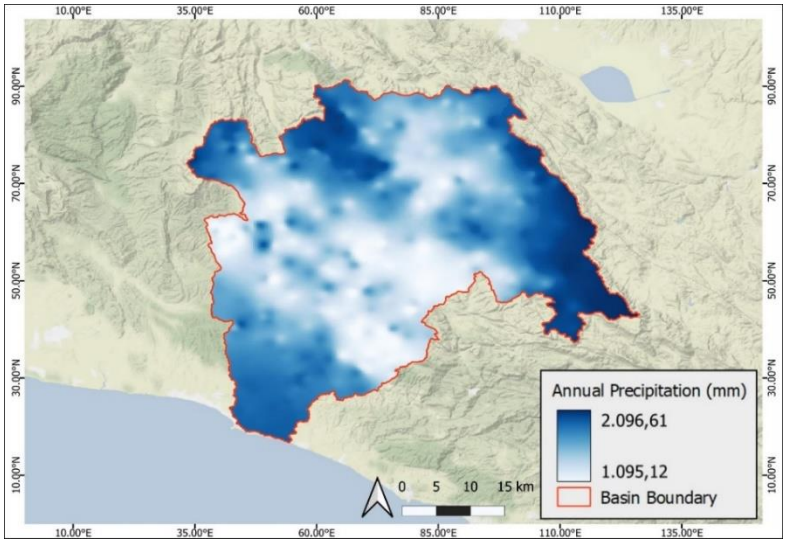

Figure 8: RBF Result Map

100 points were randomly assigned to the study area to be used in the correlation analysis (Figure 9). The annual precipitation values at the points where these points are located in the annual precipitation maps obtained by different interpolation methods were assigned using the extract values to points tool via ArcGIS software.

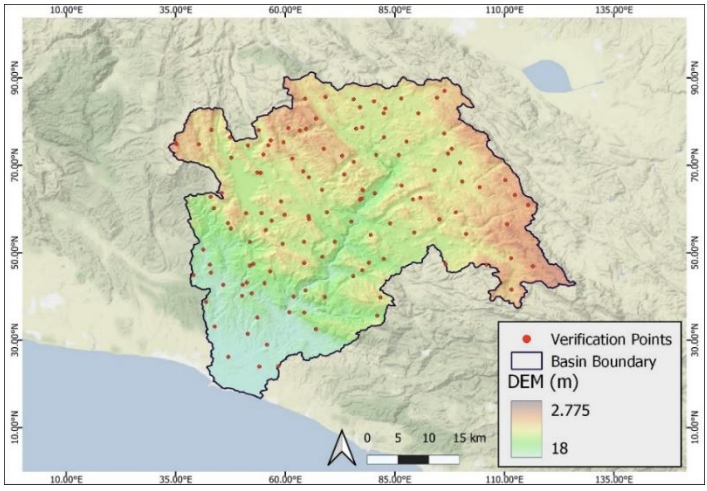

Figure 9: Verification Points

The results of the Pearson's correlation analysis performed on the SPSS 23 application for three different interpolation methods are given below (Table 3).

Table 3. Correlation Analysis Results

Interpolation Method		**RBF**	**IDW**	**Kriging**
RBF	Pearson	1	0.986**	0.979**
	Sig. (2-tailed)	-	0.000	0.000
	N	100	100	100
IDW	Pearson	0.986**	1	0.986**
	Sig. (2-tailed)	0.000	-	0.000
	N	100	100	100
Kriging	Pearson	0.979**	0.986**	1
	Sig. (2-tailed)	0.000	0.000	-
	N	100	100	100

***Correlation is significant at the 0.01 level (2-tailed).*

According to the findings of the study, strong (r = 0.986) and positive relationships between IDW and Kriging interpolation techniques, strong (r = 0.986) and positive relationships between IDW and RBF, and strong (r = 0.979) and positive relationships between Kriging and RBF were detected. In addition, the high correlation analysis results showed that the IDW method was the best representative of the annual precipitation distribution compared to other methods at the 99% significance level. These results show parallelism with the studies conducted by Taylan et al. (2016), Yenipınar et al. (2021) and İlker et al. (2019). As a result of the study, according to the precipitation distribution maps obtained by different interpolation methods, it was determined that while the precipitation amount should be low according to the Schreiber formula in the coastal areas where the altitude is low, it is distributed close to the high annual precipitation values. It has been evaluated that the reason for this is that the data of the 10 stations selected within the scope of the study are insufficient to represent the whole area and that choosing more precipitation stations in the studies to be carried out in this context can solve this problem. In addition, it

was determined that the Schreiber formula did not work well due to the high-altitude difference in the area.

3. CONCLUSION

In this study, it is aimed to determine and map the precipitation distribution of a medium-sized sub-basin extracted from the Antalya basin using DEM data. DEM data and AMOS data from ALOS Palsar satellite were used in the study. Within the scope of the study, precipitation distribution maps of the basin were produced by using Schreiber formula and IDW, Kriging and RBF interpolation techniques. According to the findings obtained, high and positive correlations were obtained between the interpolation techniques used in the study while it was determined that the IDW technique had a relatively higher representation power of the precipitation distribution in the area. It is thought that the use of higher resolution DEM data in future studies to determine and map the precipitation distribution, as well as the use of other factors that are thought to be effective on precipitation (climatic parameters such as relative humidity, land cover, surface temperature, etc.), may positively affect the success of these studies.

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CHAPTER 5

PREFERENCES FOR THE MEDITERRANEAN NATIVE TREES AND SHRUBS IN LANDSCAPING

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INTRODUCTION

Regarded as overall characteristics of the environment, landscape is often beyond scenery with a combination of natural and cultural features. As defined by European Landscape Convention landscape is 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). Multiple layers that the landscape consists of can be followed as topography, geology, water, flora, fauna and soil besides man made built components.

Landscaping in particular is a professional attempt to link people to nature in such a built, often concrete environment. Morrow (1957) articulated that landscape architecture is a discipline that combines scientific and artistic principles to design, plan, manage and protect land. It includes both natural and constructed elements, as well as cultural and scientific knowledge (ASLA, 2003). Design and planning are the two pillars of landscaping together with plants for long term sustainability of natural capital where sustainable landscaping refers to a set of principles that pursues in fair way of using natural resources while creating liveable spaces for people in a defined environment.

Plants are one of the inseparable elements of humans and their environment, and they often offer a strong link between the built environments in which humans live and nature. Although the food, food, fuel and medicinal properties of plants have been known from past to present, their contribution to human life and comfort has been tried to be depicted through natural examples in the landscape, and they have entered our daily lives by being carried into living spaces with plant design applications.

Plant design, which is based on the creation of new spaces in line with human needs by using plants, helps us how to best use our environment outside buildings, while making it possible to ensure sustainable exchange between humans and their environment. Here, plants of different qualities such as trees, shrubs and groundcovers form the main material, and a new space is created by using the functional and aesthetic properties of the plants with vegetal design.

Native species refer to plants that can grow in an area under completely natural conditions without human influence. Here, the ability of natural plant species to tolerate extreme climatic conditions supports the concept of sustainability, which has been widely discussed in recent years. It is of great importance to use natural species in landscape architecture applications for

reasons such as reducing maintenance costs, providing a healthy plant tissue, adapting to the local environment and improving environmental quality.

Mediterranean region has a high diversity of natural vegetation types where macchia is typically compose of plants that resistant to hot and dry conditions of the climate with hot summers and mild winters. The native plants of the Mediterranean have high tolerance to extreme climate and can survive extendedly long dry seasons. Therefore native species are essential in landscaping particularly in the Mediterranean.

The aim of this study was to examine role of the Mediterranean native plants species more specifically trees and shrubs in landscaping. Study was conducted in one of the largest public park in the Mediterranean city of Antalya, by searching public preference for the use of native trees and shrubs in urban environment.

1. MATERIAL AND METHOD

Material of the study consisted of Mediterranean native plant species of trees and shrubs. Atatürk Kültür Park in Antalya City was chosen as study site that subjected to Mediterranean climate with very hot and dry summers and mild and rainy winters. Atatürk Kültür Park is one of the largest and most visited public open green spaces of Antalya city (Figure 1). The vegetation composition has a wide diversity from Mediterranean native trees, shrubs, bushes to exotic ornamental plants brought from different geographical locations. The park represents a natural memory of the city before urbanisation. Therefore both vegetation and plant diversity is noteworthy and obviously visible on site.

Figure 1. Location of study area

Method of the study was manifold. Starting from landscaping and planting design, the emphases has been put on the benefits and functions that native plants able to provide when used in landscaping and planting design. Following two sets of plant visuals were prepared with best representative picture of 5 tree species and 6 shrub species that native to Mediterranean (Figure 2). For the analysis of preferences for native plants, on site interviews were carried out with 100 people from the visitors of Atatürk Kültür Park. Preference for native plants was searched of being visual quality, intact with nature, rarity, providing place quality and shade.

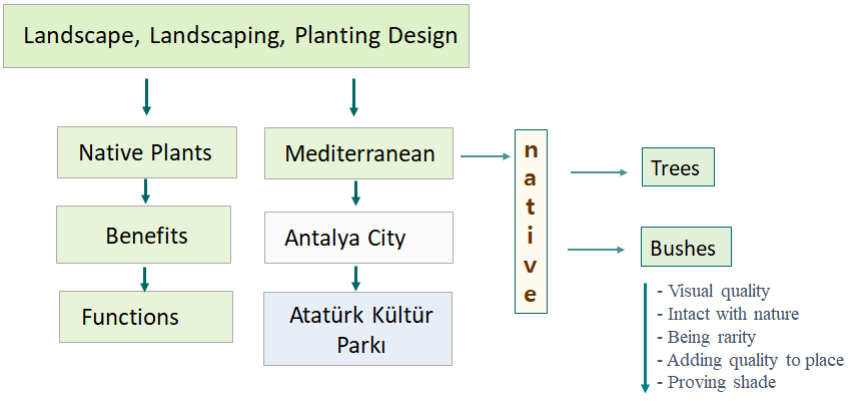

Figure 2. Main steps in the study

2. RESULTS

2.1. Design with Native Plants

Initiating space for people with planting design for a better quality of environment which autonomously enhance the quality of life is the most crucial part in landscaping. Pleasure that we get from a-well designed and planted garden and feeling about the nature around us can contribute greatly to our well-being and give us genuine spirit of the space. Landscaping helps us on how we can best shape, manage, benefit and use our environment. Here, planting design in particular maintain a sustainable relationship between people and the environment in a way conserving valuable ecological assets and creating new habitats.

In planting design functional properties as well as ecology and aesthetics are the basic components. However, in creating a healthy and cost efficient open green species native plant species are an effective solution in protecting water resources, as well as their ecological, aesthetic and economic benefits. According to Karagüzel (2007), in connection with the concept of sustainability, natural species and genotypes have high resistance to diseases and pests and environmental stress factors such as salt, low and high temperatures and drought.

Especially the vegetation of the Mediterranean Region stands out with its resistance to drought and heat. One of the most important issues in landscape architecture applications is increasing the visual quality, beautifying the urban aesthetics, breaking the mass effect of buildings, and preparing more liveable environments for people. By supporting the harmony between building masses and the natural environment by using local species in plant design, it is possible to increase the visual environmental quality and ensure environmental integrity (Atik and Karagüzel, 2007).

Native plant species that grow locality and most adapted to local environmental conditions have multiple benefits (Table 1). They are healthier and resistant to changing environmental conditions such as short of water, air pollution, plant diseases. Native plants simultaneously backbone of habitats for wildlife. They create and offer shelter, food and nesting for many animal species. From an ecological point of view habitat function help for ecosystem provision particularly in urban areas. Native plant species greatly support

pollinators in the wildlife such as bees, butterflies, insects, birds etc, this return essentially important for an healthy urban environment.

On the other hand biodiversity that based on the diversity of plant and animal species, their habitats and genetic diversity is vital in many terms. From protection point of view, replacing exotic plants with native plants sustain diversity even in the cities. Habitat provision of the native species has high value in the biodiversity protection. Because they are already collective components of natural landscapes, their acculturation in the urban environment is to sustain living urban landscapes in highly built and fragmented cities.

Needing less irrigation, fertiliser, pesticides, use of native plants provides economic benefits. Low maintenance cost help long term upkeep of the urban vegetation which is highly supportive for local administrations and municipalities. It is not only less maintenance but also less labour and craftsman that help to decrease overall cost for urban green spaces.

Table 1. Benefits of native plants in landscaping (Atik and Karagüzel, 2007)

Ecological Benefits	
Protection of Biological Diversity	It prevents the decline of species in nature and ensures the on-site protection of endangered, rare or endemic species. Biodiversity in situ; It supports the preservation of natural living conditions or nearby environments.
Providing Habitat for Wild Life Species	Natural vegetation is a source of food and shelter for wildlife. Native plants provide habitat for wildlife species specific to the region. It contributes to the preservation of species diversity and biodiversity. It encourages plant species that are resistant to drought and pests, especially bird species.
Maintain a Healthy Vegetation	Native species that are well adapted to local environmental conditions improve soil, prevent erosion and improve environmental quality. In addition to improving soil, air and water quality, it is possible to reduce the damage to soil, water and air through spraying, fertilizing, irrigation and mowing maintenance.
Economic Benefits	

Decreasing need for fertilisation, chemicals and irrigation	Exotic species brought from abroad are more sensitive to environmental conditions, and their demands and costs for irrigation, fertilization and pesticides are high. The use of natural plant species minimizes maintenance costs such as irrigation, spraying and fertilization, and their negative effects on soil and water resources are reduced because the natural species of the region are resistant to plant diseases and damages.
Lowering Maintenance Cost	Unless a very specific area and species characteristic is required, maintenance costs such as pruning and thinning of natural species are minimal. The phenological characteristics of species in their natural habitats are spontaneously shaped within the plant composition to be realized, reducing the need for intervention in the plant.
Aesthetic Benefits	
Improving Environmental Quality	One of the most important issues in landscaping is ensuring visual quality, beautifying urban aesthetics, breaking the mass effect of buildings, and preparing more liveable environments for people. By supporting the harmony between building masses and the natural environment through the use of local species, it will be possible to ensure environmental integrity as well as increasing the visual environmental quality.

2.2. Most Preferred Native Tree and Shrub Species in Antalya City

Plants are essential part of our environment. When we design environment with plant we design with nature. The perfect balance between natural environment and built-environment is crucial issue in planting design. Robinson (2004) emphasised that planting is a structural process as well as creating space which must be in a perfect harmony with visual properties of plants as form, line, texture, colour in addition to functional provision of plants. Thus, planting design evolves strongly also with the management of natural vegetation in case of semi natural and natural environment.

Most powerful meaning of planting design is to create ideal living environments for people using aesthetic and functional properties of plants. This has higher value in completing such built structures and softening their visual intrusiveness. Character and purpose of planting design has been diversifying depend on the human use of land as far as the history of

management and cultivation of plants goes back. Therefore well-design of plants is expression of functions and the needs of the users.

Idea of planting design first appeared with the attempts of making environment suitable for human need and activities consequently as a management of natural vegetation. Aesthetic value is based on the dendrological properties of plants such flowers, leaves, branches, trunks, seeds, crown shapes which are even enriched by reflections, shadows and inherited beauty of plants. However, in case of Antalya city, respondents of the visitors in Atatürk Kültür Park expressed their concern about the native trees and shrubs of being pleasing to the eye, beautifies the space but overall making close connection with nature.

When users were asked which natural tree species they would like to see in the park *Cercis siliquastrum*, which draws attention with its pink flowers, came first. They preference was due to their wish to see the park lively and colourful. However, on the contrary, those who think that these flower features will be valid for a limited time and then this feature will disappear stated that they preferred *Ceratonia siliqua* because it is evergreen and provides strong shade.

The most preferred native tree species was indicated as Plane tree (*Platanus orientalis),* Carob *(Ceratonisa siliqua)* and Olea (*Olea europa)* by means of creating a vibrant vegetation in the area all year round and providing shade (Figure 4, Figure 6). Aesthetic pleasure is important in planting design as people admire beauty and planting offers sensory experiences and creative opportunities for art and design as well as improving quality of human life. Regarding to most preferred native shrubs Oleander (*Nerium oleander),* Myrtle *(Myrtus communis),* Chaste *(Vitex agnus-castus)* and Laurel (*Laurus nobilis)* became prominent (Figure 5). Their preference clearly showed that native plants can be both visually attractive but also functional with their evergreen, drought resistant texture as well as medicinal properties (Figure 6).

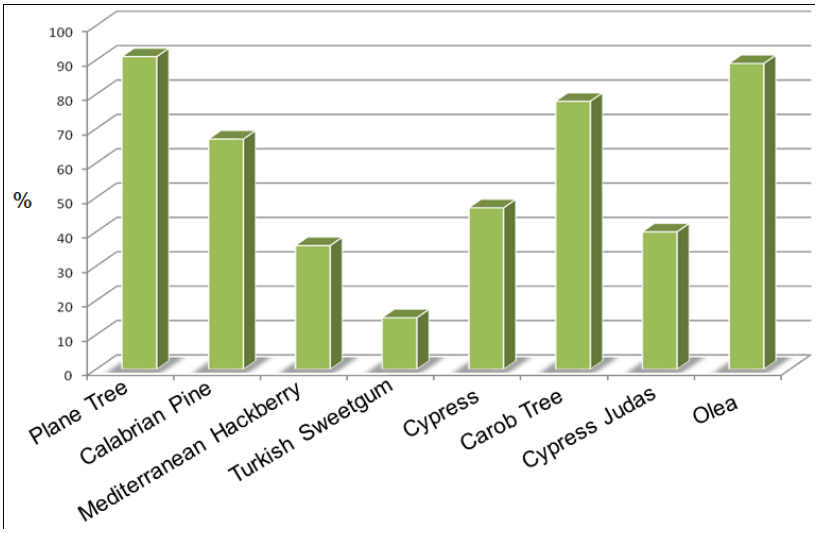

Figure 4. Most preferred native tree species in Antalya city

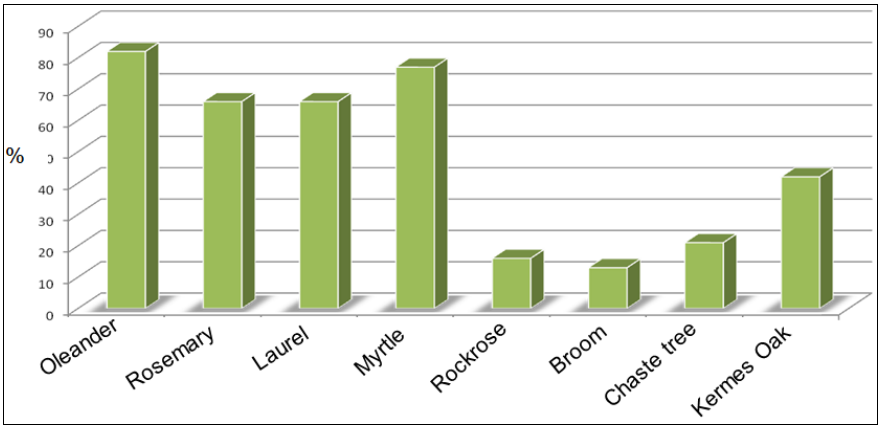

Figure 5. Most preferred native shrub species in Antalya city

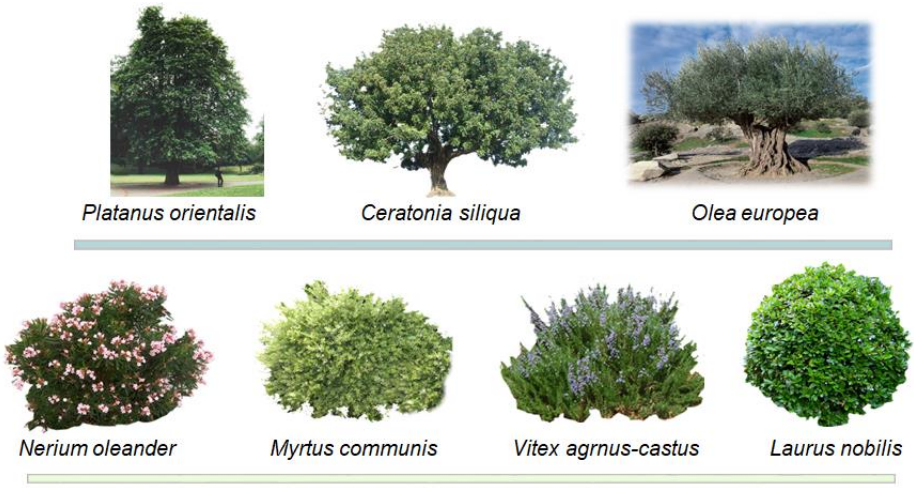

Figure 6. An index of the Most preferred native tree and shrub species of the Mediterranean in Antalya city

Mediterranean native vegetation is highly diverse. They consist of sclerophyll plants that typically are drought resistant, leathery broad leaved species. They strongly accustomed to extreme climate characteristic of long arid season of the Mediterranean. Some deciduous trees in particular such as Plane (*Platanus orientalis)* and Sweetgum (*Liquidambar orientalis*) have seasonal changes as the testimony of biological processes in the landscape. Evergreen native trees Carob *(Ceratonisa siliqua)* and Olea (*Olea europa)* resemble vitality and long life of the nature.

3. CONCLUSION

In recent years, increasing concerns about due to climate change and short of water have brought need for alternatives in landscaping which depends heavily natural resources and use of local environmental features. In this respect, sustainable landscaping with best employment of local flora, natural material and local practices.

Total mass of a plant with trunk, braches and leaves can create strong from (Walker, 1991) in the landscape. Large shrubs and small trees constitute a rich, varied category with many uses bringing transition ground plane to the shade tree canopy (Harris, 2021). Particularly in the Mediterranean region it is highly important to maintain good solutions for balancing temperatures,

providing shade, reducing uncomfortable effect of wind, amelioration of air humidity and precipitation.

In this study, the potential of using natural plants, especially trees and shrubs in planting design was investigated in the example of Antalya, Atatürk Cultural Park. Results indicated that Plane tree (*Platanus orientalis),* Carob tree *(Ceratonisa siliqua)* and Olea tree (*Olea europa)* as well as shrubs of Oleander (*Nerium oleander),* Myrtle *(Myrtus communis),* Chaste *(Vitex agnus-castus)* and Laurel (*Laurus nobilis)* that native to Mediterranean found to be most preferred by the inhabitants of Antalya city.

Native plants refer to plants that occur naturally in a particular region. Priority of using native plants is not naturalising the environment but is to sustain presence of the plant species that already grow in the nature. Study results showed that native tree and shrub species have a great potential for use in landscaping and planting design. On the other hand, Bekci et al. (2010) stated that the most important problem encountered in the plant materials used in landscape designs today is that the species that grow naturally in the region are not available at all or in sufficient numbers and characteristics in nurseries, and the presence of exotic plants instead of natural species in nurseries and greenhouses limits the designer's plant choice. Although some natural species such as Plane tree (*Platanus orientalis*), Olive tree (*Olea europea*) and Oleander (*Nerium oleander*) are widely used in the Antalya region, there is a need to cultivate more native plants species.

Native vegetation offers also ornamental value with leaves, flowers, fruits and with many other parts. However, their strengths come from their ecological benefits. In addition to protecting biological diversity, native species offer a sustainable alternative against climate change and temperature increases. Most of all native plants create living landscapes for people as well as wildlife species. Landscaping with native plants can be best way to preserve biological heritage, keeping sense of local landscapes and most importantly helping sustainable management of the environment.

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CHAPTER 6

URBAN EQUIPMENT ELEMENTS IN CITY IDENTITY

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INTRODUCTION

Throughout the history of humanity, cities have emerged with the transition to the environmental order where people come together. The most significant reflections of this change are seen in the towns in our ever-changing and developing world (Yildiz, 2022).

Cities change according to people's lifestyles, traditions, and needs. Rapid urbanization and technological developments have had a faster impact on the change of cities and caused people to spend more time in urban spaces. The increased time people spend in urban spaces has made urban spaces more critical. This situation has improved the comfort of urban areas and the importance of urban equipment elements with functions such as sitting, sheltering, protection, enclosure, play, sports, transportation, lighting, and communication.

The term urban equipment, which first appeared in England in the 1850s, was gas lamps used for lighting. Afterward, it was used frequently in European countries and America and had an essential share in urban architecture for a short period (Durmus, 2008).

Urban reinforcement elements provide the comfort of individuals in urban spaces and give identity to urban architecture. Urban reinforcement elements have an essential place in the essence of cities. Cities are also symbols of political, administrative, natural, and cultural factors in the civilization of countries. Cities are differentiated by displaying distinctive physical, cultural, and socio-economic features. Combining natural and artificial elements within a city creates a distinct identity that separates it from others.

The formation of a city's identity is a phenomenon that requires a historical process and is formed and shaped over a long period (Bayrakci, 1989). The city's historical texture, climatic characteristics, topographical features, natural structure such as geographical structure, cultural structure, traditions, lifestyle, artificial environment, architecture, and urban equipment elements effectively shape cities.

Identity is one of the essential elements in the formation and development of cities. Urban equipment elements are critical to organizing, producing, and transferring cities to future generations. Urban reinforcements, which are as important as buildings in cities, show themselves in a wide range, from meeting the needs of urbanites to reflecting the characteristics of the town. Urban reinforcement elements have unique and essential tasks for urbanites. Examples of these tasks include the lighting of a walkway at night, a shelter to be protected when it rains, a bench to sit on when we are tired, and the unifying effect of the elements that surround the life of cities (Konuk, 1991; Sancak, 2009). While urban reinforcement elements meet the needs of individuals in urban areas, they affect their psychological, perceptual, and behavioral characteristics. Human psychology and human relations are perfect in a well-designed environment, and life values increase (Sancak, 2009).

The reinforcement elements directly related to urban identity vary depending on the cultural characteristics of countries and cities. Improper selection and use of these reinforcement elements in the urban texture cause a lack of originality and create visual pollution. Urban reinforcements should be technically and visually sustainable and designed holistically in connection with urban and environmental identity (Bayrakci, 1989).

The impact of urban reinforcement elements on the plan and appearance of cities has become more significant due to the initial disregard for aesthetic concerns, changing living conditions, rapid urbanization, technological developments, and Landscape Architecture studies. These effects cause similar designs of urban reinforcements as technological developments increase the communication possibilities between cities (Kir, 2009). However, urban reinforcement elements should be designed to reflect the unique natural, historical, and cultural structure of the city in which they are located.

When we look at some cities in the world, cities that stand out with their reinforcement elements, which are accepted as an integral part of

the city identity, have a place in the perception of people with their designs or have reinforcements designed with features that reflect the identity of the city; always ensure the continuity of the identity formed in the aesthetic, regular and historical process. London's old telephone booths, Barcelona's sidewalks and streetlamps determine the identity of cities.

The location, form, and language unity between the urban equipment elements that define and complement the environment in which they are located help to form the identity of a city and ensure that the architectural expression in the city is strong (Kir, 2009). For this reason, every element in the city should be handled as a design product and reflect the city's identity elements. In this way, the reinforcement elements make urban life more enjoyable and meaningful, creating urban comfort and urban identity (Tarakci, 2003).

Urban reinforcement elements reflecting the urban identity also create an awareness of urban identity in individuals living in the city and newcomers to the town. The values of cities are more easily transmitted to future generations. In developing countries such as Turkey, problems such as urban identity deterioration and loss exist. To reduce these problems and to transmit urban identities to future generations, it becomes much more critical that the designs of urban reinforcement elements are unique to each city.

This study's starting point is that urban reinforcement elements effectively gain the city's identity. In this context, it aims to emphasize the importance of urban reinforcement elements that bring visual richness and uniqueness to the city, address the issue regarding urban identity, and develop suggestions that can contribute to urban life.

1. IDENTITY CONCEPT AND URBAN IDENTITY

The Turkish Language Association (TDK) defines identity in the most general terms: "The whole of the characteristics that help to identify any object" (TDK, 2018).

According to Guvenc (1994), identity makes any living creature or object unique by distinguishing it from others in a way perceived by visual and auditory senses. In its simplest definition, identity is the answer or set of answers given by individuals, groups, societies, or communities to the question "Who are you? Who are you from?".

According to Lynch, identity can be formed not by similarities but by differences, and identity is the state of being unique and different from all other beings (Lynch, 1960). The principal element in defining identity is not equality but individuality, uniqueness, and originality (Ocakci, 1995).

Within the scope of these definitions, identity is primarily a defining principle. It can be characterized as a concept that aims to define and introduce an entity, differentiate it from its peers, and reveal its unique characteristics. After describing all the features that make a living or non-living entity its own and introducing who or what it is, it focuses on the elements distinguished from others with their difference, singularity, and individuality (Bayazit, 2018).

If the concept of identity defines any entity, cities are also determined by their identities. Moreover, cities are living organisms. Cities have a structure that constantly changes and develops (Lynch, 1960). This variable structure interacts with geography, time, and individuals residing in the town. The city is a product of these interactions. Since these interactions develop depending on a different effect and formation process in each town, cities show other characteristics. These differences are explained by urban identity (Ilgar, 2008; Tokmak, 2015).

Suppose the definitions of identity in the literature are integrated into urban identity. In that case, it is a set of elements that distinguish a city from other cities, which allows us to quickly determine it from other towns by having a character of its own (Bayazit, 2018).

2. URBAN IDENTITY COMPONENTS

Urban identity components are binding elements that provide continuity from the past to the future of cities. These elements are essential in forming a city's identity and contribute to identity formation (Onem & Kilincaslan, 2005).

According to Ocakci (1995), the identity of a city is composed of

- Identity elements arising from the natural environment
- Elements of identity arising from the human environment

-It consists of identity elements arising from the built environment and evaluating these elements as a whole with their spatial elements (Figure 1).

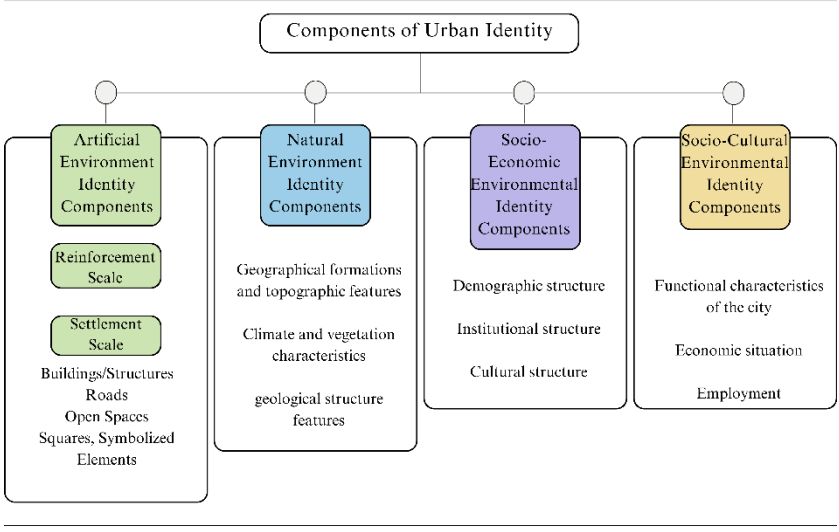

Figure 1. Components of Urban Identity (modified from Lynch, 1960; Suher, 1995; Ocakci, 1995; Deniz, 2004)

According to Deniz (2004), while evaluating the identity of a city, the city is considered as a whole with the spatial elements of its socio-cultural, socio-economic, natural, and built environment. The total of the city's cultural level, architectural structures, traditions, geographical structure, and lifestyles define the city's identity (Ocakci, 1995).

To identify the constituents of the urban character, it is essential to correctly perceive and define the surroundings first (Deniz, 2004; Onem & Kilincaslan, 2005). The city identity, formed due to the mutual relations between the natural environment, social structure, socio-cultural structure, and artificial environment, should be considered and evaluated as a whole (Onem & Kilincaslan, 2005).

3. URBAN EQUIPMENT ELEMENTS

In any urban area, streets, roads, avenues, squares, and recreational public or private rooms, all landscape elements that provide comfort and environmental quality support and strengthen essential functions such as seating, shelter, transportation, information, lighting, protection, enclosure, communication, play, and sports, facilitate social life and gain the appreciation of users are gathered under the name of "Equipment Elements" or "Urban Furniture" and are called "urban equipment elements" (Anonymous, 1992; Esen, 2007).

In urban planning, the term "reinforcement element" has been used by our country's designers, landscape architects, architects, and environmental scientists since 1980 (Guner, 2015).

Today, it has a meaning far beyond the purpose of reinforcement elements (Celbis, 2001). As the possibilities increase with technological developments, reinforcement elements have diversified with different arrangements and created other industrial design products. Since the reinforcement elements are formal, they primarily reflect the city symbol and form the city identity (Erhan, 1990; Tarakci, 2003).

The elements that make up the reinforcement elements pavements, sidewalks, stairs, ramps, curbs, seating elements, lighting elements, telephone booths, garbage bins, directional signs, information communication boards, advertising boards, water elements, bus stops, plant crates, plastic-art elements, shading elements, children's play elements, kiosks-kiosks-parking meters, deterrent limiters, grids under trees and vegetative elements (Zulfikar, 1998; Esen, 2007).

All these reinforcement elements can be classified according to different groupings and perspectives since they have many different characteristics. In the literature, researchers have classified reinforcement elements in different parameters according to disciplines, factors, and perspectives. Among these, classifications have been made in many parameters according to their functions in use, where they will be placed, their installation forms, and their types of use and technical equipment.

According to Esen (2007), urban reinforcement elements are classified into two groups: living urban reinforcement elements and non-living urban reinforcement elements.

3.1. Live Urban Equipment Elements

The living urban accessories that comprise the natural cover of cities and nature consist of trees, shrubs, shrubs, climbers and climbers, grasses, ground covers, seasonal plants, and aquatic plants. Plants that comprise the green texture stand out as identity elements in cities and their functions (Esen, 2007).

It is essential to use the natural vegetation of the city or a plant species associated with the town in the landscape of urban areas and to ensure the continuity of urban identity (Can, 1999).

Living elements play an essential role in the perception of the city, creating triangulation points or growing plants specific to cities, and living elements that are effective in commemorating towns play a crucial role in city identity (Esen, 2007). For example, in the town of Antakya, there is a century-old Platanus orientalis (plane tree) located in the historical long bazaar, and the place is known as "Çınaraltı." Similarly, plants such as *Citrus sinensis* (Citrus), *Musa cavendishii* (Banana), *Washingtonia filifera* (Palm trees) in the Mediterranean, *Olea europaea* (Olive trees) in the Aegean region, and *Washingtonia filifera* (Palm trees) in İzmir's promenade and Mersin give cities and regions an identity (Bayazit, 2018).

The redbud (*Cercis siliquastrum*), which is the reason why the city of Istanbul is often referred to by its 'redbud' color, the muscat apple (*Malus domestica*) in the town of Amasya, and the reverse tulip (*Fritillaria imperialis*), an endemic species in the natural flora of Hakkari, Malatya's apricot (*Prunus armeniaca*), Giresun's Turkish hazelnut (*Corylus colurna*), the chestnut tree (*Castanea sativa*), which forms the green texture of Bursa and is used to make chestnut candy, and the pistachio (*Pistacia vera*), which has become the symbol of Gaziantep, The palm tree (*Chamaerops excelsa*) of Mersin, known as the "palm paradise" or "palm city"; the saffron (*Crocos savitus*) that gives Safranbolu its name and makes it synonymous with the city; the laurel tree *(Laurus nobilis*), which is associated with the town of Hatay and mentioned in mythology, The oil rose (*Rose damescana*) in Isparta, which is known as the "Land of Roses", and the orange tree (*Citrus sinensis*) in Adana, which is identified with the city where an international "orange blossom festival" is held in the town during the orange blossom season, are very important in the identity of cities (Kisakurek and Bayazit, 2019) (Figure 2).

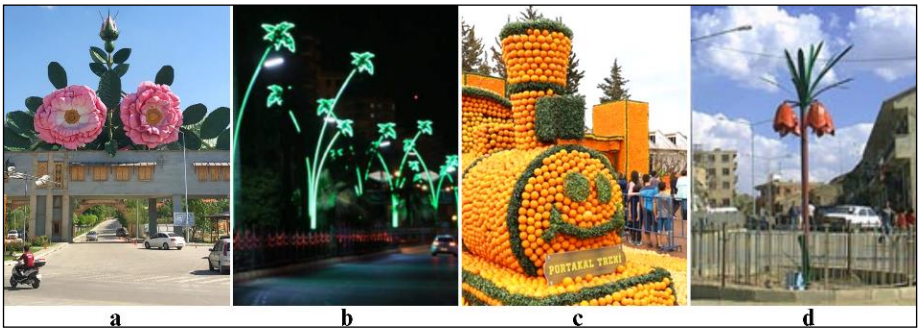

Figure 2. a) Rose figural art object in Isparta; b) Palm-shaped lighting element in Mersin; c) Orange blossom festival in Adana; d) Inverted tulip figural art object in Hakkari (Anonymous-1, 2019).

Live urban reinforcement elements show a more effective, permanent, dominant, aesthetic, and functional quality in the arrangement of streets, boulevards, and medians in the metropolitan area

(Kucuk & Gul, 2005). Since roads, boulevards, refuges, and especially city entrances, which are essential places of cities, are the prestige areas of cities, arranging living elements reflecting the symbol of the town in these places plays a vital role in highlighting the city identity (Aslanboga, 1997; Kucuk & Gul, 2005).

In addition to reflecting the urban identity, living urban reinforcement elements have multifaceted aesthetic and functional effects in cities: The aesthetic effects of plants are to break the monotonous appearance of the town by creating moving variations in the environment with their different dendrological characteristics, to create aesthetic spaces by using the mass effect and functions of plants, to soften the hard corners of the building masses thanks to their visual qualities, to strengthen the spatial development, to reduce the pressure between high building masses and to reduce it to human scale, to separate and direct vehicle and pedestrian spaces, to hide unwanted images. The functional effects of plants contribute positively to urban health and micro-climate, blocking solar radiation, increasing radiation conditions and air humidity, contributing to climatic conditions such as adjusting ambient temperature and wind speed, reducing noise, providing recreational activities, contributing to human health in terms of mental and physical aspects, improving the wildlife of the city, helping urban hydrology (Aslanboga, 1986; Esen, 2007; Onder & Akbulut, 2011; Saglık et al., 2012; Kucuk & Gul, 2005).

3.2. Lifeless Urban Equipment Elements

Non-living/artificial urban equipment that serves individuals in urban spaces also increases visual quality and gives identity to the city with its forms, colors, and aesthetic effects.

3.2.1. Lighting elements

The primary purpose of lighting is to provide visual comfort rather than to obtain a bright space. Inadequate illumination of cities negatively affects visual impact, safety, comfort, and architectural features (Unver,

2001; Celik, 2013). Lighting elements that are suitable for the urban texture and reflect the urban identity add aesthetics and meaning to the city (Figure 3).

Figure 3. Lighting elements that give identity to the city (Anonymous-2, 2018).

With the developing technology, lighting elements are used in our age as "smart lighting" designs. As an example of these designs, in Miami, instead of fixed lighting units, a sphere-shaped lighting system was used on a rail that can move along the pedestrian zone of the street (Figure 4a). The lighting elements in Las Vegas convert the kinetic energy of pedestrians' steps into electricity. The lamps also serve as wireless chargers and Wi-Fi access points (Anonymous, 2016) (Figure 4b).

Figure 4. a) Moving lighting element in the rail system in Miami; b) Smart lighting elements that convert kinetic energy into electricity in Las Vegas (Anonymous-3, 2018).

3.2.2. Telephone booths

Telephone booths in urban areas to provide communication are designed in three ways: on a carrier, wall-mounted, and in a cabin (Figure 5a). With the widespread use of mobile phones due to technological developments, they are being replaced by new urban equipment models. These new urban facilities serve users in open spaces for Wi-Fi and charging (Figure 5b).

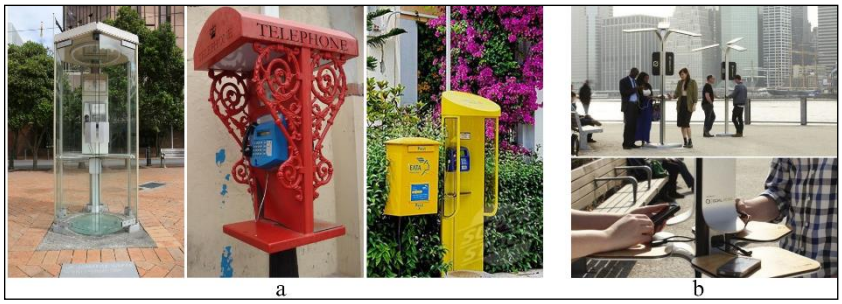

Figure 5. a) Telephone hut designs; b) equipment element serving needs such as Wi-Fi and charging (Anonymous-4, 2018).

3.2.3. Bus stops

Bus stop facilities are generally where buses drop off, pick up, and transfer in urban areas and protect users from weather conditions while waiting for the bus (Celik, 2013).

Bus stops are expected to look the same throughout the city. In addition, they increase the environmental quality of the town with aesthetic designs suitable for urban identity and architecture (Figure 6). In bus stop designs, structures integrated with other equipment, such as seating elements and garbage bins, are functional (Zulfikar, 1998). The main objects that should be included in bus stops are a sign identifying the halt, a signboard with the name of the visit, and the timetable of the buses (Akyol, 2006). In the design of bus stops, wood, inox, fiberglass, polyester, polycarbonate, concrete, stainless steel, and transparent materials such as glass, plexi, and Polyvinyl Chloride (PVC) are used in vision control panels (Akyol, 2006; Celik, 2013).

Figure 6. Bus stop designs (Anonymous-5, 2018).

3.2.3. Fountains

Fountains, among the first known reinforcement elements, are urban reinforcement elements located in urban spaces to meet the water needs of individuals (Zulfikar, 1998).

Fountains can be made of stone, cast iron, marble, concrete, and stainless steel in various forms and features (Zulfikar, 1998). Designs vary according to the identity of the place and space used, and modern and classical designs are included in the identity of the cities (Figure 7).

Figure 7. Modern and classical designs in fountain fittings (Anonymous-6, 2018).

3.2.4. Sales units

They are urban reinforcement elements where newspapers, magazines, books, food, and beverages are sold in urban areas that individuals want to reach easily (Zulfikar, 1998). They are placed in areas with intense pedestrian circulation, at intersections, near bus stops,

piers, and stations, and in parking areas. They should be placed at points that are easy to access and in a way that does not obstruct pedestrian traffic (Hacıhasanoglu, 1991; Durmus, 2008).

In the design of sales units, many different material options, such as wood, aluminum, metal, and hard plastic, are used together or individually (Figure 8). The color and material of the sales units should be designed by the urban texture and harmony with other urban reinforcement elements (Zulfikar, 1998).

Figure 8. Sales units that give identity (Anonymous-7, 2018)

3.2.5. Infrastructure facilities maintenance hatches

When infrastructure problems are encountered in urban areas, the covers placed to reach the problem point to solve the problem are defined as sewer or infrastructure maintenance covers. All infrastructure installations related to natural gas, city water, telephone, fiber internet, electricity, sewage, and rainwater constitute maintenance covers.

Maintenance covers are produced as cast iron, cast concrete, or aluminum, and they bring aesthetic value to the area where they are used with their different shapes and patterned or colored surfaces (Akyol, 2006). Maintenance covers are expected to show integrity with the texture and identity of the city and provide aesthetics (Guner, 2015) (Figure 9a). Figure 9b shows examples of maintenance covers reflecting the city's identity in Japan.

Figure 9. a) Aesthetic example of infrastructure facilities maintenance cover; b) Designs reflecting urban identity in Japan (Anonymous-8, 2018).

Maintenance hatches for infrastructure facilities should not narrow the vehicle and pedestrian path and should not create a level difference on the ground axis. Otherwise, dangerous consequences may occur in pedestrian and traffic areas. Good planning, correct positioning, and maintenance are essential (Guner, 2015).

3.2.6. Square hours

The first clock towers used to tell the time in urban areas were seen in England, France, and Italy in the middle of the 14th century and Anatolia in the 19th century. Square clocks continue to enrich social spaces from the past and are used in cities today (Zulfikar, 1998).

Square clocks, which add value to the places where they are located with their importance from the past, are essential in the city's identity. Their designs are aesthetic and original due to their monumental and triangulation features (Figure 10).

Figure 10. Unique square clock designs give the city identity (Anonymous-9, 2018).

Square clocks should not obstruct pedestrian circulation or change pedestrian circulation in a controlled manner (Durmus, 2008). Square watches should be of a certain height and size to be easily perceived from a distance. Materials suitable for weather conditions and climate characteristics, such as wood, aluminum, and stainless steel, should be used. When square clocks are used with other urban elements with visual qualities (seasonal flowers, special lighting techniques, border elements), they give even more aesthetic appearances to their places (Akyol, 2006).

3.2.7. Information, communication, signage and billboards

These are the equipment elements built and rented by local governments or private organizations to promote and advertise shopping units and companies in urban areas where their emblems and names are written (Celik, 2013).

The billboard includes electronic boards, advertising towers, racket boards, banner changer billboards, illuminated billboards, LED screens, and the like (Durmus, 2008).

Information and directional signs are a standard model that does not disturb the aesthetic and architectural texture of the city, is compatible with the natural and historical silhouette of the town, simple in design, understandable, and shared throughout the city (Yildirim, 2011) (Figure 11).

Figure 11. Information and directional signs in harmony with the environment (Anonymous-10, 2018).

The reinforcements are positioned in the urban area without affecting pedestrian circulation, based on other information and directional signs and tree axes, and without blocking a historical or essential site (Akyol, 2006; Yildirim, 2011). The city's climatic conditions, socio-economic structure, and geographical factors shape the material used. Generally, neon, aluminum, stone, wood, glass, steel, ceramic and porcelain, and cast metal are used (Akyol, 2006). Neon, aluminum, wood, cast metals, and glass screen panels are also used in billboards.

3.2.8. Floor coverings

Covering the ground plane with a natural or artificial material deliberately in line with the design purposes constitutes flooring/floor coverings (Booth, 1983; Akyol, 2006).

A horizontal plane is created with natural and artificial elements in floor coverings. Natural features: parks, gardens, refuges, and urban open spaces are covered with vegetation such as grass ground cover. Synthetic ingredients are covered with hard and inanimate materials such as stone, brick, concrete, decking, vehicle and pedestrian roads, squares, and urban spaces (Figure 12).

Figure 12. Floor covering designs (Anonymous-11, 2018)

Floor coverings combine aesthetics and function (Seckin, 1997; Kuskun, 2002). Colors, patterns, and materials compatible with the city's identity and architectural structures are significant for the perception of

the city and its visual quality. Regarding functionality, pedestrian and vehicle traffic safety should be at the forefront by creating a hard, dry, and non-slippery surface. Circulation can be directed by creating a sense of direction for users (Sancak, 2009; Yildirim, 2011).

3.2.9. Delimitation elements

In urban spaces, delimitation elements are reinforcement elements that keep vehicle traffic under control without creating visual obstacles. These reinforcement elements provide visual and functional purposes, preventing vehicles from entering certain areas without disrupting pedestrian traffic, separating usage areas, and providing traffic control (Sancak, 2009).

Boundary elements are located in cities as a structure that strengthens identity and aesthetics in urban areas. They should be integrated with the city's architecture, form, and understanding. They are essential reinforcement elements that reflect identity (Akyol, 2006; Ghorab, 2015).

Boundary elements are produced and used with many materials, such as wood, concrete, plastic, metal, aluminum, iron, and stone (Figure 13). They should be designed as movable or articulated for emergency service vehicles in urban areas and should not prevent wheelchair passage and pedestrian flow on pedestrian roads (Durmus, 2008). It is essential for visual perception that the dimensions of the delimitation element should be planned at the level of the eye contour and should not exceed 180 cm in height. There should be integrity regarding visual perception in its design and a ratio between the landscape elements used and the element used as a delimiter.

Figure 13. Boundary elements in different designs and materials (Anonymous-12, 2018).

3.2.10. Seating elements

Seating units are the essential reinforcement elements to increase the time spent in urban spaces and provide long-term use and comfort away from the circulation channels of urban spaces (Akyol, 2006; Sancak, 2009).

Seating elements are designed in various models according to the urban area. These are circular seating units, sitting benches, wall benches, fixed benches, mobile benches, sitting pockets, sitting places, and sitting elements under trees. Seating element models are grouped as with backrest, without backrest, with armrests, and without armrests (Akyol, 2006) (Figure 14).

Figure 14. Examples of seating elements (Anonymous-13, 2018).

In urban areas, design models of seating elements are determined by considering the density and duration of use of users. It is not preferred that more than three people share the same linear seating element. While the seating units to be used in areas with short usage time or in socializing areas should be close to each other, in areas with long usage time or where a socializing environment will not be created, seating elements

should be more distant from each other and single design models are used (Feyizoglu, 2008) (Figure 15).

Figure 15. Different types of seating element designs (Anonymous-14, 2018).

The shape and materials of the seating elements should be compatible with the urban texture and other reinforcement elements. The materials should resist external conditions, physical effects, and impacts (Zulfikar, 1998). The comfortable seating height of seating elements is approximately 40-50 cm (Neufert, 1982). Seating elements must not obstruct pedestrian circulation when they are located on the sidewalk.

In some unique places, seating elements are placed for visual purposes other than as seating elements (Figure 16a). A seating unit set for these purposes is fundamental in reflecting the identity of where it is used (Anonymous, 1992; Yildirim, 2011). The fact that the seating element designs, which are essential in reflecting the urban identity, reflect the characteristics of the city and are integrated with the texture of the town increases the quality and aesthetics of the environment. With technological developments, seating elements are seen with various shapes, materials, and intelligent systems. Today, solar-powered seating elements in urban areas meet needs such as lighting equipment, Wi-Fi, and charging (Figure 16b).

Figure 16. a) Example of a seating unit for aesthetic purposes; b) Seating element with solar system (Anonymous-15, 2018)

3.2.11. Plant crates

Fountains, one of the first known reinforcement elements, are urban reinforcement elements located in urban spaces to meet the water needs of individuals (Zulfikar, 1998; Ghorab, 2015).

In urban areas where concretization is intense and plants cannot be grown directly in the soil, to break the cold appearance of concrete and add identity and value to the city, the pot reinforcements for growing plants are defined as "plant crates" (Feyizoglu, 2008).

Plant boxes, which increase the green texture in urban areas, can also delimit spaces and transitions.

Plant boxes should be of a material, shape, and size suitable for the plant to be used by the texture and identity of the city (Figure 17). Concrete, terracotta, asbestos, and fiberglass are preferred for durability. Wood and metal materials are coated with a durable material inside the crates because they are not resistant to decay and rust (Feyizoglu, 2008).

Figure 17. Plant crates in harmony with the space (Anonymous-16, 2018).

Plant boxes are used solitary or in groups and integrated designs with other reinforcement elements according to the purpose of use and space. Their location should not affect pedestrian and vehicle circulation; there should be at least 240 cm width between them, and attention should be paid to the needs of the plants in the crate, such as light, temperature, and sun (Durmus, 2008).

Plant crates should be at least 15-30 cm for ground cover plants, 50-100 cm for medium-sized ornamental plants, and 100-150 cm for large shrubs and trees (Akyol, 2006). Trees and shrubs without deep roots, flowers, and grass species are preferred. The selection of species suitable for the natural flora of the city also provides integrity in identity and perception. Maintenance is also essential; poorly maintained plant boxes negatively affect the beautiful and pleasant appearance of the town.

3.2.12. Garbage bins

Garbage poses a danger to environmental health. Disposal in urban areas is ensured by well-designed, well-maintained, and properly positioned garbage bins of quality materials (Zulfikar, 1998; Feyizoglu, 2008). The task of garbage bins is to accumulate the garbage produced in them and protect it without harming the environment until it is transported by the necessary vehicles.

Garbage bins are divided into three groups according to their design features: open-mouth, closed-mouth, and hinged (Akyol, 2006). Garbage bins should be located within the urban reinforcement strip on the sidewalks. They should be located in appropriate places in terms of hygiene and aesthetics in areas where squares and pedestrians are concentrated (Durmus, 2008).

The bins' shape, size, and materials should provide integrity with the urban fabric and other reinforcement elements (Figure 18). A wide variety of materials such as concrete, glass reinforced concrete, heavy alloy steel, aluminum, low-density polyethylene plastic, wood, galvanized sheet metal, concrete with armatures, enamel painted steel,

polyethylene coated steel, galvanized wire basket, heavy alloy wire basket, galvanized stainless steel are used in design (Feyizoglu, 2008). Color is essential in the perception and recognition of waste bins. Colors should be long-lasting and resistant to corrosion and misuse (Akyol, 2006).

Figure 18. Examples of waste bins in various materials and designs (Anonymous-17, 2018)

3.2.13. Artistic objects

The sculpture is a three-dimensional work of art, sculpture, or plastic object created by sculpting, molding, kneading, and baking from stone, bronze, clay, iron, plaster, wood, and ivory (Booth, 1990). Artistic objects, the oldest and universal branch of fine arts, are essential artworks in open and green areas for aesthetic purposes with visual and semantic ethics (Ghorab, 2015).

Artistic objects are elements that increase the visual value of the landscape and fully reflect the city's identity and all the city's characteristics with their expression and design features. In addition to their expressive qualities, they have pleasurable and aesthetic values (Uzun, 1997; Celik, 2013) (Figure 19).

Figure 19. Examples of art objects in urban areas (Anonymous-18, 2018)

They are positioned in urban areas, squares, parks and gardens, pedestrian axes, shopping centers, alone or with a water element. Artistic objects are placed in urban areas to create a focal point, explain the city, attract attention, and give people a message (Feyizoglu, 2008).

While their design features are expected to share the same language with the texture and architectural features of the city, they bring dynamism and energy to the place they are located (Uzun, 1997; Celik, 2013).

3.2.14. Under-tree grids and guards

The fact that soil surfaces in urban areas are covered with ground coverings prevents root respiration, water, and fertilizer from reaching the plants. This situation, which affects the development of trees, can be solved with under-tree grid reinforcements (Anonymous, 1992; Akyol, 2006).

Instead of impermeable floor coverings, a grid is used around the tree that does not interfere with pedestrian circulation and the soil surface of the tree. Thanks to these grids, trees can adequately meet their water and air needs (Zulfikar, 1998). In addition, galvanized or plastic-coated lattice wire, primarily to protect newly planted trees from external influences, protects the trunk of the tree (Feyizoglu, 2008) (Figure 20).

Figure 20. Under-tree grating and protective designs (Anonymous-19, 2018)

Tree grates should be at the same level as the floor coverings and should not create obstacles to walking on them. The soil surface around the tree should be left for about four m² of grating area, and the dimensions vary between 90 cm and 180 cm. Cast iron or concrete are standard materials (Feyizoglu, 2008).

Tree grates should be preferred in geometric shapes, colors, and designs compatible with ground coverings and urban texture. Under-tree gratings with aesthetic qualities increase the visual rate of the city (Akyol, 2006). In cases where the grid system is not used, surrounding the tree with bricks, cobblestones, or large pebbles creates visual pollution in cities. Tree grid models can be designed to be integrated with seating and bicycle parking elements (Figure 21).

Figure 21. Tree grates that are compatible with paving and integrated with seating units (Anonymous-20, 2018)

3.2.15. Bicycle parking elements

The equipment that enables bicycle users to park their bicycles regularly and safely in urban areas is defined as "bicycle parking elements."

Bicycle parking elements consist of equipment that allows bicycles to stand perpendicular or inclined to the ground without damaging each other. Well-designed equipment has qualities such as organizing the parking areas of public and private spaces, preventing theft, preventing the chaos caused by scattered bicycles, and encouraging cycling (Celik, 2013).

If bicycle parking elements are located along a line, linear designs are used, and if they are located in a circular area, such as around trees, radial methods are used (Zulfikar, 1998) (Figure 22). The function of any urban equipment and pedestrian circulation should be clear (Durmus, 2008).

These reinforcement elements, which can be designed in many different designs, should be used in colors, forms, and materials suitable for where they are used. Visuality should also be at the forefront when reinforcement is full or empty (Durmus, 2008; Celik, 2013). The material used is usually metal and concrete. It gives aesthetics and identity to different-colored spaces (Ghorab, 2015). Designs integrated with seating elements are functional and aesthetic according to the room they serve in the urban area and their intended use (Figure 22).

Figure 22. Different designs of bicycle parking elements (Anonymous-21, 2018)

3.2.16. Top cover elements

In urban areas, pedestrian zones, parks, and recreation areas, sheltered from weather conditions for sitting and resting purposes, are defined as upper cover elements. They are generally called pergolas (Hacihasanoglu, 1991; Ghorab, 2015).

Covering elements are used adjacent to the entrance and circulation eaves of buildings or in urban areas to create a separate space (Hacıhasanoglu, 1991; Durmus, 2008). Covering elements can be formed by structural reinforcements such as pergolas, awnings, umbrellas, or living covers with winding plants (Figure 23).

Figure 23. Upper cover element designs (Anonymous-22, 2018)

According to the shape of the upper cover element and the profile used, cloth, canvas, bamboo, reed, and PVC materials are used to create the upper cover. Quality can be given to the space used by creating a shadow pattern with the top cover form (Ghorab, 2015). Accessories with winding plants provide aesthetic, identity, and a comfortable urban space (Yucel, 2006; Ghorab, 2015).

4. CONCLUSION

Urban reinforcement elements that give identity to cities consist of floor coverings, sidewalks, stairs, ramps, curbs, seating elements, lighting elements, telephone booths, garbage bins, directional signs, information communication boards, advertising boards, water elements, bus stops, plant crates, plastic-art elements, shading elements, children's

play elements, sales units-parking meters, limiters, grids under trees and vegetative features (Zulfikar, 1998).

Urban reinforcement elements help a city to differentiate from other cities, to gain quality, and thus to gain the town's identity. Urban reinforcement elements are essential elements in terms of urban identity. For this reason, in creating a coherent urban identity, urban reinforcements should be designed within a conscious plan and organized in line with the solutions produced by different disciplines in coordination. Solutions and suggestions for inanimate urban reinforcement elements.

- The design, material selection, location, and form of urban reinforcement elements should be determined according to the city's climate, history, cultural characteristics, and architecture.
- It is also essential to consider each urban reinforcement element as a design product and consider design principles.
- Each element should be considered a unique design product that reflects the historical and cultural texture of the city and is in harmony with its environment.
- City municipalities should have a department for the design of urban reinforcement elements.
- Plants, the living urban reinforcements of cities, give identity and symbolism to the town. They help the city to be perceived, and foreigners come to the village to gain the right impression of the city—solutions and suggestions about living urban reinforcement elements.
- City-specific and natural species should be selected in the city's vegetative landscape projects.
- Plant elements play an essential role in the sustainability of the city's identity.
- Developmental characteristics, maintenance, site selection, determination of seasonal plant species, planting, and care of plant elements should be done well in urban areas. Poorly maintained and poorly developed plants will negatively affect the city's appearance.

- Non-living equipment elements directly related to vegetation elements well-maintained and well-maintained plants in plant crates and under-tree grids will also have a good effect on the identity of this equipment.

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CHAPTER 7

INNOVATION IN OFFICE EQUIPMENT DESIGN*

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* This study was produced from the master's thesis titled "A Perceptual Approach to Electronic Office Equipment Design", completed in 2007 at Anadolu University, Institute of Science and Technology, Department of Industrial Arts.

INTRODUCTION

Developing technology and innovations in communication have accelerated the transition from an industrial society to an information society. Information society attaches importance to sharing, reproducing, collecting, transmitting, processing, storing, and producing information. Information management has always been done through communication from the past to the present. From the past to the present, information management in professional life has been provided by offices and office equipment. It can be said that the reflection of technological innovations in information and communication is felt mostly in office life. Information and communication technologies have changed the way of working, and the design of required offices and office equipment has also changed in this context.

In the information age, a society is formed where the importance of speed increases and space becomes meaningless, therefore the need for offices independent of space increases. There is a need for fully automated electronic office equipment that can perform many tasks simultaneously and is easy to understand and use. While the offices of the future were defined as mobile offices in the 2000s, today the offices of the future are defined as virtual offices. Although innovative approaches in information and communication technologies have enabled this reality throughout history, the suddenly developing COVID-19 epidemic has disrupted the traditions of professional life and accelerated this process. People have started to carry out their office traditions from home. Individuals who can choose to work from home or in another environment have experienced remote working (Chen, 2023). It can be said that this experience, which emerged out of necessity, may become a tradition for all employees in the future.

In this study, the changes in offices and office equipment from the past to the present and the effects of innovative solutions in information and communication technologies will be discussed. This study was produced from the master's thesis titled "A Perceptual Approach to

Electronic Office Equipment Design", completed in 2007 at Anadolu University, Institute of Science and Technology, Department of Industrial Arts.

1. OFFICE DESIGN

The society, which was engaged in agriculture and animal husbandry, was introduced to industry and technology in the 18th century. Increasing trade with the development of the industry created a need for offices. Buildings with different original purposes were used as offices. Offices and work spaces where information is processed and information communicated is perceived as fixed physical spaces that support and control sales and production in the past. For this reason, the designs of the first examples of offices were oriented towards basic functionality. These offices were thought of as places consisting of simple rooms or rooms, where people talked on the phone and worked at a desk. With the development of technology in the 20th century, offices experienced changes in the way work is done in offices, as well as changes in the fields of office plans, office space, office furniture, and office equipment. With new technology, new tasks related to computer, software, and hardware development and production began to emerge. These tasks affected the physical and social components of offices.

Office plans focusing on people and equipment were created. The developing technology in the late 20th century and today has made space and time meaningless, enabling us to be faster in working life, to work anywhere, and to communicate everywhere. Today, offices and workspaces where information is processed and information communicated present themselves as physical and social spaces that facilitate information and communication. A traditional or electronic office is an organization of equipment and people structured around specific activities and tasks. These tasks often involve different forms and levels of complexity of information transfer and storage (Pulgram and Stonis, 1984).

Throughout history, concepts in working life have moved from hierarchy to teamwork, from formality to relaxed communication, and from discipline to creativity. Offices today can be thought of as informal spaces where employees come together and discuss, like hotel lobbies. Offices should be a social repository for exchanging projects and suggestions (Raymond, 1997).

Offices are presented with many concepts from past to present. One of the concepts used today, based on technological developments, is the mobile office. If professions are divided into brain power and physical power; It can create a mobile office concept for white-collar employees. Nowadays, it is possible to perform these professions through 'mobile offices' and remote access. Today, offices suitable for working life are designed with remote access, defined as telework. Office geography is liberated with satellite technology. All kinds of information can be exchanged from a normal phone with only a receiver and a transmitter.

Mobile office or telework examples, which were presented as concepts in the 2000s, have become a reality today. 2020 offices Pulgram and Stonis (1984) discussed telework offices in 2020 and presented concept designs (Figure 1 and Figure 2). Thanks to laser technologies and communication technologies, participants from different places can come together and manage information.

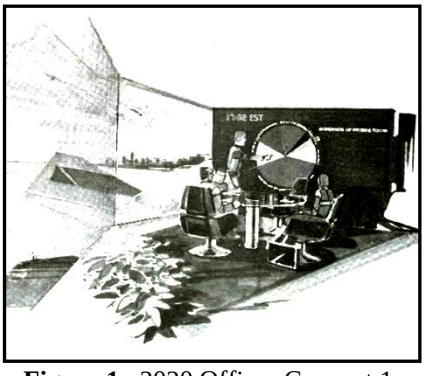

Figure 1. 2020 Offices Concept 1
(Pulgram and Stonis, 1984)

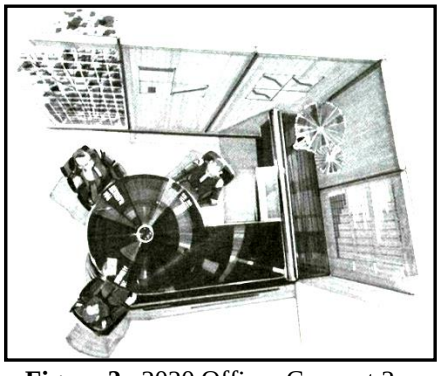

Figure 2. 2020 Offices Concept 2
(Pulgram and Stonis, 1984)

Kleeman et al. (1991) argued that there will be computer terminals in buildings in the future. It can be said that this prediction has come true today, although not in all buildings today. Not only homes, but all social spaces can consider having computer terminals in their buildings, such as having sinks. In his study, Russell (1992) argued that offices will be wherever people work with laptops and palmtop computers, and he cited today's offices in the past. Offices are mobile systems consisting of equipment that employees carry with them. In summary, the nature of information does not change in all traditional, open plan, automation, and other office types where information is processed from past to present; The methods, formats, spaces electronics, and auxiliary equipment used to process information vary.

2. OFFICE EQUIPMENTS DESIGN

It can be said that creating, changing, recording, storing, and communicating information to distribute and transmit information constitute the foundations of working life. In the 19th century, information was processed manually and was used to support production and sales. In the first examples of offices, the processes of creating, changing, and recording information were done on paper and were copied and stored on paper. Communication between organizations was generally done through mutual correspondence or face-to-face meetings, in a period when an international mentality had not yet spread. While communication could only be done with paper in the past, today it can be done electronically and digitally. It can be said that the most important change in these processes was experienced in terms of speed, location, and quality.

Equipment that helps employees, designed with functional, ergonomic, and physical concerns, using electronic and digital technologies that have accelerated and decentralized the activities carried out within the scope of working lives since the 18th century, is called electronic office equipment. These equipment were needed due to

increasing tasks in working lives, and especially after the Second World War, there were great changes in the types and designs of office equipment. Between the 19th and 20th centuries, office equipment changed greatly in terms of mechanical and electronic operation.

Traditional paper, electronic, and digital media were used in written communication in offices to exchange information between and within organizations from past to present. Although information flow is provided electronically in automated offices, paper still plays an active role in some cases. Kleeman et al. (1991) explain the reason why storing information with paper not be given up is that paper is concrete, felt, and visible information. Another reason is that no tool is equal to paper in terms of ease of use. Quinn (1985) explains this situation by the fact that paper is simpler to use and does not restrict how users perform their tasks or their physical posture. Most information communications end up on paper. Therefore, storage requirements are generally related to paper (Jarrett, 1984). Paper is one of the determining factors in the dimensions of office furniture and equipment. It is seen that paper measurement is also used in computer software used today. This relationship sometimes limits the size of the equipment.

To reduce paper usage, researchers have introduced the electronic paper display (Figure 3) as an alternative to traditional paper. Electronic paper displays (EPD) have a millimeter-thick plastic structure with transistors. However, it appears that the electronic paper screen does not have all the features of traditional paper. It is not possible to write by hand on electronic paper screens. It can be said that it is used as a paper-thin, foldable display screen. However, this technology was not accepted in offices and was limited to the use of electronic books and newspapers (Figure 4).

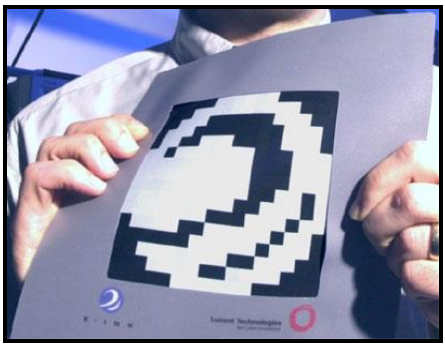

Figure 3: Electronic Paper Display, Bell Labs, 2001

Figure 4: Electronic newspaper, Plastic Logic

With the developments in communication technologies, electronic office equipment has reached an important position in the information age. It can be said that the electronic office equipment of the Information Age has made space meaningless with its portability. Portable information storage devices, called flash disks in 2000, make it easier for the user to carry, share, and transfer digital information without the need to carry a computer. In 2000, the world's first wirelessly connected mobile phones were produced by Motorola. In 2003, mobile phones began to include the functions of individual digital assistants (PDAs). Sending electronic letters via the Internet, recording and transporting on a compact disc, and wireless transmission of information can also be provided. In the 21st century, individual portable phones are not only used for mutual voice communication but also mobile phones can be used as computers thanks to their many functional features such as business card holders, agendas, written, verbal, and visual communication tools, cameras, voice recorders and video cameras. Calculations can be made, information can be created and transmitted. It also becomes a powerful hardware in terms of its relations with other electronic office equipment. Although it is individual equipment, working individuals frequently use this individual equipment in their working life. Today, office meetings can be made via phone via video.

Hardware has affected office environments, furniture, and communication between individuals. The designs of the hardware were influenced by technological innovations. As industrial technology developed, electronic office equipment became faster and more portable. Changes have been seen in the physical and functional designs of electronic office equipment with transistors and chips. The working methods of office equipment have become electronic. Technological developments have become information-oriented rather than material-oriented. Processing and communication of information began to be done electronically. Developments in electronic office equipment have enabled the individual to save time and made information timeless and spaceless.

In today's offices, the same work can be done with less equipment than in old offices. It can be said that a computer, a modem for internet connection, a printer and an external disk are sufficient for individual work in an office. Sharing information in the office can be achieved by using projection devices, audio and video systems.

3. OFFICES OF THE FUTURE AND OFFICE EQUIPMENT

Offices are in a relationship with this equipment because they are places where the equipment used in working life is located. With the typewriter, offices, chair shapes, and sitting styles have changed (Asatekin, 1997). Developments in technology change the physical and social communication of electronic office equipment with its environment and other elements around it. With new technology, new tasks related to computer, software, and hardware development and production began to emerge. Today, offices are more than just surfaces where electronic office equipment is positioned, stored, and used. Offices have become a part of the power supply of electronic office equipment. Today, in the age of information and communication, offices communicate not only with the working individual and the environment

but also with electronic office equipment. Office equipment is designed by being influenced by the physical structure of mobile offices. Products that will serve telework are used.

Considering that offices and work spaces will not only be places determined by organizations in the future, and that working life can be continued in places such as airports, homes and cafes, not only the furniture used in offices and work spaces, but all the elements that make up this space will be able to communicate with electronic office equipment. A desk can be designed as a computer screen and a desk.

NTT Docomo Company (2007), which makes mobile communication technologies applications, states that in the future, every surface used in offices and work spaces will be used as a screen and interface. Instead of using traditional paper, touch screens in paper structure and size will be used. According to NTT Docomo, by attaching this unit, where individual information is stored, to the table, commands can be entered on the digital touch keyboard that appears on the table and information can be shared with the image formed on the wall. The individual can use the individual information storage unit as a video phone. Electronic office equipment will be combined with daily use products. It can be used with products such as watches, glasses, phones and tables and chairs.

As can be seen in the research of NTT Docomo Company, activities in working life such as creating information, changing information, recording information, and communicating information can be done within the framework of virtual reality. It can be said that the virtual two-dimensional communication made with the audio and video technologies used today can be replaced by virtual three-dimensional communication with a pair of glasses.

Virtual reality can be defined as reality imitated by a computer. This is a second artificial world. It can be provided with technical equipment. Essentially, everything is just on a computer screen. Virtual reality includes all perceptions received through the senses in the real

world. (Sight, sound, texture, taste, movement) Based on real experiences (Albus et al. 2000). Equipment such as suitable gloves and glasses can be used to perceive these real but unreal sensations.

Individuals will be able to be in their workplaces, meet with their colleagues anywhere in the world, and perform the tasks they need to do, simply by entering the three-dimensional virtual reality created by the glasses they carry with them. Tomorrow, an office will be a system that can be accessed via a terminal at any time and place (Kleeman et al. 1991). It is conceivable that virtual reality devices, which will also be used in daily life, will be used as office equipment. In this context, future innovative electronic office equipment can be listed as virtual glasses, audio equipment, headphones, microphones, sensors that track hand movements, desktop screens, computers, and internet devices. You will need audio equipment to communicate with users. The environment in which this equipment is used is today defined as the metaverse.

In summary, it can be said that with innovations in information and communication technologies, offices will move from the telework environment to the metaverse environment, and offices and office equipment can become designed abstract environments and products. In addition to all these, the devices required for metaverse use can be shown as new-generation office equipment.

4. DISCUSSION AND CONCLUSION

Information has existed together with human beings. It is also knowledge to light a fire with the spark produced by rubbing two pieces of wood together. Human beings always share the knowledge that exists with them and pass it on to the next generation. Human beings transfer this information through various methods and tools, words, pictures, writing, signs, face-to-face communication, voice communication, and electronic, digital, audio, and visual communication.

Laptops, flash disks, and phones, which are considered essential in office work today, are the main equipment needed in the 21st-century

working life. These requirements can be listed as information creation, modification, recording, transmission, distribution, sharing, portability, audio-visual communication, and text communication, considering the purposes of use, functions, and technologies of this hardware. These requirements continue to be met with different methods but for the same purposes through technological innovations.

It is seen that the mechanical usage of previously used electronic office equipment has changed with the electronic developments in the 21th century. Functions performed mechanically can now be performed electronically. With electronic office equipment, digital technology, chips and computerization, the tactile communication between the product and the user becomes smaller from the surface to the point. Some physical components and elements now become redundant. Digital, network and emerging chips replace some products. Functions increase while objects become invisible. Function appears to take precedence over physical presence. Albus et al. (2000) ask the question of whether designers trying to create a balance and harmony between technology, aesthetics, and ergonomics will design the intangible while everything becomes invisible. With these technologies, the functions of electronic office equipment have increased, but their physical structures have become invisible.

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CHAPTER 8

THE ROLE OF DIGITAL TECHNOLOGIES IN PLANNING AND DESIGN

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INTRODUCTION

Technology, one of the most important concepts of today, is a phenomenon that exists and is used in every aspect of life. Thanks to technology, producing, processing, planning, designing, sharing, communicating, etc. information can be done easily and practically. In addition, completing the intended work in a shorter time with technological tools also saves time. Pullen (2009) defined technology as tools and equipment that are human-centered and show its structure, making life easier. Digital technology refers to tools that enable the compression of large amounts of information in small storage devices that can be easily protected and transported and change the way people communicate, learn and work (MacLean & Elwood, 2009). Today, the opportunities provided by digital technology are used in many areas. Among the sectors where digital technology is used extensively, there are also professional disciplines that work on planning and design.

Digital design technologies offer new solutions to complex problems with the programs in which they are developed (Kolarevic, 2003; Beşkaya, 2022). The use of 3D modeling tools, visualization software, VR (Virtual reality) and AR (augmented reality) applications in the design phase, and Geographic Information Systems and Remote Sensing in the planning phase are frequently used and the most preferred tools today. With these tools, it is possible to provide realistic experiences or control the most optimal use of a land.

1. USAGE AREAS OF DIGITAL TECHNOLOGIES IN PLANNING AND DESIGN PROCESSES

In our century, when the use of information technologies is expanding, its use in the fields of arts and sciences is rapidly increasing due to the increase in efficiency and the opportunities it provides, and a digital technology revolution is taking place that fundamentally changes traditional forms of drawing. This change has brought about changes in

the preparation and presentation of art, design, planning, and presentation techniques (Yılmaz, 2011; Korkut and Özyavuz, 2016).

Today, software and hardware developed based on computer technologies have become important tools for designers to realize their 3D imagination. In addition, images created in the digital environment are preferred for reasons such as realistic image quality, easy and long-term storage, mobility and impressiveness. Digital visualization techniques are techniques used when traditional methods are insufficient. For this reason, visualization studies should not be considered separate from traditional methods. Explaining inputs such as perception of space, concept of scale, perception of space, light and shadow are important and can yield successful results. Unlike traditional methods, these techniques require tools such as computers, printers and software. Visualization software is preferred due to its advantages such as saving time, less cost, ease of revision, easy storage of data, allowing drawings with zero errors, rapid reproduction of drawings, and easy production of new alternatives (Uğur and Özgür, 2003; Korkut and Özyavuz, 2016).

1.1. Computer Aided Design (CAD), 2D-3D Modeling and Visualization Tools

With the advancement of technology and the development of computer techniques, new design-based opportunities have been offered due to its algorithmic structure. The reflection of this innovation on landscape architecture and architecture has revealed different design concepts (Kaya, 2022).

Computer-aided design tools work and are used on different algorithms. The use of CAD (Computer Aided Design) software in the design process has become a design tool that facilitates hand-made designs in the digitalization process. The use of computers has significantly affected design thinking in design processes. Algorithms that create a mathematical calculation order to make designs have begun to be used in contemporary design methods. The rules created by algorithmic designs are a set of steps to define, calculate and process

data. In the design, the algorithm is considered as a piece of data and fulfills the functions defined on it. While the design algorithm provides input with the information defined in this way, it also obtains a design as a result of the operations it performs. There are various program parameters that need to be taken into consideration during the design process, and each parameter defines an algorithm. In this way, problem solving is achieved during the design process. CAD software has become programs that can be used to create algorithmic and creative designs on the computer (Kaçmaz 2019; Kaya, 2022).

The most used CAD software today is AutoCAD. It is a software preferred by many professional disciplines. Apart from this, there are also widely used programs such as Adobe Photoshop, Adobe Illustrator, Krita, Artweaver, Adobe Indesign.

Modeling types used in design are classified as follows;

- Conceptual Modeling and Render Programs
- Animation Programs
- Element Based Drawing Programs
- Component Based Programs
- Design Development Programs

Conceptual modeling and rendering programs: These are models used mostly in the conceptual phase of the design process. It has improved mostly on visualization and presentation. Google SketchUP, McNeeL Rhinoceros, Lumion (Figure 1) and Autodesk 3D Studio Max (Figure 2) programs are used in conceptual modeling (Turan, 2009; Beşkaya, 2022).

Figure 1. Lumion image (URL-1)

Figure 2. 3D Max image (URL-2)

Animation programs: These are modeling programs using programs such as Autodesk Maya (Figure 3) and Softimage, where visualization, animation and simulations that we encounter mostly in the presentation phase of the design process can be made (Turan, 2009; Beşkaya, 2022).

Figure 3. Autodesk Maya image (URL-3)

Element-based drawing programs: Modeling that includes two-dimensional drawings and documentation of projects. Programs such as Autodesk AutoCAD (Figure 4), Nemetschek, Vector Works are the main ones used (Turan, 2009; Beşkaya, 2022).

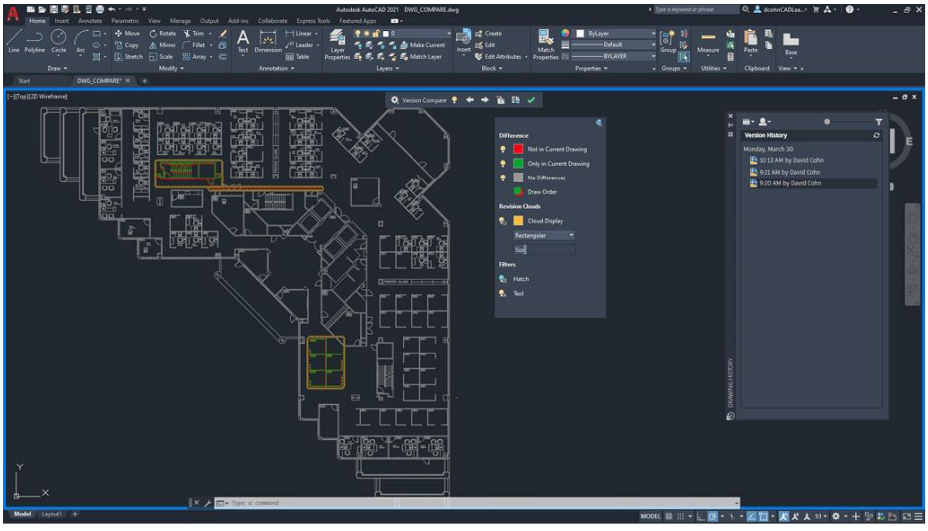

Figure 4. Autodesk AutoCAD image (URL-4)

Component-based programs: These are programs that use three-dimensional components and objects. It is the type of modeling most frequently preferred by architects for architectural design and visualization. The most preferred programs are Architectural Desktop, Autodesk Revit (Figure 5), MicroStation, Nemetschek Allplan, Graphisoft ArchiCAD (Turan, 2009; Beşkaya, 2022).

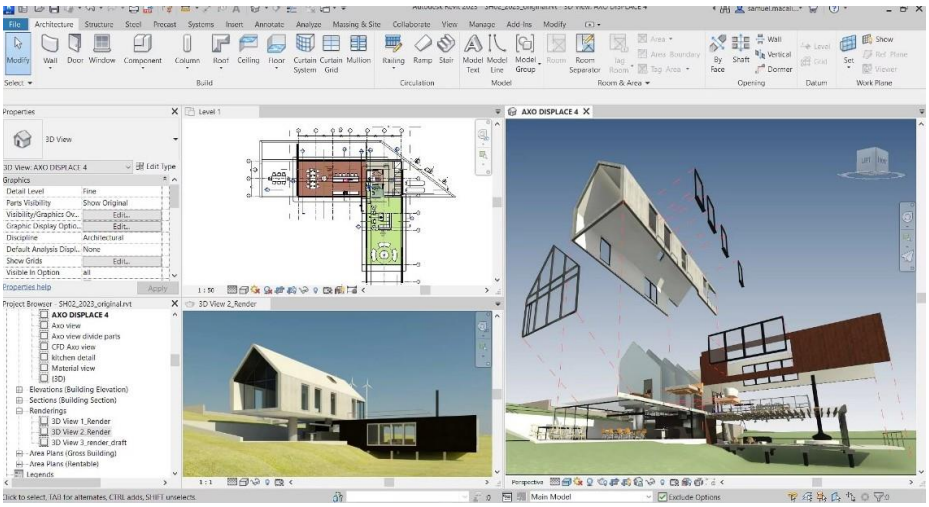

Figure 5. Autodesk Revit image (URL-5)

Design development programs: These are programs that enable the transformation of an aesthetically, functionally and technically solved design from a schematic design. Programs such as Dassault Systemes CATIA, Bentley's Generative Components, SolidWorks (Figure 6), PTC Pro/ENGINEER, UniGraphics are included in this group (Turan, 2009; Beşkaya, 2022).

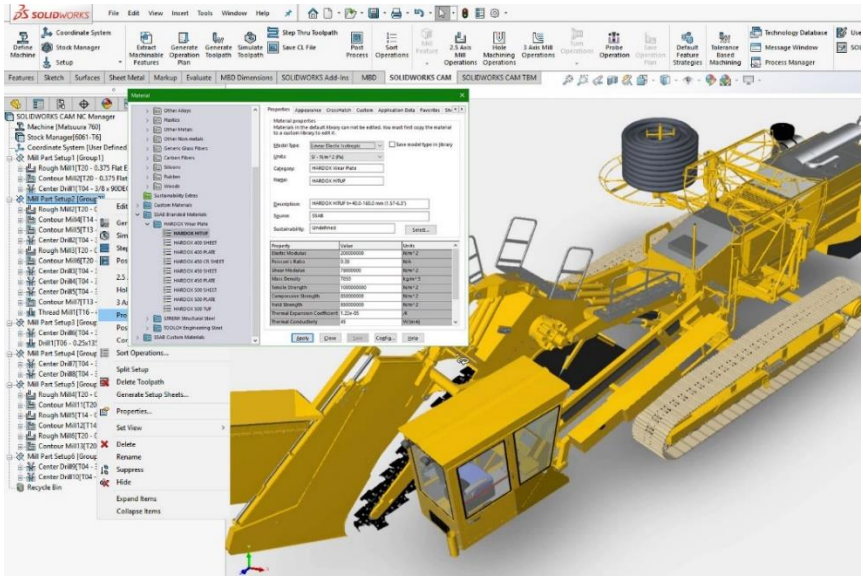

Figure 6. SolidWorks image (URL-6)

1.2. Augmented Reality (AR) and Virtual Reality (VR) Applications

Augmented reality is defined by Wang and Dunston (2007) as enriching the physical environment in the real world with information received from the virtual world. Augmented reality is considered a part of virtual reality technology. Virtual reality enables the objects we can see to be transferred to the computer environment and watched interactively with 360° videos. With virtual reality, you feel like you are in the video you watch and are experiencing that moment (Kıvrak and Arslan, 2018). No camera is used as the source, the images presented are pre-recorded videos (Köymen, 2014). In short, in augmented reality the user sees virtual objects superimposed on the real world in an enriched space (Kaleci et al., 2016; Aksu and Ercoşkun; 2022).

Augmented reality (AR) is the interaction of computer-aided created data with visual, auditory, tactile, olfactory senses and the perception of reality by amplifying the reality, including the somatic nervous system that processes the senses. Today, although augmented reality has many applications from medicine to the military area, it can

be used extensively as a graphic design application in education, visual arts, architecture, industrial design, publishing, commerce and video games. Today, software and hardware are intertwined in augmented reality systems, and screens, projectors, and a wide variety of stimulating equipment worn on the head, hand, and body are used (İpek, 2020). Augmented reality hardware is 1) Screens: HMD and OHMD, 2) Glasses: Smart Glasses 3) Head-Up Display: HUD 4) Handheld Devices: Tablets and Phones 5) Spatial Systems: Projection 6) Motion Tracking: Sensors and 7) Computer (İpek, 2019).

Augmented reality increases the perception of existing reality through data flow within the physical environment. Virtual reality (VR) creates new artificial environments independent of the physical environment. Virtual reality is considered as a computer-aided digital environment that is experienced and interacted as if it were real. Virtual reality systems, which continue to be developed for many branches of industry in line with technological developments, can be used in education, visual arts, architecture, industrial design, publishing, commerce and video games in the field of graphic design application, with many applications ranging from serious games to entertainment, especially simulation applications. Jerald (2016) exemplifies that the beginning of virtual reality goes back to human imagination, verbal communication and cave paintings, and that in ancient times, communities used illusions to entertain or control, and in the middle ages, magicians used smoke and concave mirrors for ghost and devil illusions (İpek, 2020).

Virtual reality systems used today are based on gyroscope, motion sensors, small-sized HD screens and processor technologies that monitor head, hand and body positions developed for smartphones (Kelly, 2016). Virtual reality systems are computers, headsets and simulators (İpek, 2020).

DAQRI Smart Helmet, Morpholio AR, DAQRI Smart Helmet, Sketchwalk, Augment, Fologram, GAMMA AR, ARki can be given as

examples of augmented reality applications developed for use in architecture and design fields (ENSCAPE, 2021).

1.3. Data Analysis and Geographic Information Systems (GIS)

Geographic information systems, which consist of a series of subsystems designed especially for the management of location-based information, play a very important role in applications that require complex analysis such as the management, planning and integration of economic, political, social and cultural resources (Ayhan et al., 2010). Geographic Information Systems (GIS), which has always been a part of technology since its emergence, has developed and advanced its application areas with technological developments (Şahin et al., 2020). Location information stored in GIS is called geographic data. Details of residential areas, roads, etc., and natural features such as lakes, streams, and hills contain numerical information consisting of graphical data expressed as location coordinates in a certain reference system and their associated attribute data (Bensghir and Akay, 2007). GIS, a spatial information system, performs the function of managing graphic and non-graphic information based on location. It offers the opportunity to analyze spatial and non-spatial data by correlating them with each other. Spatial data with two or three coordinates are point, line and polygon data. Data that explains spatial data and indicates their attributes are also considered non-spatial data. GIS is used in many professional disciplines that make decisions through spatial thinking and this way of thinking. Rapid developments in GIS technologies have led to the emergence of many definitions. According to these definitions, the necessity and importance of spatial data for GIS is the common point between these definitions. GIS must have a database, map information and computer support to provide the connection between these two (Hepdeniz, 2014). GIS is based on the principle of modeling spatial data, which is observed or measured through spatial thinking, in a computer environment

according to the feature model of the geographical space (Konu Eskitoğlu, 2022).

The concept of the internet of things is a new infrastructure and digital data source made available for GIS use, with data transmitted through millions of objects on the internet and cloud computing bases where the data is stored. Considering the most important component of GIS as data is the most accepted idea in the field of GIS. Data is the component expected to be the most accurate and up-to-date for GIS, especially in engineering studies where the result is expected to be produced with unmistakable accuracy. In the last decade, the concept of Big Data has been effective in wide-ranging fields such as medicine, politics, social fields, natural sciences, and has also been used effectively in the field of GIS. Software is another important GIS component that provides the functions and tools needed to store, analyze and display spatial information (Şahin et al., 2020).

The two most widely used programs in the field of GIS today are ArcGIS (Figure 7) and NetCAD.

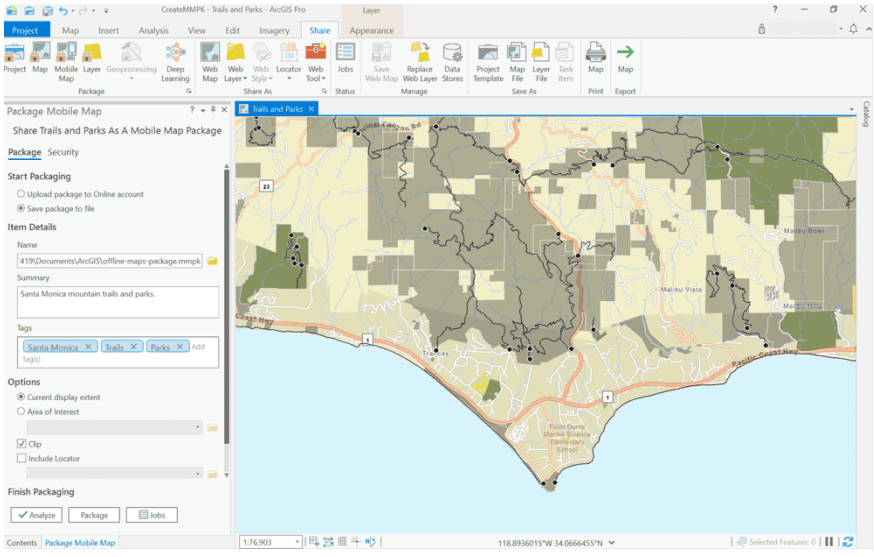

Figure 7. ArcGIS image (URL-7)

1.4. Artificial Intelligence

“Is there a machine that can use intelligence and intelligence? Can a machine think?” In his study, Turing (1950) investigated machine intelligence and the thinking ability of machines and argued whether machines could think by developing the "imitation game" test. This idea brings to mind the question: "Can a machine be made that resembles and imitates human intelligence, such as problem solving, reasoning, learning and perception, with artificial intelligence?" In recent years, the use of artificial intelligence has begun to increase in many fields of work and professions. This situation has contributed greatly to the increase in interest in artificial intelligence and the progress of studies on artificial intelligence (Arora, 2022; Özdemir, 2022).

The concept of artificial intelligence in general is the machine's ability to exhibit intelligent behavior. Intelligent behavior includes perceiving, reasoning, learning, communicating and acting in complex environments, respectively. In the long term, the goal of artificial intelligence is to develop machines that can do the things that humans can do at least as well or even better than them (Nilsson, 1998). In another definition, Luger and Stubblefield (1998) define artificial intelligence as "the branch of computer science that deals with the automation of intelligent behavior" (Karabulut, 2021).

With developing technology, artificial intelligence applications have become an important part of human beings' daily lives. Artificial intelligence is known among the public as a system that includes a number of technological solutions that aim to imitate human intelligence and, thanks to these technologies, gives machines the ability to perform tasks that human intelligence does, such as learning, decision-making, and language analysis (Russell ve Norvig, 2009). Artificial intelligence is used in various fields in daily life, for example, data analysis, recommendation engines, automatic driving systems, healthcare, automatic translation, voice recognition, financial markets, chess,

military simulations, social media, etc. (McCorduck 2004; Özdemir, 2022).

Artificial intelligence is used in both design and planning fields. There are many design software that work with artificial intelligence. When working with artificial intelligence, code knowledge is required for some programs. There are also applications and websites that can be used without coding knowledge (Özdemir, 2022). The most commonly used artificial intelligence tools in design include Canva, Kroma, Adobe Sensei, Sketch2Kodu, Fronty, Myth.

In recent years, artificial intelligence techniques have been used effectively within the scope of geographical data management in the effective and rapid processing and interpretation of complex spatial data (VoPham et al., 2018). The basis of the concept that has developed as GeoAI (Geospatial ArtificialIntelligence) in the literature is the combination of advanced analysis techniques of artificial intelligence techniques with the comprehensive database of GIS and a wide range of application approaches (Vozenilek, 2009). With artificial intelligence, many classical GIS applications have evolved to respond to more complex problems. Within the scope of geographical data management, GIS integration of artificial intelligence applications has been successfully applied in various remote sensing applications such as image classification, pattern and pattern extraction, production of sensitivity and risk maps, and in areas such as transportation, agriculture and forestry, logistics, environmental ecology (Şahin et al., 2022).

2. CONCLUSION

Rapid developments in the field of science and technology greatly affect the professional disciplines of planning, design and architecture. Digital technologies provide many advantages and facilitate planning and design work. With the use of these technologies, the design process accelerates and efficiency increases. In addition, the fact that error rates are almost zero helps designers and planners to produce error-free data.

Advantages such as three-dimensional, high-quality and realistic visualizations, unlimited presentation techniques, and achieving accurate analysis results are other factors that increase the impact of digital technologies. Thanks to cloud-based platforms, collaboration and sharing of data becomes easier, thus eliminating time and space restrictions.

Many digital technologies provide the user with opportunities to create scenarios and make simulations, allowing the creation of alternatives to the design or the data obtained, thus encouraging new ideas.

As a result, the types of digital technologies that have many advantages and the number of software and tools created with these technologies are increasing day by day. These tools, used in all sectors and all professional disciplines, show new ways and open new horizons with the services they offer in the production, evaluation and sharing of information.

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CHAPTER 9

ADIYAMAN ESKİ SARAY MOSQUE: CONSERVATION PROBLEMS AND RECOMMENDATIONS IN PRINCIPAL CONTEXT WITH HOLISTIC APPROACHES

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INTRODUCTION

Adıyaman is located in the west of the South Eastern Anatolia Region. At the same time, the settlement, located at the intersection of main roads coming from Asia, Europe and Africa, attracts attention with its rich natural resources (Uzun and Hanol, 2019). For this reason, it has incorporated many civilizations. A large number of architectural heritages that have survived from these civilizations are concentrated especially in the context of belief structures.

There are many mosque structures in Adıyaman city center as important representatives of the architectural heritage. One of these, Eski Saray Mosque, stands out with its location in the city, its place in the city's memory and its reflection of the characteristics of the period to which it belongs. However, it is quite remarkable that such an important structure has been subjected to many interventions throughout the historical process and that there is not enough work on its conservation. Article 3 of the Venice Charter, which is a turning point in conservation, contains the following statements: "*The purpose of preserving and repairing monuments is to preserve them as a historical document as well as a work of art.*" Article 13 of the same regulation states: "*Additions may be permitted only if they do not harm the interesting parts of the building, its traditional location, composition, balance and relationship with its environment.*" (URL 1). Accordingly, there isn't enough data about the Eski Saray Mosque and the structure itself is a historical document. In addition, the approach to the interventions the building undergoes is closely related to Article 13.

The aim of the study is to contribute to the conservation of Adıyaman Eski Saray Mosque and its transfer to the future. Thus, it is aimed to draw attention to the conservation of the urban identity and ongoing belief culture and to the continuation of tangible and intangible cultural values together. In this context, the belief culture in Adıyaman was examined in general and as a product of this, the current qualities of the Eski Saray Mosque and its conservation problems were revealed. In

order to address these problems, suggestions have been made in principle by making use of the relevant literature. As a result, it is thought that it contributes to the conservation of the architectural heritage both environmentally and structurally, as well as with all its intangible qualities.

1. FAITH CULTURE IN ADIYAMAN

Adıyaman is a province located in the Middle Euphrates Section of the Southeastern Anatolia Region, at the northern periphery of the region. Kahramanmaraş is located in its west, Diyarbakır in the east, Malatya in the north and Şanlıurfa in the south (Figure 1).

Figure 1. Location of Adıyaman (edited by the author, taken from URL 2)

The settlement, which is known as Adıyaman city center today, was called Hısn-ı Mansur before 1928. This name was given because of the Mansur Castle built here by the Umayyads in the 7th century. The use of the name Adıyaman is based on the ancient belief culture in the settlement. The name given in the region to the seven brothers who were killed by their pagan father for opposing the "Seven Yaman" belief changed to Adıyaman over time (Halaçoğlu, 1988).

The history of Adıyaman dates back to B.C. It dates back to 40000 years ago. The settlement, which attracted the attention of many

civilizations due to its fertile and rich natural resources, was located on the trade route during the Assyrian period and became an important point for commercial caravans coming from Mesopotamia. However, it is known that the settlement, which was mentioned as Kummuhu in Assyrian inscriptions and was later named Commagene, covers the borders of today's Adıyaman. Adıyaman, which was under Hittite, Hurrian, Kummuh, Assyrian, Med, Persian, Commagene, Roman and Byzantine rule before Islam, remained under Umayyad, Abbasid, Seljuk, Artuklu, Zengi, Dulkadiroğlu, Mamluk and Ottoman rule after Islam (Nakipoğlu, 2000; Aykaç, 2013).

The influence of Islam increased in Adıyaman, especially after the 7th century, and many Islamic scholars lived in this geography. In addition, many lodges and zawiyas were established in the settlement, tombs were built when the Islamic scholars living here died and all these structures enabled the culture brought by the Islamic faith to become increasingly influential (Nakipoğlu, 2000; Filik, 2021).

In Adıyaman, where the belief culture brought by Islam is gradually intensifying, many mosque structures have been built both in the city center and in the districts and villages. Some of these, Çarşı Mosque, Kab Mosque, Yenipınar Mosque, Musalla Mosque and Eski Saray Mosque, located in the city center today, were built during the Ottoman period (Figure 2). The Ulu Mosque was built by the Dulkadiroğulları Principality but was brought to its current form during the Ottoman Period (Figure 2).

(a)

(b)

Figure 2. Adıyaman Yenipınar Mosque (a) and Ulu Mosque (b) (Author's archive, 2022)

Mosques located in the center of Adıyaman, which are architectural heritage, face many problems in terms of conservation. The Eski Saray Mosque, which is located in a very central location, is noteworthy in terms of its importance for the settlement and the interventions it has undergone. In this context, the study examined the Eski Saray Mosque and identified conservation problems.

2. ADIYAMAN ESKİ SARAY MOSQUE

Eski Saray Mosque is one of the architectural heritage values located in the center of Adıyaman and reflecting the religious culture of the city. This building, which attracts attention in the context of conservation, was examined in terms of its location, history, architectural qualities and conservation problems within the scope of the study.

2.1 Location and History

Eski Saray Mosque is located on Gölbaşı Street, in Eski Saray District, in the center of Adıyaman province (Figure 3, Figure 4). Next to the building is the Şire Market, one of the important and central trade points of Adıyaman. According to the inscription on the entrance gate, it was built by İbrahim Bey between 1148 Hijri and 1735-1736 Gregorian. Although it is stated in various sources that it was built in 1638, many sources state that this is not true (Kılavuz, 2005; Şancı, 2012; Polat and Orhanlı, 2020).

Figure 3. Location of Eski Saray Mosque (edited by the author, taken from Google Earth, 2023)

Figure 4. Eski Saray Mosque from Gölbaşı Street (Author's archive, 2022)

The Eski Saray Mosque went through various interventions during the Republican Period. It was registered and protected on 12.02.1977 (URL 3). The building, whose many features changed especially with the comprehensive restoration it underwent in 1992, was also affected by the

earthquakes that occurred on February 6, 2023. In this context, it can be stated that it is a structure that has undergone great changes throughout the historical process. In addition, the plane tree next to the building is a very old and protected natural heritage. For this reason, it is also known that Eski Saray Mosque is called Çınar Mosque (Kılavuz, 2005; Şancı, 2012; Polat and Orhanlı, 2020, Filik, 2021).

2.2 Architectural Qualification

Eski Saray Mosque is a rectangular planned building. The building is entered from a courtyard accessed via Gölbaşı Street. In this courtyard, which was apparently created later, there is a protected plane tree (Şancı, 2012; Polat and Orhanlı, 2020) (Figure 5). A door located in the west of the courtyard extending in the north-south direction leads to the last congregation area of the mosque, which was closed and added later. The door in the south direction opens to the harim.

Figure 5. The protected plane tree in the courtyard of Eski Saray Mosque (Author's archive, 2022)

The harim section is covered with a flat wooden top cover. This cover is carried by four legs in the middle of the harim. The original top cover of the building was an earthen roof, but this cover was removed and a wooden cover was added in 1967. However, with the restoration

work carried out in 1992, all elements of the building except the minaret, door and inscription were changed (Kılavuz, 2005; Polat and Orhanlı, 2020) (Figure 6).

Figure 6. The harim area of Eski Saray Mosque (Author's archive, 2022)

The original building material of the mosque is cut stone. The building, built with a masonry system, was expanded towards the north using glass and metal materials. In addition, the toilet and ablution units, which can be accessed from the courtyard created later, are also structures that serve the mosque (Figure 7).

(a) (b)

Figure 7. Additional prayer (a) and ablution/toilet units (b) (Author's archive, 2022)

The original and surviving minaret of the building has a square base, cylindrical body and a single balcony. There are eight arch-shaped niches in its body. A large part of the body, under the balcony and around the niches are decorated with ceramics (Figure 8).

Figure 8. The minaret of Eski Saray Mosque (Author's archive, 2022)

When the relevant literature is examined, it is understood that the graves on the south side of the mosque were moved. However, it is known that stone material with a unique pomegranate figure was used in the altar of the building, but it did not survive together with the mihrab (Kılavuz, 2005; Polat and Orhanlı, 2020).

2.3 Conservation Problems

Eski Saray Mosque is an architectural heritage that has undergone significant changes from its construction date to the present day. Despite this decision, major changes have occurred in the registered and protected structure. This situation made it difficult to preserve the structure in its entirety. In this context, the conservation problems identified in the Eski Saray Mosque were discussed environmentally and at the building scale.

• Conservation Issues on an Environmental Scale

Eski Saray Mosque is located in an environment that changes and transforms over time. When the environment in which the building was located in the past is examined, it is understood that it did not have a courtyard and was entered through a very green axis. However, over time, this green texture was lost and a courtyard and toilet/ablution units were added to the building as an addition that did not match the original. In this sense, the structure, whose immediate surroundings have changed, could not be preserved in a holistic manner.

Eski Saray Mosque is located in a very busy spot in the city center of Adıyaman. The main axis on which the building is located was used mostly for pedestrian circulation in the past, but today it is exposed to heavy vehicle traffic. This situation causes noise problems in the mosque, and the stone surfaces on the exterior facades become dirty rapidly due to exhaust gases.

• Conservation Problems at Building Scale

The conservation problems at the building scale identified in the Eski Saray Mosque are mostly caused by unqualified interventions and natural-environmental factors. Protection problems arising from unqualified interventions can be listed as follows:

○ The flat adobe material top cover of the building was replaced with a wooden top cover and the system carrying this cover was created using reinforced concrete columns and beams.

○ All exterior walls of the building, except the south and east walls, have been reconstructed. Meanwhile, there is no information about the reuse of original materials.

○ The toilets and ablution units that were built later adjacent to the western façade, where the entrance gate to the last congregation place is located, changed the character of the facade.

○ Another place of worship was added to the north of the last congregation place, built using stone and glass and metal materials to a

height of approximately 50-90 cm. Thus, the northern facade of the building was completely closed.

- Many air conditioning boxes, lighting elements, electrical cables and signs were added to the exterior of the building (Figure 9).
- The last congregation place is covered with wooden material at a height of 60 cm from the ground.
- There are many lighting elements, cables and various elements that are contrary to the original on the stone wall of the last congregation place.
- The space added to the north of the last congregation area caused this area to lose its semi-open feature and become completely closed.
- A women's gallery was added to the harim area using metal materials (Figure 10).
- The walls of the prayer hall are covered with wooden material up to a height of approximately 60 cm from the floor.
- Cables for the heating system were added to the floor of the prayer hall and the narthex and these elements were covered with carpet.

Figure 9. Air conditioning boxes and metal pipes on the wall of the mosque (Author's archive, 2022)

Figure 10. The women's gallery (Author's archive, 2022)

In the Eski Saray Mosque, conservation problems at the building scale arising from natural-environmental factors along with unqualified interventions are also noticeable. The problems identified in this context are:

- Intense air pollution caused by the vehicle road adjacent to the southern facade of the building damages the stone material on its facade.
- Darkening caused by moisture has occurred on the stone surfaces under the roof eaves.
- Due to the effect of moisture, intense darkening and corrosion occurred on the surfaces where the minaret and the wall intersect.
- There are darkening caused by water on the surfaces where the air conditioner boxes are hung on the exterior.
- The earthquakes centered in Kahramanmaraş, which took place on February 6, 2023, caused the collapse of the minaret of the Eski Saray Mosque, which is known to have survived to the present day (Figure 11).

Figure 11. The minaret of the mosque after the earthquake (Author's archive, 2023)

It is seen that almost all of the conservation problems at the environmental and building scale listed above arise in connection with each other. In this context, eliminating all of these problems is of great importance in terms of preserving the structure holistically.

3. EVALUATIONS AND CONCLUSION

Adıyaman is a very rich settlement area in terms of religious culture and the architectural heritage that is a reflection of this culture. In this context, the city center hosts historical mosque structures that are an important part of the heritage in question.

Located in Adıyaman city center, at a very busy point in terms of pedestrian and vehicle traffic, Eski Saray Mosque is an architectural heritage that draws attention with its deep-rooted history as well as the repairs it has undergone throughout history. In this sense, when the building is examined on an environmental and structural scale, it is

understood that it faces many conservation problems. Providing innovative and sustainable suggestions for these problems is of great importance for the preservation and sustainability of the city's belief culture.

Suggestions that can be taken into consideration on an environmental scale for the protection of the Eski Saray Mosque are as follows:

- High-scale environmental decisions should be taken for the entire architectural heritage in Adıyaman city center and the Eski Saray Mosque as a part of it. Multidisciplinary studies should be carried out for these decisions.
- Vehicle density around the building should be reduced; alternative routes should be created.
- Ablution and toilet units added later should be renewed in accordance with the original structure and within the context of the principles and regulations for additional building designs to monumental buildings.

In order to preserve the Eski Saray Mosque and pass it on to future generations, the following suggestions on a structural scale can be taken into consideration:

- All archives and information sources regarding the history of the building should be investigated in detail and a detailed restitution proposal should be put forward.
- As non-original additions to the building, the new space in the north and the upper cover should be rearranged in accordance with the original. Accordingly, the need for new space should be met by taking into account the criteria for additional building applications to monumental buildings.
- The western and northern walls built later should be examined both structurally and in terms of materials and usage. Parts that are not suitable for restitution study should be revised.

- Cables, lighting elements and air conditioning boxes on the exterior and interior of the building should be removed, lighting and heating/cooling systems that do not spoil the original qualities should be created with a multi-disciplinary work.
- The women's gathering place in the Harim area, which is contrary to the original, should be removed. The need for a women's community should be met by taking into account the information obtained through restitution studies.
- The non-original wooden wall covering in the prayer hall and outside the north wall should be removed.
- Usable stones belonging to the original minaret that collapsed due to the earthquake should be protected. Stones of the same quality should be provided instead of unusable stones and the minaret should be repaired with its original construction system.
- Interdisciplinary studies should be carried out to detect damage to the ground and foundation due to the earthquake.
- In order to obtain data on the compressive strength and mechanical properties of the structure after the earthquake, tests that do not damage the structure, such as the flat jack test, should be applied (Bieniawski, 1978).
- Strengthening/reinforcement procedures should be applied when deemed necessary.
- Chemical cleaners, water repellents and strengthening materials should be used to remove and repair contamination and abrasions on stone surfaces (Ziyaettin, 2010).

It may be necessary to make some additions to a historical building along with various interventions to ensure its survival and increase its lifespan. With this very critical intervention, the structural balance of the building should be restored, and on the other hand, it should be essential to preserve the integrity of the architectural form and mass. Permanent additions must be compatible with the historical structure in terms of form, proportion and material. For this reason, it is vital to carry out

multidisciplinary studies in fields such as architecture, engineering and art history, starting from the survey and restitution stages (Örmecioğlu, 2010).

As a result, the study emphasized the value and importance of the Eski Saray Mosque, about which there are not enough studies, especially in the context of conservation, as an architectural heritage. Considering the current state of the building, attention was drawn to the conservation problems and it was aimed to contribute to its transfer to the future with suggestions.

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CHAPTER 10

LEARNING WITH THE LANDSCAPE: ROLE OF LANDSCAPE DIVERSITY IN ENVIRONMENTAL EDUCATION

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INTRODUCTION

Landscape diversity is a crucial tool for environmental education to reduce human impact on the environment and natural resources (Pirchio et al, 2020). Landscape diversity plays an important role in improving the understanding of ecosystems, a fundamental aspect of environmental education (Aksu, 2021). By exposing individuals to a variety of landscapes, they can observe and learn about different interactions between living organisms and their environment. This can help individuals gain a deeper understanding of the complex relationships that exist within ecosystems, including the interdependence between different species and the impact of human activities on the environment. By developing a comprehensive understanding of ecosystems, individuals can make more informed decisions about how to protect and preserve the environment (Cukur and Ozguner, 2008).

Promoting the conservation and preservation of biodiversity is another important aspect of environmental education that can be facilitated through landscape diversity (Aksu, 2021). Thus individuals could understand the importance of preserving biodiversity and the critical role it plays in maintaining healthy ecosystems. Additionally, by understanding the interconnectedness of different species within ecosystems, individuals can better understand the importance of conservation efforts and take action to protect natural resources.

Providing opportunities for hands-on learning and experiential education is another important benefit of landscape diversity in environmental education (Uztemur et al, 2018). By participating in activities such as field trips, nature walks, and hands-on projects, individuals can gain a deeper understanding of environmental issues and develop a sense of personal responsibility for protecting the environment (Ogurlu, 2016). This type of experiential education can be particularly effective in engaging individuals who may not respond well to traditional classroom-based learning. By providing hands-on learning and experiential education opportunities, environmental educators can foster

a greater sense of connection with the natural world and encourage individuals to take an active role in environmental protection (Cabuk et al, 2019).

In environmental education, knowledge about the role of landscape diversity is becoming increasingly important. Research in this area enables us to understand the effects of various natural landscapes in educational environments. Studies by Kavak and Coskun (2017) and Louv (2008) show that students learn more effectively in different natural environments and that learning in diverse landscapes helps them internalize knowledge in a more sustainable way. In addition, Kuo et al (2019) states that various landscapes increase student motivation and contribute to developing a positive attitude towards nature. In this context, it can be said that various landscapes have a unique potential in environmental education and play an important role in increasing students' sensitivity to sustainability issues. This study will examine in more detail the contributions of landscape diversity to environmental education in the light of the information obtained from these sources.

The aim of this study is to evluate the potential of natural and cultural landscape values in environmental education as a learning medium in case of Kilis City, Turkey. Providing information on to what extend landscape may function in the environmental education and how the diversity in the landscape can help to understand the need for protection, maintenance as well as improvement of the environment would be useful information for both institutions, municipalities, local entrepreneurs as well as educators.

1. MATERIAL AND METHOD

Due to its nature and geography suitable for settlement, Kilis has hosted many tribes (Babylonian, Hittite, Huri-Mitanni, Aramean, Assyrian, Persian, Macedonian, Roman, Byzantine, Seljuk, Mamluk/Kölemen, Ottoman) throughout history. With its rich cultural diversity, Kilis offers learning opportunities from the landscape. Kilis is

a province located in southeastern Turkey and generally has continental climate characteristics. Area of the province is 1521 km2. However, the natural landscape of Kilis generally consists of steppes and steppes. Compared to the surface area of the province, its forest areas are limited, and the vegetation is generally more arid and steppe in character.

Kilis is very rich in terms of natural, historical and cultural values (Figure 1). Ravanda castle, located in the Afrin valley, is important in natural, historical and cultural terms with its monumental trees and rich plant population (Celik, 2020). It has hosted many tribes throughout history. Among the historical and cultural heritage that has survived to the present day, the "mounds" and Kilis houses, which were the settlements of the past, are the most important ones (Kilis Provincial Directorate of Culture and Tourism, 2023).

Ravanda Castle and Monumental Tree (Celik, 2020).

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Figure 1. Natural, Historical and Cultural Values of Kilis

Figure 2 indicates the location of area of study, Kilis city centre. In the first stage of the research method, a literature study was conducted by searching articles, theses, congress and symposium papers on the environmental factors and landscape diversity of the city of Kilis and environmental education, as shown in the flow chart (Figure 2).

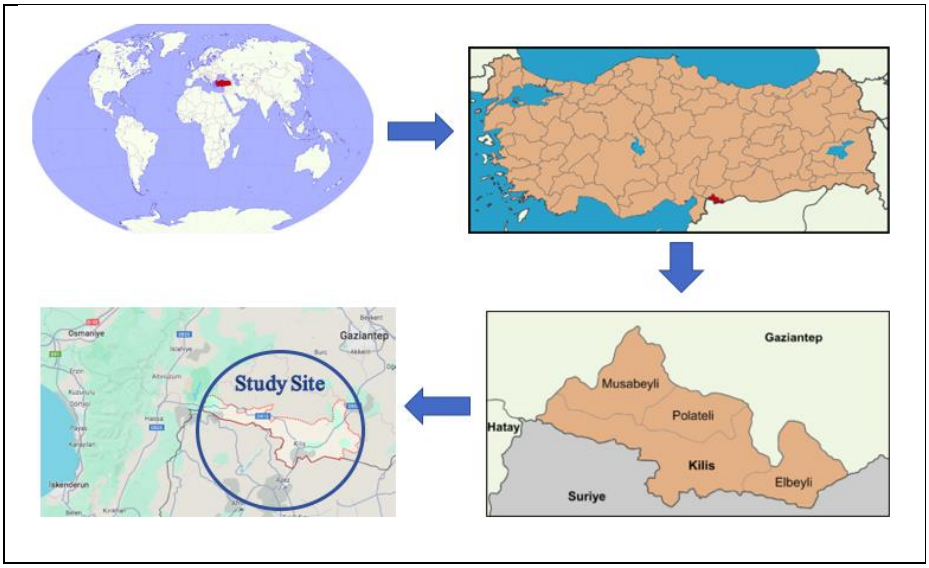

Figure 2. Location of Study Site, Kilis (Google map, 2023; Wikipedia, 2023)

As a result of this literature study, as shown in Figure 3, data about green areas, parks and gardens, forests, and endemic species in Kilis city center were collected from the archives of local governments. Then, it was analysed how the landscape diversity in Kilis city center was associated with education, and in the final stage, suggestions were presented.

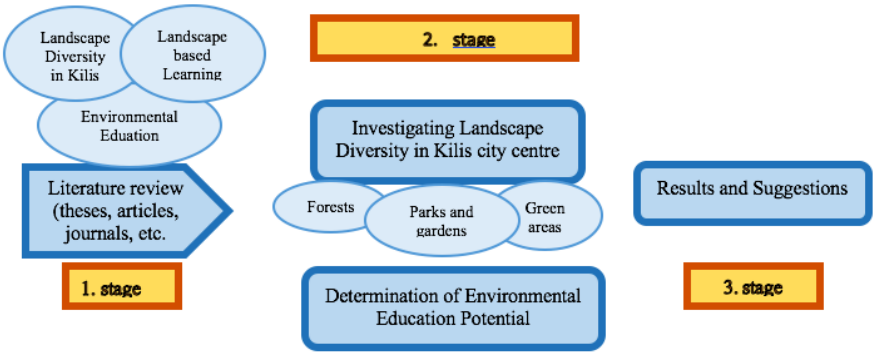

Figure 3. Flow of the study

2. RESULTS

2.1. Environmental Education

Environmental education is an important field of education that aims to increase the awareness of individuals and societies against environmental problems, gain environmental awareness and develop sustainable behaviours (Emir, 2022). UNESCO defines environmental education as ' educating environmental literate citizens who are aware of the environmental problems the world facing and know how to solve them' (UNESCO, 1980). UNESCO's definition was replicated by the researchers as the main purpose of environmental education is to create environmentally literate society (Roth, 1996; Rothkrug and Olson, 1991; Wilke, 1995). Regarding the issues that environmental education is mainly concerned with, sustainability educator Stephen Sterling stated that environmental education initially deals with the history and study of nature and conservation education in terms of mitigating environmental problems caused by human actions (Sterling, 2004).

Much research on environmental education has focused on environmental awareness, sustainability education, and nature-based learning. A study about environmental education in the university led to a conclusion about the importance of environmental education in schools. Collado et al (2020) presented evidence that nature-based environmental education activities such as scouts or summer camp had a greater positive effect on Spanish primary school students' environmental attitude than traditional curriculum. Collado et al (2020) promote supporting the curriculum with a nature-based pedagogy.

Although Azizi and Wilkinson (2015) argued that green buildings do not influence occupants' environmental awareness and energy saving behaviour, Clarke (2013) investigates in his doctoral thesis whether buildings have pedagogical roles and sustainable buildings shape environmental behaviour. According to the assumptions from his survey analysis, sustainable buildings support sustainable behaviours (Clarke, 2013). Another doctoral study by Rokosni (2019) aims to understand

how the architecture of sustainable buildings may shape sustainable occupant behaviours. The author uses mixed method, both interviews with the architects of BREEAM-certified accommodations in order to explore designed affordance, and surveys with students in order to explore perceived affordance. The thesis has contributed to the statement 'sustainable architecture supports sustainable occupant behaviours when occupants perceive their needs are well supported by the building and its features' (Rokosni, 2019).

In addition, the space in which the learning and teaching occurs has an impact on learning. Gokmen asserted that schools that have sustainable design offer a higher success rate, increased student participation and performance and satisfaction, positive changes in student behaviour (Gokmen, 2012). In this context, Reynolds and Scott suggested that sustainable schools encourage students in learning by enhancing attitude, behaviour and motivation; they also support healthy lifestyles and school environments (Reynolds and Scott, 2011).

The physical context in which students undertake pedagogic activities covers the natural or built environment. This means that some classes can take place in buildings or outside. There is a real potential teaching value in each of these settings. Louv (2008) mentions that education might work really well in the natural environment (Louv, 2008). According to Louv (2008), having classes in the natural environment and using natural habitats for learning and teaching can be really positive. Louv (2008) also suggests that nature could be a laboratory for teaching about the environment and developing children's creativity, development and learning skills. According to Louv (2008), a connection with the natural environment can be a really enriching and important experience for children.

The natural environment in which students can learn might contribute to their learning (Louv, 2008). Kavak and Coskun (2017) supported Louv's view with a study about the use of materials in nature for early childhood education. In this journal article, the authors

investigated the difference between pre-school teachers in Turkey and Germany in terms of developing informative material. The authors also noted that teachers in Germany benefitted more from materials in nature. These materials had a positive impact on children's learning because the activities designed with natural materials encouraged children's creative thinking skills and imagination. Therefore, integrating the places where children live with nature has a crucial role in environmental education (Kavak and Coskun, 2017). In this context, Orr indicates that physical environment and environmental education are two convenient disciplines to be able to integrate (Orr, 2000).

The physical environment in which students undertake their learning also plays a really important role in supporting environmental education. Accordingly, Bingler (1995, as cited in Shapiro, 2016) indicated that the physical learning environment could be used as a resource in teaching and learning (Bingler, 1995, as cited in Shapiro, 2016). Also, Taylor asserts that students interact with and learn from the physical environment of school buildings at many levels (Taylor, 1993).

This study evaluates that providing nature-based education and learning with landscape can be effective on environmental attitudes and behaviours.

2.2.Landscape Diversity of Kilis City

Kilis city center is a region generally under the influence of steppe climate and forest areas are limited. However, forested areas are generally found in mountainous regions in the northern region (Figure 4). Major Mountains of the Province are Kurt, Darmik, Hazil, Karruca, Kartal, Arapdede and Sof Mountains. Major Rivers are Afrin Stream and Sabun Water. Musabeyli, Elbeyli, Polateli are its districts. One of the forest-covered areas in the region is the serpentine-shaped Kurt Mountains in the northwest of the provincial borders. The vegetation here includes Kermez oak, rarely Tar Juniper, Sandalwood, Rosary Tree,

Gum, Terebinth, Pınar Oak, and Thuja Oak, but the most common species is Red Pine (The Ministry of Agriculture and Forestry, 2023).

Some natural plant species in the regions flora are Kızılçam (*Pinus brutia*), Fıstık Çamı(*Pinus pinea*), Kavak (*Populus tremula*), Meşe (*Qercus sessiliflora*) (*Quercus ilex*) (*Quercus cerris*) Ardıç (*Juniperus oxycedrus*), Akçaağaç (*Acer negundo*) Dişbudak (*Fraxinus ornus*), Servi (*Cupressus sempervirens*), Yabani Zeytin (*Olea europea*), Sandal (*Arbatus andrachne*), Akçakesme (*Phillyrea media*), Sakız (*Pistacia lentiscus*), Funda (*Erica arborea*), Tespih (*Sytrax officinalis*), Laden (*Cistus villosus*) Sütleğen (*Euphorbia amygdaloides*), Karaçalı (*Paliurus spina-christi*).

Compared to other regions, biological diversity and plant density are lower in Kilis.

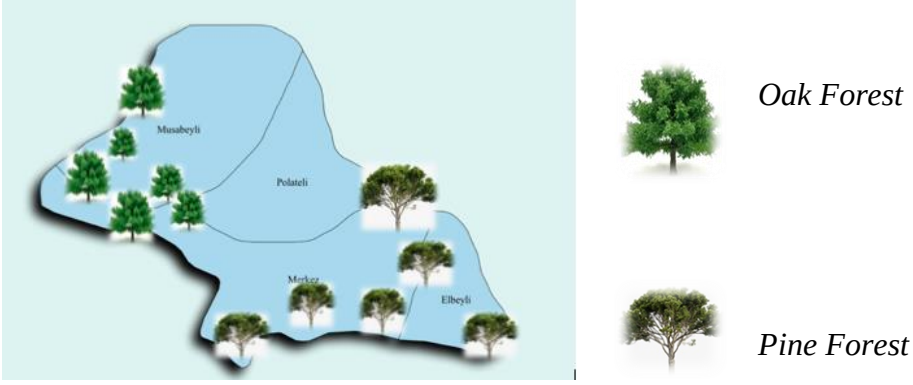

Figure 4. Natural Vegetation Map for Kilis (Forest District Directorate of Kilis, 2016).

Endemic species in Kilis: *Arum detruncatum* C. A. Meyer var. *caudatum* (Engler) K. Alpinar et R. Mill, *Asteraceae anthemis* L., *Brassicaceae, Anthemis pauciloba* Boiss. var. Microstephana (Eig) Grierson, *Hesperis* L., *Centaurea hausknechtii, Corchicum davisii, Hesperis aintabika* Post, *Dipsacaceae scabiosa* L., *Satureja aintabensis, Scabiosa kurdica* Post, *Fabaceae astragalus* L., *Astragalus aintabicus* Boiss., *Astragalus dipodurus* Benge, *Dorycnium pentaphyllum* Scop.

subsp. Haussknechtii (Boiss) Gams, *Liliaceae*, *Fritillaria* L., *Fritillaria viridiflora* (The Ministry of Agriculture and Forestry, 2023).

Of the 51 parks in Kilis, 16 with an area of over 2000 m^2 are shown on the map (Figure 5).

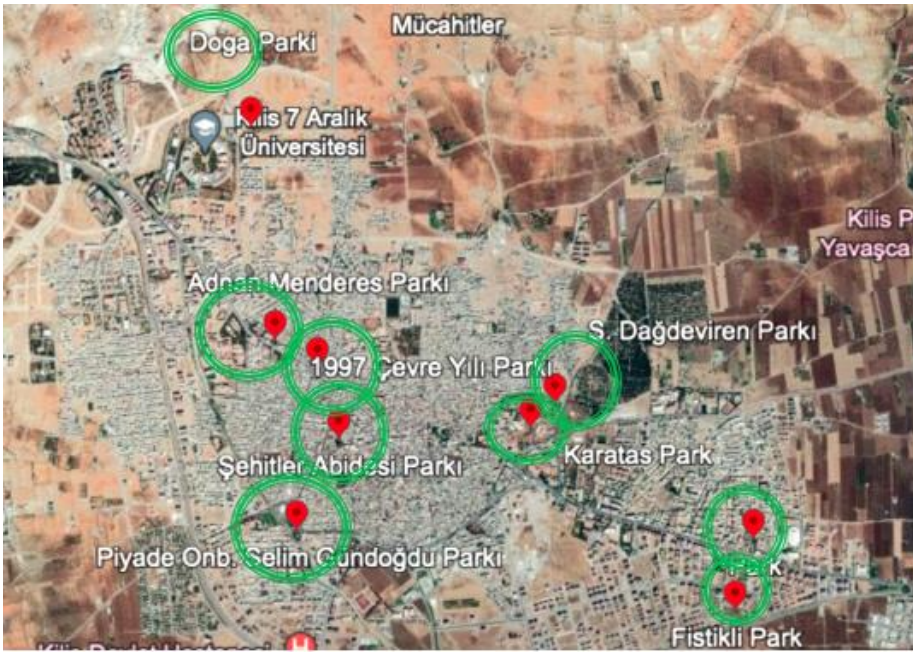

Figure 5. Parks and Green Areas in Kilis City Centre (Google map, 2023)

When we examine the green areas of the city of Kilis in the context of environmental education, especially urban open green areas, natural and semi-natural areas and historical-cultural regions have an important potential. The parks and gardens in Kilis city center offer residents the opportunity to be in touch with nature. These green spaces be an effective tool for environmental education. Activities held in parks can be useful in terms of understanding natural life. The natural or semi-natural areas around Kilis can be considered as important resources for environmental education on ecosystems and biodiversity. These areas can be transformed into learning environments for students and the general public with walking routes, nature observation areas and similar

activities. The historical and cultural riches of Kilis offer students learning opportunities on local history, traditions and architecture. Using historical regions and buildings in environmental education can help students understand and protect local culture. Environmental education can be reinforced with various educational activities organized in these areas.

As a result, the city of Kilis seems to have an environment with rich potential in terms of environmental education. Utilizing this potential can increase society's environmental awareness and encourage them to adopt sustainable living principles.

2.3. Role of Kilis Landscape Diversity in Environmental Education

Green areas, which create escape points where people can breathe in cities that grow without an identity, can create positive effects in terms of integration with nature, meeting active and passive recreation needs and human health (Çetinkale Demirkan, 2019, cited in Yücekaya et al, 2019). Green areas, botanical gardens, forests, ponds and parks have an important potential in environmental education. Although green areas are limited in Kilis, recreational activities where learning is possible with the environment can be evaluated. In this sense, participants can be informed about plant diversity by organizing activities to recognize and name different plant species in botanical gardens or parks. Ecological studies conducted in parks and botanical gardens can help participants observe how various plant and animal species interact with each other. Giving participants their own plant growing experiences and organizing gardening workshops can raise awareness about sustainable agriculture and gardening. Natural landscapes are important resources for creative activities such as painting, photography or nature-inspired artistic works. By using informative boards or guidance materials in parks, botanical gardens and recreation areas, participants can be informed about environmental problems and their awareness can be increased. While

these activities encourage learning in natural areas, they can also give participants a broader perspective on environmental issues.

Using forests, which are an important part of green areas, in environmental education can enable participants to experience the natural environment, gain nature awareness and be sensitive to environmental problems. Nature walks organized in the forest are an effective method of providing participants with information about flora, fauna and ecosystem. Activities such as reading, painting, or writing in the forest can help participants develop creative and literary skills in a forest environment. Organizing camping in the forest or organizing outdoor activities allows participants to establish a closer connection with nature and learn while having fun. By visiting the villages around the forest, opportunities can be created to learn about the local people's interaction with nature and their experiences on environmental issues. Environmental education can be provided through the senses by providing participants with opportunities to listen to the natural sounds of the forest and discover its smells. These activities can provide an interactive learning experience that aims to explore many aspects of landscape diversity and increase environmental awareness.

3. CONCLUSION

This article highlights that landscape diversity plays a critical role in environmental education. Reseaches show that different landscapes are important resources for creating environmental awareness, increasing the understanding of biodiversity and raising awareness about sustainable living. This study shows that environmental education based on landscape diversity helps individuals develop a deeper connection with the natural world and understand their environmental responsibilities. It also reveals that this education contributes to individuals' understanding of interactions in various ecosystems and adopting sustainable behaviours.

Environmental education has become increasingly important in recent years, as the need to protect and preserve our planet becomes more urgent. One factor that has been shown to have a significant impact on environmental education is landscape diversity. This study analysed the role of landscape diversity in environmental education, using a case of Kilis province. By examining the impact of diverse landscapes on learning and engagement, it aimed to better understand how to design and implement effective environmental education programs. This paper emphasised the significance of the topic by following a review of the relevant literature on landscape diversity and environmental education.

Moreover, it has been found that a diversity of native plants in the landscape plays a crucial role in sustaining a healthy environment, highlighting the importance of biodiversity conservation in environmental education (Eckel, 2018). In this respect, research has examined the impact of landscape diversity on environmental education. One study aimed to clarify whether educational attainment, sense of community, and grounded occupation influenced landscape socialization (Peng, 2021). Therefore, it is important to incorporate landscape diversity into environmental education to promote sustainability and preserve natural resources for future generations. These findings can guide the development of strategies and programs addressing landscape diversity in environmental education. In this context, it is possible to present environmental education in a more effective and comprehensive way with suggested practices and policy changes.

The research entitled “Learning with the Landscape: Role of Landscape Diversity in Environmental Education” sheds light on the importance of incorporating landscape diversity in environmental education. The study highlights that landscapes are not just spatial arrangements of biophysical and socioeconomic components, but they are also heterogeneous. Therefore, educating individuals about the diversity of landscapes is crucial to promote sustainability and preserve natural resources for future generations. The research examined the

impact of landscape diversity on environmental education and suggested that it can enhance educational outcomes. The study identifies a gap in the literature, suggesting that further research is needed to fully understand the impact of landscape diversity on environmental education.

Education focusing on landscape diversity can increase environmental awareness by enabling individuals to become more aware of and understand their natural environment. By providing students with the opportunity to understand the connections between different landscape types and the complexity of ecosystems, they can develop a deeper understanding of sustainability and natural balance. Project-based learning and hands-on work in natural areas can help students develop practical skills such as landscape design, conservation and restoration. An emphasis on landscape diversity in environmental education can encourage greater participation and responsibility of local communities in environmental issues. Understanding the diversity of the natural environment can increase individuals' love for nature and therefore encourage a desire to protect natural resources more effectively. Various learning environments, such as outdoor classes, visits to botanical gardens, and field studies, can make learning more attractive by offering students the opportunity to put theoretical knowledge into practice and be in touch with nature. These results may be important for educators who want to design and implement environmental education based on landscape diversity.

As a result, environmental education focusing on landscape diversity can strengthen individuals' relationships with the environment, contribute to the sustainable use of natural resources, and contribute to raising future generations as individuals who are sensitive to environmental issues. Therefore, it is critical for a sustainable future that landscape diversity plays a central role in environmental education.

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CHAPTER 11

MODERN ARCHITECTURE IN IRAQ

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INTRODUCTION

Generally, to understand architecture, it's critical to understand many factors such as: the historical, political, economic, social, etc. Factors, architecture is a direct reflection of the political management, it seems that the statement of "we shape buildings then they shape us" to be correct with every architectural study. However, modern architecture in Mesopotamia occurred in an era that could be read as a part of international style, came with an imperial occupying power, British Empire, and its multidiscipline engineers. As a part or at least working with different sectors of the imperial force, the imperial force engineers dominated engineering services from 1920 to 1960 in "Kingdom of Iraq", the question: Was the modernism a tool to control and colonize nations or to build a state "Kingdom of Iraq"? Were the imperial forces' engineers familiar with local properties of Mesopotamia? Did they understand Mesopotamian history, local weather, local inhabitant's perspective, etc.? How such a new architecture style changed the local inhabitants? Did the modernization truly change life style of local inhabitants? Did the modern designs fit with local community's needs? Was the architectural situation before the modernization truly bad? Was the modernization a tool to legitimate the imperial force? Were the designs of famous international architects later –big names in modernism- successful in Iraq late 1950s? How the projects changed during and after British mandate? Were local architects who had western education able to compete with western architects? Were local architects able to link the present with the past in their designs?

To answer these questions, it's important to understand what were the imperial forces' motivations, purposes, and perspective. Also, to understand local habitant's situation prior to the modernization and after it. Thus, reading thoroughly the history, culture, politic, social, etc. Is essential to elaborate a sophisticated article. Unfortunately, there are few researchers, who could be consider as third parts, or authentic neutral monitors, in addition, to the lack of researchers in this field. However,

this is the main obstacle for any researcher, who wants to seize correct results, understand the whole picture of it.

Iain Jackson from Liverpool University wrote a very good article, but the tone of the article goes to praise the British Empire generally, and its mandate period on Mesopotamia particularly, and underrates Mesopotamian history and Ottoman period. On the other hand, Ghada Al-Silk, an Iraqi Arab researcher from university Baghdad, has a few short articles, she praises Mesopotamian history and Iraqi architects, and underrates modernization process of British Empire mandate period. Fortunately, there are other researchers, from other countries, who could be considered as a third part, each one of them covered a part that related to modernization, as Lydia Harrington, Panayiota Pyla, Pedro Azara and Caecilia Pieri, whose articles could be very good start point, in spite, their backgrounds go to praise western education and works, where they studied and work.

Modernity means convert to new and leave the past, it changed architecture as a result of culture changing, it comes with rapid science and technological discoveries. Moreover, modernity was a revolution on past paradigms.

It's critical firstly to discuss the main character of the British Empire engineering works, who was the British mandate period's architecture, who was James Mollison Wilson, known as JM Wilson, A Scottish architect. However, due to some similarity between Iran and Iraq, particularly weather and economic, moreover, JM Wilson worked in both countries, thus, I tried to table some of the JM Wilsons' works in Iraq and Iran. Furthermore, I tried to break down this topic –Modernity in Iraq- into two periods, 1910-1930, and 1930-1960, there is also, another period from 1960-2003, can be read as the third period, which is the era of Pan-Arabism (Arab nationalism). However, discussing the first two periods are very enough to understand the Modern Architecture in Iraq. The first period of British mandate to 1930 as official mandate then the second one from 1930 to 1960 Iraq kingdom were also indirectly

under the control of British Empire. Yet, after the second period there was an intervention form architects around the world also local Iraqi architects, the latter took the designs including the new plan of Baghdad from a British firm, as a result of anti-imperialism coup in 1959, and gave it to an international architect, who was a Greek architect.

As mentioned above, each determined period is related to major political change, then the political environment of each period has changed the architectural product. The first period is the British mandate period, that tried to colonize Mesopotamia and make it as the British colonial in India. The second period was the extension of the first period, but with the intervention of the new kingdom in Mesopotamia, that called "Iraq". The third period was the born of Pan-Arabism "Arab nationalism" especially after the coup in 1959, this period lasted to 2003, it converted the Kingdom to republic of Iraq. Yet, its end was by an invasion from USA and its allies, that changed the political environment in Iraq.

1. BRITISH MANDATE ARCHITECT JAMES M WILSON

James Mollison Wilson (Table 1, Figure 1) – a Scottish architect, was born in Dundee, costal town in 1887, his literature name is JM. Wilson. Moreover, he finished his high school in Dundee, later hated his work as a Lawyer for six months and left the work office. Fortunately, as he was a young boy he joined William Alexander's 'City Architect of Dundee' architecture office. He worked with the mentioned office for seven years, that was 1910 when he became an assistant for a firm (Gibson, Skipwith & Gordon firm) in London. Yet, at his arrival time, that firm worked inside London. His new place of living allowed him to join the Royal Academy Schools, after three years he attended the office of Edwin Lutyens, that was where he found works of planning New Delhi, this was his first chance to get know the East. The works in Edwin Lutyens' office was a tipping point in JM Wislon's career, thereby, he accepted to move to India, and in 1916 he moved with British

multidisciplinary officers, and Indian military militia to Mesopotamia (Hakiminejad, 2021).

Table 1. JM Wilson Biography

Name	James Mollison Wilson
Designation	Architect
Born	28 March 1887
Died	26 June 1965

Figure 1. James Mollison Wilson (Hakiminejad, 2021)

1.1. Wilson's Works in Mesopotamia

British troops (British multidisciplinary officers, including engineers, and Indian military militia) from its colony in India arrived in Fao, a Peninsula of Ottoman Basra province in Nov 1914. Furthermore, the arrival date could be considered as the first step of inviting the kingdom of Iraq. However, British Empire agreed to make a state from the rests of Ottoman Empire in Apr. 1920. Despite the League of Nations' mandate doubts at the San Remo Conference, British Empire got the approval to make an independent state (modern national state) from three Ottoman Empire provinces, Baghdad, Basra, and Mosul. The Empire declared its new mission in Mesopotamia with the League's Permanent Mandates Commission monitor (Toby Dodge, 2006).

The position "Architecture of the Government" was very important in the Kingdom of Iraq, that made by British Empire in the first part of

‘1920’s. However, Architecture of the Government was responsible of designing and overseeing the construction of all buildings, public and private. Then, government made an agent that called “, the Public Work Department” (PWD), PWD was a larger entity that replaced the Architecture of the Government. The new PWD had a staff of British architects, and the most important architect was JM Wilson. Yet, another member of the new PWD was Maison H.S (Shatha Abbass, 2018). Mason H.S later became partner with JM Wilson after the end of the mandate, and together they established the private “Wislon and Mason” office for architectural services in Iraq (Figure 2).

Figure 2. Iraq PWD photograph: J. M. Wilson is sixth from the left, first row seated, and H. Mason is seventh from the left, first row seated (Jackson, 2016)

JM Wilsom moved with his last work’s office to India, Edwin Lutyens’ office, in India he worked on New Delhi planning as an assistant as before. During the First World War JM Wilson was in India, worked as a part of an official mission, then he moved to Mesopotamia, and his promotion came due to the little numbers of British officers in Mesopotamia, also, he had good experience with overseeing construction. He started building the mission’s buildings, including his department, then he assessed the existed infrastructure by visiting buildings, and roads, he also contributed with the archaeological works of Gertrude Bill (Iain Jackson, 2016).

In Mesopotamia JM Wilson nominated as the head of PWD and its main architect too, thereby, he was responsible of designing and constructing all the infrastructure buildings such as town plans, government buildings, hospitals, schools, universities, and even museums. In spite, his first town plan as a chief architect was in Mesopotamia. As British Empire delegation, and the head of PWD JM Wilson met Gertrude bill several times, the latter was famous archaeologist, writer, and traveler, then she became the Oriental Secretory to the high commissioner in Baghdad, that allowed her to do many archaeological digs. Due to lack of fund in Mesopotamia in 1926 JM Wilson resigned, and moved to London, he stated his private office in London. Only one years later, the oil discovery in Kirkuk in 1927, continues oil revenues enticed JM Wilson, so, he came back to Iraq again. His return later allowed him to work in Persia too (Ahmadreza Hakiminejad, 2021)

Figure 3. Map of Iraq (showing Saraies designed by Wilson) (The black circles are the Saries) (Jackson, 2016)

PWD as an important agent (organization) of the British Empire, established in 1855, PWD's main work was to build the main government shelters, buildings that are essential for official work such

as: law and order (Saraies and Prisons), medical treatment (hospitals), communication (post office). In Mesopotamia PWD took the responsibility of civil infrastructure too, such as transportation, education, water supply, electric lighting system, etc. PWD executed all the mentiond building in the Mesopotamia (three Ottoman provinces and its districts too). Civil buildings' fund were from related civil directories (Iain Jackson, 2016).

PWD effectively completed the government plans, of making the required infrastructure of the kingdom of Iraq, and the most important element was Saraies (could be translated as 'Palace' from the Turkish Seraglio), whether rehabilitating old ones or making new Saraies. Also, established multiple civil buildings such as prisons, hospitals, schools, post offices. All the buildings were prepared to meet with the needs of each districts' administrative works, including the size of each Saray. Moreover, the Saraies meant the existence of the government, and had rooms for to contains horses and cars such as courts, police offieces, PWD rooms, justice rooms, and other rooms for required works of taxes, giving salaries, officers' rest room, etc, all in one building. PWD carefully designed and executed Saraies, in a way to fit each district's needs. However, there were Saraies in major city centers, from Ottoman era, but British Empire established more Saries in necessary locations in the first part of '1920's, for protecting the routes between cities (Iain Jackson, 2016) (Figure 4).

Wilson designed all kind of buildings, he was the architect of British Empire in Iraq, so, from 1920 to 1930 all official building designed by Wilson. Wilson and Mason (Wilson's assistant) set up business together in 1935, dominating building design in the region for two decades. (Iain Jackson, 2016). British official and private engineers dominated the design and oversee official building in Iraq till the coup in 1959, the coup was a part of Arab nationalism and was against British Empire existence in Iraq, after the coup, Iraqi government did not assign

official projects to British engineering agencies, even private agencies (Hussein, 2022).

#	Photo	Place	Date	Name of the work	Building Function	Current Situation
1		Basra	1918	Map of Basra	The old neighborhoods in Basra	It was executed in Basra
2		Baghdad	1918	Map of Baghdad	The old neighborhoods in Baghdad	Partially executed
3		Basra	1921	Hospital in Basra	Hospital	Unknown
4		Duhok	1921	The main goverment building (The Saray)	Official building	A part of HI park in Duhok. Also, partially demolished
5		Duhok	1926	Kawa school	Educational	Kawa schoolin Duhok
6		Baghdad	1927	Al Il Beit University,	University	Unknown
7		Iraq	1928	Roads network	Car Roads	Unknown
8		Ramadi	1928	Saray of Ramadi	Saray	Unknown
9		Baghdad	1928	King's Palace	Palace	Unknown
10		Basra Airport	1929	Airport	Airport	Demolished
11		Baghdad	1930	International station	Station	Unknown
12		Baghdad	1930	The house of prime minister	House	Excuted

Figure 4. Some of Wilson's wordk in Iraq (Original, 2023) (Some figures are adapted from Jackson, 2016)

As a researcher I sent some emails to official and private organizations, including Wilson's own office in UK, to obtain Wilson's archive, organizations who have information about Wilson's biography and archive of his works, such as RIBA, Scottish architects' website…etc. Unfortunately, due to some restriction and policies there was no proper results. However, Iain Jackson paper – English researcher from University of Liverpool- had the access to Wilson's archive, Jackson's paper -The architecture of the British Mandate in Iraq: nation

building and state creation, contains decent amount information about Wilson and his major works.

1.2. Wilson's Works in Persia

After only one year, JM Wilson came to the Iraq colony of British Empire, but this time with Persia too. It was Arnold Wilson -the former civil commissioner in Baghdad during Wilson's service- who asked JM Wilson for Persian designs, later Arnold Wilson became the head of of the APOC. At that time, there was regimen change in Persia, and Raza Khan took the throne, started to empower himself in Persia. In 1927, as first design of JM Wilson in Persia, he designed the general hospital in Abadan. In the next three years he received many projects too, including 'Memorial to the Fallen' of the first world war at the fields, it was the commission from APOC, also, some other projects as three houses for senior staff of the Abdan refinery, Technical press called it "example of stringent restrictions imposed by local materials… paying respect to traditions of Persian architecture". It became a sort of trust between APOC and JM Wilson, so for the twenty years later JM Wilson's practice was in Persia through APOC projects, except the period of World war II, the most valuable project was the development plan of Abadan (Hakiminejad, 2021).

Arnold Wilson gave JM Wilson in 1927 his first commission in Persia by APOC to design a general hospital in Abadan, Arnold Wilson later became the head of APOC. Not surprisingly, the strong relation between JM Wilson and APOC took another direction, when JM Wilson nominated as the APOC architect in 1944. JM Wilson design many other projects for APOC such as Masjid-i- Sulaiman, Agha Sair, Gach Saran, Kermashah and Bandar Mashin in Iran (Reem IR Alissa, 2012).

Despite the nationalization of the oil industry in 1957 the relations of Wilson Mason and Partners with Iran stayed strong. JM Wilson's son had good friendship with an Iranian associate Aziz Farman, opened an office in Tehran. In 1958 there was a new name for JM Wilson's

architectural practice, that was Wilmafar that practiced till 1973 (Barry Joyce, 2022).

#	Picture	Place	Date	Name of the work	Building Function	Current Situation
1		Abadan	1937	plan for Bawarda, Abadan	City planning	Unknown
		Tehran	1938	AIOC Headquarters Offices	Administration building	Unknown
		Abadan	1938	The Technical college	College	Unknown
		Abadan	1939	Taj theater	Theatre	Unknown
2		Abadan	1940	House	Housing	Unknown

Figure 5. Wilson's three buildings in Iran (Hakiminejad, 2021)

2. THE FIRST PERIOD FROM 1910 TO 1932

Modern architecture in Ottoman's Basra province (5 years later Kingdom of Iraq) started with entering British Empire troops to Basra in 1914, architecture projects were a significant part to legitimate occupying and later the mandate period, the building used for administration purposes, they gave power and identity to British Empire and later Iraq state.

There was a German aim to control Mesopotamia, for this purpose Germany prepared a railroad, which called Berlin-Baghdad, that can connect Berlin to Baghdad. Contrary, British Empire used military power to control Mesopotamia, and Ottoman left Mesopotamia in 1917 due to a ceasefire with British Empire. The latter set a border for the three Ottoman provinces, Mosul, Baghdad, and Basra under the name of "Kingdom of Iraq" as a British protectorate under a League of Nations Mandate in 1921. The Empire brought an Arab family from Hijaz and

made a monarchy, the Hashemite dynasty for the new Kingdom, and set Faisal as the king (Lydia Harrington, 2014, p31). British Architects James H. Wilson and Harold Mason, brought from India to Mesopotamia, Wilson was the manager of Public Works Department (PWD), with mas contributing to connect Mesopotamia with the British Empire through colonizing the region, JM Wilson had education and practice in British Empire, and JM Wilson was the main character, in terms of designing government buildings until 1935.

In 1918 British Empire with a new map for Basra, attempted to create a British environment, by changing names of the places into English names, such as streets, crossroads, etc. The Empire used its famous names such as Piccadilly Circus, Old Kent Road, Oxford Street and Jaipur Road, though that means losing the old names of local residents, including its history (Iain Jackson, 2016). Law, orders, security, also, it can be understanding the military purposes restricted the city planning. The plan was grid streets around Basra ports, contained municipal center, kept the dwelling as they were separated. The most noticeable point was making easy access to the ports, also, rehabilitated the dock building and its wharves: 'The prospect of bridges over the river, the termination of the Great Road in some imposing pile of masonry, the picturesque creeks ornamentally treated, the surrounding magnificence in artistic structures, should make an imposing climax' (Iain Jackson, 2016). Besides, of its military purposes, the new Basra plan was a major step towards modern Architecture, it surly benefited Basra inhabitants and made a new era of European character, despite, British Empire's lack knowledge of the history, culture, weather, and the character of Basra, It looked like an Indian province in terms of organizing and administration, British Empire used Indians as backup soldiers then labors in executing Basra plan, it's worth to mention that British Empire did not have enough men power to first control and then establish buildings in Basra.

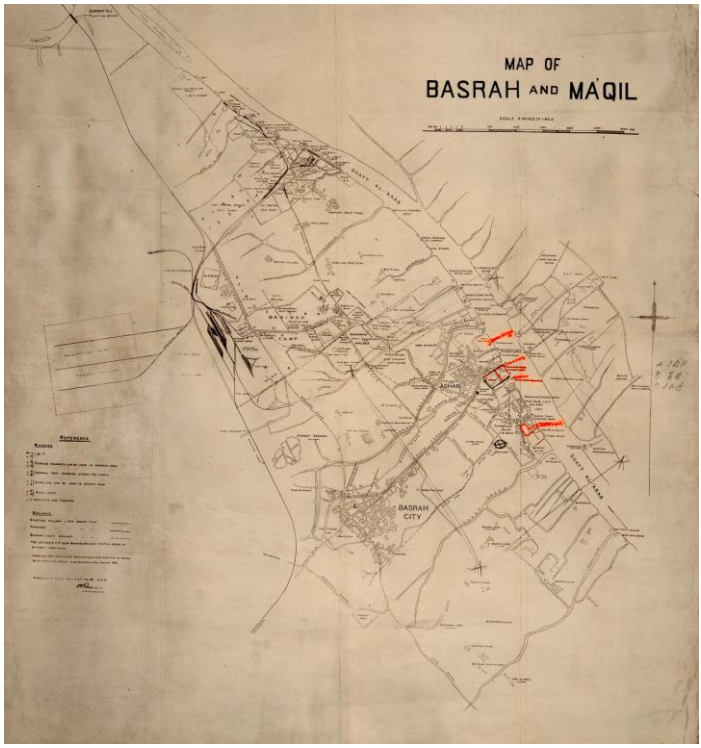

Figure 6. Map of Basra development from 1918 (The National Archives, MPK 1/449)

As in Basra, British Empire designed a plan for Baghdad in 1918, adding new sectors, grid pattern, mostly settlements (dwellings, schools, churches…et.) with the existed parts of the city, in addition, series of administrative buildings on the west bank of Tigris. British Empire built many buildings through PWD (public works department) included schools, hospitals, water-supply system in Baghdad…etc. Before the planning, streets were narrow to protect from harsh weather like direct sunlight, heat and sandstorms. Planners tried to convert Baghdad to a modern European city. Rich families could buy European style houses in new neighborhoods and separate from poor families for the first time. The new houses were classical with Mesopotamian history features for

decoration, used by both Imperial architects and later Iraqi architects in 1960s (Ahmed Hussein, 2022).

British Empire moved forward by PWD, it wanted to show that it created a country with its own identity, as PWD constructed a museum in Baghdad. The new museum contained some of ancient Mesoptamian archaeological artefacts, which Gertrude Bell excavated. The British Empire wanted to show that the Empire is doing good works and the museum is for showing the history of Mesopotamia (Iain Jackson, 2016).

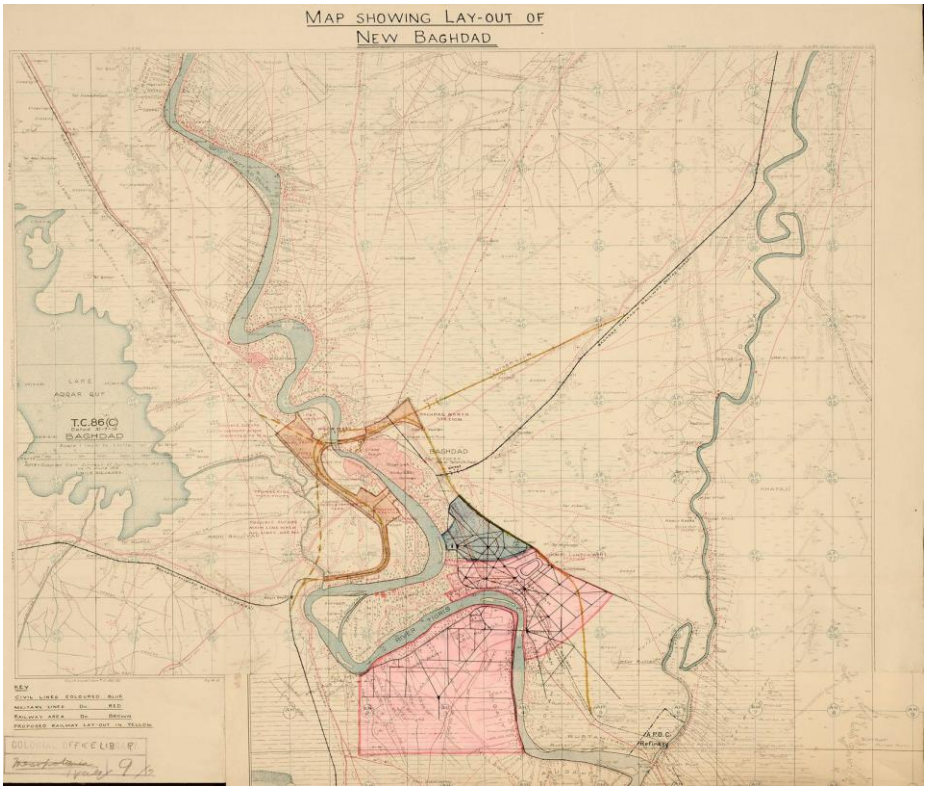

Figure 7. Map of New Baghdad showing Civil, Military and Railway proposals (The National Archives, CO1047/466).

As PWD head and main architect JM Wilson designed Al LBeit College, which was a campus. The scheme was linear of two parallel lines around a garden. It seems that JM Wilson wanted to make the scheme light by putting building blocks around a big garden, also, to

show that the British Empire has good intentions. Moreover, the college syllabus would be as the British model of education to thrive leadership and administrative characters (Iain Jackson, 2016). However, JM Wilson attempted to use Mesopotamian materials and local architectural features, also, to build an identity for the nation.

The new projects, modernization of Mesopotamian architecture can be understanding as an imperial tool in many points, the first one is that British Empire wanted to be the only imperial force to ensure the sustainable interests, as trade routes with Ottomans, oil, etc. And the second point is it wanted to legitimate the occupation with a set of new building, as hospitals, schools, etc. The third point is it wanted to express the it is a liberation force, and the fourth point is that it wanted to express that they are building a state "Iraq".

As it tried to secure the multiple trade routes to its colonies especially India, also, the trade with Ottoman Empire, oil flow –Navy's oil supply-, strategic location –. British Empire took the provinces despite Imperial ambitions of both France and Germany, also as an Indian frontier, etc. In 1921 British Empire putted by power three Ottoman provinces, that had a mix of cultures, nations and languages: Mosul, Baghdad, and Basra together. Yet, under a new state, that called "Kingdom of Iraq" under a monarchy with ministers protected by British military. Mesopotamian inhabitants were forced to accept the new government, British military suppressed opposition tribes and clan rebels. However, the Empire used air force to bombard the cities of rebels against the new kingdom, such as Sulaimnayah, which locates north Iraq (Hussein, 2022).

Figure 8. Al Il Beit University, masterplan (The National Archives, MPG 1/1207

Figure 9. Al Il Beit Theological College Building, 1927 (Architect & Building News, June, 1927)

2.1. Saraies

Saray means "Palace" it is from a Turkish word "Seraglio", Saraies in Iraq Kingdom were the same as the ones in India, had different plans due function and the place, generally had courtyard and were protected by firepower, however, they were a powerful British tool used as administrative buildings in big cities and districts, with many rooms of Police, Court, clerk, Tax office, small orison, PWD office, destination for officers, stores…etc. They were established on the major transport routes, as in Baghdad, Ninewa, Basra, Sulaimanya, etc (Hussein, 2022) (Figure 10).

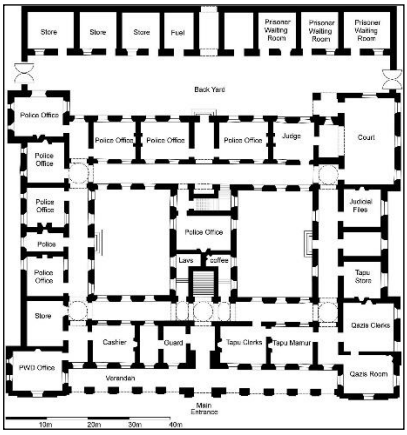

Figure 10. Sulaymaniah Serai plan; redrawn by the Author from Iraq Administrative Report of the Public Works Department, 1928

Saraies –outside cities- secured the desert access between cities and oil flow pipeline, whereas Sarais –inside cities- were for law and order purposes (Iain Jackson, 2016). British used air force to protect Saraies in urgent situations. In 1927 due to a financial cut used as British political agenda Public Works Department (PWD) almost stopped, the director of PWD J. M. Wilson left Iraq, until 1927 oil discovered in Kirkuk, this required new infrastructure, as roads, pipelines, bridges, sanitation projects, accompanied train line, etc. Thus British Eighty British engineers arrived from India to complete the infrastructure. Generally, due to many aspects as: religion, social, political…etc. Local inhabitants of Mesopotamia were with Ottomans, even after they left Kirkuk in 1918 due to a ceasefire with British, through Saraies British Empire enticed former Ottoman local officers, and local inhabitants to work with the new projects especially after discovering oil in Kirkuk, also British was trying to empower the monarchy family.

2.2. King's Places

With big oil revenues, and Monarch sided British, British moved further in expressing the support and legitimate the monarch, in spite that the monarch were not from Mesopotamia.

The building was in Baghdad, on sides Tigres (Figure 11), JM Wilson - the designer-used Mesopotamian historic features, symmetry, and big gate in the main elevation, but used British royal style inside the building. He used local materials as bricks. The costs of these projects fully paid by Iraq Kingdom government, directly or indirectly, in addition of using British equipment or advisors. This was true for Basra port, Baghdad railway, etc.

Figure 11. Perspective drawing of Proposed Palace for King Feisal by J. M. Wilson (courtesy of Wilson Mason LLP)

3. THE SECOND PERIOD TO 1960

JM Wilson started an architectural office with his assistant Mason in 1935, by using his relation with both British and Iraqi governments, JM Wilson received the designs for next twenty years (Iain Jackson, 2016). Despite, having trained Iraqi architects in Iraq, who studied abroad, had western education, all projects assigned foreign (Imperial) architects. They designed airports for Baghdad and Basra, British claimed that the two airports are for connecting Iraq kingdom with Asia and Europa, transferring goods, mails, passengers…etc. contributing to the notion "state" for the Iraq's kingdom. The two airports built with "prestige" that enticed western oil companies to Iraq. However, Basra airport function changed to military purposes by The British Empire during the world war II, at war time Iraq was completely under British

control, monarchy and the government of Iraq kingdom had no authorities (Hussein, 2022).

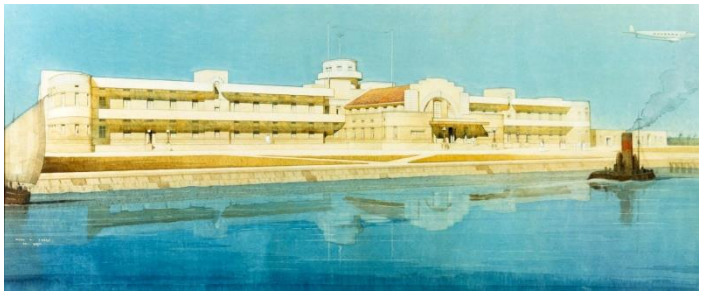

Figure 12. Perspective of Basra Airport (courtesy of Wilson Mason LLP)

1948 through a convection, British had the right to do the works in Iraq for another twenty-five years. Thereby, based on the rapid population growing, and migrating from rural areas to cities, The British re-planned of Mosul, Baghdad and Basra – the coup in 1958 cancelled the plans, due to its anti-imperialism principles. Moreover, the new republic of Iraq did not accept the existence of the British in Iraq anymore (Iain Jackson, 2016). Till 1940s the residential buildings were and stayed intentionally eclectic, in terms of aesthetics of the residential buildings, this was the result of using local materials and local construction methods, in addition to the residential plans still had a center inner space. The eclecticism became modern for residential buildings due to use concrete instead of local bricks, for both of the structure and ornamental motifs (Caecilia Pieri, 2014). The skyline of the main city and capital of Iraq, which is Baghdad changed in the 40s, due to construct the first multi-story building, that was abnormal with Baghdad's horizontal character since its establishment in 762-766 AD. Buildings in Baghdad did not exceed the height of one floor or two except minarates and domes of the mosques. A good example of first multi-story building in Baghdad is Suffair building, which designed in 1946 by Iraqi architect Midhat Ali Madhloum and it was four stories (Ghada Al Slik and Dr. Fawzia Hussein, 2019).

The effects of Modernization started to appear in the society, there was a new style of poem that called “free-verse” poetry, instead of the traditional Arabic poetry, which was prevailed for centuries. Also, the effects appeared on music, writings, cinema, and Television. Moreover, western education took place instead of traditional education in mosques, there were first generation of college graduate students, who studied inside Iraq. Yet, new art movement such as: abstract, cubism, expressionist styles appeared in art exhibitions, for the first time there were Art societies were and art galleries. The modern movement in Iraq were related to western mode (Ghada Al-Slik and Inaam Al-Bazzaz, 2011).

3.1. Famous International Architects and Doxiadis’s Plan of Baghdad

The beginnings of 1950, a few Iraqi architects, who studied abroad, mostly British education in the UK, as Muhmmed Makiya, Rifat Chadirji, and Nizer Ali Jawdat, were employees with Iraq Kingdom agents, as Iraq Development Board (IBD), these Iraqi architects uses their positions to give the projects “the best” world architects instead of British Imperial architects. In 1950 the population of Baghdad was about a million, that needed a new city plan, firstly the plan assigned to British firm, then Iraqi young architects insisted to invite famous architects to plan the city.

Among the individuals and firms who were invited to work in Baghdad in the 1950s were: Greek architect and town planner Constantinos Doxiadis, who did the Plan for Baghdad; American architect Frank Lloyd Wright, who did the Plan for Greater Baghdad and Opera House; Spanish architect Jose Lúis Sert, who did the US embassy; German architect and educator Walter Gropius and Boston-based (Figure 13). The Architectural Collaborative (TAC), who did Baghdad University; Italian architect and designer Gio Ponti, who did the Development Board Offices; Finish architect Alvar Aalto, who did the

Baghdad Art Museum; and French-Swiss architect Le Corbusier, who did the gymnasium and stadium. After the 1958 coup, such projects were generally discontinued; the only ones that were realized were Gropius's University and Le Corbusier's gymnasium (Lydia Harrington, 2014, p38,39).

Although Famous architects were not aware of the specialty of Mesopotamia, they tried to use some historical architectural features from Abbasi and Sassanian eras, for example Louvers, which used to protect from direct sunlight and sunhat, Walter Groupios used this architectural feature in designing the university of Baghdad (Figure 14 and 15). Also in the elevations of the embassy of the United States in Baghdad by Sert. Iraqi architects used the same edits in their modern designs as Qahtan Awni in designing the campus of Mustanseria. Personally, I appreciate Ghada Al-Silks' articles on this topic, but I don't agree with her that "Modernization is a byproduct of Baghdad sons and daughters", we must mention the British role, and famous international architects too, in addition, that the father of modernization of Iraq Muhammed Makiya studied abroad, in the UK, Liverpool university (Hussein, 2022).

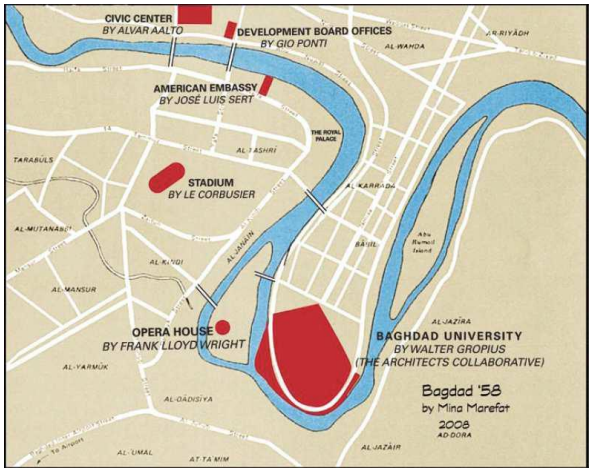

Figure 13. Projects of 1958, including Walter Gropius and TAC's Baghdad University. (Image: Mina Marefat, From Bauhaus to Baghdad: the Politics of Building the Total University.)

Figure 14. University of Baghdad (Image: Al Sultani, 2014)

Figure 15.1 Mustansiryia University B. Ministry of Industry and Minerals (Image: Al Sultani, 2014)

Doxiadis studied in Greece and Germany, worked in Greece, Syria, and Jordan, the International Bank for Reconstruction and Development recommended him to IBD to set a new plan for Baghdad, IDB choose him because of he was free from "Imperial stigma". Among all famous architects projects, Doxiadis's plan is the biggest, had the potential to change the course of Baghdad's life, modernize the society, thus, it needs to be discussed. Doxiadis's plan had two major goal: the first one is building a nation, and the second one is showing that Baghdad is an important modern city. He developed *Ekistics* style, which tends to be subjective and free from political bias.

A rectangle shape oriented plan, which is along the main northwest-southeast axis of Tigris. In spite, that Doxiadis was one of the pioneers of modernity, but he did not understand the climate, culture, and history of Baghdad. He designed a rectilinear pattern, which was the core (a commercial center), and all other parts (19 residential sectors, that has smaller neighborhoods subdivided inside) were connected to it. The new roads were very modern and better than old ones, new roads would provide easier access. The plan was divided by function, so the industrial districts were pushed to the edge of the plan. Doxidis divide residential sectors by class, not ethnic or confessional identity as before, the aim was to modernizing and homogenize the society, and keep the economic divisions (Harrington, 2014).

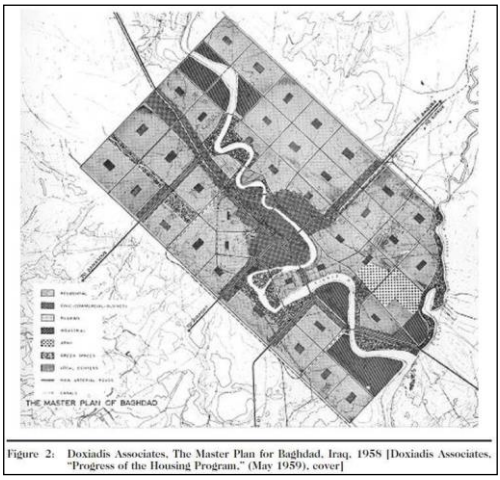

Figure 16. Doxiadis Associates' Master Plan for Baghdad, 1958. (Image: Panayiota Pyla, back to the Future: Doxiadis' Plans for Baghdad.)

Such high modernity plan came from lack of knowledge about Iraq's history and the culture, the architect did not recognize the Iraq's identity, that lead to conflict between the society and the architect, also between the government and the architect. The plan is as any modern plan of any modern architect for any modern city! Ignored tribal, religion, ethnic, and the specific demographic dynamic of Baghdad, ignored the big migrants from rural areas to Baghdad, who searched for

better life condition. Houses in Baghdad has many architectural features to protect for direct sunlight, heat, provide a private space, and cooling the mono-environment through Shanashil –from wood- and courtyards. Doxiadis removed or altered such architectural features, he pushed the courtyard to the back, outside the house, also removed Shanashil and replaced it with steel-glass window. This was a sign that he did not understand the culture and local architectural of Iraq. A part of the plan executed in the west side of Baghdad, besides, as the result of the conflict between the architect and the government, the government cancelled the plan after the coup in 1959, because the plan had the potential to change –destroy- Baghdad (Hussein, 2022). (Figure 17).

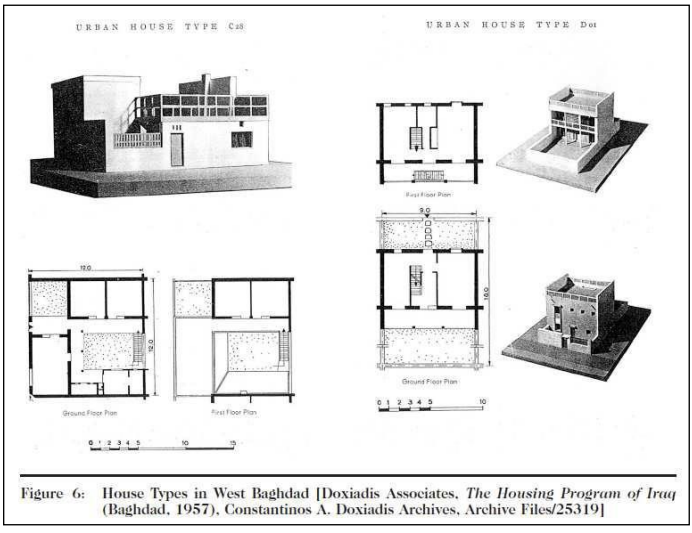

Figure 17.2 House Types in West Baghdad, DA, 1957

3.1.1. Former American Embassy in Baghdad in 1957

This is also a very good example to understand the modernization in Iraq, especially its strong relations with political situations. Generally, by discussing this building, it will be very easy to know why modernization failed in Iraq? The building was USA embassy, it's worth mentioning, that after the coup 1959 the relation between Iraq and USA

were very bad, USA invaded Iraq in 2003, put blockade on Iraq from 1990 to 2000, destroyed the infrastructure of Iraq in 1991 by air force. The compound is designed in Baghdad by a Spanish architect in exile and dean of Harvard University (an institution which, like the Ford Foundation, who had strong relations with American government. The architect was Josep Lluís Sert (Pedro Azara, 2011). The architect has close relations with USA government, so he was chosen to design a new building for the American embassy in the Kingdom of Iraq. The building locates on the right side of Tigris river, which had more space and less populated, it consisted of administrative building, ambassador's house, staff and guests' accommodation, gardens, and pool with side water canals.

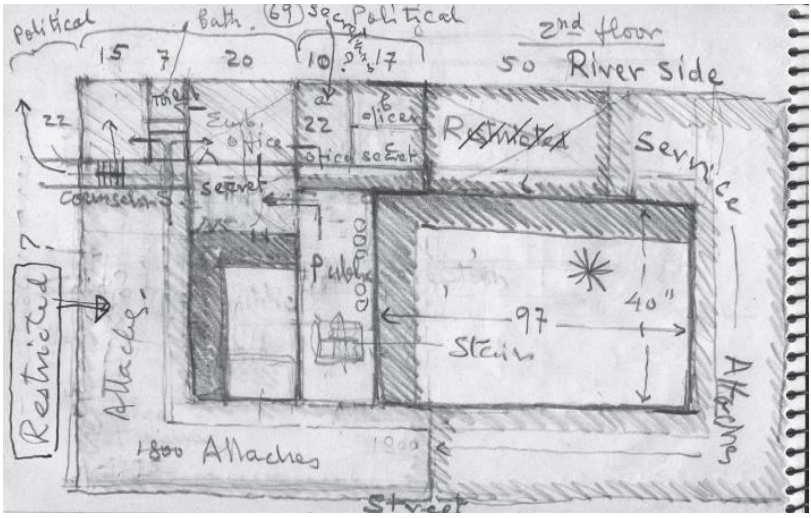

Figure 18. Notebook sketch by Josep Lluís Sert.

The architect design the elevation to protect from heat by using Layers of latticework screening, also, air spaces under the roof for ventilation (Figure 19 and 20).

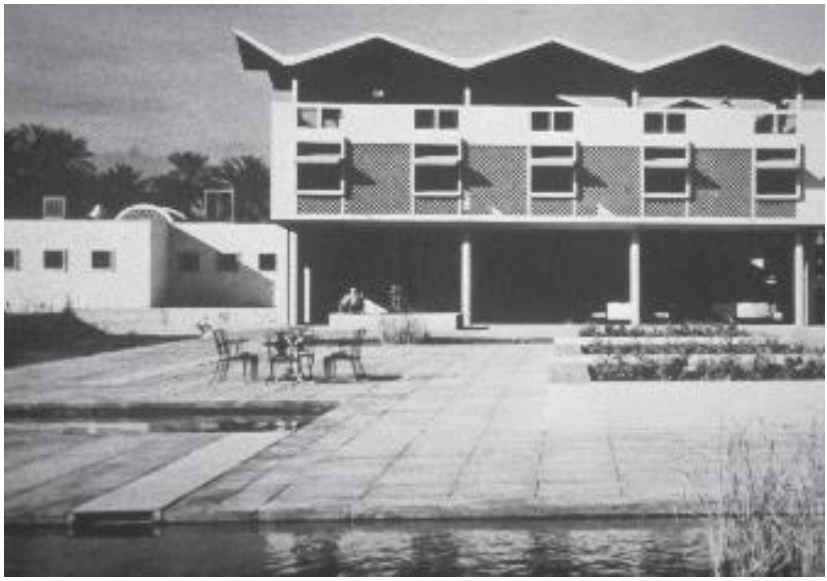

Figure 19.3 Ambassador's Residence. Sert Archive at Harvard University, Cambridge.

Figure 20. Chancery building (Photo by Ghada Siliq, 2011)

The plan was not appropriate as an embassy, and the building was not suit for a harsh and hostile environment as Iraq's environment. The building used as an embassy till 1967, the embassy moved to another building in Baghdad. The architect did not live in Iraq before the design,

he was not aware of the whole context: culture, history, weather…etc. The building is in green zone – government zone-, it's abandoned. It used as foreign ministry affairs 1973-1983. There are proposals to demolish the building (Figure 21) (Hussein, 2022).

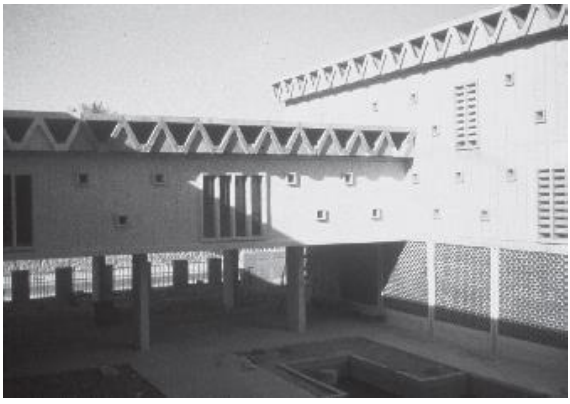

Figure 21. Chancery building. Sert Archive at Harvard University, Cambridge.

4. IRAQI LOCAL ARCHITECTS-FIRST GENERATION OF IRAQ ARCHITECTS AFTER THE MANDATE

4.1. Muhammed Makiya (1917-2015)

An Iraqi architect, studied abroad, Liverpool university, considered as the father of modern architecture in Iraq, received in 1980 Agha Khan award of lifetime. Saddam regime prisoned Makiya in 1978 in Abo-Ghraib prison for 20 months, of his political connection

1950-1960 there was a clear disconnection from the previous production, which entailed not only the adoption of modern architectural components, but also a whole change of the types and of the architectural scale of the buildings, as well as a change in the choice of the building materials. (Hamed Hyab Samir, 2017, p94). It's mentioned in previous pages that foreign architects as Doxiadis, Luis Sert…etc. Did not understand Iraq's weather, history, and culture, but local architects, who had chance to get familiar with designs of famous architects, their local designs were fit with the culture, respected weather, as they used local materials like bricks, they did not remove courtyards, presented a new

version of Shanashil, the result was a modern architecture with Iraq specific character, used local and historical elements as from Mesopotamian different peroids, Abbasid, and Sassanid periods (Hussein, 2022).

One of his important projects in Baghdad, that when the government gave him the commission to design the Monument for the Unknown Soldier in 1960. the Sassanid Palace of Ctesiphon (near Baghdad) built in 531 AD inspired him for the structure. He wanted it to be simple, as he stated that "he wants people understand his field and what he does" (Harrington, 2014).

Figure 22. The Unknown Soldier in Baghdad, Lydia Harrington

4.2. Qahtan Awni (1926-1976)

Iraq architect, studied in USA, university of California, Berkeley. Had his office in Iraq after graduation, worked also for Municipality of Baghdad (Ammanat-Al-Asima).

In expressing transformation by Iraqi architects, Al-Mustansiriyah University came with elements of Mesopotamian history as louvers (sun protection), elevation with local materials, textured surfaces, porous volumes broken down into planes and fragmented elements, and a spatial configuration where one is engulfed by the architecture, which can be read as vital characteristics. Considering, that the building is a modern object (Amin Alsaden, 2022). The design of the campus completed in 1963, establishment started in 1966, the plan was up to four-story levels,

it included some structural parts such as curved auditorium roof, and cylinder o'clock tower.

Awni's designs are considered modern buildings with abstract of local ornamentation and complicated brickwork as in fameous Al-Madrasah Al- Mustansiriyah's elevations. Regarding, that ancient Mesopotamian buildings were toward the internal space, with repetitive elements, but modern buildings are freestanding objects. Awni's modern designs with invented ideas, and plans have internal space too (Figure 23 and 24) (Amin Alsaden, 2022, p205).

Figure 23. An old photograph of the Auditorium building, Amin Alsaden

Figure 24. One of the large patios created by the U-shaped Sciences and Humanities buildings

6. CONCLUSION

It's our responsibility to authentically explain the scientific facts without certain biases. Thus, firstly modernity in Iraq started with British occupation in Basra 1914, British control over Iraq was truly till the coup in 1959.Moreover, at this period every aspect of life including architecture were under British's management, British used Iraq land and assets to widen the colonization, it made Iraq as a part of British empire

Modern architecture style was a movement from the past styles, that are not acceptable anymore. Yet, it's migrating from expensive decoration, to straight walls, pure surfaces, freedom of movement, open spaces. Furthermore, it's freedom from past classical conventions, it was expression of new world power which was USA.

British Empire set a new border for three Ottoman provinces, and set a new dynasty family, originally from Saudi Arabia (Najid), as the leaders of the new Kingdom of Iraq. The purpose of such works were later be understood as: secure the oil flow to the British Empire, Protect the trade routes with Ottoman Empire, and protect the routes to its colony in India. However, JM Wislon left Iraq in 1925 due to shortage of budget for the infrastructure, but discovering the oil in Kirkuk in 1927 was a tipping point for the Empire to complete the infrastructure projects in Mesopotamia, such as saraies, which gave the Empire ability to protect the local oil routes effectively, thus, JM Wilson returned again to Iraq in 1927. However, British Empire used military power, including Royal air force to bombard the revolutions against it existence and/or against the new dynasty family in Mesopotamia "Kingdom of Iraq".

British Empire wanted to colonize Iraq based on its colonization in India. Thus, the troops used to control Mesopotamia were mainly Indians, who entered Basra in 1914. Also, brought a British architect to Iraq, who worked in India, in addition, to the skilled workers were Indias too. However, James Mollison Wilson, was the Mandate's architect,he was the manager of the Empire's agent Public Work department "PWD", he designed all infrastructure projects in the new Kingdom of Iraq till

1932. Then, at the end of the official mandate, JM Wilson designed official buildings based on his relationships with the Empire and Kingdom of Iraq government delegations. Furthermore, he made use of these relationships till 1959, regarding he established a private office after the end of the mandate in 1932, the office was for engineering services, he was with one of his government architects, who called Harold Mason.

Early 1960s Iraq had many local young architects, some of them were against British imperial, tried to build a national identity for Iraq. Also an anti-imperial government after the coup, these local architects were aware of local attributes of Iraqi society. Thus, the modern designs of local architects were an extension of the Mesopotamian history, and weather. However, continues big oil revenues allowed Iraq to step out of British control, and enticed many international (modernity masters) architects, who designed buildings in Baghdad. The famous international architects did not understand the uniqueness of Iraq society, thus, their designs were not effective, the most notable example is the Greek planner Doxiadis's urban plan for Baghdad.

Despite, the big oil revenues, growing oil- based revenues as time goes, the process of Modernization of architecture failed in Iraq. Due to many reasons, mainly unstable of political situation in Iraq, including many coups, oppression, and three catastrophic wars. also, modern designs did not reflect the history of Mesopotamia, and did not fit the weather criteria too. Yet, Iraqi society hated the British mandated period and its legacy including architecture, which is noted clearly after the coup in 1959.

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CHAPTER 12

INNOVATIVE APPROACHES FOR EVALUATION IN DESIGN STUDIO EDUCATION*

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* This study was produced from the doctoral thesis titled " Design of Formative Evaluation Tool For Design Studio", which was completed in 2023 at Gazi University, Institute of Science and Technology, Department of Industrial Design.

INTRODUCTION

The fact Design Studio is still the central part of design education today and the education model is based on its historical roots in models such as Ecole Des Beaux Arts (1819-1914) and Bauhaus (1919-32) (Broadfoot and Bennett, 2003; Öztoprak, 2004).

According to the definition made by ICSID in 1959, the industrial designer is equipped with knowledge and skills focusing on the functional and aesthetic features of the product and is expected to have process-oriented problem-solving abilities according to the definition renewed by WDO (2015). In the context of changes in definitions, industrial design, known as the craft, has reached the goal of learning the design process to develop innovative solutions to the problem, from the goal of giving aesthetic form to the product. In recent years, industrial design education studies have been more process-oriented than result-oriented.

In design education, which is process-oriented, students are asked to deal with a project and the problem related to this project to simulate the profession. The project given to students is aimed at students to learn by doing and experiencing. Projects are carried out, developed, and finalized with the criticism given by the instructors. Student learning is aimed at critical evaluation. When the project is completed, the student presents the project in front of the jury, which can be defined as the evaluation board, and meanwhile, the criticism, formative evaluation, and learning process continue. When the jury ends, students receive a summative evaluation with a numerical value. In this context, evaluation is a learning tool. This flow in the studio creates the nature and culture of studio education.

Although the culture of studio education and the focus of education have changed throughout the historical process, studio education can be said that the model has not changed much. With the renewed definition, it can be said that simply moving towards a process-oriented education will not be sufficient. John Kolko (2005) stated that a new approach

should be brought to Industrial Design education. With the developing information and communication technologies, the application of the design studio in virtual and augmented reality environments is discussed. It can be said that design studios have partially changed physically, socially and academically throughout the historical process, but have not changed in terms of evaluation as a part of learning. Therefore, in addition to innovative approaches in designing studio learning environments, innovative approaches are also needed in evaluation.

This study was produced from the doctoral thesis titled 'Formative Evaluation Tool Design in the Design Studio', completed in 2023 at Gazi University, Institute of Science and Technology, Department of Industrial Design. The study aims to develop an innovative assessment tool that focuses on learning in design studios. In this study, the research on evaluation in the nursery and the new evaluation tool developed are presented.

1. EVALUATION IN EDUCATION

The two main purposes of evaluation in education are to provide and document feedback and motivation to students about their performance (Brown, 1999). Assessment not only measures what the student has learned, it shapes the student's approach to learning. Therefore, assessment is a part of the learning activity (James et al., 2002; Ramsden, 2003; Ferrari et al., 2009).

Evaluation in education can be classified as formative and summative. Brown and Kniglxt (2012) find formative evaluation in education more important and valuable than summative evaluation. Summative evaluation, which has a measurement feature, is defined as a course grade that cannot show exactly what the student has succeeded or failed in (Earl, 2012). Formative evaluation, on the other hand, is an evaluation that contributes to the learning process and provides feedback to the student regarding his/her proficiency (Earl, 2012). Straková (2016) tries to reveal the importance of feedback in learning by saying that the

higher education instructor should be aware that evaluation should be more than the grade at the end of the course.

Assessment from the student's perspective is supposed to give the student an idea of what is important. For student learning to be effective, students must be able to direct and manage themselves (Nicol and MacFarlane-Dick, 2006). It can be said that there is a search for more transparent, clear, and effective evaluation methods in higher education. Sadler (2010) states that the reason for switching to a criterion-based evaluation in higher education programs is that it is more transparent, open, clear, and effective.

Formative assessment is a central feature of the 21st-century learning environment. In this context, evaluation methods in education that are compatible with 21st-century learning approaches and provide feedback to students and instructors should be developed.

2. EVALUATION IN THE DESIGN STUDIO

The evaluation process is a crucial of design education and the during learning design stage (Demirbaş and Demirkan, 2007). One of the key features of the design studio course is that evaluation is not based on traditional exams, and the assessment of student achievement, knowledge, and skill are via the practices and the projects (Delahaye, 2005).

Projects are concluded with the evaluation of project suggestions by instructors at the jury meeting (Guerlain et al., 1999; Bender and Vredevoogd, 2006; Nakit and Çil, 2008). In design education, a common evaluation method is the design jury, which is the environment in which students' design proposals are evaluated, evaluated and judged by an external panel (Attoe and Mugerauer, 1991). While table critiques made in classes outside of the jury serve as an educational tool as they are a formative evaluation, jury critiques serve to give grades to students as they are a summative evaluation (Peterson, 1979; Chandrasekera, 2015;

Megahed, 2018). Evaluation involves summarizing the entire process and assigning a level to the student. (Musa, 2020).

2.1.The Problem of Evaluation in the Design Studio

One of the most frequently cited problems in teaching architectural design is that studio evaluation focuses on the final product rather than the process (Bashier, 2014). The core of criticism should focus on what the students have learned (Demirbaş and Demirkan, 2003). Many traditional forms of assessment, including design project measures, often test a limited range of skills, abilities, and knowledge, and products rather than processes (Brown, 1999). Students have expressed the opinion that the quality of visual presentation in juries affects the jury members greatly (Hassanpour et al., 2011). Although the importance of process in design education is mentioned in literature reviews, there are very limited studies on process evaluations.

It is stated that the traditional critique and evaluation in jury is often not support to learning by the students (Sagun et al., 2001; Cameron, 2003).

Straková (2016) reveals the importance of feedback in learning by stating that it should be more than the grade at the end of the course. Students state that they think that they did not get the grade they expected even though they fulfilled all the instructor's demands, or that they interpret the instructor's evaluation as unfair when they compare their results with the results of other students. If assessment is to be used to help internalize learning, it must be aligned with the learning objectives of the relevant unit. The individual importance given to the jury as an evaluation tool should be reduced. He also notes that he is concerned about whether the instructor is objectively measuring students' progress and achievement.

2.2.Evaluation Approaches in the Design Studio

In a study stated with students of the architecture department, Hassanpour et al. (2011) concluded that students preferred feedback and criterion-based evaluation methods.

Eshun and Osei-Poku (2013) in their study with graphic design students showed that 86% of students agreed that assessment criteria were helpful in their learning; They viewed the peer review process as a valuable learning experience.

Straková (2016) reveals the importance of feedback in learning by stating that it should be more than the grade at the end of the course.

Sabol and Zimmerman (1997) state that design studio course evaluation is more suitable for authentic evaluation type rather than standard and alternative criteria. Despite the benefits of determined criteria, non-dynamic, rigid and prescriptive criteria may prevent differences. Lindström (2006) stated that criterion-based evaluation can clarify tacit knowledge. It can be said that criteria-based evaluation can help students develop the idea that the process is as important as the product. Agreed assessment criteria or objectives can help to overcome arbitrariness, inconsistency or subjectivity in the assessment process, while they can determine the process or conditions of students' learning (Lindström, 2006). However, in criterion-based evaluation, the criteria and their grading should be the product of a common understanding among instructors.

3. METHODOLOGY

Considering needing the learning outcomes evaluation, evaluation methods should be compatible with these outcomes in design education (Brown, 1999). Although various studies have been conducted on criteria based evaluation, there is no study yet that clarifies the criterias (Ehmann, 2005). Biggs (1996) states that when curriculum and assessment methods are aligned, performance outcomes are greatly enhanced.

Taking into account the deficiencies stated in the literature, it aimed to use process and outcome criteria in the evaluation tool developed with this study. In this section, it is explained how the criteria were determined. For this purpose, studies on the learning outcomes targeted in industrial design education, curriculum information published on the websites of industrial design departments, and learning outcomes used in accreditation institutions have been brought together. All conversations made by the instructors in the studio courses were recorded and transcribed, and the criticisms made during the design process were aimed at determining the goals and learning outcomes. With all these data, it is aimed to obtain the largest cluster for process and learning outcomes. Content analysis and thematic coding were used as qualitative data analysis methods for data analysis.

The evaluation criteria obtained were grouped as process and result evaluation criteria. According to Archer (1984), the design process steps are grouped as process criteria, and all data obtained regarding other learning outcomes are grouped as outcome criteria. Process criteria were placed according to the project schedule determined in the design studio. The outcome measures were classified according to 5 criteria listed under 3 main headings according to De La Harpe et al. (2009). KOLB (1984) experiential learning cycle steps were used to grade the criteria.

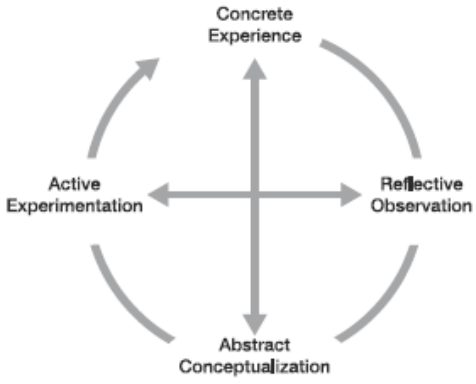

Figure 1. Kolb Experiential Learning Cycle (Kolb, 1984)

In grading both process and outcome evaluation criteria, KOLB was used for the experiential learning cycle steps (Figure 1), taking into account their compatibility with the criteria. Grading made with a scientific method aims to avoid arbitrary grading and a universal method that allows instructors to reach a common decision was preferred. In evaluating the criteria, 5 ratings were used to determine the level. A rating of 'Unacceptable' was used if the student did not work towards any subcriteria and is the lowest rating. For the other 4 degrees, the KOLB experiential learning cycle stages of Concrete Experience, Reflective Observation, Abstract Conceptualization and Active Experience were used. The Active Experience degree is the degree that the student is aimed to achieve.

4. RESULTS

The new model developed is a cyclical evaluation tool that adopts a process-oriented, formative evaluation model. The model provides learning and sustainable evaluation while providing feedback to the student in design studios. The process and result evaluation criteria and ratings obtained as a result of the research were distributed and graded according to the learning outcome groups determined by De La Harpe et al. (2009) and the developed evaluation model is presented in Table 1.

Process and result evaluation tools were specially prepared for each instructor and transferred to the digital environment with the Google Form application. Each instructor completed their evaluation by accessing the process and result cyclical evaluation tool designed for them through the access extension sent to them. The evaluation model was applied by 7 instructors in a total of four projects in the fall and spring semester of the 2020-2021 academic year at Gazi University 2nd year design studio.

With this study, which addresses the project evaluation process in studio courses in Industrial Design education, a sustainable tool has been developed to evaluate student learning. A clear and understandable tool

has been developed with a new evaluation tool consisting of evaluation criteria aligned according to learning outcomes and project process stages, along with the implicit traditional evaluation applied in studio courses. The experiential learning cycle steps used in grading the criteria measure the student's learning outcome and level of learning. Through this study, which includes the application of the criteria determined for the second-year design studio, the determination, grading and description of the criteria for varying learning outcomes in different studio degrees can be adapted according to Table 1.

Table 1. Cyclical Assessment Tool

	Criterion Main Title	Criterion	Sub-Criterion	Grading				
				No Work/Unacceptable	Concrete Experience	Reflective Observation	Abstract Conceptualization	Active Experiment
Product Evaluation Criterias	Skills	*Personal skills*	Project management					
			Communication Skill (Defense, Expression Skill)					
		Technical Skills	Visual Presentation Techniques					
			Model Making Techniques					
	Knowledge (Project Learning Outcome)	*Past project Knowledge*	Material Knowledge					
			Production Methods Knowledge					
			Mechanism Knowledge					
			Ergonomics Knowledge					
			User Product Knowledge					

	Output Dimensions	*Product*	Conceptual Design Solution (Idea)					
			Formal Design Solution (Idea)					
		Student	Professional Awareness					
Process Evaluation criteria	Output Dimensions	*Process*	Data collecting					
			Idea Development					
			Product development					

The research questions of the study are explained in the results of the data obtained and are presented below.

• Evaluation in the design studio should be planned according to learning outcomes and the design process.

• Implicit traditional evaluation can be explained by a criterion-based evaluation.

• It has been proven by the analyzed findings that a rating created with a systematic universal method for use in a criterion-based assessment tool can be made with the Kolb experiential learning cycle, which helps shape students' learning and is accepted by all disciplines. With an evaluation tool planned within a certain systematic, away from arbitrariness, implicit unexplained evaluations can be explained and shape the student's approach to learning.

• The implementation of design studios with experiential learning methods is an indication that the process is important. In the design studio, it is necessary to learn how to do rather than what to do. While talking about the importance of the design process, the findings show that the impact of the process is low on the final effects.

• A significant relationship between project process success and outcome success was obtained with the analysis results. No significant relationship was found in each of the process stages. A student who is successful in the data collection phase of the process does not necessarily result in being successful in the product development phase. However, it is seen that there is a positive relationship between the outcome measures of personal skill, technical skill, product, student and past learning knowledge, but each criterion has independent values.

• There is a difference in the learning of students whose numerical grades are close or the same. There are differences in the learning levels of the criteria.

While explaining the research questions, the information provided in the literature section was also used. Curriculum planning can be made for each student according to the data obtained with the cyclic evaluation tool. The level of learning outcomes of students may be taken into consideration in course selection. While the increasing number of students creates a disadvantage in studio courses, tool data can be used for sustainable learning and educational institution quality.

Considering the planned changes in higher education models, evaluation methods should also have universal features. When determining the evaluation criteria, arbitrary and unclear definitions were avoided. The learning outcomes used in the evaluation tool and the universal methods used in their grading and description provide sustainability and universality features to the evaluation tool.

5. DISCUSSION

More effective results can be achieved by using this developed tool in more studio classes. When measuring students' learning levels, it can be revealed which student needs to acquire the knowledge and skills they need to learn to reach the desired level (Figure 2). With this study, it can be observed which learning outcomes students focus on (Figure 3).

However, more case studies using the new tool should be conducted to obtain more valid and reliable information.

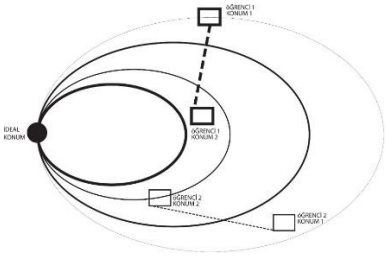

Figure 2. Student Learning Situations and Ideal Situation

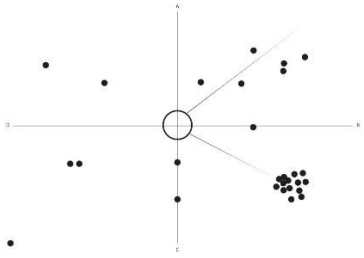

Figure 3. Student Learning Situations and Ideal Situation

With the statistical results that can be obtained by using this study for evaluation in the design studio, scientific data can be obtained for students' educational planning and for educational institutions to update their curricula and educational models. Effective data can be created to update studio training models by adding different learning outcomes with the changing definition of industrial design. For the accreditation process, which is increasingly important in higher education institutions, it is necessary to shape the student's education and the curricula organized by the institutions according to the planned, measured, and obtained results. It is thought that studies that will contribute to the education-training accreditation processes of institutions can be carried out with the developed tool.

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CHAPTER 13

BIBLIOMETRIC ANALYSIS OF SEMIOTIC STUDIES IN INTERIOR ARCHITECTURE

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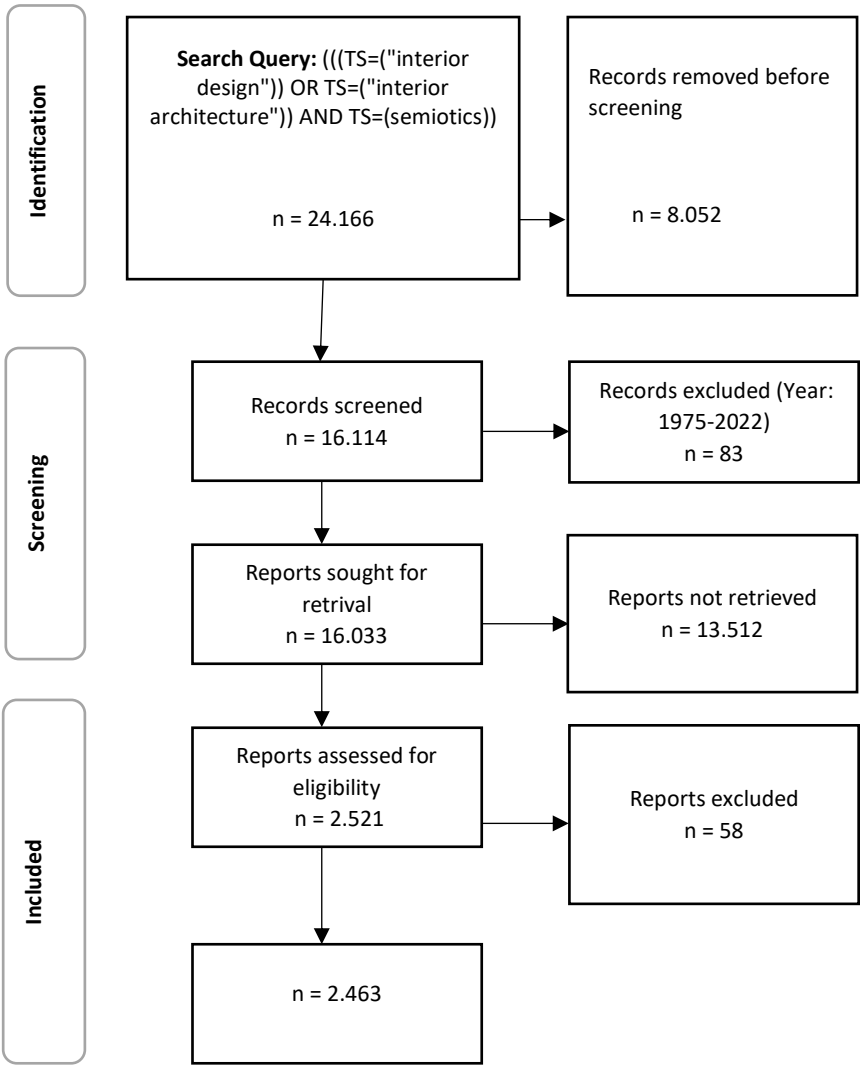
INTRODUCTION

There has been an increase in the number of scientific studies produced in recent years. Thousands of articles, papers and books on almost every known field have been published and continue to be published at an increasing pace. As these publications increase, valuable data emerges in terms of their relationships with each other. These data can reach large sizes with the participation of publications that have increased exponentially over the years (Wallin, 2005). The volume of scientific literature that is pertaining to a particular study field or subject matter is frequently burdensome (Rodrigues et al., 2014). As a result, it becomes increasingly difficult to process such big data, filter the most important tasks and evaluate their impact. Bibliometric analysis was developed as a quantitative method to process such large-scale data (Abafe et al., 2022). This form of analysis provides researchers with a systematic and transparent process. It is possible to use bibliometric approaches to evaluate the performance and research patterns of authors, journals, countries, and institutes (Waltman et al., 2012). Additionally, these methods can be utilized to discover and quantify the collaboration patterns that exist between these entities (Li & Zhao, 2015). The field of bibliometrics has the ability to shed light on the most recent developments, research orientations, and prominent themes in a certain area of research. In addition, bibliometric analysis makes it possible to identify existing gaps in a particular study field, both in terms of the content of the research and the geographical scope of the research(Wang et al., 2014). Furthermore, bibliometrics has the potential to play a significant part in the process of making decisions concerning scientific matters. The ranking of applications for academic posts, as well as the evaluation of the performance of journals, countries, and institutions, are all common applications of this process. The results of bibliometric analysis can also be taken into consideration to assist policymakers and funding organizations in the process of allocating funds for research.

The phenomena known as semiosis is what differentiates living things from inanimate items. This is something that can be simply described as the innate ability of all living creatures to make and comprehend sins. A sign is a tangible object that is created or conceived through physical means to represent an object, sensation, or other entities known as a referent. It can also represent a group of comparable or related objects, emotions, or other entities known as a referential domain(Sebeok, 2001). Many different functions are served by signs in human life. They make it possible for individuals to recognize patterns in things; they serve as predictive guidelines or strategies for doing actions; they serve as examples of particular types of phenomena; and the list could go on and on. In accordance with the ways in which its biology has been designed, every species is capable of producing and comprehending particular sorts of specific indications(Berger, 2014). In this context, "signals" might refer to anything from basic biological signals to more complex symbolic structures like words. Each species is able to (1) announce its presence, (2) transmit messages within the species, and (3) model information that is received from the outside environment through the use of signals. In the field of science known as semiotics, these functions are investigated. Interior architecture and semiotics have a close relationship in terms of conceptual expressions and semantic indicators that appear in the materials, colors, styles, construction styles and details of the space(Ashwin, 1984). It is not wrong to claim that space design is based on semantic integrity and indicators (Yanow, 2014). Therefore, it is important for the interior architecture design discipline to determine the historical situation of the studies on semiotics in interior architecture and examine them within the scope of bibliometric analysis, which is a quantitative method.

1. METHOD

In this study, bibliometric analysis was used as a quantitative method. 24,166 results obtained from the search "interior design (Topic) OR interior architecture (Topic) AND semiotics (Topic)" in the Web of Science database were evaluated in this context. 8,052 of these studies were published as papers, books, book chapters, etc. Since there were different types of publications, these were also eliminated, leaving 16,114 articles. This study started in January 2023. 83 articles published in 2023 were excluded from the scope on the grounds that they would prevent the increase over the years and affect the character of the analysis. In the selection made within the scope of Web of Science categories, only articles in the Architecture category were included, and categories such as mechanics, applied mathematics, history, archeology and zoology were excluded. The Prisma Flow Diagram of the study is shown in Figure 1.



TS: Topic Search, n: Number

Figure 1. PRISMA Flow Diagram
Source: Generated by Author

The reason for this elimination is to ensure that only publications related to the built environment and spatial design are included in the evaluation. 58 articles were excluded from the scope by examining their

abstracts on the grounds that they were produced in fields such as music, psychology and gastroenterology.

After conducting an analysis of the yearly production at both the university and country levels, word mining techniques were employed to identify patterns and trends. In the field of semiotics in interior architecture between 1975 and 2022 were examined by using Biblioshny software and VOSviewer program (Aria & Cuccurullo, 2017; Eck & Waltman, 2009).

2. RESULTS

Figure 2 illustrates the distribution of semiotic studies in interior architecture according to the years. The research reveals that the earliest investigations on semiotics in interior architecture were conducted in 1975. In light of this, the records that are contained inside the Web of Science database, which was established in 1975, continued to be popular until the middle of the 2000s, but they are exhibiting a negative tendency as we get closer to the present day.

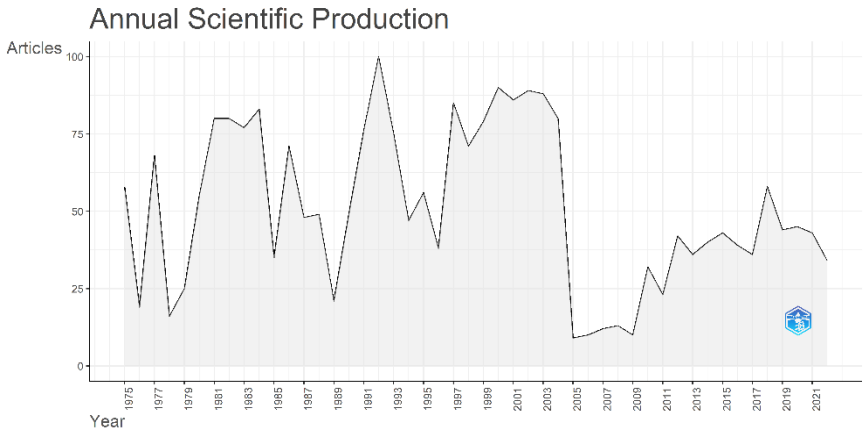


Figure 2. Distribution of publications by years
Source: Generated by Author

Figure 3 shows the 10 institutions that publish the most. Accordingly, in addition to universities in America such as the University of Minnesota and Florida State University, the University of Antwerp in Belgium attracts attention. In addition, Yıldız Technical University and Bahçeşehir University in Turkey are among the institutions with the most publications.

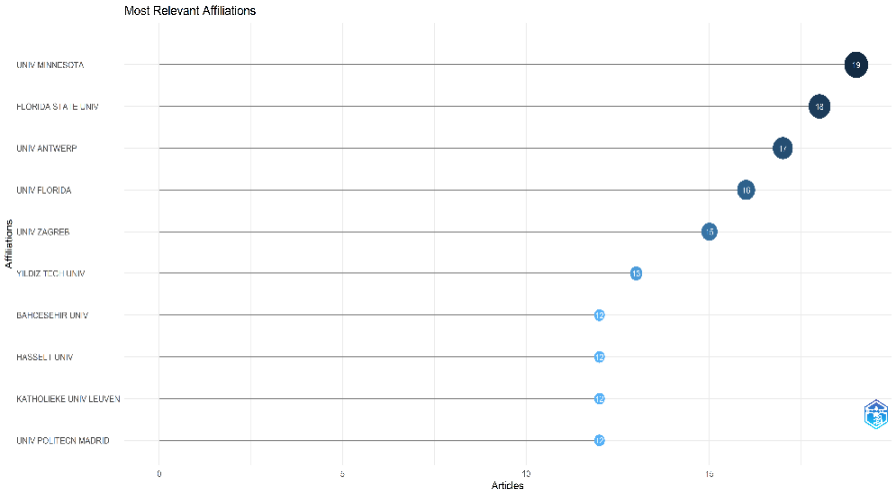


Figure 3. Universities with the most publications
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Table 1 shows the distribution of countries where the most publications were made. The largest number of publications on the subject were produced in the USA (448 publications). In Turkey, a total of 161 studies have been conducted on semiotics in interior architecture. This enabled Turkey to rank second. The third country producing over 100 studies is United Kingdom.

Table 1. Countries producing the most publications

region	Freq
USA	448
TURKEY	161
UK	129
SPAIN	89
AUSTRALIA	69
CANADA	65
BELGIUM	63
ITALY	60
NETHERLANDS	52
CROATIA	33

Source: Generated by Author

2.1. Word Mining

Within the scope of word mining, keywords determined by the authors were used. The use of at least two the same keywords in the studies shows that there is a relationship between these articles. The grouping of these words according to usage (Figure 4) and the temporal distribution of this usage are shown in Figure 5. On the other hand, the size of the circles is a representation of the frequency with which a term occurs; in other words, the larger the size, the more frequently a term occurs. The overall distance between terms is a useful indicator of how closely linked they are to one another. When the distance between two terms is shorter, the relationship between them becomes stronger. By counting the number of times that terms appear together in keywords, one can determine the degree to which they are related to one another. The colors are utilized in order to differentiate between the various groupings.

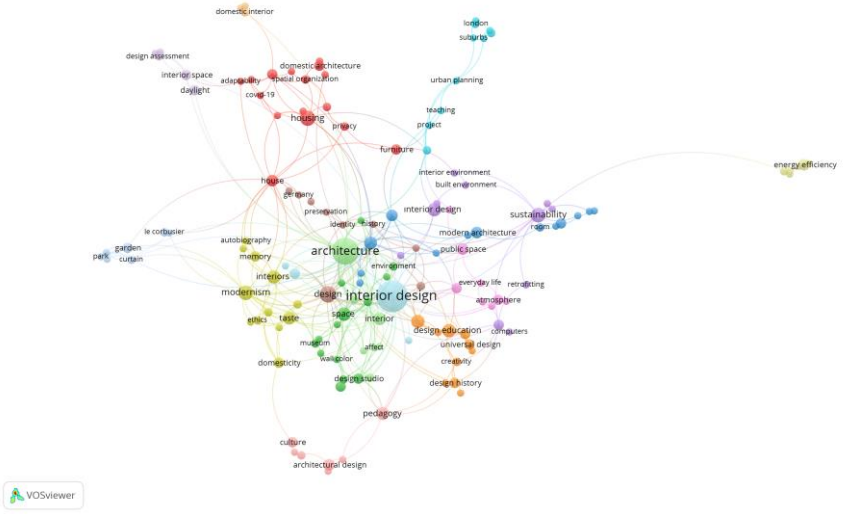

Figure 4. Text data word analysis
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A vivid illustration of eight unique clusters is provided by the terms map, which demonstrates how the terms of the semiotics publications cluster together. The most prevalent ideas that are found in clusters include architectural and interior design, as well as sustainability, design education, housing, and pedagogy. The term analysis of the bibliometrics publications in interior architecture is depicted in Figure 5, but is accompanied by information regarding the passage of time. One may determine the average publishing year of a term by looking at the color of the term. A phrase's average publishing year can be determined by taking the average of the publication years of all publications that have the term in keywords. This will give you the average publication year of the term. The terms that are used more toward the year 2020 are displayed in yellow (on the right side of Figure 5), whereas the terms that are used more toward the year 2014 are displayed in blue (on the lift side of Figure 5).

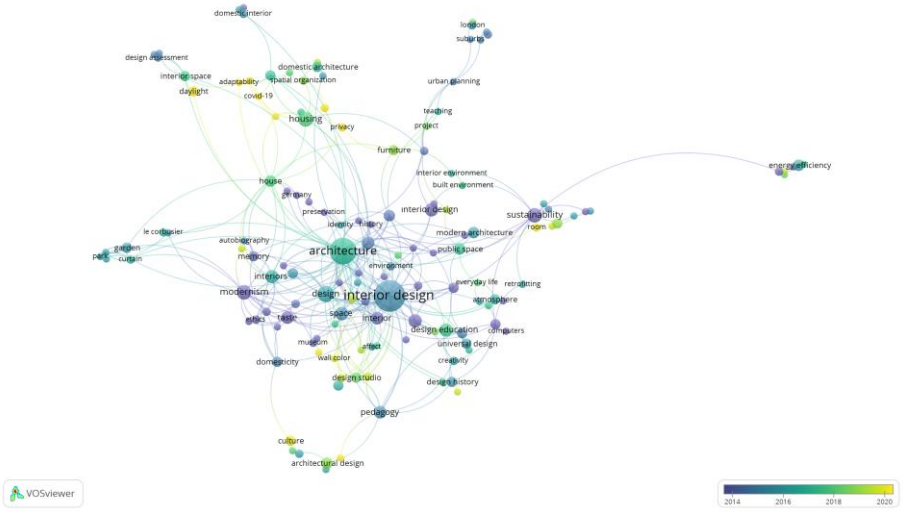

Figure 5. Time Map
Source: Generated by Author

The word cloud consisting of keywords determined by the authors is shown in Figure 6. In this context, in addition to the concepts of architecture and interior architecture, concepts related to modernism, housing and sustainability come to the fore. The term that is located in the middle represents the word that is used the most frequently in relation to that particular subject area. When the size of the word diminishes and moves out from the center, this shows that the term is used less frequently than it was previously.

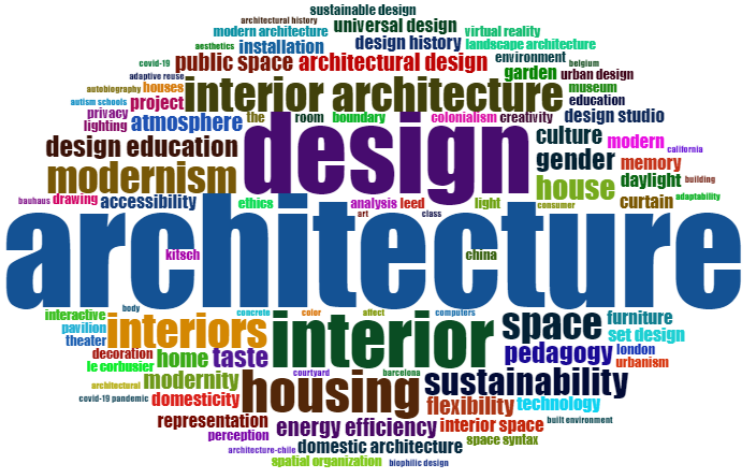

Figure 6. Word cloud created according to author keyword usage
Source: Generated by Author

3. CONCLUSION

Recently, more scientific research have been published. Thousands of articles, papers, and books on practically every subject have been written and are growing. As publications rise, useful data on their relationships emerges. Publications that have grown dramatically can contribute to big data sets. Scientific literature on a study subject or research topic might be daunting. Design is the materialization and symbolization of thinking and consciousness. Humans employ symbols as their essential elements in design. Design symbols are non-verbal and always interact directly or indirectly with people.Interior design is a creative social activity with symbolic qualities. An noteworthy finding of this study is that the subject maintained its popularity until the mid-2000s. Research on these subjects is prevalent, particularly in American and Turkish colleges. According to the results of word mining analysis, in addition to the main concepts of architecture and interior architecture, the concepts of modernism, housing, sustainable and pedagogy stand out.

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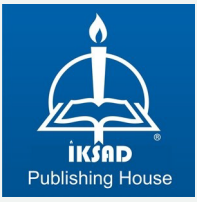

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