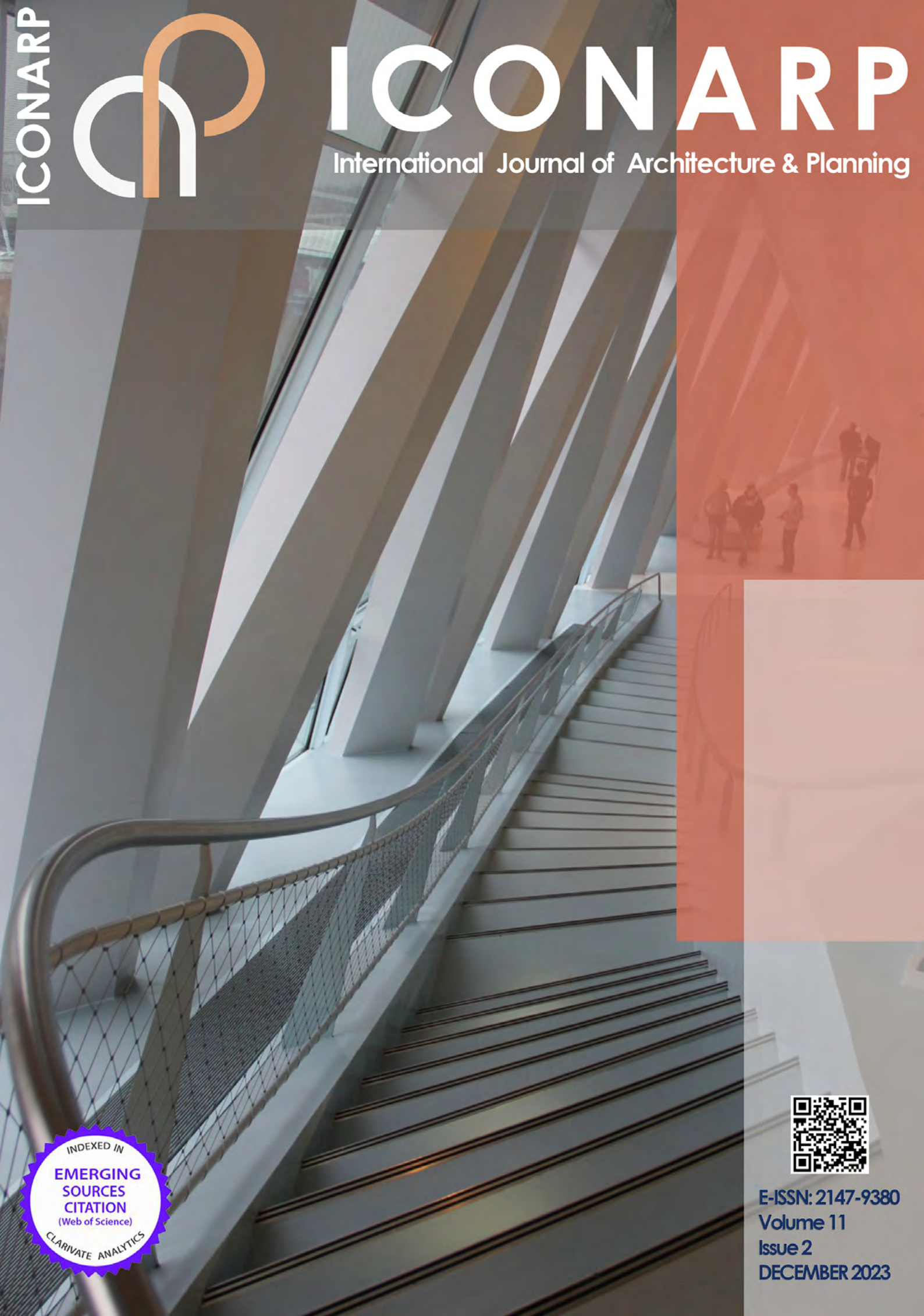

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International Journal of Architecture & Planning

INDEXED IN
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E-ISSN: 2147-9380
Volume 11
Issue 2
DECEMBER 2023

International Journal of Architecture & Planning
Volume 11, Issue 2, December 2023
DOI: 10.15320 / E-ISSN: 2147-9380
Online: http://iconarp.ktun.edu.tr

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International Editorial Board

Reviewers Contributed to This Issue

Volume 11, Issue 2, December 2023
DOI: 10.15320 /E-ISSN: 2147-9380

ICONARP INTERNATIONAL JOURNAL OF ARCHITECTURE & PLANNING

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ICONARP aims to be a reputable platform for the studies of Architecture, Planning and Design. ICONARP's objectives are:

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- To discover the relationship between Architecture, Planning and Design,
- To increase the contribution of Architecture, Planning and Design to social and behavioral sciences,
- To discover the relationship of Architecture, Planning and Design with other fields of science that are affected and affect,
- To develop theoretical and methodological foundations of Architecture, Planning and Design,
- To discuss the role of architects, planners and designers today and in the future,
- To compare the differences between architecture, planning and design research, practices and education in different countries,
- To bring a scientific view of current issues and discussions in field of Architecture, Planning and Design,
- To discover innovative methods and techniques in the field of Architecture, Planning and Design.

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International Journal of Architecture & Planning
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DOI: 10.15320 /E-ISSN: 2147-9380

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DOI: 10.15320 /E-ISSN: 2147-9380

ICONARP
International Journal of Architecture and Planning
Received: 25.02.2022 Accepted: 24.11.2022
Volume 11, Issue2/ Published: 28.12.2023
Research Article *DOI: 10.15320/ICONARP.2023.253 E- ISSN:2147-9380*
ICONARP

Evaluation of Open and Green Space Systems in the Context of Urban Livability

Özne Hızlı*
Esin Özlem Aktuğlu Aktan**

Abstract

Urban that has overgrown in recent years have affected human lifestyle and ecological balance in a negative way. Open and green spaces decreased. With this, unhealthy urban conditions occur. Therefore, urban is becoming more unlivable. The aim of this study, starting from the problem of insufficient/unqualified open and green areas in urban, is to show that cities are more livable when the open and green spaces system is designed.

The "top 10 livable cities" ranking the world cities are listed by 6 different institutions and the same cities included in this list are selected. The open and green areas of 4 different selected cities were examined. In the scope, two basic concepts are based on: open-green space systems and urban livability. As a result of the study, it has been seen that open and green space systems affect cities more livable. Therefore, open and green areas are planned systematically for maximum benefit with a sustainable approach. However, systems also need new approaches at some points. At this point, a hypothetical open green space system is proposed in this study. The concept of urban liveability and open and green spaces, an index of urban liveability, are explained. Then, open and green space systems in the literature are clarified with examples. To show the relationship between urban liveability and open green spaces, the research results done by different institutions, the most overlapping cities have been selected according to the top 10 list of most liveable cities list. The value of this study to make itself original and the literature contribution is that at the end of the research, a new open and green system was suggested based on the open and green systems in the literature.

Keywords:
Greenspace planning, liveable cities rank, open and green spaces, urban green system, urban liveability

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To cite this article: Hızlı, Ö., & Aktan, E.Ö.A. (2023). Evaluation of Open and Green Space Systems in The Context of Urban Livability. *ICONARP International Journal of Architecture and Planning,* 11 (2), 538-562. DOI: 10.15320/ICONARP.2023.253

INTRODUCTION

Because of the increase in industrialization in the 1960s, the urban population was accelerated. Therefore, there has been an increase in density in cities. Then urban started to grow unexpectedly. Urban infrastructure remained insufficient. The increasing amount of construction has reduced the amount of open space. This decrease has affected the negative way urban ecosystem. Air quality has deteriorated, and natural habitats have decreased. The citizens' lives have also changed with the hard-working conditions and transportation problems. In addition, the number of recreational areas has gradually decreased, and urban have turned into concrete jungles. As a result, urban become unliveable. With the building pressures on open and green spaces and the transformation of these areas into residential areas, legislation concerning construction was insufficient.

In the city planning regulations, there are some problems in looking at open and green areas only in terms of square meters and calculating them by dividing them by a general census. The first problem is the quantitative evaluation of open and green spaces only. This approach ignores the qualitative characteristics of open and green spaces. Another problem is which functions are included in open and green spaces. For example, calculating the per capita amount of open and green areas would be more accurate to calculate only active open and green spaces instead of passive ones like a highway side refuge.

Another problem is that all citizens are different from each other. The way a woman, an older adult, a child, and so uses the city will change; their expectations from and access to open and green spaces will also be different. As it seems, the square meter measurement per capita of open and green space is never enough to calculate open and green space sufficiency.

This study emphasizes that open and green spaces should be systematically designed with a sustainable approach for maximum benefit. Because if open and green spaces are designed systematically, urban will become more liveable. The importance of open and green spaces was recaptured after some crisis, such as a pandemic, earthquakes, global warming. While planning, determining unqualified parcels as open and green spaces and making unqualified grass areas on the bulkhead line to reach the amount of green area per capita does not benefit the public or nature. This approach of planning reduces livability in cities. In addition to this, it also reduces the quality of open and green spaces.

In this study, the concept of urban liveability and open and green spaces, an index of urban liveability, are explained. Then, open and green space systems in the literature are clarified with examples. In the central part of the study, to show the relationship between urban liveability and open green spaces, as a result of the research done by different institutions, the most overlapping cities have been selected according to the top 10 list of most liveable cities list. By making a comparative

DOI: 10.15320/ICONARP.2023.253

analysis method between these cities, the connections between the open and green areas of the cities were examined. As a result of the comparison, it was seen that the open and green areas were planned systematically. At the end of the study, a new system has been proposed in addition to the open and green space systems in the literature.

URBAN LIVEABILITY

This section explains the concept of liveability and quality of life. Factors and indexes affecting urban liveability are included. Subjective, objective, and mixed techniques used to measure urban liveability are explained. Information about the organizations that make these measurements are given, and the indexes they use are mentioned.

Concept of Liveability

The concept of liveability dates to the Ancient Greek as Aristotle wrote essays about what a good life would be like (Serag El-Din et al., 2013). The concept of liveability does not have a clear definition. Because it varies according to time/space/individual (Oktay, 2007:37). Moreover, it can be said that liveability is part of social, economic, structural, and environmental factors that affect human life (Kuru and Özkök, 2017). In other words, liveability is the comfort and satisfaction of life (Serag, El Din, et al., 2013). The concept of good life changes according to the expectations and cultures of society. In addition, it is difficult to determine a general standard because different needs and expectations occur in different geographies. After all, it is a subjective concept.

The concept of urban liveability fulfills all the necessary conditions for the citizens to live. In other words, it is the state of providing the city's standards or even being above these standards. For example, appropriate infrastructure, adequate recreation areas, education, and health services, and providing access to these services create the perception of a liveable city. The literature seems the same in urban liveability and quality of life. However, the difference between them was created when the word quality came into our lives after the Industrial Revolution. Liveability is a concept that has been used since ancient times (Kuru and Özkök, 2017).

Urban liveability can be divided into personal perception and living environment (Sipahi, 2002). Personal perception can be explained as people being satisfied with their life and feeling happy (Henden, 2018; Mostafa, 2012). It is interested in people's feelings and emotions. It includes education and health status (Salihoğlu, 2012). The living environment includes urbanization by contemporary urban and environmental standards, citizens' rights, and the individual's assessment of urban conditions. It involves the environment in which people live. It includes good air and water quality (Yavuzçehre and Torlak, 2006; Salihoğlu, 2012).

Urban liveability is directly related to the quality of people's lives. The use and plans of spaces, preservation of historical-cultural-natural values, accessibility to services, urban planning, and urban design affect

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urban liveability (Aydemir, 2008). For urban to be liveable, it must carry out healthy urban conditions and be planned by the principles of sustainability (Yavuzçehre and Torlak, 2006). For this reason, urban liveability is not just an issue that concerns politicians and economists. Many topics concern the urban planner and need to be considered in this context. When planning a city or making an urban design, increasing urban liveability should be the primary goal.

Factors Affecting Urban Liveability

When citizens meet their needs to live, they want to live there (Henden, 2018; Keyman, 2016). Therefore, urban living standards should not be confused with urban liveability. Urban liveability is the state of being above the standards (Kozaryn, 2011).

Urban liveability is related to how citizens are affected by social, economic, and physical conditions and consists of interacting these components with each other (Mostafa, 2012). While measuring this interaction, it is calculated whether these values provide for the needs of the citizens (Emür and Onsekiz, 2007).

Economic factors include purchasing power and cost of living criteria such as income status, employment opportunities, food-shelter expenditures, unemployment rate (Emür and Onsekiz, 2007; Yavuzçehre and Torlak, 2006). Social factors include criteria such as lifestyle, age and sex ratio, gender inequality, crime rates, educational status, benefiting from health services, and place attachment (Emür and Onsekiz, 2007; Boylu and Paçacıoğlu, 2016). Psychological factors and urban policy are also included in these criteria (Serag El-Din, 2013). It can be said that business life affects urban liveability because it affects mental health (Demiral, 2001). Physical factors include criteria such as the presence of open and green spaces, transportation network, accessibility, infrastructure, public service, quality of residential areas, protection of the natural and historical environment, urban planning, and urban mobility (Emür and Onsekiz, 2007; Serag El Religion, 2013; Boylu and Paçacıoğlu, 2016).

Even if each economic, social, and physical factor is of different importance, all three must be above the standards to ensure urban liveability (Yıldız 2007). This measurement and comparison should be made to develop urban liveability (Başaran and Çiftçi, 2011). The strengths and weaknesses of the urban should be determined. Then, solutions should be considered to strengthen these weaknesses or how urban liveability can be increased (Karakaya and Aktürk, 2020). These measurements should be made regularly and systematically (Sönmez and İnan, 2019).

Urban Liveability Index

Various indicators are used to determine urban liveability. However, these indicators vary according to research, some internationally accepted common indicators (Marans, 2007). These are generally in

DOI: 10.15320/ICONARP.2023.253

housing, education, health, environment, security, culture, sports and recreation, transportation, infrastructure, technology, and communication (Sönmez and İnan, 2019; Kozaryn, 2011).

Three different methods are used when measuring urban liveability: Subjective, objective, and mixed- functional structure (Matins, 2007; Yıldız, 2007; Marans, 2007). Liveability is based on objective indicators related to the individual's life and subjective indicators according to perceiving life (Yıldız, 2007). As seen in Table 1 below, the calculation method and criteria used in subjective and objective indexes were evaluated together.

Table 1. Index Types and Criteria (Türksever, 2001; Şenlier et al., 2007; Salihoğlu, 2012.)

Index Types	Methods	Criteria
Objective	-Counts -Published official reports -Environmental measurements -Statistical data	Housing conditions Recreational activities Open and green spaces Residential areas Health facilities, number of physicians Income status Unemployment rate GDP per capita Air quality
Subjective	-Review reports measuring personal perceptions -Subjective assessments -Survey and face-to-face interviews	Expectations, happiness, satisfaction levels Sense of security Life experiences Service quality Accessibility

Subjective measures generally consist of subjective values such as health, safety, peace, happiness, and satisfaction and vary from person to person (Emür and Onsekiz, 2007). An individual's satisfaction with his/her environment affects the quality of life (Yavuzçehre and Torlak, 2006).

Objective measurements include measurable criteria such as numerical values, economic data, and social activity areas of the built and natural environments (Emür and Onsekiz, 2007). For example, data such as death rates, time spent in traffic, environmental pollution measurements, amount of green space per capita are objective measurement forms that affect livability (Güvenç, 1998).

In mixed functional structured measurements, subjective and objective data are used together (Martins, 2007). Studies show that mixed-structured measurements give more accurate results (Parlak, 2011). According to Kuru and Özkok (2017), two different methods should be used for liveable cities. According to Sönmez and İnan (2019), it was emphasized that only objective index or subjective index would not be sufficient alone and should be used together.

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Each index has its advantages and disadvantages. Objective indicators provide convenience when calculating on a large scale. However, finding similar data readily available in another geography can be difficult. If found, the comparison is easy. Using subjective indicators on large scales is costly and long-term. Since subjective indicators will change from culture to culture and society, it may be challenging to reach accurate results (Sönmez and İnan, 2019). While a place in different geography is defined as liveable even though it is challenging to live in, it may be unliveable due to the differences in the perceptions of individuals and societies despite being liveable in another place (Oktay, 2007).

Measuring Urban Liveability

Urban livability is measured annually by various institutions, and its scales can be regional or include all world cities. Indexes were created for these measurements. These are gathered political, social, physical, and cultural environment, public service quality, and accessibility (Kuru and Özkok, 2017; Henden, 2018; Batal, 2016). This part of the study covers the methods and criteria used by research organizations worldwide, not regionally, to measure urban liveability.

Mercer urban quality of life survey

Mercer, an international advisory organization, is research owned by the Human Resources Organization. They analyse liveable cities (Mercer, 2021). It includes a total of 440 cities worldwide. It evaluates these cities according to 39 criteria and ranks them (Kuru and Özkok, 2017). These criteria are political and social, economic, cultural, health-related issues, schools and education, public services and transportation, recreation areas, consumer goods, personal goods, housing, and the natural environment (Mercer, 2021). As seen in this research, the determination of recreational areas as a criterion shows that open and green areas are effective in the quality of urban life.

EUI global liveability ranking

It is research affiliated with the journal 'The Economist.' It is made by the 'Economist Intelligence Unit' organization. It provides consultancy services about the situation of cities at the international level. It regularly lists the world's most liveable cities every year. There are 140 cities in total, and these cities are evaluated according to 30 criteria and five different categories. These are military stability, health, culture, environment, education, and infrastructure (EIU, 2021). There are sports fields under the open and green areas in the environment section (Kuru and Özkok, 2017).

Monocle most liveable cities survey

Monocle, searching for the most liveable city among known cities globally, is a British culture-history-arts magazine. It makes its evaluations according to 11 criteria that should also be in urban planning.

DOI: 10.15320/ICONARP.2023.253

These are security, health, climate, international connections, public transportation, architectural quality, environment and nature, urban design, business life (Monocle, 2019; Henden 2018).

Numbeo quality of life comparison

Numbeo is a global database system. Every year, it researches livability and lists the cities. It has survey data on quality-of-life indexes, including housing indicators, crime rates, quality of health care, and many other statistics (Numbeo, 2021).

ECA

It is an organization that provides a data set. This set includes healthcare, housing assets, utilities, access to a social network and recreation areas, infrastructure, climate, personal safety, and air quality owned by global cities (ECA, 2020).

Deutsche bank liveability research

It includes 56 cities. According to the liveable cities ranking in 2019, the criteria are safety, environment, pollution, cost of living, happiness, and health services (URLs 1 and 2). In all these studies, it is seen that the existence of open and green spaces is evaluated within the categories of environment, public, and health spaces. The presence of open and green spaces in urban spaces, their density, and the way they access and use these areas increase urban livability (Henden, 2018; Kuru and Özkok, 2017; Sönmez and İnan, 2019).

OPEN AND GREEN SPACES

In this part, the concept of open and green areas and the standards of these areas are given. Ecological, economic, physical, social, and psychological, aesthetic functions of open and green spaces are explained. Open and green space systems are examined as green belt, green wedge, greenheart, and greenway.

Concept of Open and Green Space

Unbuilt areas are called open spaces. For example, water surfaces, urban squares, transport networks, parks are defined as open space (Gül and Küçük, 2001; Önder and Polat, 2012). Open and green spaces are versions of open spaces with vegetation. Areas surrounded by herbaceous and woody plants or combined with a particular part are also defined as open and green areas (Gül and Küçük, 2001). According to Chong et al. (2013), open and green areas are defined as areas with vegetation. For example, forests, cemeteries, national parks are types of open and green areas (Pamay, 1978; Gül and Küçük, 2001). According to the regulation for the preparation of Spatial Plans (2014), in Turkey, open and green areas include neighbourhood and district parks, children's playground, zoo, expo areas, botanical gardens, regional parks, urban squares, picnic areas, and coastal areas. The main idea to be drawn from

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here is that since every green area is an open area, the definition of the green area alone is not used. The correct usage in the literature is open and green space. However, it should not be forgotten that not every open area is green.

Urban open and green spaces are open and green spaces within the city borders. According to Aytaş (2017), these areas contain various landscape features. In addition, urban open and green spaces gain importance in economic and social aspects. According to Bilgili and Gökyer (2012), urban open and green spaces are natural and semi-natural areas where open and green spaces are in cities with human influence. According to Baycan et al. (2009), these areas are defined as plant communities, considered public spaces within the urban areas beneficial for the citizens. From this point of view, urban open and green spaces can be called the city's lungs because they allow the city to breathe.

Considering the urban open and green areas in terms of quantity, it covers the size of these areas and the amount of these areas per capita. In addition, it includes numerical values such as the number of trees, parks, and playgrounds (Gül et al., 2020). In terms of quality, urban open and green spaces include social, cultural, economic, and ecological services. In addition, the selection of plants and materials to be used in open and green areas should be suitable for their context. For a place to be called an open and green space, it is expected to fulfill the functions of open and green space (Gül et al., 2020). For this reason, urban open and green spaces should be looked at in terms of quantity and quality.

Open and Green Space Standards

Open and green space standards are calculated per capita according to the quantity of these spaces (Gül and Küçük, 2001). This measurement emerged in England in the 1800s and is considered a pointer of civilization (Yazgı and Yılmaz, 2017; Gül et al., 2020). While the law enacted in 1956 in Turkey was 7 m^2 per person, the amount of active open and green space per capita specified in the law in 1999 was 10 m^2. The amount is again 10 m^2 accordingly to Turkey's 2014 Spatial Plans Construction Regulation. (Önder and Polat, 2012). However, these standards vary from country to country in the world. Open and green space standards in various countries are given in Table 2.

As can be seen from Table 2, Turkey is behind the world countries in terms of open and green space standards. In addition, Turkey does not even reach the standards in its laws. For example, Istanbul's amount of open and green space per capita in 2018 was 6 m^2 (Gül et al. 2020). Looking at other world cities, It is 40 m^2 in London, 29 m^2 in Edinburgh, 46 m^2 in Cambridge, 38 m^2 in Washington, 48,5 m^2 in Los Angeles, 29 m^2 in Brussels, 25 m^2 in Vienna, 16 m^2 in Munich (Singh et al., 2010; Khan, 2012; Morar et al., 2014; Maryanti, 2016).

DOI: 10.15320/ICONARP.2023.253

Table 2. Open and Green Space Standards (m^2/person) (Aksoy, 2001; Önder and Polat, 2012)

Country	Urban Park	Neighbourhood Park	Playground	Sports Field	General
Sweden	23	-	5,5	10	87
America	16	4	-	-	80
Britain	40	20	-	10	78
Italy	12	5,5	3	7,5	45
Holland	9	-	-	6,5	45
Poland	5	15	-	7,5	45
France	10	4	3,5	8	35
Turkey	3,5	2	1,5	3	10

In addition, it is not the right approach to look at open and green spaces only numerically. Because the functions and implementation of open and green spaces are also essential, another point is that there are no provisions in the regulations regarding the planning and practice of open and green spaces (Gül and Küçük, 2001; Yazgı and Yılmaz, 2017). This uncertainty complicates open and green space planning, which is left to the personal vision of the city planner or the urbanization policies of local governments. Since it is left only to them, insufficient, scattered, do not have the characteristics of open and green areas, qualitatively deficient open and green areas emerge.

Functions and Classification of Open and Green Spaces

Open and green spaces have many different functions. It is possible to collect these functions in five main categories. These categories are ecological, physical, economic, social-psychological, aesthetic. The ecological function of open and green spaces provides the microclimate in the city. At the same time, it cleans the air of the city. The physical function of open and green spaces is to act as a buffer to prevent an expansion of the city. The economic function of open and green spaces includes areas that can be used for tourism activities, agricultural activities, and the forest industry. In addition, housing rents around the parks were found to be higher. Open and green spaces' social and psychological function prevents stress and regulates human relations. It provides the opportunity to socialize. The aesthetic function of open and green spaces consists of design principles such as order, texture, color created with the plant species used. Such arrangements offer visual quality to urban areas (Gül and Küçük, 2001). It is necessary to plan open and green spaces more effectively in all these functions. It is essential to look at these areas in terms of quantity and quality. If open and green areas are designed systematically, it is seen that they fulfill the functions of open and green areas.

Open and green spaces can differ according to ownership status, usage types, and scales. Open and green areas' ownership status is divided into

three public, semi-public/semi-private, and private areas. Public open and green spaces are freely accessible to citizens. These places are common public areas such as streets, pedestrian roads, parks, children's playgrounds. Semi-public or semi-private open and green spaces are changeover from private to public spaces. Examples of these are courtyards, communal gardens, and parking lots. Private open and green spaces are privately owned areas (Öztürk, 2004; Gül and Küçük, 2001; Gezer et al., 2009).

Open and green areas' usage types are divided into active and passive. Active open and green spaces are open to public use and organized for entertainment, recreation, and health. These areas are playgrounds, playgrounds, fairgrounds, zoo, botanical garden, woodland, picnic areas, and promenade areas. Passive open and green areas are not open to public use, generally arranged for environmental health, protection, and aesthetic purposes. Areas such as orchards, nurseries, poplars, cemeteries, topographical thresholds, green belts, forests, median surfaces of roads are also passive areas (Öztürk, 2004; Gül et al., 2020).

The open and green spaces scales are divided into six groups as in Table 3: region, city, district, neighbourhood, neighbourhood unit, and housing group. Open and green areas include at the regional scale; forests, national parks, regional parks, nature parks, nature protection areas, and the arboretum; at the city scale urban parks, zoos, botanical gardens, and sports facilities; at the neighbourhood scale sports fields, swimming pools, and playgrounds. Open and green areas include neighbourhood parks and school gardens at the neighbourhood scale. Parks, walking, and cycling paths form the open and green areas at the scale of the neighbourhood unit. Open and green areas at the scale of the housing group consist of playgrounds and residential gardens (Aydemir et al., 1999; Gül and Küçük, 2001).

Table 3. Types of Open and Green Spaces (Aydemir et. al., 1999; Gül and Küçük, 2001)

Scale	Types of Open and Green Spaces
Region	Forests, national parks, nature parks, nature reserves, arboretum
Urban	City parks, zoos, botanical gardens, sports facilities
District	Sports fields, swimming pool, playground
Neighborhood	Neighborhood Park, school garden
Neighborhood Unit	Parks, walking and cycling paths
Housing Group	Playgrounds and residential gardens

Open and Green Space Systems

For good urban planning, open and green areas must be designed because they shape the form and physical structure of the urban. Therefore, open and green spaces have an integrative feature that affects the urban morphology (Manavlıoğlu and Ortaçeşme, 2007).

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The systematic planning of open and green spaces is the task of the urban planner. Analysis, synthesis, and design of the appropriate green system should be done on the existing open and green areas. The green system setup should not be ignored in urban plans. In addition, green space plans and master plans should be made simultaneously (Yücesu et al., 2017).

Open and green spaces should be planned from the macro to the micro-scale system. In this context, the quality of open and green spaces and their suitability for the city's identity is another important point. In addition, open and green spaces should be extensive enough and accessible to meet the city's needs (Yücesu et al., 2017).

As a result of the literature review, it is seen that many open and green space systems have been developed. Hellmund and Smith (2006) evaluated all urban and rural systems in their studies. In this study, the green belt, green wedge, greenheart, and greenway systems associated with the city are explained (Table 4).

Table 4. Open and Green Space Systems

Green Belt	Green Wedge	Green Hearth	Green Way
			
Build-up Area Open and Green Spaces	Build-up Area Open and Green Spaces	Build-up Area Open and Green Spaces	Build-up Area Open and Green Spaces

Green belt

As the name suggests, the green belt means the ring surrounding the city consisting of open and green areas (Önder and Öztürk, 2009). With its general definition, the green belt is the integrity of open spaces planned, implemented, and managed for ecological and recreational purposes. It is a continuous belt from the urban area to the rural area. The main principles of green belt planning are as follows: The natural systems shape the green belt's form and boundaries, ecological and integrative planning approach, the creation of the continuity of areas from urban to rural, and the relationship between resources and land uses in the balance of protection and usage (Çulcuoğlu, 1997). The most important implementation of the green belt was made in London (Figure 1). The function found in the green belt is agricultural, wooded, forests, and public open spaces. The length of the green belt in London is 190 km, and it is 30 km from the centre. Its width is 16 km. This green belt has a function that facilitates transportation from other cities on the edge of the city to London, alleviates the traffic between the suburbs and the city, and reduces the heavy traffic in the downtown (Öztürk, 2004).

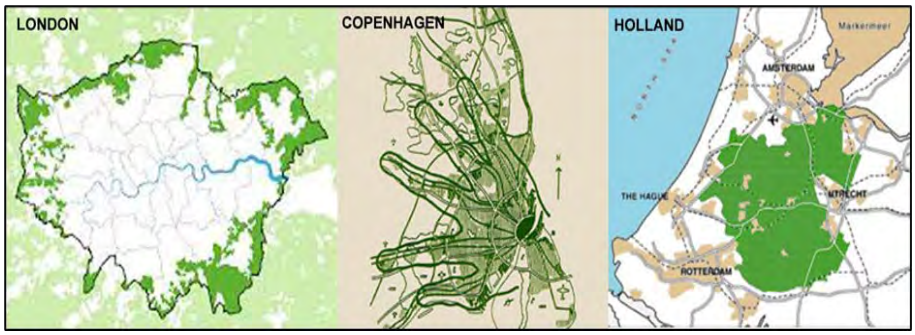

Figure 1. Open and Green Space Systems in London, Copenhagen, and the Netherlands (URL 3,4 and 5)

Green wedge

In the green wedge, open and green areas extend into the city. Besides that, it progresses depending on linear natural structures such as streams and valleys and creates a green texture in the city. It generally takes a wedge shape by narrowing rural areas towards the city centre. It is more accessible than the green belt. In this typology, green areas cannot reach the city centre due to the compact structure in the city centre and stay around the centre. However, if natural linear elements such as streams or valleys pass through the city, it creates a green area potential for the city centre. For example, Washington and Copenhagen (Figure 1) can be shown as green wedges (Öztürk, 2004).

Green hearth

Unlike the green belt, which separates urban and suburban settlements and acts as a buffer, the green heart is an open and green space system that connects cities on a regional scale. In this system, cities are located around a central open space, forming a ring. It is a polycentric planning concept that connects cities of the Netherlands such as Rotterdam, the Hague, and Utrecht (Figure 1). If we consider this typology at the urban scale, the idea of creating a great open space in the city centre will emerge (Öztürk, 2004; Kuhn, 2003).

Green way

The city's open and green areas reach the city centre through corridors. It is very similar to the green wedge in terms of its characteristics. However, the most distinctive difference is that the open and green space enters the city centre with a narrow pedestrian path or park. The importance of green corridors for the city comes to the natural city centre through these corridors. Renn greenway in France can be cited as an example (Scudo, 2006; Arslan et al., 2007).

EFFECTS OF OPEN AND GREEN SPACES ON LIVEABILITY

When urban liveability is examined in terms of economic, social, and environmental aspects, it is seen that open and green spaces are evaluated under the title of environment. Besides that, considering the ecological, economic, aesthetic, social-psychological, and physical functions of open and green spaces, it is evident that each function increases urban liveability. It should be designed as a system to use open

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and green spaces with maximum function and benefit. In that case, the relationship between urban livability and open and green space systems can be mentioned.

Urban Selection and Method

To examine the assumption that open and green space systems affect urban livability, open and green areas of cities with high urban livability have been examined. First, the top 10 cities are listed in the urban livability rankings. While making this list, 6 different research institutions were included. The research organizations are as follows: EUI, Monocle, Mercer, Numbeo, Deutsche Bank, ECA. The cities in the top 10 rankings of these 6 organizations are discussed. The overlap ratios of the top 10 cities in all lists were determined (Table 5). The overlapping cities in the different lists and their overlap rates are as follows: 5/6: Zurich;4/6: Copenhagen; 3/6: Auckland, Wellington, Vienna; 2/6: Helsinki, Adelaide, Tokyo, Geneva, Melbourne, Brisbane, Sydney, Basel.

Table 5. Urban Livability Rankings by Different Organizations (EUI, 2021; Monocle, 2021; Mercer, 2021; Numbeo, 2021; Deutsche, 2021; ECA, 2020.)

	EUI (2021)	Monocle (2021)	Mercer (2019)	Numbeo (2021)	Deutsche (2020)	ECA (2020)
1.	Auckland	Copenhagen	Vienna	Adelaide	Zurich	Copenhagen
2.	Osaka	Zurich	Zurich	Canberra	Wellington	Bern
3.	Adelaide	Helsinki	Vancouver	Wellington	Copenhagen	Hague
4.	Wellington	Stockholm	Munich	Raleigh	Edinburgh	Geneva
5.	Tokyo	Tokyo	Auckland	Zurich	Vienna	Eindhoven
6.	Perth	Vienna	Dusseldorf	The Hague	Helsinki	Stavanger
7.	Zurich	Lisbon	Frankfurt	Madison	Melbourne	Amsterdam
8.	Geneva	Auckland	Copenhagen	Columbus	Boston	Basel
9.	Melbourne	Taipei	Geneva	Austin	San Francisco	Dublin
10.	Brisbane	Sydney	Basel	Brisbane	Sydney	Luxembourg

As shown in Table 5, the highest overlap rate belongs to the EUI institution. Therefore, the top 10 cities belonging to the EUI organization are listed between the years 2015-2021 (Table 6). However, studies for 2020 could not be done due to the Pandemic.

Table 6. EUI Urban Liveability Ranking by Years (EUI, 2021)

	2021	2019	2018	2017	2016	2015
1.	Auckland	Vienna	Vienna	Melbourne	Melbourne	Melbourne
2.	Osaka	Melbourne	Melbourne	Vienna	Vienna	Vienna
3.	Adelaide	Sydney	Osaka	Vancouver	Vancouver	Vancouver
4.	Wellington	Osaka	Calgary	Toronto	Toronto	Toronto
5.	Tokyo	Calgary	Sydney	Adelaide	Adelaide	Adelaide
6.	Perth	Vancouver	Vancouver	Calgary	Calgary	Sydney
7.	Zurich	Tokyo	Tokyo	Perth	Perth	Perth
8.	Geneva	Toronto	Toronto	Auckland	Auckland	Auckland
9.	Melbourne	Copenhagen	Copenhagen	Helsinki	Helsinki	Helsinki
10.	Brisbane	Adelaide	Adelaide	Hamburg	Hamburg	Zurich

The city selection criteria are made following: The top 3 cities in Other Organizations are found in the EUI's rankings organized by years. In the list made by different organizations, the ones that overlapped 5, 4, and 3 times were considered, and their rankings were found in the list of EUI made by years. If it was included in the list only once, that city was not selected. As a result of this method, the following cities were selected: Auckland, Vienna, Zurich, and Copenhagen.

Urban Studies

The open and green areas of the cities of Auckland, Vienna, Zurich and Copenhagen, which were determined according to the results of the city selection, were examined in line with the information obtained from the literature. The existing open and green areas of these four cities were analyzed with the help of satellite images. Due to the information that can be obtained, the cities' quantitative open and green space presence has been examined. The location coefficient method was used by calculating the ratio of the total area of the city to the area of open and green areas. Then, these four cities' open and green areas were evaluated in terms of system setup, and these cities were compared with each other by taking the mode and arithmetic averages of their rankings in the urban livability ranking.

Auckland

Auckland is in the north of New Zealand (Figure 2). Its area is 1060 km^2 in total. Its population in 2017 was 1,657,000. It is the highest open and green areas among the world cities. It has 591 km^2 of open and green area surface. There is 357 m^2 of open and green space per person (URL-17). Looking at the city on a macro scale, a natural green belt has formed on its peripheries and these forest areas limit the city and act as a buffer. In addition, a part of this forest area has been included in the city limits. Therefore, the location coefficient was found to be 0.55. It has an open and green area about half of its surface area. It is the city with the highest

DOI: 10.15320/ICONARP.2023.253

location coefficient. When we look at the place where the construction is in the city centre, open and green areas of all sizes have been created. These areas are evenly distributed in the city centre.

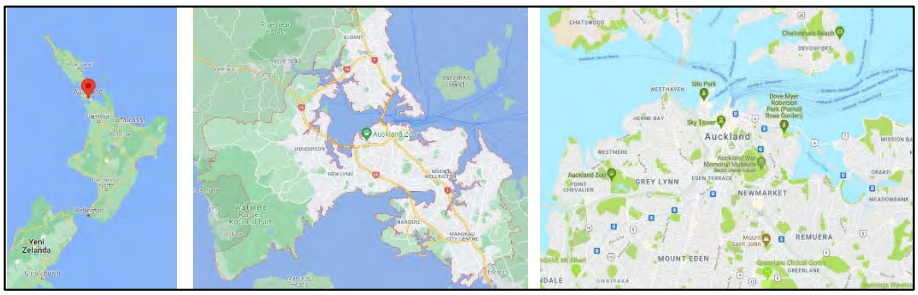

Figure 2. Geographical Location and Open-Green Areas of Auckland
(URL 7 and 8)

Looking at Tables 5 and 6, the city of Auckland; It ranked first in the EUI 2021 rankings, eighth in the Monocle 2021 rankings, fifth in the Mercer 2019 rankings, and again eighth in the EUI 2015, 2016 and 2017 rankings, and it has maintained its place in the lists. His mode overall is eighth. Its average is 6.3. It has been in the top 10 6 times in total.

Vienna

Vienna is in the northeast of Australia (Figure 3). Its area is 415 km^2 in total. Its population in 2019 was 1,900,000. It is the city with the highest population density. It has 114 km^2 of open and green area surface. There is 60 square meters of open and green space per person (URL-20). The forest area in the periphery is not included in the city limits. As seen in Figure 3, there are open and green areas that try to extend from the periphery of Vienna to the centre. When we look at the city on a macro scale, although it resembles a green wedge on its walls, there is no full wedge formation. The location coefficient was found to be 0.27. It has an open and green area about one third of its surface area. Like Auckland, Vienna has created open and green spaces of varying sizes at equal intervals within the city. On the coast, an open and green area extends in the form of a green corridor, although its continuity is interrupted at a certain point.

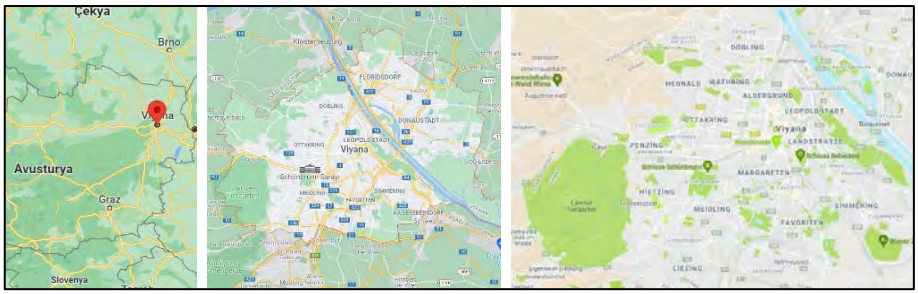

Figure 3. Geographical Location and Open-Green Areas of Vienna
(URL 10 and 11)

Looking at Tables 5 and 6, the city of Vienna; It ranked sixth in Monocle 2021, first in Mercer 2019, fifth in Deutsche Bank 2020, second in EUI 2015, 2016, 2017, and first in EUI 2018 and 2019. Generally, the mode is first and second place. Its average is 2.5. It has been in the top 10 8 times in total. The most livable city in the livability rankings is Vienna.

Zurich

Zurich was in the northeast of Switzerland (Figure 4). Its area is 88 km^2 in total. Its population in 2019 is 403,000. It has 10 km^2 of open and green area surface (URL-23). There is 25 square meters of open and green space per person (Pamay, 1978). It is the city with the least open and green areas per capita. The forest area in the periphery is not included in the city limits. As can be seen in Figure 4, the city borders are limited by passive open and green areas like other cities. When we look at the city on a macro scale, green wedge formation is more common than other cities. The open and green space tried to enter the city by merging with the river. Although there are open and green areas by the river, it is not exactly in the form of a green corridor / road and these areas do not contain continuity. The location coefficient was found to be 0.11. It is the city where the ratio of open and green areas to surface area is the lowest. Open and green areas of homogeneous size were created at equal intervals in the city.

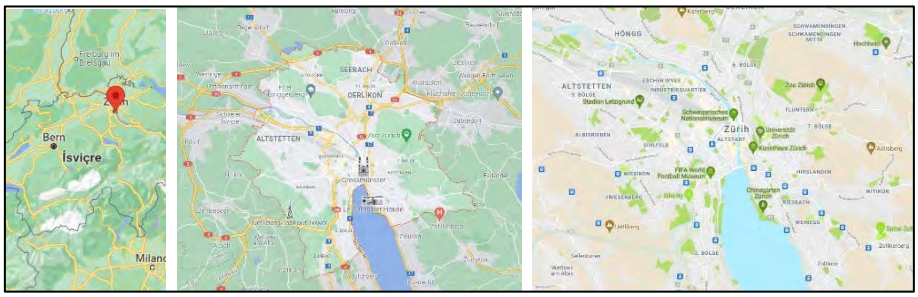

Figure 4. Geographical Location and Open-Green Areas of Zurich (URL 13 and 14)

Looking at Tables 5 and 6, the city of Zurich; It ranked seventh in the EUI 2021 rankings, second in the Monocle 2021 and Mercer 2019 rankings, fifth in the Numbeo 2021 rankings, first in the Deutsche Bank 2020 rankings and tenth in the EUI 2015 rankings. Overall, his mode is second place. Its average is 4.5. It has been in the top 10 6 times in total.

Copenhagen

The city of Copenhagen is located in eastern Denmark (Figure 5). Its area is 89 km^2 in total. Its population in 2017 is 603,000. It has an open and green area of 25 km^2. There is 42 m^2 of open and green space per person (Irmak and Avcı, 2019). The green wedge open and green space system is designed in the city. It is a city that is shown as an example of open and green space systems in the literature. As can be seen in Figure 5, the city borders are limited by passive open and green areas like other cities. When we look at the city on a macro scale, it merges with the river and the open and green space enters the city, forming a green wedge. The location coefficient was found to be 0.47, which has an open and green area approximately half of its surface area. The city centre's open and green areas of different sizes are seen at equal intervals. On the coast, there is an open and green area extending in the form of a green corridor. However, it was cut in the city centre.

DOI: 10.15320/ICONARP.2023.253

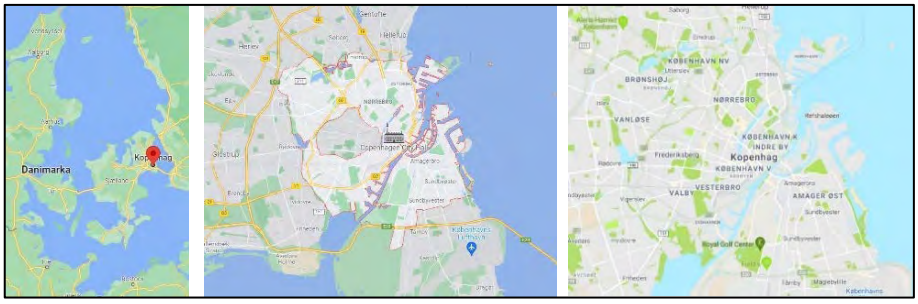

Figure 5. Geographical Location and Open-Green Areas of Copenhagen
(URL 15 and 16)

Looking at Tables 5 and 6, the city of Copenhagen; It ranked ninth in the EUI 2018 and 2019 rankings, first in the Monocle 2021 rankings, eighth in the Mercer 2019 rankings, third in the Deutsche Bank 2020 rankings, and first in the ECA 2020 rankings. Overall, his mode is ninth. Its average is 7.3. It has been in the top 10 6 times in total.

Comparative Analysis and Evaluation

The information obtained within the scope of the research of these four selected cities was compiled by categorizing and Table 7 was created.

Table 7. Comparative Analysis

Urban Name	**AUCKLAND**	**VIENNA**	**ZURICH**	**COPENHAGEN**
Area (km^2)	1.060	415	88	89
Population	1.657.000	1.900.000	403.000	603.000
Population Density (Person/km^2)	1.563	46.341	4.579	6.775
Open and Green Area (km^2)	591	114	10	25
Open and Green Area Per Capita (m^2)	357	60	25	42
Location Coefficient Ratio (0<...<1)	0,55	0,27	0,11	0,47
Livability Average	6,3	2,5	4,5	7,3
Open and Green Systems				

Looking at the comparative analysis in Table 7, it is possible to reach the following conclusions:

-It has been observed that the surface area and population of Zurich and Copenhagen are close to each other. It has been seen that the city with the largest area and population is Auckland. Considering the open and green areas per capita, it can be said that there is no city less than 25 m^2. The location coefficients vary between 0.1 and 0.6. The largest number of

open and green spaces belongs to the city of Auckland. Although the areas of Zurich and Copenhagen are close, the location coefficient of Copenhagen is higher than Zurich, since the amount of open and green spaces changes.

-When we look at open and green spaces in terms of system setup, a change in form from green belt to green wedge is seen in Auckland, Vienna, Zurich and Copenhagen, respectively. In general, open and green areas are evenly distributed in the city. The linear form has been gained in the green corridor in streams and valleys. Green corridors are clearly visible in Vienna and Copenhagen.

-To summarize the open and green spaces of cities, the amount of open and green spaces in Auckland in New Zealand is more than half of the city. Considering its open and green areas, it is noteworthy that it is homogeneously distributed in the city. Many large and small open and green spaces are diversified according to their service capacity. When we look at the city of Vienna, parks are homogeneously distributed in the city center, and larger uses are located on the peripheries of the city. On the other hand, the city of Zurich saw the coastal areas as a potential and put recreational activities in these areas. However, it does not have a continuous design. On the other hand, Copenhagen is famous for its green wedge-shaped system and is shown as an example of open and green space systems. The river passing through the city is also included in the open and green area system.

-If we compare the urban livability rankings according to the arithmetic average results, Vienna is 2,5; Zurich 4,5; Auckland 6.3; Copenhagen is 7.3. Although the amount of open and green spaces per capita is low, Zurich is the only city with higher livability compared to other cities.

Table 8. Comparative Analysis Result Hypothesis Testing

CRITERIA	**1.**	**2.**	**3.**	**4.**
Liveability Ranking Arithmetic Averages *(Out of 10)*	Vienna	Zurich	Auckland	Copenhagen
	2,5	4,5	6,3	7,3
Amount of Open and Green Area *(km^2)*	Auckland	Vienna	Copenhagen	Zurich
	591	114	25	10
Amount of Open and Green Areas Per Capita *(m^2)*	Auckland	Vienna	Copenhagen	Zurich
	357	60	42	25
Location Coefficient *(Ratio of open and green area area to total area)*	Auckland	Copenhagen	Vienna	Zurich
	0.55	0.47	0.27	0.11

In Table 8, to test the hypothesis, it is seen that the four cities, whose arithmetic averages are taken, and their urban livability is ranked, are mostly directly proportional to the location coefficient. However, it can be said that there is no one-to-one direct relationship, that affects it indirectly. The reasons for these can be explained as follows:

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- Indicators are also affected by various factors. It does not only cover open and green areas. Economical such as labour, housing rents; Ranking effect score is low because it includes social issues such as education level. When different criteria come into play or the percentages of these criteria change, there may be some changes in the results.

- The four cities are not the same size and have the same population. The problems brought about by the population and the size of the city affect urban livability.

- While the amount of active green areas in the city centre is low, different results emerge in the per capita calculation when passive and large open and green areas such as forest areas enter the city limits. When making comparisons, it can give wrong results because the forest areas around the city are not included in other cities.

CONCLUSIONS AND RECOMMENDATIONS

As a result of the literature research, it has been seen that the need for open and green spaces is increasing day by day due to dense construction, unplanned growth, and rapid population growth. Moreover, open and green areas are gradually decreasing due to construction pressure. This decrease negatively affects cities both environmentally and socially. As a result, livability in cities is decreasing.

Although livability does not have a clear definition, it does not give precise results when measuring. Because the measurement method may vary according to the researcher and the criteria used in the measurement, this study has tried to include institutions that conduct more than one livability research to reach the most accurate result. Considering the criteria of each research, open and green spaces are in the lower step of the environmental category. The amount of green space per capita directly affects urban livability. To embody four cities selected in the livability rankings are discussed. It has been observed that the amount of open and green areas in these cities is high. For example, Auckland's amount of open and green space in New Zealand is more than half of the city. When we look at its open and green spaces, it is remarkable that it is homogeneously distributed in the urban. All sizes open and green areas are diversified according to their service capacity. When we look at the city of Vienna, parks are homogeneously distributed in the city center, and more extensive uses are located on the peripheries of the city. On the other hand, Zurich saw the coastal areas as potential and placed recreational activities. Copenhagen is a city that is famous for its 'green finger' plan, which is shown as an example of open and green space systems.

As it is known, open and green spaces have many functions. These functions can have different derivatives in different sources or be grouped into five in general. Economic, ecological, aesthetic, social-psychological, and physical functions benefit the city and its inhabitants. As a result of the research in the literature, it has been seen that when

open and green areas are planned systematically, these functions are more effective than the sum.

The open and green space systems that have been discussed in the literature so far are those that are considered as urban; green belt, green wedge, green formal/mesh, green heart and green road/corridor. The common purpose of these systems is to solve the open and green space problem in cities and to shape the urban macro form. These systems can be summarized as follows:

- While the green belt acts as a buffer, the green road/corridor acts as a router.
- The green wedge has developed with the star city form. Open and green spaces extend hierarchically from rural to urban areas.
- The green heart can be applied between cities and the city centre.
- The green road/corridor acts as a connector. It ensures the continuity of open and green spaces with each other.

There are many open and green space systems. Even though these systems diversify within themselves, they need new approaches at some points. At this point, based on the results of this thesis, suggestions for open green space systems have been developed. It is thought that this system proposal, which includes parts of the green belt, green wedge, green road and green heart systems, will bring a new perspective to urban open and green spaces.

However, systems also need new approaches at some points. That is why they need variety. At this point, a hypothetical open green space system is proposed in this study (Figure 6).

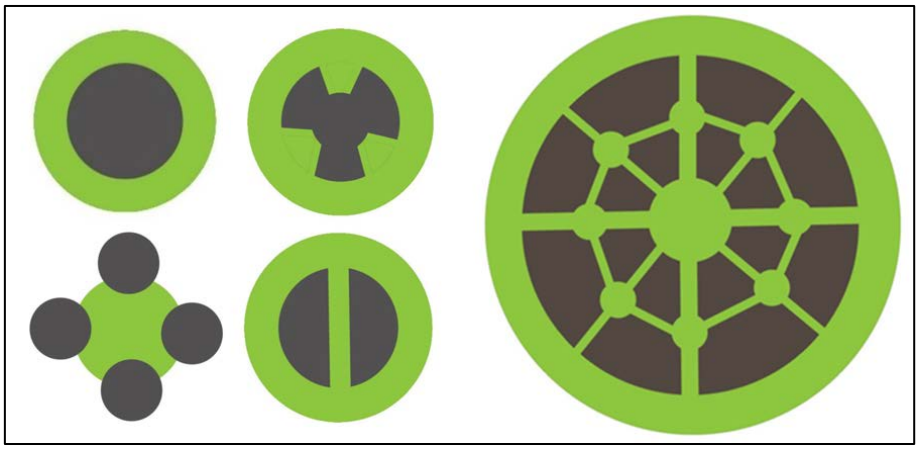

Figure 6. Open and Green Field System Recommendation

This system can remind of a spider net. There is a city park downtown. The open and green space with the transportation axes is integrated into the radial macro form. It does not always have to be a transport link. It can also be adapted if a water surface passes through the city or in places with coastlines. There are pedestrian connections. At intersections, there can be public spaces or neighbourhood parks. A green belt prevents the

DOI: 10.15320/ICONARP.2023.253

city from developing unformed and acts as a buffer (Figure 6). In the downtown, there is a reduced-scale central park. There are structures such as municipal service areas, city centre business areas, and public buildings around this park. All roads in the city form a green corridor with boulevards and descend from the edge to the centre. Integrating with pedestrian roads, transportation axes, road afforestation, and linear parks has been implemented. Active and public medium-sized open and green spaces are located at the intersection points of the proposed green roads in each neighbourhood.

This suggestion is purely hypothetical. It is an adaptable system proposal even if it is applied to real life, even if property, urban policies, cost, topography, and many more problems are encountered. It can be applied in medium-sized cities with the themes of sustainability and ecology. This proposal system design aims to increase access to open and green spaces. While doing this, open and green space hierarchy was considered, and open and green spaces were diversified. While determining the types of open and green areas, they must be public and active spaces.

ACKNOWLEDGEMENTS/NOTES

This article is derived from the master thesis which named "*Açık ve Yeşil Alan Sistemlerinin Kentsel Yaşanabilirlik Bağlamında Değerlendirilmesi*" (Hızlı & Aktuğlu Aktan, 2022). It was also translated and published in the KBAM abstract book (Hızlı & Aktuğlu Aktan, 2021).

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DOI: 10.15320/ICONARP.2023.253

ICONARP
International Journal of Architecture and Planning
Received: 26.02.2022 Accepted: 24.10.2022
Volume 11, Issue 2/ Published: 28.12.2023
Research Article *DOI: 10.15320 /ICONARP.2023.254 E- ISSN:2147-9380*
ICONARP

A Theoretical Approach to the Spaces of the New Future: Planning under the Uncertainty Principle

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Abstract

Over the past few decades, the world has become an increasingly dangerous and complex place, and thus, expectations from spatial planning have changed. The study defines the concept of uncertainty as an important problem area of spatial planning. Based on lack of native studies on this subject, it is aimed to reveal how the uncertainties in spatial planning process are handled in international literature. It consists of two basic steps. In the first step, a three-stage model, "Uncertainty Components of Spatial Planning" is proposed. These stages involve (i) the conceptualization, (ii) the classification and (iii) the evaluation of uncertainty. In the second step, a triangular framework was formed for the conceptualization stage of this model having components of (1) identification and modelling, (2) theories and processes, (3) legal regulations. The theoretical handling suggested that the concept of uncertainty is synonymously used with the concepts of vagueness and ambiguity in everyday life despite their differences. It is also found that uncertainty is the subject of many international studies having a common point of presenting either a model or a method to evaluate uncertainty. These studies were categorized in three groups in handling uncertainty; (1) in multidisciplinary context within a general framework, (2) in the field of planning under two subcategories (2a and 2b), and (3) in the field of environment. The studies carried out in the second category allowed for regular conceptual patterns in themselves, and they were shallower and more inward-oriented than those studies in the 1st and 3rd groups, and there is an apparent interaction between the 1st and the 3rd groups. In the model proposed, the focus was only on (i) the conceptualization. However, as the origin, definition and basis of the concept of uncertainty were revealed, it might provide an important initiation for future studies. The study is original in introducing the concept of uncertainty to native literature by elaborating on how it is handled in international studies. Proposals were offered on how to place this concept on a theoretical basis before establishing an evaluation framework for uncertainties within the spatial planning process in Türkiye.

Keywords:
New future, New order, Spatial planning, Turkish planning system, Uncertainty

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To cite this article: Saka, M.Ö., & Erdoğan, A. (2023). A Theoretical Approach to the Spaces of the New Future: Planning under the Uncertainty Principle. *ICONARP International Journal of Architecture and Planning,* 11(2), 563-583. DOI: 10.15320 /ICONARP.2023.254

INTRODUCTION

Spatial planning is a process of organizing and implementing a plan by establishing an order between decisions given in the past, at the present, and in the future. However, the order in this process may not always proceed smoothly and be stable due to its multi-actor and multi-component nature. This may be said to be mainly the result of the increasing "unhealthy piles" of population in cities, as well as how wrong political engineering and planning–as a means of spatial intervention– decisions are addressed by precision approach. Since the late 20th century, the increase in negative impacts of climate change on social (drought, famine, poverty, climate migration, and wars) and natural life (extinction of species and destruction of nature) a new period came into the scene. Moreover, the level of capitalism, which is the ultimate point of modernism today and the Covid-19 pandemics since the end of 2019, has called for the need to the question of "new era order". At this point, there is need to remind that “the chief purpose of spatial planning at the level of regional, and even more so national planning is to give guidance in situations that are characterised by uncertainty and conflict around spatial development where there needs to be mutual learning.” (Faludi, 2000, p. 304).

It is a fact that the daily environment is significantly affected by the dynamic environment experienced, yet spatial planning has long considered this environment as “static”. However, as De Roo et al. (2020, p. 2) stated “[d]ynamic processes of change … that lead to … unexpected and unpredictable change demand a different planning perspective”. In particular, uncertainties, which display a breaking point or milestone characteristic, dominate gradually in everything today, are increasing, and “[a]t this stage, the issues of uncertainty and uncontrollability in social life, confront mankind with difficult and complex problems to solve.” (Karakaş, 2020, p. 551). In sum, recognizing and handling uncertainty in planning, an effective means of intervention in shaping the future, has become a key task (Silva, 2002; Maier et al., 2006).

The complement of the information, the lack of information, the gap between what is known and what needs to be known are typical characteristics highlighted in the definition of uncertainty. Uncertainty definitions have been made in various fields; however, an overall handling has not been possible due to its broad scope. Van Asselt and Rotmans (2002, p. 78) emphasize that it is difficult to define uncertainty, which is usually carried out by classification and that a means for this requires investigation of different sources of uncertainty. In planning discipline, deepening the concept of uncertainty by in a more comprehensive manner is important for the ideal management of urban uncertainty, which has a multi-dimensional structure as the city, but in today's complex systems, even this remain incapable. Being among the issues that decision-makers are focusing on, it is a priority for cities to find out what uncertainty measures can be in the urban planning process. In this context, unlike the principle of certainty that dominates the Turkish planning system, which is mainly shaped by the principles of traditional planning, it is necessary to develop methods that enable the evaluation of uncertainties in the setting of the new future. Although this discussion increasingly draws attention of international scholars, it remains as an issue that is not addressed in Turkish planning literature. In the literature reviewed, the focus on the classification of uncertainty

DOI: 10.15320/ICONARP.2023.254

has caused a shortfall in the theoretical look that is important in setting a base for the conceptualization of this phenomenon.

This study, remaining in the field of planning theory, focuses on the overlook of the uncertainty problem in Turkish the planning process. From here, the main goal is to make an in-depth literature review on uncertainty, and to discuss characteristics and the basis of handling the definition and conceptualization of uncertainty, models created for it, the related changes in planning approaches in a historical perspective. In this context, two key steps have been identified in the study. In the first step, a three-stage model called "Uncertainty Components of Spatial Planning" was proposed to address a theoretical framework based on uncertainty in defining the concept. The stages of the model with feedbacks in between are (i) the conceptualization, (ii) the synthesis, and (iii) evaluation of uncertainty. In the second step, a triangular framework was formed by focusing on the first stage, the conceptualization. This framework comprises components of (1) identification and modelling, (2) theories and processes, (3) legal regulations. The scope of the study was based on the conceptualization of uncertainty, the first stage of the model, and the first two components of this stage, "identification and modelling" (Section 2) and "theories and processes" (Section 3), were investigated in literature.

IDENTIFICATION AND MODELLING

In literature review, mainly the definition of uncertainty, its models, and grouping of these models were focused, and the link between the study and literature was set.

Identification

Uncertainty is a very broad term that can be interpreted differently and its forms can be defined in different ways. The "uncertain" that is addressed in this respect is defined as; "1a: not known beyond doubt, 1b: not having certain knowledge, 1c: not clearly identified or defined" in Merriam-Webster dictionary; "feeling doubt about something; not sure" in Oxford English Dictionary; "1) The degree to which a value or relationship is unknown. Uncertainty can be a result of a lack of knowledge, disagreement about what is known, data errors, ambiguous concept or terminology, or similar reasons. 2) Increasing likelihood of unpredictable development of future expectations, the failure to know the possibilities and changes in a specific subject or field" in the Glossary of Terms against Desertification/Land Degradation and Drought (2015). Öztürk et al. (2019, p. 36) who studied the impact of the phenomenon on institutions/organizations defined uncertainty as "inability to predict accurately what will happen in general". Since the "probability world of thermodynamics" and its first laying out by Heisenberg in the field of quantum physics in 1927 (Tekeli, 2009, p. 305) and from the 1920s to the 1960s, in the works of Heidegger, who saw the purpose of philosophy as basic ontology and who was one of the important philosophers of existentialism, uncertainty has found place in theory and practice of many fields.

Led by these studies, "[i]t has become important to address the future through indeterminacy perspective, and moving away from Newtonian understanding of causality and thus approaches that the future will be closed to surprises and predictable." (Tekeli, 2009, p.

305). According to Balamir (2018, p. 63) "uncertainty is a situation, where there is a lack of knowledge in risk management environments or where change predictions are impossible due to the numerous factors and where there are decision-making difficulties." This phenomenon has been widely discussed in economics, especially in the 20th century, and has been the subject of many studies in methodological and theoretical context (Aksoy and Şahin, 2009).

"In reality, uncertainty is complex and, in many cases, the full concept is difficult to communicate or condense into one or two sentences." (Skinner et al., 2013, p. 196) and "it can be seen as a result of error, ambiguity, vagueness or lack of information and forms an umbrella term for these concepts" (Fisher; 1999 and Atkinson and Foody, 2002 cited in Vullings et al., 2007, p. 3). At this point, it is also necessary to clarify the concepts of ambiguity and vagueness, which are often used synonymously with the concept of uncertainty (Table 1).

Table 1. Definitions of the terms ambiguity and vagueness

Dictionary	Concept	Definition
Turkish Language Institution	ambiguous	the state of being ambiguous
	vague	uncertainty
Oxford English	ambiguous	that can be understood in more than one way; having different meanings
	vague	not clear in a person's mind
Merriam-Webster	ambiguous	doubtful or uncertain especially from obscurity or indistinctness; inexplicable; capable of being understood in two or more possible senses or ways
	vague	not clearly expressed: stated in indefinite terms; not having a precise meaning; not clearly defined, grasped, or understood: indistinct, slight; not clearly felt or sensed: somewhat subconscious
Cambridge	ambiguous	having or expressing more than one possible meaning, sometimes intentionally
	vague	not clearly expressed, known, described, or decided

A simple example of definitions in Table 1 can be given as;

- Ambiguity: I saw Melissa with my binoculars. -There are two possible meanings.

First, I saw Melissa while wandering around with my binoculars, and Second, I saw Melissa while she was looking at something with my binoculars.

- Vagueness: I saw Melissa there. -There's no detail about where she was seen.

"[U]ncertainity … that involves the shock, surprise that an individual experience … is an ex-post concept. However, uncertainty also means lack of knowledge about the future [as seen from the dictionary definitions discussed above]; that gives [to it] ... an ex-ante dimension (Yalçınkaya and Özsoy, 2003, p. 4). Decisions taken by planning, which is a broad-framework discipline, can create uncertainties to an acceptable extent (Türk and Erkan, 2018). Based on his claim that "[t]he future is the great unknown" Abbott (2005, p. 237) emphasizes that "[p]lanning is about changing the future, or at least the expected future."

DOI: 10.15320/ICONARP.2023.254

As Myers stated (2001, p. 366), "the future is the only issue that other professions have transferred to planners as a relatively undisputed field". According to Abbott (2005, p. 237), "[u]ncertainty is a term that is used widely but rarely defined" According to Christensen (1985, p. 63) "[a] crucial planning task is to discover, assess, and address uncertainty." As Moroni and Chiffi (2021, p. 10) also stated "[r]ecognition of the existence of uncertainty does not imply in itself that we can know nothing or do nothing. It simply asks for adequate strategies to cope with it." Based on these explanations and in its broad scope, it can be stated that "to address uncertainties is one of the reasons for existence of planning". However, the basis of the definition offered to planners under the unknowns is not sound and is not expected to be so under the current circumstances.

As of the first quarter of the 21st century, all natural events/hazards such as floods, earthquakes and landslides that are now more severe as a result of human pressures accumulated on nature pose increasing threats to settlements and cause disasters that result in damage and loss. This is supported by the latest reports from the Intergovernmental Panel on Climate Change (IPCC). The 5th report predicts that the increase of greenhouse gases will continue, especially with applications for the development of the energy sector, and thus global warming and climate changes will continue in the future (IPCC, 2014). The 6th report mentions that even if carbon dioxide emissions are reduced to net zero and global warming stops, glacier melting and sea level rise will take thousands of years (IPCC, 2021). In addition, with the Covid-19 global pandemic started at the end of 2019, predictions for the future are fundamentally upset. In order to ensure the support for this new order of planning paradigm and practice within the scope of this changing social order, the focus should not only be on future uncertainties but also on the uncertainties and its dimensions for the past, present and future. This is one of the important issues on the agenda of the international article studies (Bulutay, 2011).

Environmental issues and uncertainty in planning are defined in two ways.

- "Ordinary uncertainty derived from probabilistic nature of the phenomena, and
- Incertitude, defined by the uncertain knowledge or even ignorance, not knowing the environment and the processes in it." (Chechile, 1991 cited in Mlakar, 2009, p. 93).

According to Mlakar (2009, p. 92) "[t]he uncertainty in spatial planning is reflected as a series of diverse doubts in virtually all aspects and phases of planning, as the causes for uncertainty are numerous." As for Sissoko (2020, p. 33), "[u]ncertainty can be defined as the difficulty to predict with accuracy the outcome of planning during the planning process or the actors' behavior toward plans implementation." However Denoo (2020, p. 13) states that "the perspective of uncertainty in theory and practice of urban planning is nearly uncharted." A similar thought is

asserted by Marris (1987, p. 159) as "[p]lanning means, essentially, controlling uncertainty – either by taking action now to secure the future, or by preparing actions to be taken in case an event occurs".

The current situation of planning, characterized by the traditional planning paradigm, as Yaman Galantini (2018, p. 57) states "plans … are not dealing with unexpected change, they are not updated and they no longer respond to the current requirements" has called for a need to establish the acceptable criteria of the uncertainties–such as illegal/ irregular construction, construction densities, continuous interventions to natural areas, gaps between decisions and their implementations–and evaluate their state. In line with this, from the late 1970s to the present, "a significant emphasis is made on the concepts such as "ambiguity, uncertainty, contingency, [...], indeterminacy" (Çelik, 2003, p. 194).

Modelling

The fact that uncertainty exists in all areas and the need to be dealt with in a transparent and effective manner is inevitable. Different categories are used to understand and conceptualize uncertainty in the studies that deal with this subject (see Van der Sluijs, 1997; Walker, 2003; Maier and Ascough, 2006). Early research focused on assessing uncertainty due to possible systematic errors in a physical measurement (Henrion and Fischoff, 1986; Beck, 1987), yet, over time, a need has emerged to address this concept in various dimensions. In particular, for the last two decades, there has been a rapid evolution in the conceptualization of uncertainty. These studies for modelling uncertainty in decision-making process were summarized in three groups with respect to their addressing of the uncertainty either (1) in interdisciplinary scope in a general framework; (2) in planning–examined in two subcategories (2a and 2b), and (3) in the field of environment (Table 2).

The pioneering study in the creation of a general assessment framework for uncertainty in the first group is the uncertainty matrix developed by Walker et al. in 2003. In this context, three dimensions and their subcomponents are proposed concerning the location, level, and nature of uncertainty (Table 3). Although the basic framework of the matrix remained similar in the subsequent studies referring to this study, it was used by making changes especially to its subcomponents. According to this matrix, uncertainty should be addressed by it locational subcomponents of context, model, inputs, parameters, model outcomes at the levels of statistical uncertainty, scenario uncertainty, or recognized ignorance, and as epistemic or variability uncertainty in terms of its nature (Table 3).

DOI: 10.15320/ICONARP.2023.254

Table 2. Studies on uncertainty literature reviewed and their grouping within the scope of the study (*)

Group	Author/s-year	Study
1	Walker et al., 2003	Defining uncertainty: A conceptual basis for uncertainty management in model-based decision support
	Petersen, 2006	Uncertainty and economic analysis of climate change: A survey of approaches and findings
	Van der Sluijs et al., 2008	Exploring the quality of evidence for complex and contested policy decisions
	Knol et al., 2009	Dealing with uncertainties in environmental burden of disease assessment
	Kwakkel et al., 2010	Classifying and communicating uncertainties in model-based policy analysis
2a	Christensen, 1985	Coping with uncertainty in planning
	Friend, 1993	Planning in the presence of uncertainty: principles and practice
	Stacey, 2007	Strategic management and organisational dynamics: The challenge of complexity to ways of thinking about organisations
	Bertolini, 2010	Coping with the irreducible uncertainties of planning: An evolutionary approach
2b	Abbott, 2005	Understanding and managing the unknown: The nature of uncertainty in planning
	Vullings et al., 2007	Dealing with uncertainty in spatial planning
	Mlakar, 2009	Uncertainty in spatial planning proceedings
	Abbott, 2012	Planning as managing uncertainty: Making the 1996 Livable Region Strategic Plan for Greater Vancouver
	Lau, 2015	Tackling uncertainties in plan implementation: Lessons from a growth area in England
	Wei et al., 2016	The general land-use planning in China: An uncertainty perspective
3	Maier and Ascough, 2006	Uncertainty in environmental decision-making: Issues, challenges and future directions
	Refsgaard et al., 2007	Uncertainty in the environmental modelling process – A framework and guidance
	Ascough II et al., 2008	Future research challenges for incorporation of uncertainty in environmental and ecological decision-making
	Mosadeghi et al., 2013	Uncertainty analysis in the application of multi-criteria decision-making methods in Australian strategic environmental decisions

(*) The studies from which the arrows originate, pioneer the methodology of the ones where the arrows reach, either in the same or different group.
(The groupings belong to the authors)

Table 3. Uncertainty matrix (Walker et al., 2003, p. 15)

LOCATION		LEVEL			NATURE	
		Statistical uncertainty	Scenario uncertainty	Recognised ignorance	Epistemic uncertainty	Variability uncertainty
Context	Natural, technological, economic, social and political, representation					
Model	Model structure					
	Technical model					
Inputs	Driving forces					
	System data					
Parameters						
Model Outcomes						

Using this framework Kwakkel et al. (2010), have made changes to its level and nature subcomponents. Ambiguity is introduced into the

nature dimension of uncertainty and the importance of considering multiple frameworks is emphasized. In the level subcomponent, it was criticized that in the previous matrix it was classified with groups for technical examination and was open to multiple interpretations, and four levels were proposed in expressing the level of uncertainty with a sound setup of the "measurement scales theory" including shallow, medium, deep uncertainty and recognized ignorance (Kwakkel et al., 2010, p. 312). Despite these changes, the common characteristics of the studies are the use of location, level, and nature dimensions to understand uncertainty (see Refsgaard et al., 2007; Van der Sluijs et al., 2008). The content of these three dimensions is briefly summarized below.

- Nature: It is related to the question of why a phenomenon is uncertain. It is whether the uncertainty is caused by external factors or entirely from the process itself (such as lack of information). For example, ontic uncertainty, epistemic uncertainty.
- Level: It is related to the question of to what extent uncertainty can be reduced. Here, an indicator chart is used, from the generally certain situation to the full state of ignorance.
- Location: It is related to the question of what is uncertain. It aims to understand what kinds of uncertainties (data uncertainty, model uncertainty) exist in which step in the stages of the development of the phenomenon.

Another model that broadly addresses uncertainty in the first group is the framework proposed by Petersen (2006) and developed by Knol et al. (2009, p. 3) defines six characteristics of uncertainty as "location, nature, range, recognized ignorance, methodological unreliability and value diversity among analysts". Analysing uncertainty as a "technical" problem or simply addressing it through consensus interpretations of inconclusive evidence has been inadequate over time. With a different approach, Van der Sluijs et al. (2008) suggested various focuses such as the creation of the problem framing, involvement of stakeholders, selection of indicators, appraisal knowledge base, mapping and assessing of relevant uncertainties and reporting uncertainty information. In the focus of mapping and evaluating the relevant uncertainties, the development of the uncertainty matrix proposed by Walker et al. (2003) and integrating it with the sample uncertainty issues examined is aimed. As a result, a typology of uncertainty for the assessment and communication of uncertainty was developed and implemented in terms of an environmental problem (Van der Sluijs et al., 2008).

In the second group, the handling of uncertainty within the scope of planning discipline was examined in two subcategories (2a and 2b) (Table 2). The first category (2a) comprises the framework proposed by Christensen (1985) and similar ones following his pioneering work. All the works in this category try to understand the impacts of complex and

DOI: 10.15320/ICONARP.2023.254

indeterminable situations. The second category (2b) involves the framework proposed by Abbott (2005) and the studies pioneered by his work. All the works in this category focus on the continuous interaction of the planning process and the social environment though emphasizing the need for their separate handling in the context of uncertainty.

In Christensen's (1985) matrix, which is widely used and forms the basis of the uncertainty studies in the first category (2a) (Table 2), to achieve a total of four planning situations of uncertainty 'the state of knowledge' is related to the tool (technology) variable and 'the state of compromise' is related to the goal variable on the axes of binary dimensions (Figure 1). Here, the focus is on agreement on the goal and on knowingness of the tool (technology) for transitioning from certainty to chaos in planning. In other words, "[t]he matrix produces four prototype variations of conditions that can characterize planning" (Christensen, 1985, p. 64). In the first region (A) there is certainty in planning. In the second region (B), planning turns into a learning process, in the third region (C), it turns into a negotiation process. In the last region (D), there is chaos environment in planning (Figure 1).

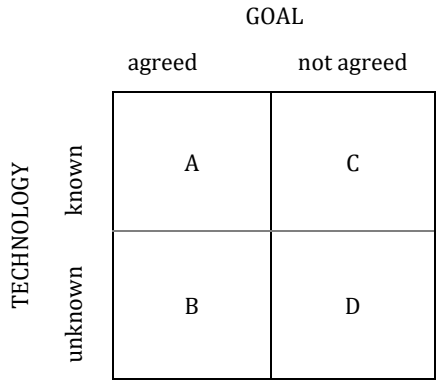
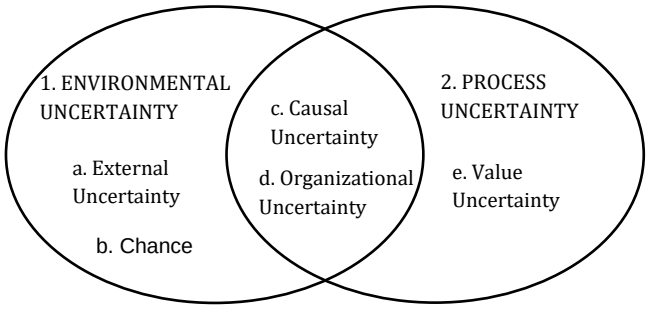


Figure 1. Prototype conditions of planning problems (Christensen, 1985, p. 64)

Again in this category (2a); another effective framework for assessing uncertainty in the strategic choice approach was proposed by Friend (1993). Unlike Christensen's framework (1985), this framework is based on the handling of uncertainty within the planning process, not on tools (i.e., technology) and goals. Uncertainty is defined in three areas. The first field is "in the work environment", which requires different examinations, and the second is "for the guiding values" that show the transparency of the objectives, and the third is the uncertainties "about the relevant choices" outside the problem area (Friend, 1993, p. 3). Based on these areas, the need for planning to learn in managing uncertainty in a strategic manner is emphasized. The state of chaos (region D in the matrix), which was characterized by unknown technology and no agreement among the four variations of Christensen (1985) is detailed by Bertolini (2010) with a similar framework composed of quadruple regions. In another study examined, Stacey (2007) proposed a quite similar framework to Christensen's (1985) yet different from it in terms of the nature of the variables. So as to make graduality/rationing possible, a shift is made from the binary categorical

scale to the ratio scale in variable measurement and the goal-technology duality turned into a disagreement-uncertainty duality. Adapting the matrix in this way allows the complexity of the planning problem to be defined with respect to the amount of uncertainty and disagreement (Stacey, 2007).

The second category (Table 2) was pioneered by more recently by the model developed by Abbott (2005) who synthesized the proposals of Christensen (1985) and Friend (1993). With this model, it is aimed to discover the five dimensions of uncertainty that affect planning, and these five dimensions are addressed under two main areas of uncertainty arising from the social environment that everyone can perceive at a different level and the planning process that only those responsible/concerned can perceive (Abbott, 2005, p. 239) (Figure 2). One of the main uncertainties arising from Christensen's goal and technology (tool) form the basis for process uncertainty while its subcategories (c, d, e shown in Figure 2) are composed of some types of uncertainties proposed by Friend (1993).



1. ENVIRONMENTAL UNCERTAINTY; Uncertainty caused by the social environment or uncertainty of planning;
   a. External uncertainty; uncertainty about the wider social environment and how it relates to and influences the situation
   b. Chance; truly unknowable for once chance events
   c. Causal uncertainty; uncertainty about the basic causal relationships (physical, economic, and social) in the situation
   d. Organizational uncertainty; uncertainty about predicting the actions and future intentions of other people and organizations in the situation
2. PROCESS UNCERTAINTY; Uncertainty arising from the planning process;
   c. Causal uncertainty; uncertainty about the basic causal relationships (physical, economic, and social) in the situation
   d. Organizational uncertainty; uncertainty about predicting the actions and future intentions of other people and organizations in the situation

Figure 2. Dimensions of environmental and process uncertainties
(The explanations and the figure combined from Abbott, 2005, p. 239, 242, and 245)

In the study of Vullings et al. (2007), which was examined in the second category (2b) of planning, a framework dealing with uncertainty in spatial planning and aiming at increasing transparency of planning processes is described, and similar to Abbott (2005), the need to address uncertainties throughout the planning process, is highlighted. An uncertainty classification guideline consisting of plans, processes and procedures has been developed for spatial planning. Mlakar (2009), who designed his work according to these two frameworks, was interested in uncertainties in the field of spatial planning based on

DOI: 10.15320/ICONARP.2023.254

certainty and absolute knowledge. The author (2009) proposed procedures based on two main principles of standardization (norms and rules depending on predefined solutions) and optimization (best solution), focusing on the reduction of uncertainties in planning similar to Vullings et al. (2007). According to Mlakar (2009, p. 102) "[t]he co-existence of both principles is possible and necessary, but the reasonableness of using one or the other depends primarily on individual steps within the planning process and the context of solving everyday spatial planning problems." In relatively new studies, it is seen that the implementation dimension for uncertainties in planning has been a prevailing issue. One example is Abbott's study in 2012, in which he applied the model he developed in 2005 to a plan, examining the impact of planning on uncertainties (Abbott, 2012). As a result, it is stated that the uncertainties in the implementation process have not disappeared even for a finalized plan that has been agreed upon. Another is Lau's 2015 study, defining the two broad types of uncertainty based on Abbott's (2005) model covering the plan making process. In complementing the shortcoming of Abbott's model that lacks the plan implementation stage, Lau (2015) contributed to literature by revealing how different types of uncertainty can be discerned and handled through both plan making and plan implementation by means of sample plans.

In another study, Wei et al. (2016), in order to reduce uncertainties in land-use planning has defined the social environment uncertainties in Abbott's (2005) model as external; process uncertainties as internal factors and applied them to a planning case. In addition, the authors (2016, p. 375), similar to the two main principles defined by Mlakar (2009) state that as for the forms of intervention into internal uncertainties; "[i]n future planning practices, we should improve land-use planning theory, optimize land-use planning schemes and strengthen land-use planning legislation to incorporate the uncertainties fully and ensure the legislations authority, effective implementation, and value as a guideline in the planning process."

Studies reviewed in the third group (Table 2) address uncertainty in resolving environmental problems, and some of them adapt models proposed in the first and second groups to environmental problems. Maier and Ascough (2006) took into account the data, model, and human factors in modelling uncertainty in environmental decision-making process and pioneered in the measurement of uncertainties related to human impact with the model they proposed. Afterwards, Ascough II et al. (2008), by combining the uncertainty criteria with their types, defined a wider framework, where they proposed criteria for information, variable, decision, and linguistic uncertainty. Mosadeghi et al., (2013) have used the uncertainty framework including uncertainty types of location, level, and nature, which also formed the bases for the works of Walker et al (2003) and Refsgaard et al. (2007).

As seen, various models of uncertainty have been developed in different fields. Skinner et al. (2013), who investigated such models in terms of the characteristics of uncertainty as part of environmental risk research, concluded that even in a single scientific field, the terminology that is established is inconsistent and sometimes contradictory. The studies reviewed above also support this conclusion. It can be said that the reason for this is to be a direct classification of a concept, such as uncertainty, which is rather abstract and not yet defined in a particular form in any field, without further investigation.

THEORIES AND PROCESSES

A brief look at the history of civilization would be an essential starting point to interpret the historical development of planning in terms of increasing uncertainty. Toffler (2008) defines this history as three waves: The first involves agricultural development, the second involves industrial development, and the last one involves technological progress. In other words, "[c]ivilization; evolved or has been evolving with sometimes slow and sometimes or rapid pace under various names such as agricultural society, industrial society, information society, modern or post-modern society." (Yalçınkaya and Özsoy, 2003, p. 2). The approaches of planning as a regulatory institution, which is necessary for solving the unique problems of different, diverse, and very long-term social characteristics,–for example, the industrial revolution is divided into four different periods as 1.0, 2.0, 3.0, 4.0 periods (Eğilmez, 2018)–also evolved/has been evolving.

Until the mid20th century, the spatial planner was regarded as an organizer who did not need to explain how he/she arrived at the solutions of the problems in planning and predicted the future perfectly. However, this ongoing state of affairs underwent a significant change in the 1960s, especially by environmental movements. While initially the focus was on the final product (plan) by focusing only on the content/essence of planning, later approaches that took into account the planning process and were based on communicative rationality began to gain importance (Figure 3). In other words, "[p]reconceived notions based on the view that assume plans as ideal policy decisions (such as technical, rational, non-political, neutral, long-term and comprehensive best solution, complete and precise knowledge, homogeneous society and unitary public interest) are now controversial." (Demirci, 2004:309). That way, previous approaches dominated by the deterministic decision-making environments in which the future is seen as predictable, and the uncertainty is ignored despite its factual existence in every period, have come into question, and it has become essential to deal with uncertainties in later approaches (Eraydın, 2017) (Figure 3).

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	1900-1950s	1950-1960s	1950-1960s	1980-1990s	2000s +	
	PLANNING APPROACHES					
Deterministic decision-making environments are dominating and uncertainty is not on the agenda yet.	- Classical Planning - Urban Utopias: Garden City Beautiful City Linear City Industrial City Radiant City Wide Land City	Rational tradition: - Comprehensive Rational Planning - Judicious Planning - Marxist Planning - Systems Planning	- Incremental Planning - Pluralistic and Advocacy Planning	Globalization and project-based planning approaches: - Process Planning - Strategic Planning - Participatory Planning - Communicative Planning - Interactive Planning	- Adaptive Planning - Sustainable Planning - Protection-oriented Planning - Various urban planning approaches (eco-cities/healthy cities, etc.)	Discussions on uncertainty and the risks associated with came ito scene. Planning may not be able to foresee the future.
	- 19th century modernist planner solutions for the poor living conditions of industrial cities - Analytical frameworks built on the stability of the social and political structure - Only the problems related to the physical structure of the city are handled - Controlling urban changes with deterministic and top-down plans.	- The era of instrumental rationality - Holistic planning Approaches related to content/essence - The aim of reaching the final product based on modernity after World War II - What is a good plan? The city is not only handled physically, but also as a whole with its social, economic and societal problems.	- The dominant idea is that a fragmented social structure with different interests makes a rational and comprehensive planning approach impossible in an environment of high uncertainty - It is not discussed how the plan will be made, but for whom it will be made.	- Habermas's Communicative Action Theory based on communicative and strategic rationality - Prosedürel approaches It is important to agree on the process while reaching it, not the final product. - How to get a good plan? A more scientific and analytically based flexible perspective for cities that become complicated as a result of lacking a final physical plan	- Action-oriented and visionary approaches - Planning to respond to complex problems and act flexibly for the uncertain future	
	THE CONTENT OF THE PLANNING					

Figure 3. Changes in planning approaches over time and their handling of uncertainty
(Created using the figure in Yiftachel, 1989, p. 27, the explanations from Ayrancı, 2013, p. 42 and Ersoy, 2007; Tekeli, 2009; Levent and Sarıkaya Levent, 2011; Eraydın, 2017; Prosperi and Morgado, 2011)

It is seen that the concern in foreseeing the future has decreased, the main goal has become to arrive at a consensus on a solution" (Eraydın, 2020, p. 6) when looking at the theories and practices of the communicative planning approach that have its foundations established in the 1990s. However, since the early 2000s signals for an agenda of complex problems in the future started with large-scale changes made by neoliberal processes in cities (Keskinok, 2006; Levent and Sarıkaya Levent, 2011). As neoliberal pressures start causing irreversible destructions in cities (rapid population growth, floods, earthquakes,

etc.) and as conflicts between different interests on spatial decisions (e.g., economic development and ecological principles) emerge, an increase in focus on environmental planning issues is observed. So much so that the new world order

> spatial planners today need to balance many different interests contemporaneously, such as fighting against land scarcity while supporting economic growth, or striving to achieve a socially just distribution of land while emphasizing the importance of healthy urban living and flood resilient cities. (Gerber et al., 2018, p. 344).

This changing nature of space is expected to be addressed as the complex problems of the new world order, especially with sustainability and climate change issues, and uncover the need for renewed planning approaches to these issues (Rittel and Webber, 1973; Eraydın, 2017).

As seen in Figure 3, adaptable, participatory, interdisciplinary and mixed-focus planning approaches have been forming the bases of current planning practices, which entered into the agenda as a result of increasing uncertainty since the 2000s (Ersavaş Kavanoz, 2021). In this theoretical study, it can be stated that although the planning approaches are directed towards uncertainties, as far as the implementation is concerned, that is, in practice, the planning process still focuses on the final product and the uncertainties are ignored due to the continuation of traditional planning habits under the principle of certainty.

MODEL PROPOSAL ON "UNCERTAINTY COMPONENTS OF SPATIAL PLANNING"

Since the 1950s, the theoretical basis of planning, in which the future is predictable and identifiable with reference to "rational holistic planning" as a reflection of modernist thinking, continues to have an effect as a dominant understanding, and there is no room for uncertainty in planning decisions (Eraydın, 2020, p. 4). That is, uncertainty is not a concept taken into account in this understanding of planning as it has the infrastructure to know all kinds of circumstances for the future from today. Eraydın (2020, p. 14) expresses this situation by pointing the present day as: "Unfortunately, there is no concern on Türkiye's planning agenda to prepare cities and regions for the future and to develop capacity to cope with uncertainties." New theoretical studies are being carried out, including the issues that even the near future cannot be fully known and that planning should be dealt with approaches based on different foundations (Figure 3). However, it is also the case that these approaches do not have norms and standards and applications that can survive for years as the traditional planning approach (Ersoy, 2007). Moreover, as Abbott (2005, p. 239) emphasizes, "[u]ncertainty about the future is not the only relevant uncertainty for planning. Many aspects of the past and present may not be known or are uncertain". There may be ambiguities in information about past events, information about the current environment, and even the views of individuals or groups. From a different aspect, this situation can be grouped as the uncertainties related to the values of the guiding groups

DOI: 10.15320/ICONARP.2023.254

and political-technical decisions arising from the implementation framework. The process in which these approaches are joined in holistic manner is the "planning process". According to Mlakar (2009, p. 98), "[t]he framework for defining the other guidelines of uncertainty reduction is the planning process itself." Evaluating the rules or the steps of this process can enable the identification and management of uncertainties to a significant extent. However, for Turkish cities, the lack of "no concern … to prepare cities and regions … to develop capacity to cope with uncertainties", as Eraydın (2020, p. 14) states, and the ingrained, traditional planning approach adopted in practice as mentioned above are among the important shortcomings.

The planning process consists of the steps defined for the spatial plan to take its final form. In this study, a suggestion is made for the need for handling of spatial planning on the basis of uncertainty, and thus a need for developing a process-oriented approach. However, it should be a priority to present a scientific basis for the expression of uncertainty that we often use in everyday life. In this way, a shift can be made to the stages of embodying the concept of uncertainty, which is an important requirement for establishing a connection between spatial planning and uncertainties. Uncertainties cannot be managed if they are not identified, and potential types of uncertainty may not be identified if they are not understood. The direct focus on the classification of uncertainties in the reviewed literature should be approached critically. In addition, there is no clear method that directly relates this concept to urban planning in the discussions in the uncertainty literature. Based on this shortcoming, in this study, a three-stage model is proposed for how uncertainties should be defined in the Turkish planning system by considering a theoretical framework on the basis of uncertainty in the first step. This model consists of (i) the conceptualization, (ii) the synthesis, and (iii) the evaluation stages with feedback processes in turn, which are collectively referred to as the "Uncertainty Components of Spatial Planning" (Figure 4).

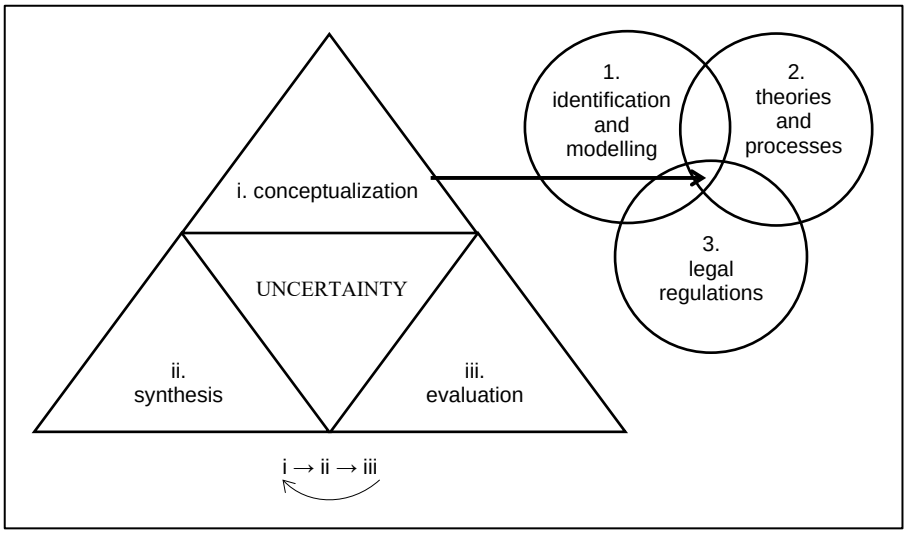

Figure 4. Uncertainty components of spatial planning and the subcomponents of its conceptualization
(Created by authors)

In the second step, a trivet was developed by focusing on the conceptualization stage (Figure 4). The features of this trivet and how it should be handled are described below:

(1) Identification and modelling: It is the examination of various definitions and suggested methods (models) for uncertainty within the scope of revealing the criteria for an uncertainty-based assessment that cannot be reduced to less. Here, the focus should be on international and native papers, research reports, books, and theses. In the present study, this review was carried out in terms of the international papers.

(2) Theories and processes: It comprises, from a historical perspective, the handling of contemporary planning theories for how their planning process steps and actions these for steps progress and change within the context of uncertainty. Here, it will be important to shift from the universal level to the site-specific investigation. In other words, in a study whose case area is in Türkiye, first, planning theories and uncertainty in the planning process should be evaluated, and then the prevailing planning approaches and uncertainty assessment in Türkiye should be taken into account. In this study, a literature review regarding the former step, i.e., the one before the site-specific investigation was conducted.

(3) Legal regulations: It is the introduction of how legal instruments such as laws, regulations, decrees, technical specifications that are binding for spatial planning provide the infrastructure in terms of uncertainties. Here, site-specific investigations will gain importance. That is, in a study whose case area is in Türkiye, the legal bindings of Turkish planning practices should be taken into account. This stage is not covered in the current study.

CONCLUSIONS AND RECOMMENDATIONS

Although planning approaches tend towards uncertainties with their changing context over time, it is observed in real planning practices, which should be based on such a basis, ignore uncertainties due to the continuing dependence of the traditional approach on the principle of certainty. Although it is criticized in many respect today, in the known state of “the involvement of the approaches and principles of holistic planning in implementation” (Eraydın, 2017, p. 564), which are effective in planning, at the very least, it will be required to reinterpret the basic stages of the traditional urban planning process in terms of the assessment of uncertainties. In the new world of the 21st century, along with the revision in the components of many disciplines, such a change/development in planning has become a necessity that cannot be postponed. It is important to define “uncertainties” for such an adaptation in the urban planning process. By doing this, it will be possible to assess whether urban planning processes are sufficiently effective or to what extent decisions are made under uncertainties. The starting point for such an assessment requires an in-depth conceptual analysis of uncertainty and an understanding of how the concept has gained a place in urban studies. The important aspect here is that the

DOI: 10.15320/ICONARP.2023.254

process of challenging with uncertainty should not only cover increasing the certainty of events but also providing room for manoeuvre in case of an unpredictable development of events. According to Abbott (2012, p. 571), "[t]he concepts of planning and uncertainty are closely linked …. [and in concluding his case study he explains that this particular] "plan-making process … is a dynamic interplay of expected and desired outcomes, actions and proposed actions, and uncertainties".

The international literature review in this study revealed that there has been a rapid evolution in the conceptualization of uncertainty, especially in the last two decades, and that different concepts have been used to classify uncertainty (see Walker et al., 2003; Abbott, 2005; Maier and Ascough, 2006). With the grouping of studies reviewed into three categories, a higher level of detail and interaction were observed between the dimensions and subcomponents of the uncertainty handled (1) in multidisciplinary studies in a general framework and (3) in environmental studies contrary to more shallower and inward-oriented (2) planning related studies.

As for a main limitation of the reviewed studies it can be stated that there have been no findings to address the conceptual foundations of uncertainty, models synthesising site-specific characteristics, and/or assessment of uncertainties in implementation. From here, the "Uncertainty Components of Spatial Planning" model is introduced, which will involve all these three stages as the main framework. With this model, it is thought that awareness will be raised for addressing uncertainties that are increasing daily, especially in the field of spatial planning, yet cannot go beyond discourse. After the completion of the three-stage model, one part of which is covered in the study, and the trivet in its first phase, an uncertainty-based evaluation framework should be established that will conform to the spatial planning system of Türkiye.

In this context, an effort is made to establish a conceptual basis for the places of the new future where uncertainty is decisive, and it was concluded that more comprehensive studies should be carried out in this regard, especially in the field of planning, on this subject ensuring a higher level of interaction with other disciplines.

Thus, with the development of the proposed model in future studies, it will be possible to embody an uncertainty-based evaluation framework that can be integrated with Turkish spatial planning system in the context of planning problems in example cases.

ACKNOWLEDGEMENTS/NOTES

This study was a preliminary work for the PhD thesis entitled "Mekansal Planlama Sürecinin Yeniden Ele Alınışı: Belirsizlik Temelli Bir Değerlendirme Çerçevesi", by Mihriban Öztürk Saka under the supervision of Aygün Erdoğan in Karadeniz Technical University.

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DOI: 10.15320/ICONARP.2023.254

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ICONARP – Volume 11, Issue 2 / Published: 28.12.2023

ICONARP
International Journal of Architecture and Planning
Received: 27.02.2022 Accepted: 06.02.2023
Volume 11, Issue 2/ Published: 28.12.2023
Research Article *DOI: 10.15320 /ICONARP.2023.255 E- ISSN:2147-9380*
ICONARP

Psychogeography in Planning: A New Methodological Approach via Representations of 'Body', 'Urban Space' and 'Walking'

Yasemin İlkay*

Abstract

Pattern of urban space penetrates the minds and bodies of citizens; this penetration results in a two-folded map: physical and psychogeographic maps. *Mental representations* enable (re)-reading the invisible components of physical organization through spatial practice. Re-mapping such an authentic spatial knowledge is a crucial but neglected field of enquiry within planning to grasp the gap between 'what is conceived' and 'what is experienced'.

'Psychogeography' concentrates on how the environment influences individuals' feelings and attitudes and therefore –at the intersection of geography and psychology– it presents an epistemological basis to examine such a gap and offers methodological inputs to cover the interrelation among top-down designs of urban space and bottom-up reproductions of 'the soul' of the city. Within this context, the main question of the study is "how the representations of walking experience can be used within planning with reference to the two-folded map assumption". During this examination, theoretical and methodological readings on psychogeography led us to an *epistemological baseline*, as an initial step to construct a new spatial methodology of the 'body' and 'walking experience'.

The studyk is composed of three sub-sections. Firstly, the gap between 'physical' and 'psychological' maps is conceptualized. Secondly, the concept of *psychogeography* is defined as a source and method of spatial knowledge within its deficiencies and potentials. Lastly, the term, *Dérive*, implying 'deviation' and 'resistance', is discussed as a methodological path in grasping the gap between physical and psychological maps via the experience of body and conception of the designer.

Keywords:
Body, dérive, psychogeography, representations of space, walking.

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To cite this article: İlkay, Y. (2023). Psychogeography in Planning: A New Methodological Approach via Representations of 'Body', 'Urban Space' and 'Walking'. *ICONARP International Journal of Architecture and Planning,* 11(2), 584-603. DOI: 10.15320 /ICONARP.2023.255

INTRODUCTION

Urban spatial pattern indicates a two-folded map while penetrating citizens' minds and bodies. On the one hand *the physical map* exists as a real and concrete scale of reality and on the other hand *a psychogeographic map* appears as a personal and abstract level of representations of spaces. The physical patterning, which is composed of 'occupancy' and 'vacancy', touches the walking body in urban space and shapes the *mental representations* within spatial repertoires through *nodes* and *routes*. Collecting and evaluating these mental representations of the body in relation with urban space, via the spatial experience of walking, gives room to re-read the invisible components of both physical organization and spatial practice within its psychological and societal inputs. On the basis of such a reading, re-mapping invisible components of spatial practice is possible, which is crucial to grasp the gap between 'what is conceived' and 'what is experienced'. Planning as a discipline neglects such enquiries which may generally result in unsuccessful top-down trials of spatial re-formations. A meso-level enquiry (from 'the self' to 'the context'[1]) is needed to grasp the gap between these two realities – the physical-spatial and the socio-psychological levels– and so 'psychogeography' appears as a field of study, giving alternative methodological inputs to produce such a knowledge of urban spatial pattern. Then what is *psychogeography*?

[1] Layder (1993) introduces four scales of research: (1) context, (2) setting, (3) situated activity, (4) self. This frame can be adopted socio-spatial analyses as well.

Psychogeography examines the interaction between geography and psychology concentrating on how the natural and built environment influence the feelings and attitudes of individuals. We can trace its development especially in the field of literature as Covery (2011) demonstrates in his book named *Psychogeography*. It is new to adopt the term to spatial analyses, which has a fruitful potential in planning and design areas. In 1950s, led by Guy Debord (1955), *Situationist International Movement* posed the concept 'psychogeography' within their artistic point of views, however a political content flourished with the term, *Dérive* (implying 'deviation' and 'resistance'); soon this term evolved to 'a political tool to transform the urban everyday life' (Covery, 2011). In her thesis, *Psychogeography as a Tool of Urban Spatial Experience*, Jale Sarı (2013: xv) defines the term 'derive' as: "saunters of individuals throwing everything in the wind within their everyday life," which implies the main technique of psychogeography while experiencing the urban space.

Psychogeography has an elastic and ambiguous nature which complicates the construction of a possible methodology within planning since psychological projections of urban space change rapidly and it is difficult to use the knowledge and maps of individuals as an objective and general source of knowledge. Therefore, to construct a psychogeographic methodology in planning occurs as an epistemological problem also discussed in the book of Covery (2011) as well. He argues that Debord later retired the concept since it was insufficient to serve his objective

DOI: 10.15320/ICONARP.2023.255

scientific approach (Covery, 2011), which is true to some extent as a result of the vague character of the concept. It is difficult to adopt psychogeography within a scientific methodology to planning discipline but it not impossible. At this point, the very basic and simple psychogeographic method, *Dérive,* enables such a construction: *walking and documenting what you perceive within your deviations*.

The main axis of this problematic is the interaction between body and urban space and the representations of this reciprocal interaction. Within this frame, the body, which contacts *with* and *at* urban space, is placed at urban space within its moves and stays. In his book *Urban Bodies*, Paquot (2011 [2005]) emphasizes on 'the suffering and lost body' at urban space; this starting point presents a backcloth for an interrelated phenomenological analysis in the disciplines of planning, design and urban policy with reference to the two-folded maps of reality. The aim of this study is to examine the limits and potentials of the concept of *psychogeography* as a *methodology* in planning to question related themes (such as walkability, spatial appropriation, (collective) memory, representations of space, (re)production of space, and design).

The main question of this study is "how the representations of walking experience can be used within planning with reference to the two-folded map assumption in relation with psychogeography". The study is composed of three sub-sections. First part concentrates on the nature of the gap between 'physical' and 'psychological' maps; the 'touch' of the urban space onto human body is discussed and examined during this first subheading. Second part questions the definition and limits of *psychogeography* as a source and method of spatial knowledge within its deficiencies and potentials in relation with the nature of urban spatial patterning. Third part concentrates on the term, *Dérive* which means 'deviation' and 'resistance'; related methodological papers are discussed within this subheading as a trial to open a path to the construction of psychogeographic methodology to grasp the gap between physical and psychological maps via the experience of body and conception of the designer.

(RE)POSITIONING 'THE WALKING BODY' ONTO URBAN SPACE

Discussion on gathering the information of the walking body is the focus of the first step to construct a psychogeographic methodology in planning discipline. How can we position the body onto space then? This query indicates both the *movement* and the *contact* of the body. Starting from a random spatial spot or location, the body would move and stop on several points within an imaginary path and would knit 'a lacework of routes' [as stated by Paquot (2011: vi)] within its nodes and traces, through a dialectical and rhythmic spatial practice of urban daily life and would act like a slug which can be monitored from the bird's-eye-view by an imaginary flying, attentive urban voyager (Fig.1.).

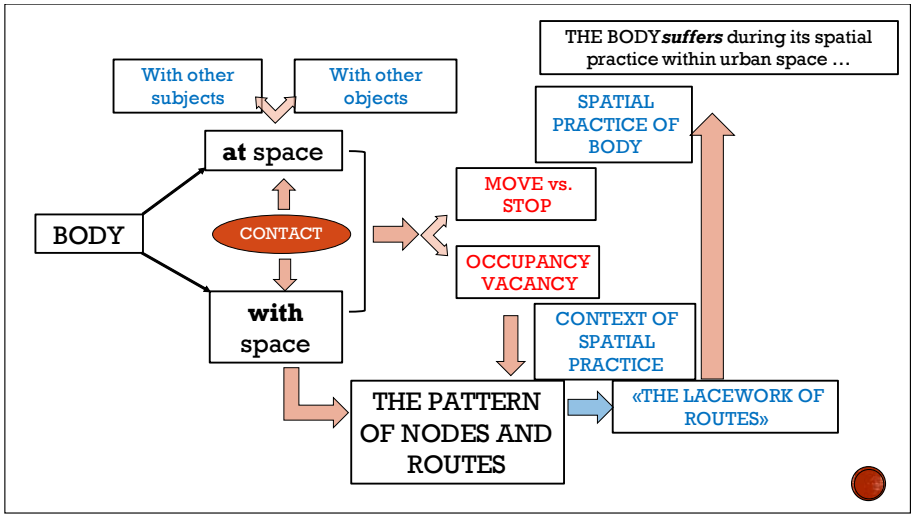

Figure 1. The contact of the body *with* and *at* space resulting in the lacework of routes and bodily suffer (Produced by the author for the presentation at KBAM 2021, December)

Such an imaginary urban voyager or urban analyst would recognize a pattern of this movement; the contact of body to and at space would leave readable traces, which are formed through movements and stops of the individuals. The patterns of urban occupancy and vacancy enable both motion and contact of the body with and within urban space. The body contacts **with** and **at** urban space (with other subjects and objects) during this spatial practice. Such a contact is shaped through on the one hand spatial hierarchy (which can be re-read physically) and on the other hand the sociological and psychological factors (which can be monitored via mental representations). The pattern of occupancy and vacancy limits the perception and experience of the body within nodes and routes (which can be monitored via spatial topology analysis and rhythmanalysis). In addition to the physical map (which is real and concrete) a second map appears as a psychogeographic map which is relatively personal and abstract and therefore is difficult to document. This psychogeographic map is formed through the mental representations coinciding with spatial repertoires, and it can be revealed through techniques such as *attentive walks*, *mental maps* and *in-depth interviews during walking together*.

The pattern of urban occupancy and vacancy penetrates the spatial experience of the body and frames the setting of walking practice of the body on three levels. First level of this penetration occurs as 'the *crash* of body' to the spatial patterning physically and mentally; the body perceives, sees, smells, feels, hears, and senses the urban space within its physical, visual and later symbolic boundaries. Getting out of his/her 'home' to the street, the body encounters differentiated scales and hierarchies of urban space from the neighbourhood to the whole city; and reacts to such a differentiated spatial patterning via its moves and stops.

These reactions carry us to the second level of penetration: the psychological facet of the bilateral map within patterns of nodes and routes. After the first encounter (seeing, hearing, touching, smelling, sensing the space) the body recognizes and then reads and rewrites the map of the space in his/her mind and (probably unaware of the conscious

DOI: 10.15320/ICONARP.2023.255

preferences) decides *how to react* to the space and his/her spatial experience. From a different point of view, this space is designed and constructed with respect to technical codes and policies, which is materialized in the physical space and represented in a field map. But now, it is re-written by the individual who perceives and starts to experience the space via his/her own psychological backcloth which is probably not the same map with the designers' conceptualization. Such a backcloth has been formed via both psychological-sociological contents and has been re-shaped through the recent spatial practice of the body; therefore, it is open to change and be reshaped within different time lapses and experiences. This mental representation of the individual is re-drawn via the body's perception and experience; moreover it is difficult but crucial to be revealed. Therefore, the conceived space and its representations overlap with mental nodes and routes and constitute the basis of the mental representations in addition to spatial repertoires; this process results in a two-folded map: real/concrete/physical map and personal/abstract/psychogeographic map. The facets of this two-folded map indicate the opposite sides of 'the representations of space', discussed in the spatial trilogy of Lefebvre (1991) shaped via spatial practice: 'the conceived space' [or 'representations of space'] and 'the perceived space' [or' the spatial practice'].

Then what does the gap between physical and psychological maps state to planners and policy makers? Or how can we interpret such a distinction? Now we reach to the third level of penetration, which gives way to reproduction of space both physically and politically, corresponding to the nature of this gap and enables a creative and positive interpretation of the relationship between what is designed and what is sensed and lived. At this point, gathering and evaluating the mental representations (of 'the body' and its spatial practice during the walking experience) shine out. On the basis of two-folded map assumption, the psychogeographic representations gathered during the daily derives would make the hidden, unseen snapshots of the city visible, and therefore the researcher and designer would reach neglected sensory-cognitive parts of urban experience. Re-reading space via such neglected and invisible parts and experiences, would also enable to sense, re-read and probably re-write the soul of urban space through differentiated urban narratives. Such a re-reading would result in a spatial synthesis of psychogeographic inputs through the set of derives, mental maps, urban narratives within spatial topology and rhythm analyses, all of which indicate a new methodological approach in urban spatial analyses based on psychogeography.

PLACING THE PATTERN OF PUBLIC SPACES WITHIN PSYCHOGEOGRAPHY

The discussion of gathering information on the spatial patterning via psychogeography is the focus of the second step to construct a psychogeographic methodology in planning discipline. While discussing

this phenomenon mental constructions and representations of space and spatial experience gain importance. First, the characteristics of physical environment are essential within perception and representation mechanisms, since the form and structure of the space influence the minds of the people (Göregenli, 2010). Werner and Schindler (2004) propose that the separate patterns (as a result of arrangement of physical components) affect the differentiated mental organizations on the basis of perception and representation. In addition to such a frame, Paquot (2011) introduces the concept of 'suffering body' who could not find his/her place in the city, which is the starting point of the idea of psychogeographic analysis within this research. This concept also designates a potential field of problem formulation and analysis in planning and especially in the education of the discipline in relation with design and urban policy planning. *Body suffers through its experience and motion in urban space*, which generally implies the physical and symbolic pattern of urban public spaces (or common spaces as Stavrides (2018) re-conceptualizes).

The position of the body is a critical issue within this frame; when urban space touches onto the body, the body would position oneself with reference to both physical patterning of space (with the objects on it) and the mental-social repertoire of the individual. According to examinations, pre-observations at urban space and in depth thinking processes during theoretical readings, we can propose that this self-positioning and repositioning of the body occur at mental, social, and physical levels; body positions itself with reference to spatial patterning (especially the pattern of public or common spaces within spatial hierarchy) and moves within its conceptualization on what is limited and what is accessible among subjects and objects at space.

Sennett (2008 [1996]) examines the interrelation between body and urban space in his book *Flesh and Stone: The Body and The City in Western Civilization*; he discusses *the disciplinary character* of urban space on human body in the example of Roman city. He writes: "As a Roman, you could not ramble on the city. The massive buildings would command you to adopt yourself to the city. … The geometry of Roman city disciplines the movements of the body and in this sense gives the order of 'Look and obey," (Sennett, 2008: 99). Herein, urban space is on the one hand a spatial matrix of occupancies and vacancies through which we pass during our daily walks, on the other hand turns out to be a constructive, shaping and positioning actor in our everyday lives. With respect to such an implication, relational spatial approach steps forth; leaving behind the absolute space approach (which sees the urban space as the scene or container of social phenomena) and relational space approach (which reduces space to the relations among social objects on the space) (Şengül, 2000).

Physical pattern of space is the dominant factor shaping the positioning of body and the disciplinary role of the space. In a remarkable pioneer study, Lynch (2010 [1960]) proposes five spatial elements which constitute the image of the city, bridging the real/concrete map to the

DOI: 10.15320/ICONARP.2023.255

representations shaped in human minds. These elements are, *paths*, *edges*, *districts*, *nodes* and *landmarks*, all of which can be traced in the mental representations of the citizens via mental maps. This framework partially can be adopted to our bipolar map assumption however it especially indicates the physical/concrete map, which is on the side of designer not the daily citizens, although it is based on gathering mental maps of citizens. Lynch's frame of reference should be supported with a more bundle of phenomenological and psychological inputs and techniques to grasp the nature of physical and mental parts of walking experience wholistically.

In her study *Spatial Topology of Walking in the city within the focus of Spatial Appropriation: The Case of Sub-Walking Districts in Van*, İlkay (2020) tries to integrate Lynch's (2010 [1960]) framework of image of the city to the place attachment conceptualization of Seamon (2013) as a first attempt of psychogeographic enquiry. The five elements of the image of the city [paths, edges, districts, nodes and landmarks] were overlapped on the six processes of place attachment proposed by Seamon (2013) which are: (1) *place interaction* – daily spontaneous encounters; (2) *place identity* – where that specific place stands within the lives of the individuals, (3) *place release* – chatting or interacting spontaneously with the people you know and encounter at the street, (4) *place realization* – physically constructing a place, giving the soul and shape of the space, (5) *place creation* – actors' taking part in the creation and (re)production of the space, (6) *place intensification* – resurrection of a place within a intentioned policy, design and application. Seamon is also known to conduct the research on phenomenology of space, which can be adopted the concept of psychogeography. Based on this overlap trial, four walking districts were distinguished in the case of Van as 'the city centre', 'university campus', 'the dock' and 'Edremit shore', and lastly own neighbourhoods of the interviewees (İlkay, 2020). Sub-districts are open to be analysed in detail via psychogeographic approaches by gathering mental maps, and urban narratives in later research.

The street (or the paths discussed as in Lynch's analysis) is the constructive and main component of a psychogeographic analysis since it enables the body to move through the vacancies and occupancies of urban space. Streets shape the paths and forms of bindings among squares and parks as well, which makes the street the constructive element of this pattern of public-common spaces. Correspondingly, 'street' is the main analysis unit of psychogeography in addition to 'walking' and 'dérive'. Moreover, psychogeography also concentrates on the practice of getting lost while walking in the city. By this way, the hidden resistance of the body fades into what is designed in the city. In addition, the researcher can become aware of the details of urban space which are dictated by the planner, designer or policy maker however refused by the bodies of the citizens; such an awareness may result in an in-depth insight to policy and design processes. After introducing and discussing main concepts of the study, in

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the next subheading selected research papers will be discussed with reference to ontological and epistemological assumptions pursued in this paper so far and a new methodology of psychogeography will be investigated with reference to the term *Dérive*.

DÉRIVE AS A METHODOLOGICAL TOOL WITHIN PSYCHOGEOGRAPHY IN PLANNING

What can be the roots of psychogeography as a scientific, methodological vein? In 1960s and 70's, a shift in mindsets and political stands occurred; therefore, the entrance of perceptual and psychological techniques can be placed in 1960s in the development of geography and social sciences. Social psychology entered the scene in 1950s and environmental psychology, examining the influence of environment on human beings, appeared as branch of social psychology (Göregenli, 2010). In 1960s, behaviourism and (radical) humanism began to dominate the field of social sciences, as a result, human centred geography took its place within the history of geography and as a reaction to positivist approaches in social sciences. Therefore, perception and mental maps entered the field of interest within social sciences and especially geography in 1960s and 70's. This period is also parallel to the timelapse where Lefebvre took to the stage with his conceptualization of social production of space within a radical humanist paradigm as a neo-marxist writer. Psychogeography can be rooted to such a tradition, and rises on three focuses: Body, walking and urban space.

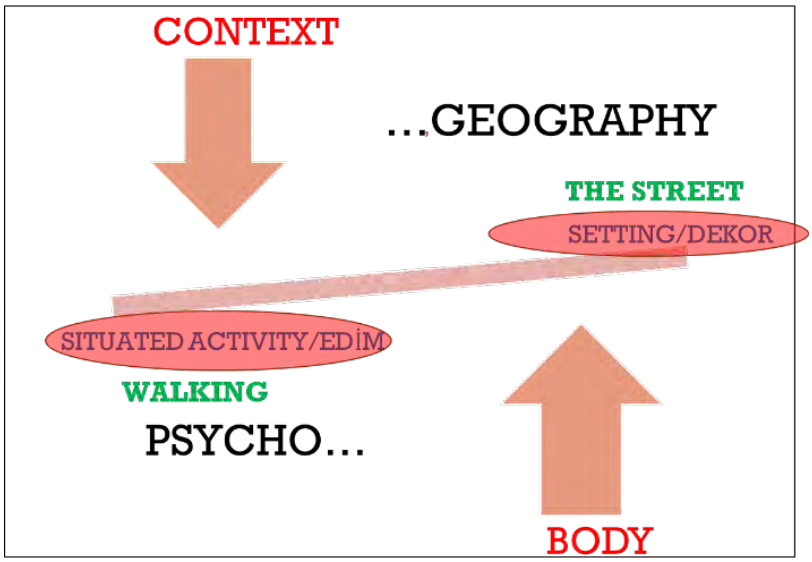

Figure 2. The scales of research in relation with main concepts of psychogeographic analysis (Produced by the author for the presentation at KBAM 2021, December).

Within this paper, mental representations of the interaction between body and urban space constitute the backbone of our examination, which we started from positioning the body at and onto urban space. This backbone is located at the intersection of psychogeography and planning. The concept of 'contact' shapes the frame of such a backbone. 'The street' indicates *the setting* of the research and 'walking' indicates *the situated activity* which can be examined during such research; wherein planning is *the context,* and the body is the individual scales of a possible spatial enquiry (Fig.2.). We can re-

DOI: 10.15320/ICONARP.2023.255

state our main question as follows: "On the basis of the bipolar map assumption, what kind of inputs can be gathered from mental representations of space-body contact to use in the processes and mechanisms of planning, design and urban policy?"

Before discussing the methodological tools, let's first re-answer what 'psychogeography' is. Psychogeography is a field of enquiry examining the reciprocal interaction of humans and space, which especially refers to the discipline of literature. At that point the main assumption is that "geography shapes space and space shapes the human beings" (Coşkun, 2017) [Fig.3.].

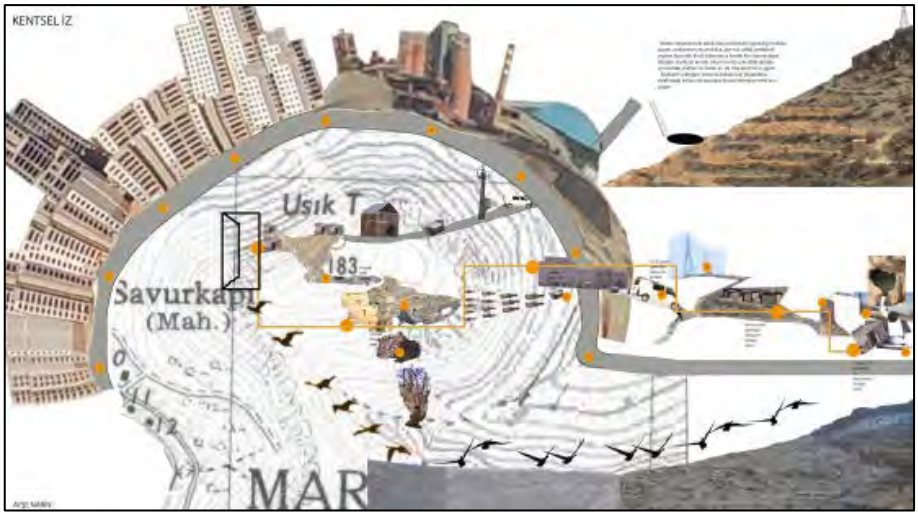

Figure 3. What is psychogeography? (Coşkun, 2017).

Psychogeography concentrates on understanding and defining the effects of the environment on the feelings and attitudes of individuals. *Situationist International Movement* raised the concept in 1950s within artistic motives, however the term '*psychogeography'* evolved gaining a political content and turned out to be 'a political tool to transform the urban everyday life' (Covery, 2011; Sarı, 2013; Şahin Yeşil, 2016). The term, *Dérive*, implying 'deviation' and 'resistance', enabled such an evolution. Jale Sarı (2013) describes *psychogeography* as a tool both to experience urban space and to grasp this spatial experience in her thesis; and moreover, on the focus of this description, she defines the term '*dérive'* as: "saunters of individuals throwing everything in the wind within their everyday life," which refers to the main method of psychogeography in the city as well (Sarı, 2013: xv).

Covery (2011) starts his book with the definition of psychogeography as "the guide of beginner" and defines a psychogeographic tour with reference to a passage from MacFarle's (2005) *A Road of One's Own*. He guides the reader as [shortened and translated by the author, to give a brief idea on the very basic method of psychogeography]:

> If you want to make such a tour or create such a road, first open a map of London's streets and mark a circular area on the map to investigate. Then go there with the marked map and tour the circle. Record and save your experience while you are walking, either by film, or photograph, or may be with your handwriting on a notebook or record your voice to a cassette, whatever you choose. During this trial, MacFarle suggests trying to capture "the textual flow" of the streets through graffities, trash buckets or other types

> and tools of communication within streets. Within this tour, open your mind to 'the changing soul' of the city. When you complete touring the circle, make a record of the results (MacFarle, 2005; cited in Covery, 2011: 7).

Covery (2011) argues that such a spontaneous urban tour (with the motive of recording the spatial experience) enables the voyager to challenge the dominant urban image which is imposed on his/her body. We argue that, recording spatial experience during spontaneous urban tours has two basic potentials; one is the citizen's recognition of one's spatial practice in relation with everyday life and the other is the designer' recognition of the hidden impacts of his/her design of the space. In addition, as Covery (2011) explains this technique would enable the researcher to transcend traditional methods of gathering urban spatial knowledge. Since this is a way or method to track the purest mode of contact of the body with the urban space during its perception and spatial practice. Based on such a methodology, the two main veins of psychogeography would take part in further research: 'space' and 'time' in the form 'parkour' and 'nostalgia' or 'palimpsest' as mentioned in Şahin Yeşil (2016).

'Parkour' refers to 'nodes' and 'paths' which can be related to our prior discussions on positioning body within the pattern of space, especially via the hierarchy of occupancies and vacancies; this indicates a similar conceptualization in the spatial topology analyses ('nodes' and 'routes') (İlkay, 2016); 'nostalgia' can be related with the collective and personal memories; 'palimpsest' may refer to the process of reading and re-reading and re-writing of the space; all of which form a wholistic framework to grasp the urban space within the time perspective. Moreover, Lefebvre's rhythmanalysis can be adopted to this frame as well. So, what are the main concepts of psychogeography in relation with planning and design? Walking, Flânéur, Dérive, nostalgia (in relation with 'memory'), parkour, palimpsest, Paris, London and mental map are some of the main concepts of psychogeography in relation with city and planning (Covery, 2011; Sarı, 2013; Şahin Yeşil, 2016).

When we examine a couple of studies which try to combine planning and psychogeography, first we recognize that this bond presents an ambiguous but a fruitful field of analysis. The studies formulate experimental methods of adopting psychogeography to spatial analyses in order to generate suitable data for planning processes. In one of the remarkable studies, Yorgancıoğlu and Çolak's (2020) introduces the concept of 'experiential mapping'. Yorgancıoğlu and Çolak (2020) conducted a workshop named 'Re-mapping Visibles and Invisibles of Vefa-Zeyrek-Fener-Balat', and within this study they aimed to enable architecture students to touch and feel the urban space within its original, real atmosphere and to grasp the interrelation among body, city, and place in depth. Students were encouraged to concentrate on their senses and feelings during the workshop and they tried to document their findings via the experiential map technique, which is a step to reveal the

DOI: 10.15320/ICONARP.2023.255

invisible levels of spatial knowledge at a historical and multi-level district of Istanbul. Then this knowledge is aimed to be translated to a kind of design data (Yorgancıoğlu & Çolak, 2020).

In another research, Kelly (2020) conducts a psychogeographic examination at an abandoned university campus, using the concept of 'attentive walk'. She grasps the site within its historical story, concentrating on the past, now, and future of the students, who joined the research; and uses the techniques of taking photographs and notes. The researcher evaluates this approach as valuing the sensory and emotional experience of a place, which would result in focusing on the 'humanness' of the space (Kelly, 2020).

Öner (2020) puts forward the 'collaborative planning' in the study and examines how differently the users perceive and experience the public spaces in the case of Kadıköy; formulating "sound walks". Mental maps are used to capture different perceptions on the public space patterning with reference to 'sound' (Öner, 2020). In another related research study, Çelen Öztürk (2016) re-reads the collective memory of the city, Eskişehir, through mental maps by psychogeographic techniques using cognitive maps (Çelen Öztürk, 2016).

Taşdizen and Kaygan (2016) evaluate critically the spatial policy on the transformation of Ulus historical city centre through examining the moral values represented by Hacıbayram and they discuss in detail the thesis of surpassing these values by the urban transformation project within a psychogeographic manner (Taşdizen & Kaygan, 2016). In another study, which presents a new framework for planning educational tours, Aksümer (2019) concentrates on the technique of 'guided tours' within planning education and discusses the inadequacies and possibilities. Merely, Önen (2016) tries to frame the relation of walking and the city in a more sociological point of view and discusses the potential contribution of walking to the process of the democratization of the cities. And while writing the ways of sociology of discovering city via walking, she also presents an alternative and critical way of reproducing urban space by walking (Önen, 2016).

The papers which are examined under the heading of 'the psychogeographic urban analyses' are listed, compared and contrasted in table 1.

Although these studies have differentiated focuses and have been conducted in variable disciplines (such as architecture, planning, and sociology), they all seem to resist a dominant planning approach. Some studies such as Öner's (2020) soundwalks case and Önen's (2016) sociology of walking concentrate on contextual outputs of psychogeographic methodology, like collaborative planning and democratization of cities. These two studies aim to distinguish the essence of individualistic differentiations on perception and experience of urban space which is usually ignored. Önen's research is more theoretical, but Öner's study uses 'mental mapping' technique to cover

cognitive-emotional representations, which is the starting point of this paper in parallel to the suffering and lost body conceptualization of Paquot (2011 [2005]). This approach seems to be valuable with respect to creating more democratic cities and creative and liveable urban space starting from top to down with a from grassroots perspective.

Table 1. Selected research papers concentrating on the concept of Psychogeography with their titles, publication dates, case studies, techniques and emphasis (2022, Produced by the author).

	Researcher	**Research Paper Title**	**Date**	**Case study**	**Technique**	**Emphasis in relation with Psychogeography**
1	Yorgancıoğlu and Çolak	Methodological Inquiry for Re-structuring Spatial Knowledge Derived from Bodily Experience	2020	Vefa Zeyrek Fener Balat İstanbul	Experiential Mapping	•Bodily Experience •Visible-invisible •A historical and multi-level district of Istanbul
2	İlkay	Spatial Topology of Walking in the city via Spatial Appropriation	2020	Van	Mental mapping	•Components of the Image of the City •Processes of Place Attachment •Spatial Appropriation
3	Kelly	Psychogeography of a Decommissioned University Campus	2020		Taking photos and notes	•psychogeographic examination •'attentive walk'
4	Öner	From Soundwalks and Spatial Perception Studies to Urban Planning: The Case of Kadıköy_AKUS TIK	2020	Kadıköy İstanbul	*Mental mapping*	•collaborative planning' •"sound walks" •'sound'
5	Çelen Öztürk	Reading Trials of Urban Memory in Eskişehir via Mental Maps	2016	Eskişe-hir	Cognitive Maps	•collective memory of the city •mental maps •cognitive Maps
6	Taşdizen and Kaygan	Immoral Objects: A Psychogeography of Urban Transformation in Ulus	2016	Ulus, Ankara	Psychogeographic manner not defined clearly	• immorality • urban transformation • psychogeographic manner
7	Aksümer	Learning the City from the Inhabitants: Application of the Commented Walk Method in Urban Studies, İzmir-Selçuk and Bursa-İznik Examples	2019	İzmir-Selçuk and Bursa-İznik	Commented Walk Method	•planning education •guided tours
8	Önen	The Sociology of Discovering the city through Walking	*2016*	–	Reproducing urban space by walking	• the relation of walking and *the* city • sociological point of view • democratization of the cities

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Apart from Önen's (2016) theoretical study, the first seven studies concentrate on practical cases and methods from individual scale to the scales of setting, situated activity and context. Four of the studies use either mental or cognitive mapping, and Yorgancıoğlu et.al. (2020) goes further with the concept of 'experiential mapping'. All these four studies have different focuses. Yorgancıoğlu et. al. (2020) aims to reveal the visible and invisible in the case of a historical urban region. İlkay (2020) uses the mental mapping technique to discover the differentiated walking districts of the city. Öner (2020) uses 'sound' as the main component of mental mapping and units separated techniques such as walking, perception and mental mapping. Çelen Öztürk (2016) examines the collective memory using the cognitive mapping technique, which also indicates both individualistic and contextual scales.

Another distinguishing feature of methodologies is the emphasis on 'walking' as the scale of situated activity. Kelly (2020) uses the term 'attentive walk'; Öner (2020) proposes the concept of 'sound walk'; and Aksümer (2019) introduces the method of 'commented walk' proposing the potential role of guided tours within the planning educations.

Lastly, almost each and every study visits a technique of recording the urban experience while walking. İlkay (2020) mentions spatial topology analysis; Kelly (2020) suggests taking photos and notes, and Önen (2017) proposes a kind of urban narrative and re-writing urban space via everyday spatial practices.

As a result, three veins of methodological techniques shine out: ***walking*** (attentive walk, commented walk, guided tour); ***recording*** (taking photos, and notes) and ***mapping*** (experiential map, mental map, cognitive map), all of which constitute all together the structure of a possible methodology of psychogeography in planning. These three techniques can be related to the very basic and simple method *psychogeography* –'walking and documenting what you perceive within your deviations'– in other words, *Dérive*.

In the following sub-section possible research themes and cases will be discussed to construct a psychogeographic methodology in planning within its limits and opportunities.

CONSTRUCTION OF A NEW METHODOLOGY: PSYCHOGEOGRAPHY IN PLANNING

The gap between 'what is designed' and 'what is perceived/experienced' is the common ground of the studies on psychogeography and planning, examined in the last part of the paper. This gap indicates the difference between physical reality and psychogeographic representations / maps of the individuals. The experimental research projects and studies discussed above, and the epistemological-ontological discussions held previously show both the potential and ambiguous ways of psychogeography as a methodology in planning, design, and urban policy.

This literature review led to a three segmented enquiry while constructing a psychogeographic methodology in planning. First part introduced the nature of the gap between 'physical' and 'psychological' maps and described the 'touch' of the urban space onto human body; we repositioned 'walking body' onto urban space under this subheading. As

an ontological level of discussion, second part aimed to place the pattern of public space in psychogeography and examined the nature of urban spatial patterning in relation with its impacts on the body with reference to the term of *psychogeography* -as a source and method of spatial knowledge. Third part examined related methodological papers concentrating on the psychogeographic techniques and emphasis and related with the term, *Dérive* which means 'deviation' and 'resistance'.

These three parts aimed to open a path to the construction of psychogeographic methodology to reveal the gap between physical and psychological maps on the same space. At this point, some possible further research themes and problems can be discussed with reference to ontological and epistemological assumptions pursued in this paper so far and possible lines of a new methodology of psychogeography can be highlighted with reference to the term *Dérive*. These themes have been structured through brainstorming with respect to both observations since the PhD thesis period in 2014-16 and readings of the author on spatial topology, space syntax, spatial appropriation, environmental psychology and psychogeography after 2016. Therefore, these problematics (presented under this sub-heading) should be considered as drafts of possible research which will be shaped and developed within upcoming months and years. We tried to cover a basic and broad framework as far as possible, especially concentrating on potential walking districts and practices, and on differentiated forms of spatial appropriation and representations. The methods can be enlarged to various cases and cities, even countries. Therefore three main segments were defined as: (1) street (alle in the periphery of the city or the public space pattern at the city centre), (2) promenade (either sea and lake coast or river coast); (3) neighbourhoods in relation with the reproduction of one's identity, urban space and everyday life.

On the basis of both this frame explained in the previous parts of the paper and the findings of the paper on sub walking districts in Van (İlkay, 2020), highlighting the phenomenon of 'street', the concept of 'alle' can be one of the possible fruitful topics; and this problem can be enlarged to spatial-experiential analyses in several universities in Turkey, some of which are constructed in 1960s and some are built as a small complex or single building after 2000s.

'Alle' is an extension of the street phenomenon within the university campuses which are interesting walking districts of the city. The integration or disintegration of the campus with the city is both a design and a place attachment issue, which concerns both principles of planning and scope of urban policy planning.

DOI: 10.15320/ICONARP.2023.255

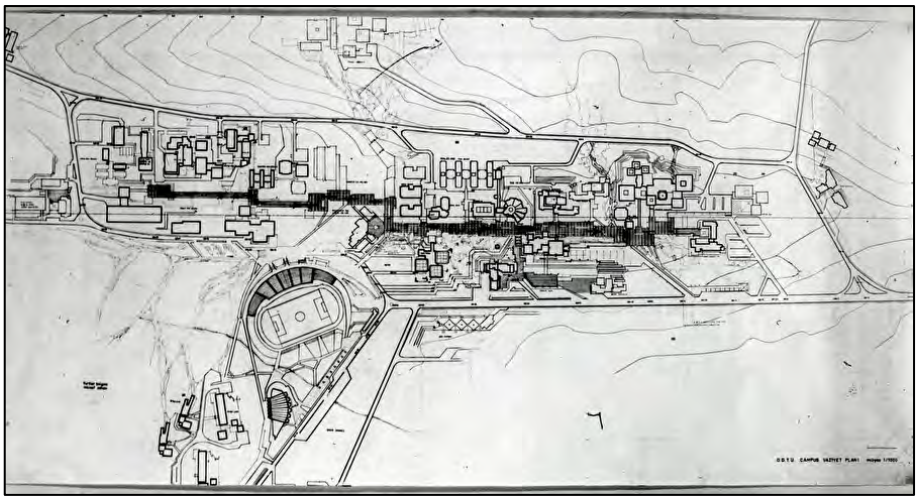

Figure 4. The layout plan of METU, by Altuğ and Behruz Çinici; the alle can be seen clearly and was designed as the main axis of pedestrian circulation (https://www.gzt.com/arkitekt/bozkiri-yeserten-beton-yerleske-odtu-3592966)

The alle in METU (Middle East Technical University) designed by Çinici's in 1960s (fig 4. And 5) can be compared with the recently realized alle case in Van YYU (Yüzüncü Yıl University) (fig 6.) as further research of İlkay (2020).

Figure 5. The alle of METU, (https://haber.sol.org.tr/bilim-teknoloji/odtu-nun-mimari-behruz-cinici-nin-ardindan-haberi-47597).

METU Campus is a well-designed and wholistically planned university campus having a historical spatial tradition shaped within differentiated layers of spatial and political practices. On the other hand, Van YYU alle has a relatively short-term history and placed in a partially designed university campus. This difference can be analysed psychogeographically via the problematic of spatial appropriation. The phenomenon of alle influences the texture, the spine and the soul of university campuses, which may shape the place attachment and spatial appropriation of both lecturers and students, and other groups living or experience campuses. Therefore, owner-visitor dichotomy points a fruitful research focus based on the university campuses and especially the alle, which has psychogeographic elements.

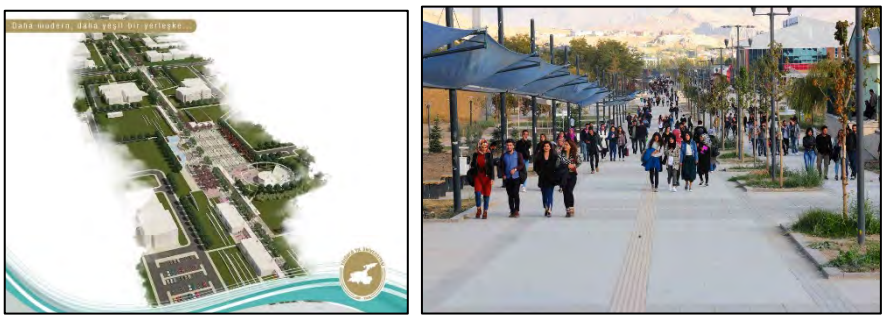

Figure 6. The alle in Van YYU. (Left: The design: https://wikimapia.org/37522194/tr/YY%C3%9C-Alley#/photo/7417760; Right: The street view in everyday life, https://www.yyu.edu.tr/foto-galeri).

Another fruitful theme is the psychogeographic analysis of the interrelation of streets, parks and squares at especially city centres of metropolitan areas, such as Taksim Square-Gezi Park-İstiklal Street in İstanbul, Güvenpark-Atatürk Boulevard-Kızılay Square in Ankara, the linear route consisting of Konak Square, park and the Cordon in İzmir. A similar formation can be traced in other cities of Turkey, a primitive analysis was held in the case of Van with respect to the prior senses and observations of İlkay (2018) on the city centre. These four patterns can be compared with reference to psychogeographic principles, and such a comparison would give us a wholistic representation of city centres as walking districts decoding the gap between what is conceived and what is perceived. As Jacobs (2011) argues the negative aspects of overemphasizing park areas in planning, such research would result in an awareness of failures of the design on creating dead spaces especially parks which are not used, not lived, as Jacobs (2011) criticises in her famous book The Death and Life of Great American Cities.

Şahin Yeşil (2016) frames the concept of psychogeography in her paper evaluating Orhan Pamuk's (2006) inspirational book İstanbul: Memories and the City; she compares Pamuk's approach with Ahmet Hamdi Tanpınar's (1960) panoramic description about İstanbul. Pamuk's (2006) narrative and Şahin Yeşil's (2016) evaluation give a sense that a historical city like İstanbul would be an interesting and fruitful case to examine with both the history of the city itself and the personal history of the observer or the derive like Orhan Pamuk. Such examinations would provide prosperous input to analyses of urbanisation, planning, and urban policy planning.

Figure 7. Donau-Canal in Wien, the relationship between human beings and water element; spatial diversity at promenade (*Personal Archive, 09.03.2014*).

A third field of possible research problematic is related with the conceptualization and perception of water element in the city, promenade is one of the major concepts in cities. Fig 7 and Fig 8 demonstrates two separate design approaches touching to the senses and perceptions of body. In the case of Dona-canal promenade, the space acts as if it unites the body with the

DOI: 10.15320/ICONARP.2023.255

water element in different shapes and experiences. In other several cases in Europe like the promenades in Budapest, Prag, Bratislava the body can get in touch with the rivers in several ways, in the form of platforms, sitting areas, step-formed common spaces, linear paths enabling cycling and walking, etc. We can see a meaningful and readable spatial patterning and hierarchy within these cases.

However, in the case of Amasya, the feeling of 'being repressed' was the dominant perception within a limited spatial organization basically shaped through boundaries and routinized barriers. While walking along the riverside, a question may occur, whether the designer protects the people from the water or the water from the people (fig.9.). This question crashes the walking body inevitably. Van is also another problematic case in this respect; although located in the edge of the largest lake of Turkey, Van is perceived and experienced as a city turning her back to such a great water element. Citizens have limited opportunities and spaces to touch and interact with the water element in the city, which can be examined and analysed in a psychogeographic research. The design and policy of water element in the city is also a critical issue in both design and urban policy. Moreover, such research would give astonishing and valuable results on the implications of the reflections (of the design and policy approaches) on the bodies and minds of citizens.

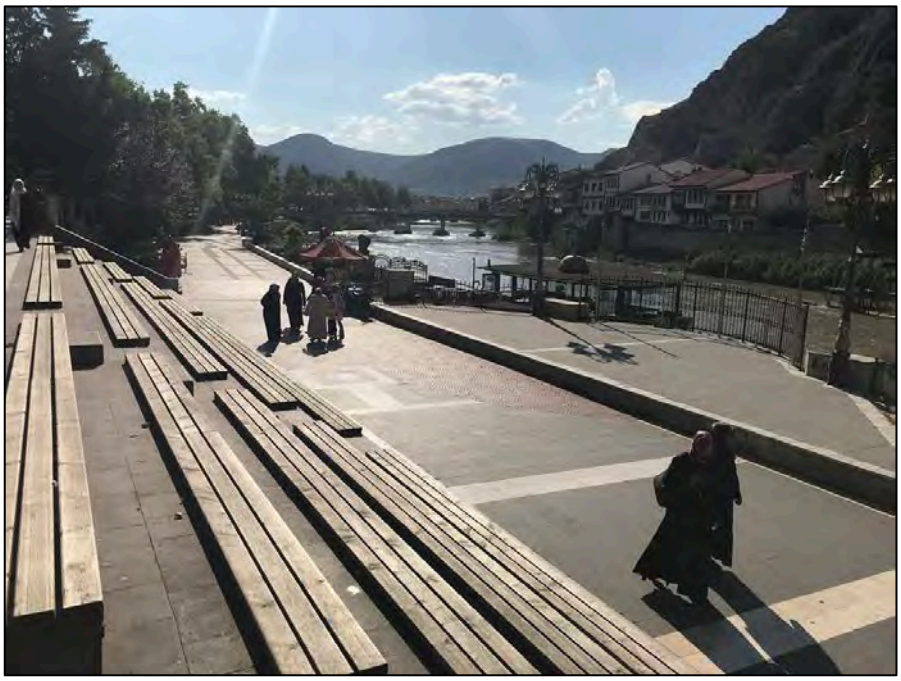

Figure 8. Amasya, promenade on the edge of Yeşilırmak, the relationship between body and water element; spatial barriers at promenade and inadequacy of spatial diversity at promenade (*Personal Archive, 27.06.2018*).

Psychogeographic examinations on the neighbourhoods of the citizens would also give an instance of the differentiation of spatial appropriation and would reflect on the different walking districts on scales from reproducing the one's identity to neighbourhood and to the urban everyday life with urban space.

These problematics indicate tentative case studies selected on the basis of the author's own experience, which can be a starting point. METU and Van YYU are the campuses where the author has lived and worked for several years. The main axes mentioned in the second theme have historical, spatial and political essence in the political-spatial history of both these cities and Turkey; therefore, Ankara, İstanbul, İzmir are good examples to conduct a psychogeographic analysis on the problematic of pattern of public spaces; and Van is added to this frame since the author has studied this region before and recognized astonishing differences and similarities to the metropolitan cities. The third and fourth themes of promenade and neighbourhoods can be generalised to other cases in any city of Turkey, but these cases Vienna and Amasra, and Van were used since the author has directly experienced them.

CONCLUSION: PSYCHOGEOGRAPHY IN PLANNING WITHIN ITS POTENTIALS AND LIMITATIONS

The possible research problematics and frames can be multiplied and developed within this perspective. The focal points of possible research indicate a two folded frame of reference. On the one hand, the body is examined in its situated activity within spatial narratives, mental maps and photographing practices. On the other hand, planning and policy making occur as contextual analyses in relation with the setting, like patterns of public spaces.

In this respect the problem of legitimacy of planning can be reconsidered as a new problem with respect to psychogeographic filter. Then how does this issue reflect on *the body*? Does the fragmentation and reduction of planning result in a fragmentation in the mental representations or not? This problem is related to the suffering and lost body mentioned in Paquot's (2011) framework.

Several examinations –discussed in the previous subheading– can be conducted on individual and contextual scales, which would result in a wholistic comprehension on the gap between physical and psychogeographic maps. So, what are the potentials and limitations of constructing a psychogeographic methodology in relation with planning, design and urban politics? Although the techniques and approach may seem to be at a very micro level, the knowledge rooted from body scale and individuals' minds would enable designers, planners, and policy makers to think in more detail on the users' needs and reactions to the built environment. Therefore, when we recognize once the gap once between what is conceived and what is perceived, then we would have a chance to create more democratic urban spaces where people decide on their own living environments and we would reproduce more humane cities, through which body can breathe and find its place easily.

DOI: 10.15320/ICONARP.2023.255

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Resume

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DOI: 10.15320/ICONARP.2023.255

ICONARP
International Journal of Architecture and Planning
Received: 11.04.2022 Accepted: 08.02.2023
Volume 11, Issue 2/ Published: 28.12.2023
Research Article *DOI: 10.15320 /ICONARP.2023.256 E- ISSN:2147-9380*
ICONARP

The Anthropocene and Disasters: Near Future, Will It Come?

Sümeyye Kahraman*
Erkan Polat**

Abstract

The Anthropocene Epoch can be characterized not as the increasing effect of humans/cities on the continental soil but as a temporal section in which the planet's surface, the atmosphere, oceans, and nutrient cycle systems began to be changed/dominated by humans/urban. Together with the urbanization trend, the impact of cities and people is the driving force that started the Anthropocene Epoch. Global problems began to emerge with increasing trends, and irreversible disaster scenarios such as climate change, sixth mass extinction, biological destruction, and disasters were brought to the agenda. The increase in the diversity, frequency, and intensity of disasters increases the vulnerability and exposure of cities and people to different hazards, triggering disasters or making them worse. Events resulting from the Anthropocene Epoch "will the near future come?" also raises questions.

For this reason, this study was created based on the assumption that the "Anthropocene Epoch includes disasters and cities play the main role here". In the context of this study, the historical process of the Anthropocene Epoch will be discussed, and the role of cities in this process will be determined. Finally, it will be investigated what will await humanity and cities shortly and which issues should be addressed in cities will be focused on.

Keywords:
Anthropocene, Urban planning, Future, disaster, Catastrophe

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To cite this article: Kahraman, S., & Polat, E. (2023). The Anthropocene and Disasters: Near Future, Will It Come?. *ICONARP International Journal of Architecture and Planning,* 11 (2), 604-624. DOI: 10.15320 /ICONARP.2023.256

INTRODUCTION

Human activities now significantly affect the entire planet, including its oceans, climate, atmosphere, and soils. The human influence has become so great that geologists (earth scientists) have proposed and argued over a new geological period: the Anthropocene Epoch. This epoch emerged for the first time in geological history as a force shaping both the surface morphology of the planet and the workings of the Earth system of a single species (Homo Sapiens).

The term “Anthropocene” was first used by Stoermer and later popularized by Paul Crutzen (Crutzen, 2002). The etymological origin of the Anthropocene combines two Greek words: Anthropos, meaning "human" and kainos meaning "new". It takes its final form with the suffix -cene, which adds the meaning of "recent" to the root it is added to (Peters, 2012, p.265). Looking at its origins, the Anthropocene is briefly defined as the "new human epoch" (Polat and Kahraman, 2021). The term refers to the gradual emergence of planet Earth from the current geological epoch, the Holocene (Steffen et al., 2011), while it is increasingly used to describe the transition to the full anthropogenization of planet earth, while it remains a suggestion and is being worked on to formalize it (Zalasiewicz et al., 2008).

In 2008, British geologist Jan Zalasiewicz and colleagues put forward the first proposal to adopt the "Anthropocene Epoch" as a formal geological range and then worked to formalize it. These scientists say that the Earth has recently moved from the Holocene to the Anthropocene epoch, that the effects of humans on the global environment are causing signed changes in the Earth's surface, mainly since the Industrial Revolution, that these can be reflected in the last stratigraphic record, leading to the beginning of the Anthropocene Epoch suggested in his studies that it might be possible (Zalasiewicz et al., 2008).

After the Anthropocene Epoch was introduced, the concept was understood that active human intervention in the processes leading to the geological evolution of the planet (Hamilton, 2014) was a major “push factor” that changed the environmental systems in the world (Rafferty, 2020), especially since the Industrial Revolution (Certini & Scalenghe, 2011, p.1272) has been used for a geological epoch, that a new period, which indicates that chemical and climatological forces have become a dominant force replacing them (Oxford University Press, 2019).

In short, the term Anthropocene is synonymous with the threat posed by human activity to planetary systems. Global urbanization (concentration of growing population in urban settlements) is the driver and accelerator of many processes (McPhearson et al., 2021).

The 21st Century is an “Urban Anthropocene” (Hillel & Oliveira, 2014), that is, a “Urbanocene” (West, 2017). It is a fact that urban populations are increasing in number, and nature is accelerating its cycles to serve its own needs, thus upsetting the ecological balance of the planet. It is a fact that the results of these degradations caused by the cities are reflected in

DOI: 10.15320/ICONARP.2023.256

the cities (disasters). From this point of view, it can be said that the future of urban settlements will determine the end of the world. So, what is the best way to manage the Urban Anthropocene?

Since the middle of the 20th century, humanity has become a global geological force in its own right. Humans have built and continue to build a world (cities) on the planet OF their kind. While artificial cities cause climate change, melting of glaciers, rising sea levels, extinction of species, and an increase in severe weather events such as floods, droughts, and hurricanes, they bring devastating effects on natural cycles such as biodiversity, nitrogen and phosphorus cycles, and microbial evolution. It is clear that this situation has driven the world away from the Holocene into a brand-new geological period, the Anthropocene, due to the significant influence of man on the planet. The problems of the Anthropocene have become particularly acute in cities as cities function as microcosms of global change: overpopulation, greenhouse gas emissions, resource scarcity, pollution, migration, and social inequality.

About the Anthropocene, significant discussions are about whether we have entered this new epoch. Can we describe a specific moment when it began? What are the main atmospheric, biotic, and environmental changes that have already occurred, and what changes can we expect in the future? Can we predict the unpredictable? What is the role of cities in all these processes? Research questions such as "The Anthropocene Epoch includes disasters and cities play the major role here" have formed the assumption in the study.

In this study, the first signs of the Anthropocene Epoch (golden spike) created by humanity will be discussed first, and the driving force of the settlements in changing the geological time with the increase of urbanization in this temporal section will be explained (1st part - I did it myself). This process will explain how the effects that push the planet's boundaries while changing the natural cycles cause disasters in the cities that host most of the world's population (part 2 - my urban found). Then, the extent of the disasters that await us shortly will be discussed (part 3 - After the Anthropocene). As a result of the theoretical and conceptual research, the Future of the Anthropocene and which issues should be addressed in cities will be discussed in the conclusion section.

TRANSITION TO ANTHROPOCENE -I DID IT MYSELF-

Man's struggle for existence in nature has led him from being a part of the ecosystem to the point of making nature suitable for his own needs. This struggle of man with soul has caused and continues to destroy nature on different scales. Traces of this destruction are recorded within the geological processes. Human activity impress affects the environment, from biogeochemical cycles to the evolution of life. For example, the carbon released into the atmosphere by human actions since 1750 has increased atmospheric CO2 to a level not seen for at least 800,000 years and possibly several million years (IPCC, 2014).

There are stratigraphic "Golden Spike" in the Geological Timeline that changed the course of history. These points and transitions indicate that the Anthropocene was not made in a day nor was it created in the same way; that is, human activities in the world have had some effects from the past to the present (Ellis et al., 2016, p.193). The strongest acceptability of these effects is the necessity of "stratigraphic, atmospheric and biotic variables at the same time" on a global scale.

Human impacts on the ecosystems in which they live, human-ecosystem interactions have increasingly deepened after a series of chronological transitions: (i) the establishment of settlements, the cultivation of agriculture and domestication of animals, the transition from hunting and gathering tribes to metropolises; (ii) global and regional connectivity/interaction through trade; (iii) transcontinental discoveries, imperialism and industrialization, and (iv) globalization, urbanization, increased macro traffic and climate change (McMichael, 2004, p.1049; Hassell et al., 2017, p.55).

The ever-present dominance of man over nature has revealed the debate whether the Anthropocene has been ongoing since the middle of the 20th century, recently or for centuries, or even for thousands of years.

Scientists have discussed the exact starting point for the Anthropocene Epoch. From the beginning of the 21st century, efforts to identify the proposed starting point for the Anthropocene Epoch have primarily raised the following interrelated questions: Level of human control – to what extent is the environment on earth under human domination and control?; geographic scale - how much of the world would the Anthropocene have to affect for it to be considered; relevant datasets - What types of information are appropriate and acceptable to use when determining the beginning of the Anthropocene?; What are the auxiliary stereotypes that document long-term changes in the earth system so that the Anthropocene can be considered? Based on how these questions are answered, the alternative suggested starting dates for the Holocene to Anthropocene transition are examined from the first man's discovery of fire to the 21st century, and its urban context is discussed.

First effects in the Pleistocene

The earliest suggested start dates for the Anthropocene date back to the first changes in local environments: up to the adoption of fire by Homo erectus (1-2 million years ago) (Glikson, 2013; Roebroeks & Villa, 2011). The first significant influence of the first people on their environment was probably the use of fire (Glikson, 2013). Critics such as Hamilton invalidate this period as a reasonable starting date since the basic concept is human influences (or even domination) on the planetary system. (Hamilton, 2016).

Another proposed starting point due to the lifestyle of hunter-gatherer people of the period is the Megafauna extinction (50,000 to 10,000 years ago). During the megafauna extinction, about half of all large-bodied mammals and 4% of all mammal species went extinct, which has

DOI: 10.15320/ICONARP.2023.256

happened in America at most (Barnosky, 2014; Malhi et al., 2016). It has been suggested that this event caused regional warming (up to 1 Co): it is claimed that reflective and snow-covered high-altitude meadows may have been replaced by dark, heat-absorbing forests (i.e., reduced reflectivity). These results suggested that the human impact on the climate began even earlier than thought (Ruddiman, 2003). The beginning of the Anthropocene should be extended for thousands of more years (Doughty et al., 2010).

It is accepted from a synoptic point of view that the arrival of the first man and the extinction of Megafauna are worldwide, and the evidence of a significant human role seems very strong. But because the extinction event is widespread and lasted more than 100,000 years, the idea is also overall that no date can describe the beginning of the Anthropocene. Therefore, according to Lewis and Maslin (2015), the Megafauna extinction was a series of events on different continents and lacked the necessary conditions defined for the Anthropocene.

During this period, archaeological data indicate that the world population dispersed and never exceeded 10 million (Chiarelli, 1998). Humanity, which earns its living by hunting and gathering, has not had fixed places where it has lived continuously.

Agriculture and Global Atmospheric Change

The more frequently suggested candidate date for the start of the Anthropocene is the start of agriculture. This is a global incident with multiple independent agricultural origins in Africa, Eurasia, the Americas, and New Guinea. It spread and increased with the development of urban civilizations over the next 10,000 years (Ellis et al., 2013). The fact that humanity began to engage in agricultural activities also started the transition to settled life (change from nomadic order to settled order) and laid the foundations of the first demographic revolution. This led to the development of villages and cities and eventually created complex civilizations that spread over large areas.

Rice farming and the increasing ruminant (farm) population are thought to have caused an increase in methane concentrations (~11,000 years ago) (Singarayer et al., 2011; Fuller et al., 2011, p.756). Ruddiman (2013) argues that the release of methane causes a greenhouse gas effect sufficient to prevent the onset of the next ice epoch. However, according to Lewis and Malin (2015), auxiliary signs may include fossilized domesticated plant pollen and ruminant remains, but they do not provide signs that collectively document simultaneous changes globally. However, according to Lewis and Malin (2015), auxiliary symptoms may include fossilized domesticated plant pollen and ruminant remains, but they do not provide signs that collectively document simultaneous changes globally. Also, another difficulty with adopting the beginning of agriculture as the beginning of the Anthropocene is that it closely coincided with the onset of the Holocene and made the Holocene epoch redundant.

The population, which did not exceed 10 million at the end of the Pleistocene epoch with the start of agriculture, increased to 50 million with the beginning of the first settled society around 5000 BC (2,500 people per 250 Km2 for the first farming communities, and 5000 for the next pre-industrial and urban phase) (Chiarelli, 1998). With the beginning of comprehensive agriculture, cities with over 5,000 around 2,500 BC were 3, increasing to 17 at the milestone (Population Commission, 1976).

The Collision of the Old and New Worlds

Another suggested date is the Old and New Worlds' collision around the 16th century. The arrival of Europeans in the Caribbean in 1492 and the subsequent annexation of the Americas resulted in the most significant human population shift in the last 13,000 years. The economic and cultural link between Eurasia-Africa (Old World) and America (New World) heralded the beginning of a globalized economy and the Columbian exchange (Diamond, 1997; Crosby, 2003). The collision of the Old and New Worlds exchanged domesticated plant and animal products between regions (Mann, 2011). This cross-continental movement and accidental transfers have resulted in a rapid, ongoing, radical reorganization of life on Earth without geological precedent (Lewis & Maslin, 2015; Chiarelli, 1992). Although the criteria for this starting date, the movement of species between continents, are signed by a strong biological signal, there are also debates on whether it does not cause a change in the functioning of the world system by itself (Hamilton, 2015). This date point is a controversial sign for the Anthropocene (Zalasiewicz et al., 2015).

During the collision of the Old and New Worlds, the world population in the 16th century was 395 million, while the urban population of over 5,000 people was 30. At the end of the 17th century, the population increased to 550 million, and the urban population of more than 5,000 remained at 30 (Population Commission, 1976). It is estimated that the estimated number of cities with over 5,000 inhabitants did not change in the 16th and 17th centuries due to continental mobility, the establishment of new settlements, and deaths from diseases.

Industrial Revolution

Many scientists have suggested the beginning of the Industrial Revolution as an actual date for the beginning of the Anthropocene. Crutzen and Stoermer (2000, p.17) state that the industrial revolution, which caused global-scale atmospheric changes (carbon dioxide and methane), is the key indicator of the beginning of the Anthropocene. Rapid fossil fuel use and rapid social changes have been important events in human history (Crutzen & Stoermer, 2000; Zalasiewicz et al., 2011; Steffen et al., 2011).

Human energy use has risen sharply with fossil and land change. Overall, these industrial societies used four or five times more energy

DOI: 10.15320/ICONARP.2023.256

than their agricultural predecessors (while the farming community used 3-4 times more than hunter-gatherers) (Sieferle, 2001). The result of energy-related (fossil fuel) processes and activities (urbanization, etc.) has led to a significant increase in human footprint on the environment. Between 1800 and 2000, the human population increased from about one billion to six billion. In particular, the use of energy, influenced by urban areas, has increased approximately 40 times, and economic production has increased 50 times (McNeill, 2000).

Rapid societal changes and the acceleration of fossil fuel use have produced significant and unique transformations in Earth's natural history. Although, the lack of stratigraphic evidence has made this landmark controversial for some scientists. Crutzen and Stoermer (2000) mark the last part of the 18th century as the Holocene-Anthropocene border and point out that the effects of global human activities were noticed. Certini and Scalenghe (2011), on the other hand, questioned whether the Anthropocene began in the late 18th century, rejecting Crutzen and Stoermer's increase in greenhouse gases as a starting sign. They argued that "a change in atmospheric composition is not suitable as a criterion for describing the beginning of the Anthropocene" they argued that GHG levels do not reflect the significant overall impact of humans on the general environment, so more indicators are needed (soils and anthrosols) (Certini & Scalenghe, 2011, p.1270-1273). Other discussions indicate: The Industrial Revolution was a local event that did not co-occur in Northern Europe (Lewis & Maslin, 2015); Many parts of the Earth's surface had already been altered by pre-industrial human activities (Kirsch, 2005); Industrialization was slow to spread from its origins in western Europe, and there has not been industrialization at the same time globally (Malhi, 2017).

The Industrial Revolution accelerated population growth; in the two centuries between 1750 and 1950, the population increased an average of 10 times more than in previous centuries (Chiarelli, 1992). The number of cities with over 5,000 people was 33, out of an estimated 728 million world population in 750 years. After the revolution, it almost doubled every 50 years. In 1950, the number of cities, which was over 5,000, reached 783. While the estimated number of cities with over 100,000 people was 15 at the beginning of the 19th century, this number increased to around 314 at the end of the 20th century. In 1950, there were 83 cities with a population exceeding one million. Urbanization has grown with the effect of the industrial revolution. Industrialization and the emergence of the factory system triggered the migration from rural to urban. While the urban population was at 5%, this rate was 30% in 1950 (Population Commission, 1976).

Great Acceleration

In the second half of the 20th century, the human-environment relationship changed drastically with industrialization, World War II, and the use of the atomic bomb (Steffen et al., 2007, p.618). This so-called

"Great Acceleration" has led to a massive expansion in the human population and significant changes in natural processes with the intensification of human activities (Steffen et al., 2007; Canfield et al., 2010).

Great Acceleration Steffen et al. (2015) summarize the evidence from a longitudinal analysis of natural and social trends from 1795 to 2010 (see Steffen et al., 2015, p.4-7). To detect massive acceleration, a set of socioeconomic and Earth system parameters (24 global indicators) were used to track the impact of human activities on Earth, including population, economics, water usage, food production, transportation, technology, greenhouse gases, surface temperature, and natural resource usage (Figure 1).

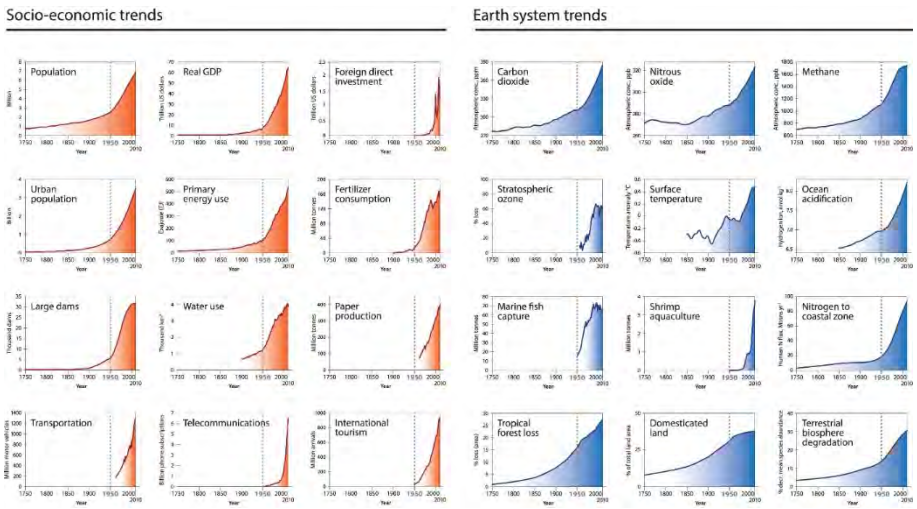

Figure 1. The Great Acceleration (Steffen et al., 2015)

Each indicator has increased dramatically since 1950. Steffen is certainly right about that. In 1950, the world's population was just over 2.5 billion, of which 746 million lived in urban areas. By 2009, the population had more than doubled to over 6.8 billion people, of which 3.42 billion lived in cities. Water consumption has also quadrupled during these years, rising from over 1000 cubic kilometers to about 4000. Another example, is the indicator of global human ecological footprint increased from 63% of the planet's bio-productive capacity in 1961 to 97% in 1975, reaching a level of 150% today; equivalent to the consumption of 1.5 planets per year (Steffen et al., 2015).

In 2016, the Anthropocene Working Group suggested the year 1950 to be the starting point of the Anthropocene since the presence of radiation from nuclear fallout caused by nuclear weapons testing is a detectable signal (Zalasiewicz et al., 2017, p.59). Lewis and Maslin (2015) pointed out that the Great Acceleration (1964) is vital in being the Anthropocene starting point as it fulfills the Global Boundary Stereotype Section and Point criteria. Also, the main advantage of choosing 1964 is the sheer variety of human influences recorded during the Great Acceleration: today and in recent years, almost all stratigraphic records point to human activity (Steffen et al., 2015; Lewis & Maslin, 2015).

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The fact that urbanization is increasing exponentially and an increase in consumption has created another impetus for the Great Acceleration. At the same time, the population was 1 billion around 1830, 2 billion in 1925, and 2.5 billion in 1950. Cities had a strong influence on the graph curves of the Great Acceleration. This effect became an even more driving force at the peak point (1950). This increase in the urban population was defined by Hern Warren (1995) as "biosphere cancer".

URBAN CONTEXT

It is not correct to characterize the Anthropocene with a single event on earth and the basis of human traces in the geological record. But the fact that cities were places of disaster that caused cannot be denied the beginning of the Anthropocene. Cities have been places that have experienced tremendous changes in what is known phase as the “Great Acceleration”.

The world population increased from 600 million in 1600 to about 8 billion in 2021. The world population has grown exponentially (the increase has accelerated since the interval considered the Anthropocene Era) and has recently begun to increase by 1 billion every 12 years. This led to estimates of a population of around 10 billion in 2050. While more than half of the world's population lives in cities today, it is predicted that two-thirds of its people will live in cities by 2050. In 1800, the world population was about 1 billion, and Beijing was the only urban with more than 1 million inhabitants. By 1900, about 16 cities had crossed this dam; this number had risen to 371 at the turn of the millennium and 548 (23 percent of the population) in 2018. If this trend continues, by 2030, there will be approximately 706 (28 percent of the population) cities with more than one million inhabitants worldwide (UN Population Division, 2018).

Land changes began to occur in cities with great speed to accommodate the increasing exponential population. In this process, three-quarters of the land and two-thirds of the marine environment have been significantly altered. Approximately 1 million animal and plant species are at risk of extinction due to the spaces built for humans (IPBES, 2019). Urbanization has increased greenhouse gas emissions, caused average global temperatures to increase by one °C compared to pre-industrial times, and the effects of the climate crisis have been exacerbated. These global changes have revealed an uncertain future not only for the biosphere but for humanity itself and the extinction of other species. Land-use change, including deforestation and modification of natural habitats, has brought many urban disasters. For example, it has been responsible for about half of the emerging zoonoses (diseases that can be transmitted from animals to humans).

Trachtenberg (2017) stated that Anthropocene and urbanization are not the same things. The Anthropocene encompasses a series of fundamental earth system processes in which humans changed the planet to live. On the other hand, Urbanization can be defined by the spatial concentration of people, who are the guiding and driving force of

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economic, social, and environmental change. The functional link with urban growth is clear: proto-industrialization would not occur if not provided the heat for the rapidly growing numbers of urban households and commerce. But even more: at the global level, it is a fact that there is a severe correlation between urban population numbers and the number of fossil fuels used over 500 years (Fischer-Kowalski et al., 2014, p.20). 80% of greenhouse gas emissions and most wastes are produced by the current urban lifestyle (Ritchie & Roser, 2018). And more than 66% of global energy is consumed by this lifestyle (Fragkias, 2013).

People have had such a significant impact with the acceleration of urbanization on earth that they have changed their geology and created new and different layers. The conversion of more than 50% of the earth's land surface for human use (Hooke & Martín-Duque, 2012) has produced anthropogenically modified materials in multiple terrestrial environments (artificial sedimentary): landfills, urban structures, mine residues, etc. (Waters et al., 2016).

In the long-term perspective, the evidence that will leave a lasting impression (marks) on the face and under the Earth is the cities. Zalasiewicz (1998) noted that this new geological layer would be the future fossils. Over thousands of years, humans have produced materials previously unknown on Earth, such as ceramics, glass, bricks, and copper alloys. The remains of these materials exist as a persistent and pervasive geological signal reflecting the city (Edgeworth, 2015, Topcu & Kubat, 2007). Almost locally unknown before the 19th century, elementary aluminum has seen 98% of its global production since 1950 (Zalasiewicz et al., 2014). Invented by the Romans, Concrete has been the primary building material since World War II. In the last 20 years (1995-2015), more than half of the concrete produced has been produced. This corresponds to approximately 1 kg m^2 of the planet's surface. Concrete and aluminum are spreading rapidly, especially in urban environments (Waters et al., 2016).

The rapid urbanization currently being experienced is another “sudden mineralization” that DeLanda (1997, p.26-27) mentions. In this case, cities are nothing more than the human (Exo) skeleton, a life support system, as Matthew Gandy states (Gandy, 2005). If the structures built by people were to stop, nature would soon take over these structures and possibly devastate them within a few centuries. Millennia later, the concrete layer and building rubble would remain. If this is the case, humans will leave their giant skeletons as urban remains (Polat & Kahraman, 2020). If the rapid post-war growth of urban areas is considered the “golden spike” and the driving force for the Anthropocene, should it be the Urbanocene (West, 2017) rather than the Anthropocene? The idea leaves question marks.

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ANTHROPOCENE AND DISASTERS

The Anthropocene itself could be considered a "disaster" - possibly equating to the asteroid event that killed about 70 percent of the species in the world about 66 million years ago. Beck (1992) has formulated the era we live in as the "Risk Society", where disasters are no longer the exception, and they have become a part of daily life. Dealing with hazards and disaster risks has become a central preoccupation for individuals, communities, and states.

Urbanization processes triggered the change in the Anthropocene, presenting environmental and social challenges unprecedented in scale, scope, and complexity (Polat & Kahraman, 2019, p.324). Cities have been places where people had a share of responsibility in the process when the Anthropocene started and where they will now live in the Anthropocene. They have become spaces open to the devastating effects of the Anthropocene (Trachtenberg, 2017). These catastrophic effects have made themselves intense in the 21st century, such as floods, storms, drought, extreme weather events, and epidemics.

In the 21st century, the nature and perception of global disaster risk have changed dramatically. Disasters such as earthquakes, volcanic eruptions, and tsunamis still occur, but “the risks of the Anthropocene” have expanded due to the increased impact of human actions (flood, fire, etc.). In addition, some dangers that were once thought to be the result of only natural processes are now known to be triggered by human action. In the "new planetscape of impossibly intertwined entangling of earthly biorhythms and colossal human engineering projects", the distinction between "natural" and "human-made" disasters can no longer be made. This reveals that we should reconsider the difference between natural and anthropogenic risks in light of the Anthropocene.

The global EM-DAT International Disaster Database, which records and evaluates data on the occurrence of "natural" and "technological" disasters by individual countries and regions, shows that natural disasters are occurring more frequently than in the past (EM-DAT, 2021). This trend can be attributed to the driving force of human activities in changing the planet's system. It also shows that the occurrence and intensity of significant disasters increase, and the diversification of global risks. The broadening of the scope of global disaster risks is associated with structural changes that link risks in unprecedented ways. Critical drivers of uncertainty include demographic change; geopolitical shifts, political transformations; technological developments, and climate change (Abdenur, 2020).

Climate change is the typical/intersection point of all the mentioned changes, from geopolitical changes to political transformations and the emergence of new technologies. According to the latest reports of the IPCC (2019), climate change will lead to more frequent and severe natural hazards, causing poverty and food shortages and displacing people significantly (IPCC, 2019).

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A debate that has characterized the climate change and disaster literature in recent years is that climate change (i.e., changes in climate resulting from anthropogenic impact) is a direct driver of disaster risk. Disasters caused by climate change affect every aspect of the economy and society. The dimensions of climate-related disasters in the Anthropocene Epoch can be summarized as follows;

- In the last decade, 83% of all disasters that trigger natural hazards have been caused by severe weather and climate-related events such as floods, storms, and heat waves. The number of climate and weather-related disasters has increased since the 1960s and has grown by almost 35% since the 1990s (IFRC, 2020).
- In the last decade, 1.7 billion people worldwide have been affected by climate and weather-related disasters.
- Severe weather and climate-related disasters (2,355 climate-related extreme weather disasters) have claimed the lives of more than 410,000 people over the past decade.
- The planet's average surface temperature has increased by about 1.18 degrees Celsius since the late 19th century.
- According to NASA, Greenland lost an average of 279 billion tons of ice per year between 1993 and 2019, while Antarctica lost about 148 billion tons of ice per year.
- The global sea level has risen about 20cm in the last century. But the rate in the previous two decades is nearly double the previous century, and it's accelerating every year.
- Since the start of the Industrial Revolution, the acidity of surface ocean waters has increased by about 30%. The ocean has absorbed 20-30% of total anthropogenic carbon dioxide emissions in recent years (7.2 to 10.8 billion metric tons per year).
- In the last two decades, climate-related disasters have nearly doubled compared to the previous two decades, affecting more than 4 billion people. These disasters claimed millions of lives and resulted in economic losses of over US$2.97 trillion (UN Secretary, 2021).
- According to research covering the last 50 years, the number of disasters caused by climatic conditions has increased five times since 1970. It is revealed that more than 2 million people lost their lives from these disasters and the most loss of life was due to drought (World Meteorological Organization, 2021).

The intensity and frequency of extreme weather events have increased and will continue to rise in the coming decades. These events will directly destroy urban infrastructure. However, if the sea level rises rapidly, many coastal cities will likely be submerged by the rapidly growing sea, sinking too quickly to be inaccessible. Here, as Zalasiewicz (2008, p.84-5) points out, "[o]ur drowned cities … would begin to be covered by sand, silt, and mud, and take the first steps towards becoming

DOI: 10.15320/ICONARP.2023.256

geology. The process of fossilization will begin". Cities have been places where people had a share of responsibility in the process when the Anthropocene started and where they will now live in the Anthropocene. The problems of the Anthropocene became particularly acute in cities as cities functioned as microcosms of global change. The dimensions of some disasters in cities in the Anthropocene Epoch can be summarized as follows:

Disasters, especially climate change, pose risks to settlement and infrastructure. For example, many cities worldwide have settled in earthquake zones, coastlines exposed to cyclones and tsunamis, and dangerous areas such as floodplains and hillsides. The earthquake in Haiti in 2010 killed more than 220,000 people, injured more than 300,000, and displaced more than 2 million people (The World Bank, 2010). In the Indonesian capital, Jakarta, floods in January 2013 (some lasted for weeks) displaced more than 14,000 people and cost nearly $1 billion in damage to homes and businesses (Taylor, 2013).

In recent years, humanity has been feeling many infectious diseases on an increasing scale, frequency, and more closely: Ebola virus disease, severe acute respiratory syndrome (SARS), avian and pandemic influenza, middle east respiratory syndrome (MERS), and the recently emerged coronavirus disease (COVID-19). Emerging infectious diseases occur in urban settings, such as the emergence of COVID-19 in Wuhan, or spread rapidly due to urbanization, such as the SARS epidemics in 2003 and the Zika virus disease in the United States (Li et al., 2020).

The Anthropocene Epoch also includes the challenge of providing health, water, food, energy, etc., to the more than nine billion (2 in 3) expected to live in urban areas in less than 40 years (UN, 2013). About 70% of the Earth's surface is covered by water, but only 2.5% is clean, and less than 1% is easily accessible. Approximately 783 million people (about 11% of the population) do not have clean and safe water. This will worsen with climate change, saltwater intrusion into coastal areas, population growth, deforestation, land degradation, and water scarcity (TWP 2014). The worst-case scenarios will cause suffer more water crises in urban areas.

While cultural and environmental changes in the Anthropocene caused golden spikes that changed geological time, these changes also led to the emergence of disasters. When we look at the golden points of the Anthropocene on the geological time scale, it is clear that people's interactions with the global environment increased, especially with the Industrial Revolution and the Great Acceleration, and almost every indicator emerged in the 1950s.

As seen in Figure 2, as the deep roots of the Anthropocene Epoch increase, the greenhouse gas emissions that cause climate change increase. Along with this increase, there has also been an increase in the number of disasters caused by climate change. The rise in the birth and number of cities is not coincidental with these increasing trends.

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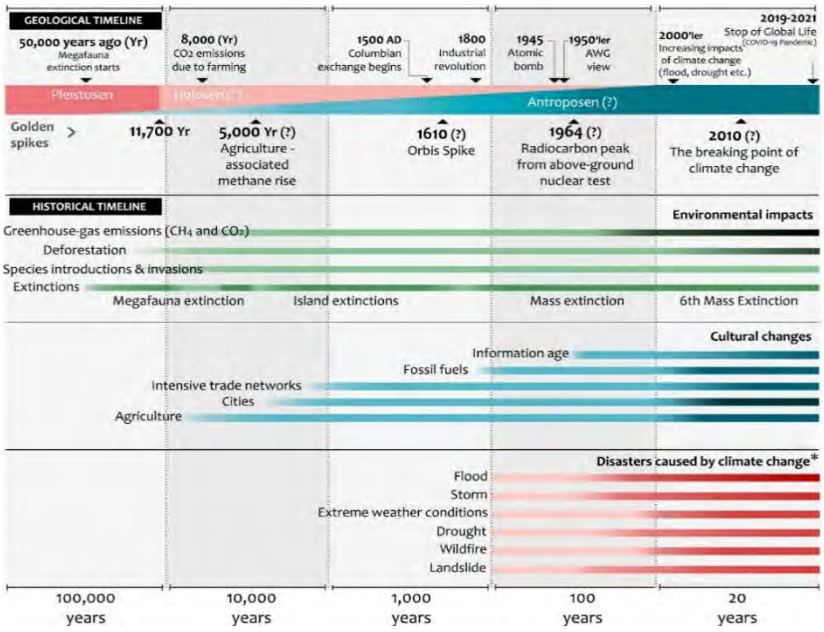

Figure 2. The Deep Roots of the Anthropocene Epoch, Environmental Impacts, Cultural Changes and Its Connection with Disaster (created by the authors with reference from Ellis et al., 2016; Polat & Kahraman, 2021).

AFTER THE ANTHROPOCENE?

Bostrom (2008) defines the risk of a global catastrophe as "a hypothetical future event which could damage human well-being on a global scale, even crippling or destroying modern civilization". From the point of view of risk, Anthropocene-specific risks superimposed new risks on old ones or exacerbated pre-existing risks. From volcanic eruptions and earthquakes to nuclear proliferation and epidemics, the Anthropocene presented more challenging risks to survival.

Our period is not the first period of high unpredictability in history. But political, geopolitical, technological, and climate changes have accelerated the pace of social transformation to change people's perception of time radically. Only twenty or thirty years ago, most people could make plans for everyday life and the near future. Today, people cannot predict the significant political and economic changes in the world in half a century and their daily lives in ten or twenty years (Hariri, 2018). People living in the 21st century will likely experience a more devastating change. It is predicted that future generations will live in a different world. This speed of social change and uncertainty makes it difficult for human society to identify, understand, and overcome emerging risks (Abdenur, 2020).

The Commission for the Human Future has issued an urgent Call to Action to tackle the ten significant catastrophic risks facing humanity and our civilization. The risks included in the report titled "Surviving and Thriving in the 21st Century" are (The Commission for the Human Future, 2020):

- The decline of critical natural resources and an emerging global resource crisis, especially in water,
- The collapse of ecosystems that support life and the mass extinction of species,
- Human population growth and demand, beyond the Earth's carrying capacity,

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- Global warming, sea-level rise, and changes in the Earth's climate affect all human activity,
- Universal pollution of the Earth system and all life by chemicals,
- Rising food insecurity and failing nutritional quality,
- Nuclear arms and other weapons of mass destruction,
- Pandemics of new and untreatable diseases,
- With the advent of powerful, uncontrolled new Technologies,
- National and global failure to understand and act preventively on these risks.

Abdenur (2020) also suggested global disaster risks and distinguished Anthropogenic and non-Anthropogenic risks. The non-anthropogenic category includes hazards outside of human action, such as an asteroid impact. However, human activity can exacerbate or trigger risks long ago considered inherent in some cases (climate change risks). These risks are an inevitable end. To better understand the extent of climate risks, one should also consult the 2019 IPCC report. The report explains that if emissions continue to rise, average global temperatures will increase 1.5°C above pre-industrial levels (probably between 2030 and 2052) and could exceed it. The report describes disaster scenarios for these possible situations (IPCC, 2019). Table 1 includes the "Typology of Global Catastrophic Risks" mentioned by Abdenur (2020) and IPCC (2019).

Table 1. Typology of Global Catastrophic Risks (Anthropogenic) (Abdenur, 2020; IPCC, 2019)

Type	Drivers	Sample scenarios
Artificial intelligence (Superintelligence) (Bostrom, 2014)	Learning computers become super intelligent and excessively autonomous, taking unexpected actions and/or out-compete humanity.	Robots manipulate social groups in ways that provoke wars. Robots can independently choose targets to attack with weapons and at scale.
Biotechnology (Noun & Chyba, 2008; Lipsitch & Relman, 2015)	Bioengineered organisms such as viruses, bacteria, fungi, plants, or animals can disrupt ecosystems or become (through intentional or unintentional action) high-virulence pathogens.	A human-made virus escapes from a laboratory and causes a global pandemic.
Cyberattack (World Economic Forum, 2018)	Offensive maneuver by state or non-state actors targets computer information systems, infrastructure, networks, or personal computer devices, sometimes as part of cyberwarfare or cyberterrorism and causing physical damage.	Rogue actors destroy the critical infrastructure of countries or regions, such as satellite systems.
Environmental disaster (Lovejoy & Nobre, 2018)	Overpopulation, economic development, and non-sustainable agricultural practices may lead to widespread deforestation, water scarcity, or species collapse.	Amazon reaches a "point of no return" due to widespread deforestation.
Experimental technology accident (SIPRI, 2019)	Humans and/or robots create a device that causes widespread destruction.	Biotechnological innovation is weaponized and leads to a pandemic.
Global Warming (World Economic Forum, 2020)	Increasing levels of greenhouse gases provoke climate change, and sea-level rise prompts loss of biodiversity and stress for food and public health systems.	Global warming leads to the spread of infectious diseases.
Nanotechnology (Umbrello & Baum, 2018)	New technologies, such as molecular manufacturing, lead to new arms races.	Rogue company or state weaponizes nanotechnology.
Warfare and mass destruction (Toon et al., 2019)	Weapons of mass destruction are deployed in ways that cause widespread damage.	Nuclear warfare.
World population and agricultural crisis (Singh, 2018)	The rapid increase in human population, for instance, due to medical developments, outpaces increases in	Population surge leads to mass starvation. Lack of food and nutrients

	agricultural productivity or dovetails with an abrupt decline thereof.	
Climate Risks - Extreme heat (IPCC, 2019)	Extreme heat increases due to climate change are increasing every year.	With a 2°C increase, sweltering days in the mid-latitudes will be about 4°C hotter than pre-industrial levels. Exposure of 28% of the world's population (2 billion people) to extreme heat every 20 years.
Climate Risks - Rising sea levels (IPCC, 2019)	With the effect of global warming, the glaciers are melting and the sea level is rising.	It is expected to increase by 0.36-0.87 meters in 2100 compared to 1986-2005. By 2100, 49 million people will be affected by 56 cm of sea-level rise.
Climate Risks - Impact on Species (IPCC, 2019)	With the effect of climate change, the structure of the habitats of the species changes and species extinction occurs.	With a 1.5°C increase, 6% of insects, 8% of plants, and 4% of vertebrates are projected 2100 to lose more than half of their climatically determining geographic range.

The risks in Table 1 are issues that directly concern the "Urbanized Planet". The top five risks that are certain to affect cities shortly are “flood, mass movements (wet), storm, extreme weather conditions, drought” (EM-DAT, 2021).

In addition to the words of sociologist Bronislaw Szerszynsk, “It is important to realize that the status of the Anthropocene is less about what humanity is doing than the traces that humanity will leave behind” (2012, p.169); it can be said that “the traces that humanity will leave behind with the Anthropocene seem to be evident (urban remains), so what will people do in the future?”

CONCLUSIONS AND RECOMMENDATIONS

Numerous dates have been proposed for the beginning of the Anthropocene, such as the emergence of agriculture and cities about 10,000 years ago, the Collision of the Old-New Worlds, the Industrial Revolution, and the Great Acceleration. Within the scope of the research, it was concluded that the most vital candidate point, which includes human control level, geographical scale, relevant data sets, and auxiliary stereotypes, was in the mid-20th century.

Urbanization contributed to the evidence leading to the beginning of the Anthropocene Era. Urban societies, both as the driving force of the Anthropocene and as regions where solutions need to be found, also represent spaces where change can best be managed and monitored. The results of "the Anthropocene", initiated by urban people with their own hands, are intensely felt in the urban spaces they live in.

The fact that the Anthropocene Epoch began to push the “planetary boundaries” has recently brought with it calls that are variously called “planetary administration” (Steffen et al., 2011); “earth system governmentality” (Lövbrand et al., 2009); and “deliberative global governance” (Dryzek & Stevenson, 2011, p.1873). Indeed, this shows that the need for new or extensively strengthened frameworks/policies/management is urgently needed for the near future to come. In addition, when the assumption is made that "although urbanization has existed for thousands of years, in its current form, it functions as an accelerating aspect of the Anthropocene", it is now necessary to reshape the nature of urbanization to balance the planetary borders and the border. We need to transform urbanization processes for a desired or “good” Anthropocene (Strategic Spatial Planning).

DOI: 10.15320/ICONARP.2023.256

Recently, it has been tried to propose solutions in planning in the context of "green," "sustainable," "smart," "flexible," "zero-carbon," and "resilient" cities. But in light of the scale of the problems faced, how effective can these initiatives hope to be? There is a great need to inject a good dose of realism into our vision of the future when planning; because the Anthropocene stands on a hard ground of uncertainty and unpredictability in planning. Because accepting the uncontrollability of extreme climatic events that can occur anywhere, at any time, is in contrast to the predict/produce solution approach of planning.

We can never restore the Planet. So how do we move forward in this changing world we've created if we can't turn the clock back?

The changes and transformations that took place in cities with the effect of the Great Acceleration are too complex to be handled with today's traditional planning approach. Social, economic, spatial, and ecological relations and connections in terms of urbanization and urban cycles in the Anthropocene must be reconsidered with the understanding of Strategic Spatial Planning. Thus, it will be possible to understand the cities of the contemporary global world that are formed by human influence and to plan correctly/well.

For this reason, the planning paradigm needs to move towards an orientation that will produce solutions by considering the problems of the 21st century. Understanding "Strategic Spatial Planning" should be adopted as one of the most flexible methods. Short, medium, and long-term solutions should be provided by producing scenarios (such as disaster scenarios - good, reasonable, bad). It is urgently necessary to make resilient/flexible/adaptable strategic decisions with alternatives for cities.

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Resume

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ICONARP
International Journal of Architecture and Planning
Received: 10.07.2022 Accepted: 15.09.2023
Volume 11, Issue 2/ Published: 28.12.2023
Research Article *DOI: 10.15320/ICONARP.2023.257 E- ISSN:2147-9380*
ICONARP

Evaluating Accessibility of Street Network in Neighborhood by Space Syntax Method: The Case of Çankırı

Pelin Şahin Körmeçli

Abstract

Designing inclusive cities by creating accessible neighborhoods in cities is one of the top agendas in urban planning and design. Therefore, it is important to examine settlements morphology to find out functional contributions to urban design. In this study, the aim is to find street characteristics that support accessibility by comparing street network of current and zoning plan in the neighborhood. The study was carried out in the Esentepe Neighborhood, which is far away from the city center of Çankırı. The fact that the neighborhood is one of the directions of urban development and is located in an area with low accessibility throughout the city requires the development of this area. The study area was evaluated by the space syntax method. The study was designed in three stages. First, the spatial accessibility of the street network in the Esentepe Neighborhood in its current state was analyzed by creating axial maps. Secondly, integration and connection maps were created to evaluate the accessibility of the street network based on the future development plan of the Esentepe Neighborhood. Finally, the current and master plan of the neighborhood was compared to understand the characteristic of accessible street network in the neighborhood. The study results revealed that integration and connectivity values increased compared to the current plan. The creation of simple, interconnected and intersected axes placed in a certain range increased accessibility of area. The long and continuous central axis providing access to the circular central area and the axes connected to this line have the highest integration value in the neighborhood. Space syntax will be a guiding tool on issues such as the selection, design and development of settlements in city plans. The transportation system, which promotes use of spaces around the residence in settlements planned far from cities, contributes to the evaluation of the social interaction areas for residents. The research develops a proposal method in terms of evaluating the future development of neighborhoods for creating a sustainable transportation system.

Keywords:
Accessibility, Çankırı, settlement morphology, space syntax, street patterns

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To cite this article: Şahin Körmeçli, P. (2023). Evaluating Accessibility of Street Network in Neighborhood by Space Syntax Method: The Case of Çankırı. *ICONARP International Journal of Architecture and Planning,* 11 (2), 625-649. DOI: 10.15320/ICONARP.2023.257

INTRODUCTION

Cities are trying to take several measures to solve the local and global problems caused by rapid urbanization, which is the common problem in the world in the 21st century. In order to reduce the urbanization in the city center, settlements are designed far from the city center. Designing accessible residential areas is important for developing better physical infrastructure systems in urban areas and creating livable cities. Settlements located far from the city are good testing areas for the evaluation of the future development of cities and create sustainable urban spaces. In order to prevent increase in social and spatial inequity and contribute to the solution of urban problems, it is crucial to accurately understand and manage the urban pattern which is created by bringing together the buildings, streets, parcels and the main physical components of the city (Günaydın & Yücekaya, 2020). The form of the city is shaped by the urban street network. The city is defined by hierarchical street patterns and residential neighborhoods designed based on the neighborhood unit model (Rofè & Omer, 2012; Omer & Kaplan, 2017). In this context, street networks in the neighborhood are one of the important factors affecting urban development that determine the life quality of cities.

Neighborhoods, which are social and cultural living spaces within the urban open space typologies to solve the transportation problem in the city centers, were first introduced by Perry (1929) at the beginning of the 20th century (Eisner *et al.,* 1993). Neighborhoods are one of the smallest living units of cities. Küçükerbaş & Malkoç (2000) classified neighborhoods as the micro-plan scale where the design begins. Neighborhood units, where social and cultural characteristics are reflected, are important study areas in order to create a transportation system with a strong physical infrastructure. Since transportation problems are not resolved in each of the neighborhood units, which are the smallest living units of cities, accessibility problems arise throughout the city.

Transportation is an important concept at every stage throughout history, starting from primitive settlement to the growth of large metropolises, and has a strong impact on the spatial structure in global, regional and local dimensions (Naryaprağı & Polat, 2020). In order to improve transportation in cities, it is aimed to improve accessibility by examining the land structure and transportation systems. Achieving accessibility to certain areas with a new transportation system also changes the land use structures of those areas in the medium and long term (Gerçek, 1996). The transportation system provides accessibility in public spaces. Accessibility is defined as "the ease or comfort of reaching a particular destination" (Kaplan, 1989). Accessibility means that no person's right to access public space is restricted and its usability is ensured, that everyone can go to every place they go in and out in daily life (school, hospital, shopping mall, restaurant, etc.) and participate in every public activity (Evcil, 2014). The design of an accessible street

DOI: 10.15320/ICONARP.2023.257

network in residential areas also increases the use of space. One of the most important parameters in providing accessibility in cities is walkability. Walkability is a concept that defines the act of movement that enables reaching from one place to another (Mıhçı & Tanrıverdi, 2021). Walkability, a component of smart, sustainable and livable cities, is the most practical tool for citizens to realize their demands and rights to access and participate in urban life (Akkar Ercan & Belge, 2017). A considerably walkable environment invites walking by way of a well connected path network that provides access to the common places people want to go (Southworth, 2005). In the neighborhoods where individuals live, transportation systems should be arranged in a way that does not hinder individuals and in a highly connected way. The street pattern, i.e. the network system formed by the roads, is another factor that ensures accessibility in the cities. Street patterns are categorized in five ways in land use; gridiron, warped parallel, fragmented parallel, loops on a stick, lollipops on a stick (Southworth & Owens, 1993). The gridiron street pattern has a higher potential for accessibility among these street models than others, with multiple intersections and route options. Grid pattern intersection points are numerous and systematically divided, making its network an alternative for pedestrians and cyclists in the equal distribution of traffic and routing. The advantage of the grid pattern is that it helps to achieve a compact settlement to use the spaces efficiently as it mostly consists of linear roads (Salleh, 2018). For quantifying street patterns, Marshall (2005) combined our Citywide Street network types (grid, linear, tributary and radial) with two types of Neighborhood Street network (tree and grid) (Marshall & Garrick, 2010). Street network classification is used to evaluate many research subjects. Therefore, it is important to consider how this classification relates to street design characteristics in order to provide a safer and more sustainable transportation system.

From a designer's perspective, sustainability can be briefly defined as improving the quality of life of societies without exceeding the carrying capacity of global ecosystems, both at the urban and architectural levels (Oktay, 2001). Sustainability in cities is one of the most important concepts that need to be solved today. There is an urgent need to take progress towards sustainability because the population is concentrated in cities. Sustainable urban planning aims at a mixed use approach that aims at the effective use of land in line with factors such as energy, environmental opportunities and transportation (Tosun, 2013). UN-Habitat (2011) lays out the three principal features of sustainable cities and neighborhoods: compact, integrated, and connected. In this respect, the value of integration and connectivity are the criteria to be taken into account in the accessibility assessment of streets. Özbil *et al.,* (2015) stated that the connectivity of street networks increases the accessibility. Connectivity is one of the criteria that are presented for the design of successful pedestrian network (Southworth, 2005). On the other hand, integration enables the discovery of the smallest and largest potential

areas of action in the urban system. By calculating integration, an urban grid system can be analyzed, mobility can be estimated and at the same time, data can be generated to clarify its existing mobility (Arslan & Şıkoğlu, 2015). The degree of correlation between integration and connectivity values can be used as a measure of intelligibility and predictability of the whole environment (Bafna, 2003). Correlation analysis can be used in order to evaluate accessibility of urban areas by using space syntax method with connectivity, integration and synergy values.

The space syntax method can calculate the mathematical relationships between spaces (Van Nes & Yamu, 2021). The space syntax method, which emerged as a result of rapidly developing technologies in recent years, analyzes spatial data and was introduced by Hillier and Hanson (1984). It examines the relationship between the social and physical structure of the city. This method analyzes how spatial textures develop by solving the mathematical structure of open spaces. Spatial syntax analysis examines the potential for people to come together in urban open spaces by overlapping the fields of movement and vision (Çil, 2006). In this regard, it is a guide in revealing the movement areas with analysis and the planning of the settlement areas. The aim of this analysis is to build a street hierarchy from the most often used open spaces to the least used in a residential area (Şıkoğlu, 2021). Space syntax offers concrete and comparable analytical data that helps to question the impact of city's complex spatial formation on the city or its role in the differentiation of cities (Üsküplü & Çolakoğlu, 2019). Many studies have found a strong relationship between integration value and usage (Hillier *et al.,* 1993, Özer & Kubat, 2007, Baran *et al.,* 1993; Özbil *et al.*, 2011; Günaydın & Yücekaya, 2020). Therefore, street network with high integration value also has high accessibility. Günaydın & Yücekaya (2020a) evaluated accessibility through the current and proposed design of the campus in a sustainable transportation model review. Öztürk Hacar *et al.*, (2020) examined the relationship between pedestrian density and space syntax measurements by comparing the current and the master plan of the campus. Alemdar & Özbek (2021) examined the relationship between pedestrian mobility and land use in the historical center of Kadıköy using wayfinding methods through street texture. Although the accessibility of street texture in many areas is evaluated with different methods based on current and future plans, for the sustainability of cities it is seen that there is a need for studies evaluated at the neighborhood scale, which is the smallest design unit of cities.

In line with the literature research stated above, this study was carried out in the Esentepe Neighborhood of the city of Çankırı. The reason for choosing this study area is that the Esentepe Neighborhood is located in a separate location from the city center. The neighborhood composes a good sampling area in terms of making field observations with its self-enclosed transportation system. This study examines the impact of changing the existing and the zoning plan street network in the

DOI: 10.15320/ICONARP.2023.257

neighborhood on accessibility. In this context, the study aims to examine and discuss its functional contributions to urban planning by revealing the morphological structure of the transportation pattern in the neighborhoods. The study aims to clarify how the street network model affects the neighborhood accessibility by comparing the current plan and zoning plan. It was based on the research question *"What should be the characteristics of the streets that increase accessibility in the neighborhoods?"* Firstly, an axis map was created according to the streets in the existing satellite data. After that, an integration map was created according to the axis map, and the connectivity values of the streets were determined. Accessibility level was evaluated according to connectivity values. Secondly, a spatial analysis of the street network was made over zoning map of study area. Finally, street characteristics were evaluated by comparing the accessibility levels of the current and future street network in connectivity and integration maps.

METHODOLOGY

Research case

This study was conducted in the Çankırı city. Çankırı is located on the Istiklal Road, which is on the route between Ankara and Kastamonu. The İstiklal Road, which has historical importance, adds value to the city and as a transit point, it creates a potential for evaluation in terms of the physical development of the Çankırı city. The study was carried out in the Esentepe Neighborhood, which resembles a satellite city located in the southeast direction from the Çankırı city center and designed at a separate point in the city in order to reduce the density in the city. As the city is developing in this direction, the Esentepe Neighborhood is a good sampling area to contribute to its future sustainability. In addition, this area, which has the characteristics of a satellite city, was chosen as a research area because it makes it easy to examine the design of the physical space by creating livable environments. According to the TÜİK (2021), the population of the neighborhood is 1,972 people. The study area is 5 km away from the city center and its geographical location in the city is shown in Figure 1.

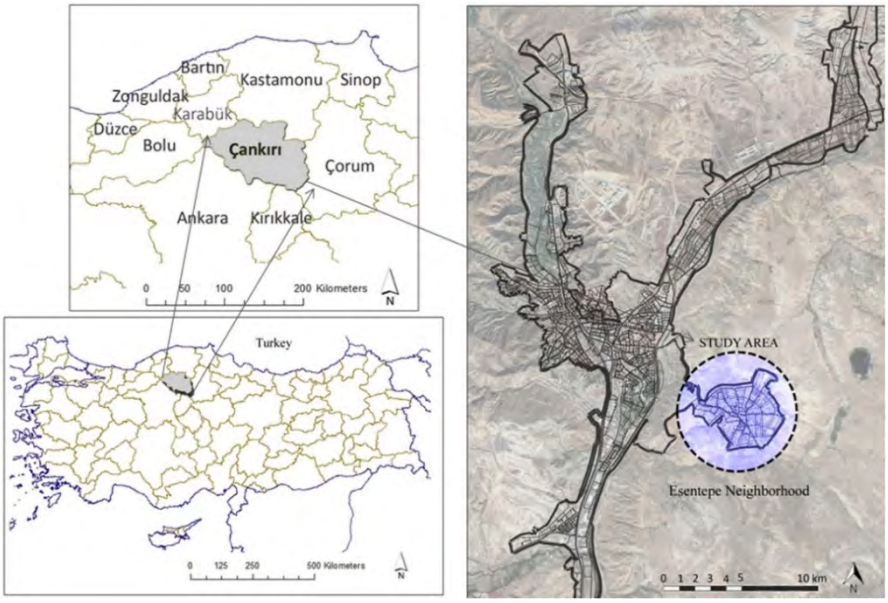

Figure 1. Geographical location of the Esentepe Neighborhood in Çankırı

The study consists of analysis, synthesis and evaluation phases. Space syntax method was used in the research. 1/1000 scale current map and 1/5000 scale zoning plan of the study area, which are provided by the Çankırı Municipality (2021), are used in the research. Çankırı 2021 address-based census (TÜİK, 2021) and field studies were used as basic tools in the study. DepthmapX 0.8 and Autocad 2017 softwares were used to determine accessibility levels.

Space Syntax

Space syntax is a method developed by Bill Hillier and his team in the 1970s to describe and numerically analyze spatial organizations from residential scale to urban scale. The method demonstrates the potential accessibility and perceptibility of streets and alleys that form a street network (Hillier *et al.,* 1993). This method is also a good tool for analyzing the city and making decisions in urban planning and design studies. The space syntax technique that analyzes the relationship between the societies and spatial structures that make it up is based on some theories from residential scale to urban scale (Dalton & Dalton, 2007). Data such as the settlement pattern, the relations between buildings and streets, and the integration of open and closed spaces reflect the social structure of the area (Hillier, 1996). One of the most important properties of the method is that it can visually show how newly designed spatial models work, compare the old and the new, and to some extent, predict future problems in small or large scale designing and planning studies (Kubat, 2015; Günaydın & Yücekaya, 2020a). On the other hand, criticisms of the space syntax methodology are summarized as follows (Kubat, 2015):

- Every researcher can draw a map of slightly different axes of opinion,
- Information on land use cannot be included in the digital environment where building heights and street widths are analyzed,
- Pedestrian sidewalks and urban highways have the same value,

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• When research focuses on only a region of the city rather than the whole, it is left to the initiative of the researcher to decide how to limit the view axes map.

• Viewing axes do not make a difference in evaluating metric lengths,

• Ignoring that the line of sight may be blocked due to differences in topography.

In the space syntax method, integration and connectivity values are evaluated. The intelligibility of a space expresses the relationship between its connection and integration values (Günaydın & Yücekaya, 2020a). The intelligibility of a space is related with the amount of connection and integration of the system, and the formal perception of the space can be explained by the correlation between these parameters (Tanrıverdi Kaya, 2020). Although the relationship between connection and integration value provides the comprehensibility of the space, it is a limitation that land use or structural features such as the presence of obstacles along pedestrian paths related to accessibility, the surface of the pavements, and the slope of the road are not evaluated on the space.

Connection is the statistical term of spaces that can directly be linked to another space (Klarqvist, 1993). Connection is the number of axial lines connecting or intersecting each line in the system (Ahmed *et al.,* 2014). Connectivity value also provides information about the accessibility of the space. The integration value gives the number of connections where each part is joined or separated. Integration of a node is stated by a value that shows the extent to which a node is separated or integrated from a system fully or from a partial system consisting of nodes several steps away (Volchenkov & Blanchard, 2008). Integration maps obtained by space syntax method express pedestrian and vehicle movement in the urban system (Hillier, 2007). The integration value is the point where each part in the system joins or separates and defines how central it is in the system. Open areas that integrate with the settlements are gathering areas which are suitable for commercial, social or cultural activities because of the slowing or stopping of pedestrian movement (Hillier, 1984, Hillier, 1996, Gündoğdu, 2014; Tanrıverdi Kaya, 2020). The integration value indicates accessibility, where a high value indicates a high correlation between the axes and a low value indicates a low connection between the axes. This value is of great importance in describing how movements operate within the urban system.

Axis maps created in order to reveal the utilization potential of the roads in the space syntax method are created by drawing the longest and fewest number of lines or sight lines passing through every accessible place in an urban area or building based on a scaled map (Özer, 2006). These maps explain where and how to reach the individual in a spatial organization, what kind of relationships exist between the functions and the spatial composition that make up this composition, and the movement within the space (Gündoğdu, 2014). With space syntax analysis, the hierarchy of the least and most used axes in the settlements is formed. The map is formed by calculating the integration value on the

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axial map created by drawing the axial lines, and by ranking the six different values from the largest to the smallest according to the spatial integration value shown in different colors. In the space syntax method, the most important factor determining the mobility in the area is the integration value (Özbek, 2007). Axes with high integration value express the axes that are accessible within the space pattern and have strong connections with the network structure, while axes with low integration value represent the axes that are difficult to access, separated from the space pattern (Hillier *et al.,* 1993). The integration value of the axial line, which is evaluated by calculating and averaging the changes in direction required to reach one place to another for all spaces in the system, determines how much this line is used in the system.

Analytical Framework

The study is focused on the comparison of the spatial analysis based on the current plan and zoning plan street network in the Esentepe Neighborhood. It was carried out in three stages: analysis of the current street, analysis based on future transportation planning and comparison of the spatial features resulting from these two designs.

In the first part of the study, roads were drawn on AutoCAD over the satellite image of the Esentepe Neighborhood. After that, this drawing was transferred to DephtmapX software and the axial map was created. By analyzing the axial map, integration and connectivity maps were created. Analyzes were made on these maps and the current accessibility situation of the study area was revealed.

In the second part of the study, the 2022 zoning plan of the Esentepe Neighborhood, which is planned for the future, was taken as basis. The street network of the study area was analyzed according to the zoning plan in the AutoCAD file, which is obtained from the Çankırı Municipality. Axial maps were created according to the roads transferred to the Depthmap X 0.8. The software creates axes according to the longest and shortest connections within closed lines. In the axial map the axes with the longest and most intersections were ranked according to their density, and integration and connectivity maps were created. Integration maps are important to explain how both vehicle and pedestrian movements work within the urban system and to understand how often public spaces are used (Hillier, 2007). The integration value obtained in the space syntax analysis shows the effect level of accessibility, and this value decreases from red to blue.

In the last part of study, evaluations were made on the development of the transportation structure by comparing the current and the future situation. In this study, by comparing the results obtained with the space syntax method, which allows the comparison of the current situation and the future plan, answers are sought for how accessibility values are affected based on the sustainable transportation system model. In order to create sustainable neighborhoods, the impact of the street network on change was examined.

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In order to determine the street network characteristic of the neighborhood, Marshall & Garrick (2011) classification, which are Linear tree (LT), Tree Tributary (TT), Radial Tree (RT), Grid Tree (GT) and Linear Grid (LG), Tributary grid (TG), Radial Grid (RG), Grid grid (GG) were used. This model was evaluated on connectivity and integration maps of the existing study area and zoning plans. By correlation of connectivity and integration value, scatter values of intelligibility values were obtained. The current and zoning plan accessibility levels are compared on the synergy graphs. This study seeks to answer how connectivity and integration values affect accessibility. The conceptual flow chart describing the study method is given in Figure 2.

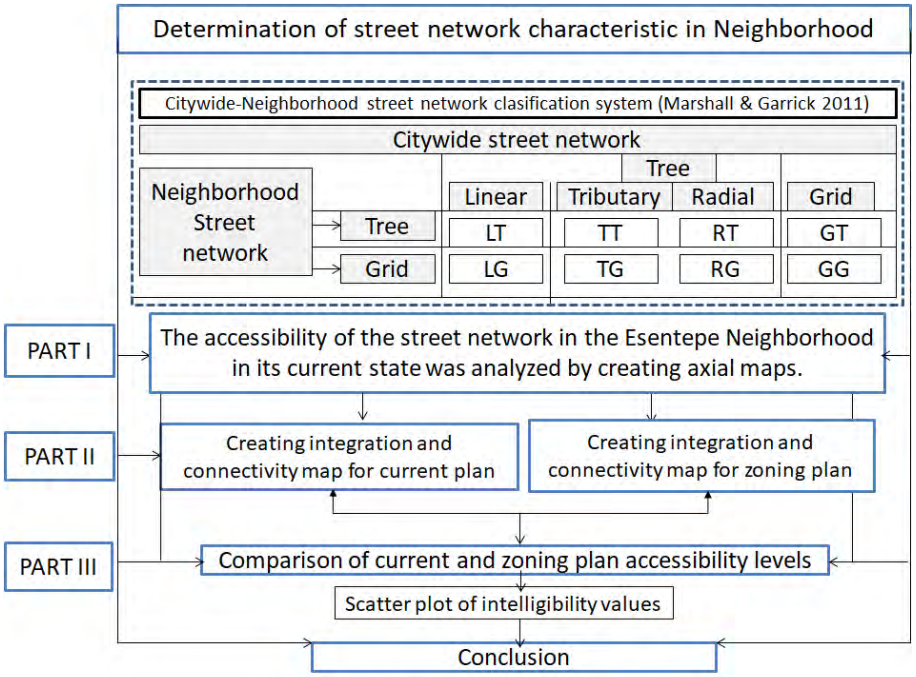

Figure 2. Study method scheme

RESULT AND DISCUSSION

Evaluation of the Current Plan

The Esentepe Neighborhood is located in the southeastern part of the Çankırı city center and is under development. In the first part of the study, existing street network is created. In this context, axes were drawn on the satellite image regarding the existing situation of the area. The satellite map of the study area is shown in Figure 3. There are 18 streets on the current map and it has been observed that the street network has irregularly spread from the center of the neighborhood.

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Figure 3. Satellite image of the Esentepe Neighborhood

The axial maps were created based on the neighborhood satellite image. Integration and connectivity values were analyzed for evaluating accessibility. The integration value is the point where each part in the system joins or separates and defines how central it is in the neighborhood street network. Integration value obtained in the study gives the number of connections where each part joins or separates. The integration value obtained in the analysis shows the degree of influence of the visible areas, and this value decreases from red to blue. Integration map of current plan is given in Figure 4a and connectivity map of curent plan is given in Figure 4b. The integration and connectivity values of the streets in the neighborhood are given by calculating on the DepthmapX (Table 1).

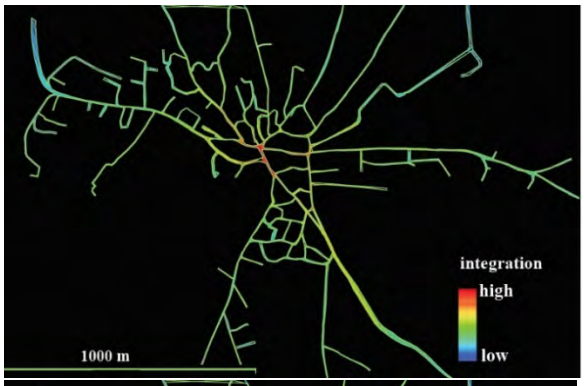

Figure 4a. Integration map of current plan

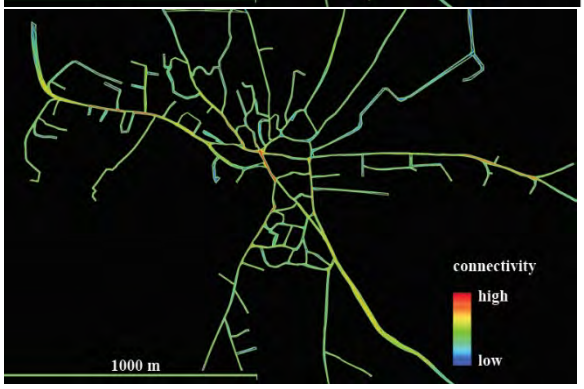

Figure 4b. Connectivity map of current plan

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Table 1. Integration and connectivity values of streets in current plan

	Streets	Integration value	Connectivity value
1	Cami Street	1.12	3
2	Çağlar Street	0.77	4
3	Su deposu Street	0.71	2
4	Tuzla Street	0.9	3
5	Tuzla-2 Street	0.63	3
6	Gökçe Street	0.88	5
7	Akyol Street	0.85	4
8	Esentepe Street	0.88	7
9	Bahçeler Street	0.94	4
10	Onbaşı Street	1.04	5
11	Okullar Street	0.67	4
12	Çamaşırhane Street	0.9	4
13	Doğantepe Street	0.98	6
14	Birlik Street	0.98	6
15	Fidan Street	0.68	4
16	Eğitmen Street	0.7	6
17	Başağa Street	0.65	4
18	Demir Street	0.81	3

It is seen that the current map of the Esentepe Neighborhood has morphologically dispersed from the center. The neighborhood street network classification is Radial tree (RT). When the connectivity and integration maps showing the metric accessibility level are examined, it is seen that the accessibility level decreases as you move away from the center. The areas with the highest level of accessibility are close to the center, while low accessibility areas are the farthest areas where the connections are fragmented in the neighborhood. The places with the highest level of accessibility are the regions close to the center, while the places where the level decreases are the farthest regions where the connections are interrupted in the study area. Neighborhood access is provided by two main central axes: Esentepe and Akyol streets. The Esentepe Street is the longest axis connected to the city and has the highest connectivity value. It became apparent that the accessibility level of the axes connecting to the city center is also important in the area. The Akyol Street, which connects with the Esentepe Street, passes through the middle of the neighborhood. It is seen that this street has a high level of accessibility. The streets of Doğantepe, Birlik, Cami, Tuzla, Gökçe, Bahçeler, Onbaşı, which are connected with each other in the center of the neighborhood, have high integration and connectivity values. The central axis providing access to the circular central area and these streets connecting to this line are also the axes with highest accessibility in the area. These streets also have high integration and connectivity values. Central axis that provides access to the circular center area and these streets that are connected to this line are the axes with the highest access in the area.

Accessibility value is high in these axes, as they form a centralized network model that is interconnected. They are also connected to the Esentepe Street, add connectivity to the system as they are the longest hangers and ensure continuity. Although the accessibility level of other axes spreading from the center is high, the access value of these axes reduces as the distance from the center decreases. The integration and connectivity value of other transportation axes in the area is low due to their lack of continuity, distorted directions and dead-end streets, and these streets reduce the level of accessibility in the system.

Evaluation of the Zoning Plan

The Çankırı Esentepe Neighborhood Revision Zoning Plan was entered into force according to the council decision dated 07.03.2022 and numbered 63 (Çankırı Municipality, 2022). The roads and land uses (sports, education, park, trade, cultural housing area etc.) are located in the proposed plan. The Esentepe Neighbourhood in the zoning plan is shown in Figure 5. Integration and connectivity of zoning plan maps are created to evaluate accessibility. Integration map of zoning plan is given in Figure 6a, connectivity map of zoning plan is given Figure 6b. In accordance with these maps, the integration and connectivity values are calculated. Integration and connectivity values of 14 streets that maintain their status according to the current map are seen in Table 2.

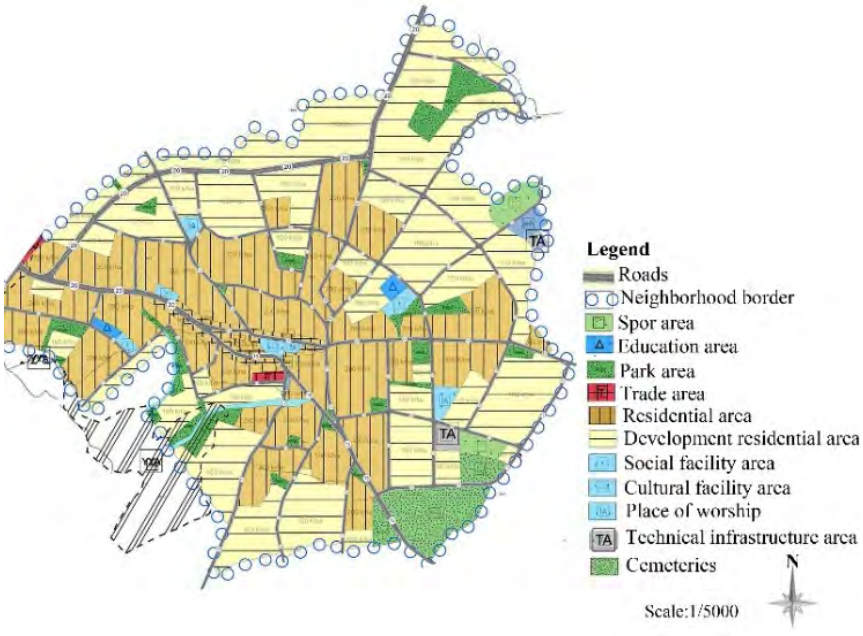

Figure 5. Zoning plan of the Esentepe Neighborhood (Çankırı Municipality, 2022)

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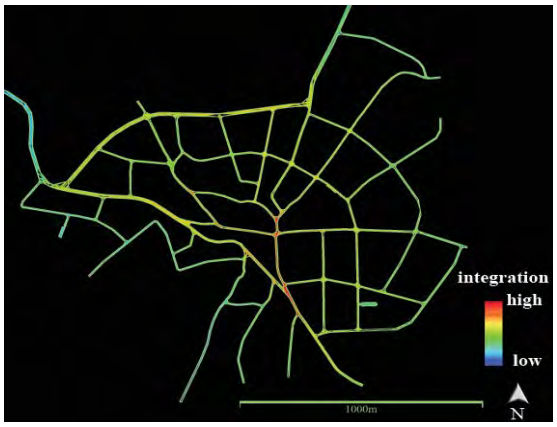

Figure 6a. Integration map of zoning plan

Figure 6a. Connectivity map of zoning plan

Table 2. Integration and connectivity values of streets in current plan

	Streets	Integration value	Connectivity value
1	Cami Street	1.06	3
2	Su deposu Street	0.71	2
3	Tuzla-2 Street	0.63	3
4	Gökçe Street	0.88	5
5	Akyol Street	0.85	4
6	Esentepe Street	0.88	7
8	Onbaşı Street	1.04	5
9	Okullar Street	0.67	4
10	Doğantepe Street	0.98	6
11	Birlik Street	0.98	6
12	Fidan Street	0.68	4
13	Eğitmen Street	0.7	6
14	Başağa	0.65	4

According to the zoning plan, the street network is designed as radial grid (RG). The street network is getting closer to the grid system. Integration value shows the pedestrian and vehicle movement and the centrality value of the axes in the system. There are more intersected streets in the zoning plan. The region where axes intersect in the center reaches a high value. The streets of Esentepe and Akyol, which connect the neighborhood to the center, are not change in the zoning plan. They have a high integration and connectivity value in the street network.

The streets of Doğantepe, Birlik, Gökçe, Onbaşı, which have high integration and connectivity values among all axes in the current

situation map, also have high values in the zoning plan. It was observed that the connectivity and integration values of the other axes were low. There is a circular expansion towards the regions where the accessibility level is very low. The streets of Çağlar, Tuzla, Bahçeler, Çamaşırhane, Demir, which are on current plan, have lost their form and have undergone a change in the zoning map. It has been found that the streets with high accessibility values in the current plan also maintain their form in the zoning plan and have high connectivity and integration values.

Comparison of Current and Zoning Plan Accessibility Levels

In the study, first, the accessibility situation of the Esentepe Neighborhood in the province of Çankırı was analyzed. For this purpose, segment analysis was performed and an integration map measuring the accessibility value was created. In the integration map of the province of Çankırı, the maximum value is 2521.18, the average value is 1649, and the minimum value is 4.02. In the integration map, it is seen that the Esentepe Neighborhood has a high level of accessibility with a yellow rank. The integration value of the axes located within the neighborhood is above the average throughout the province. Therefore, it turns out that the neighborhood is integrated with the city and open to development. The integration map of the province of Çankırı is given in Figure 7.

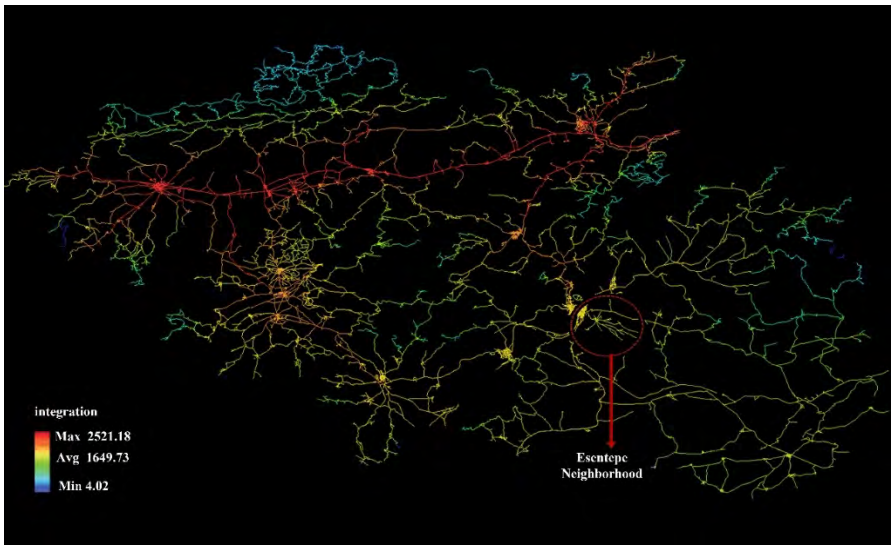

Figure 7. Çankırı city integration map

In order to determine the difference between the accessibility levels of street in the Esentepe Neighborhood current plan and the zoning plan, a comparison was made based on the minimum, maximum, and average values of all axes in the connectivity and integration maps. In both plans, the integration value was examined first. In the current map, the maximum value of integration is 1.14, the average value is 0.68, and the minimum value is 0.38. The maximum value of integration in the zoning plan is 1.26, the average value is 0.88, and the minimum value is 0.44. It was revealed that there is a 30% increase in the average integration value with this transportation plan proposed in the zoning plan. Figure 8a

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shows current map of integration values and Figure 8b zoning plan of integration values (max., min and avg).

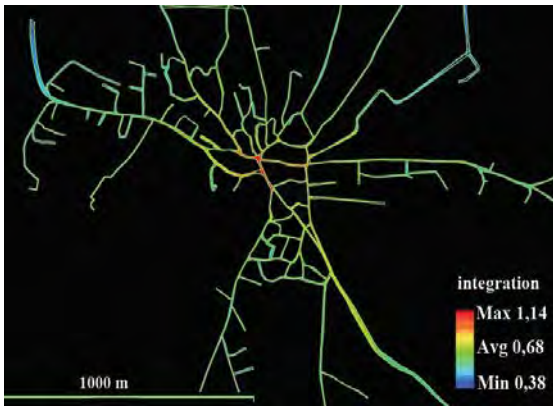

Figure 8a. Current plan of integration values

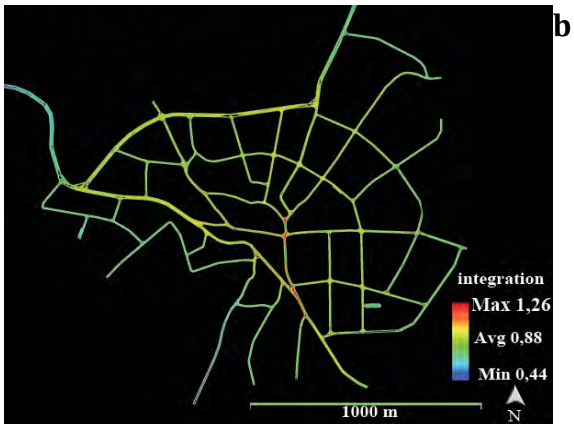

Figure 8b. Zoning plan of integration values

When it is compared with the current plan, the integration value of the street network in the zoning plan is higher. The rise in the integration value shows that the accessibility of the neighborhood transportation network has also increased. In addition, culs-de-sac streets with low accessibility in the current plan are not included in the zoning plan. In the proposed transportation map, the radial axes expanding outward from the main center have a high integration value. Current plan of connectivity values is given in Figure 9a, zoning plan of connectivity values is given in Figure 9b.

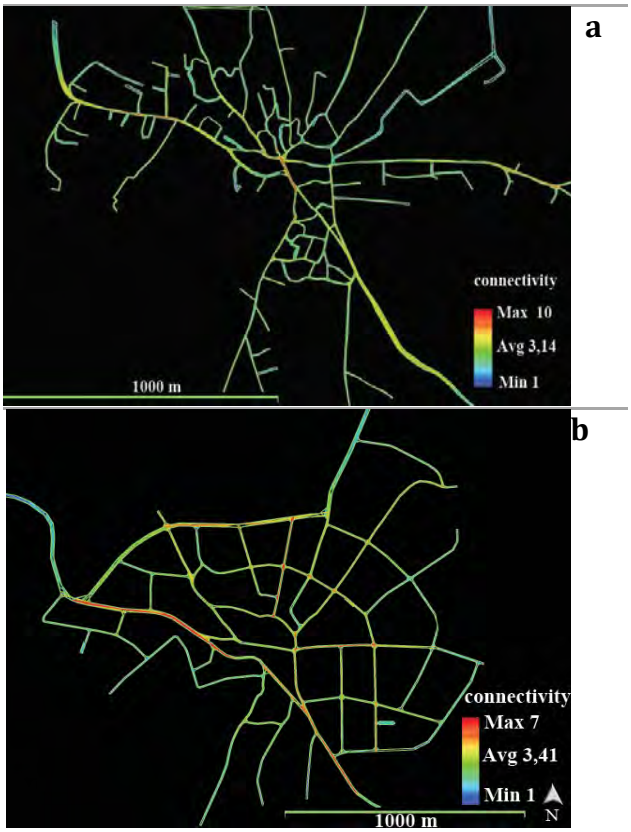

Figure 9a. Current plan of connectivity values

Figure 9b. Zoning map of connectivity value

Connectivity has a maximum value of 10, an average value of 3.14, and a minimum value of 1 on the current plan. The maximum value of integration in the zoning plan is 7, the average value is 3.47, and the minimum value is 1. It was revealed that there is a 9% increase in the average connectivity value with the transportation plan proposed in the zoning plan. It was also found that the connectivity value has a lower increase than the integration value. The decrease in the number of streets included in the transportation system in the zoning plan and the decreases in the number of intersections and number of axial lines are the reasons for the low increase in connectivity. Synergy graphs were created by considering the values obtained from the correlation of integration and connectivity map. The effect value of this relationship was calculated according to the formula consisting of these maps correlation. The synergy graph of the current plan is given in Figure 10a and the synergy graph of zoning plan is given in Figure 10b.

DOI: 10.15320/ICONARP.2023.257

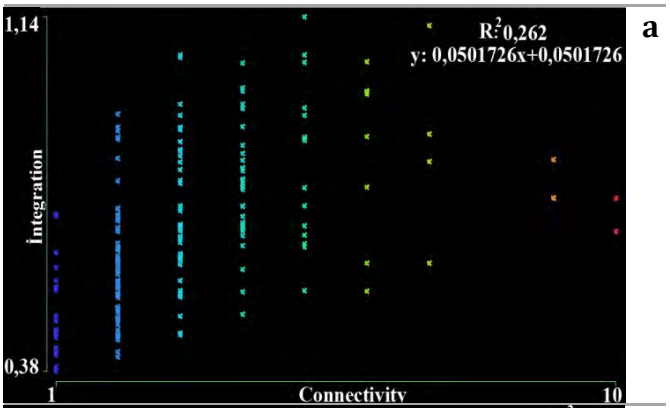

Figure 10a. Scatter plot of intelligibility in current map

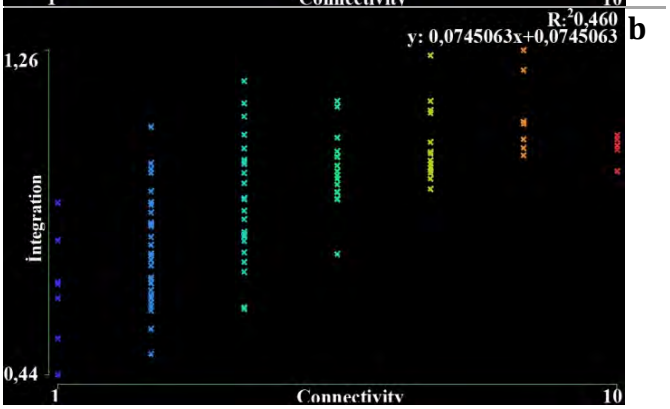

Figure 10b. Scatter plot of intelligibility in zoning map

Considering the synergy graphs obtained from the correlation of integration and connectivity values, there was a 75% increase in the proposed map compared to the current map. This result shows that the current situation has high connectivity and choice alternatives, but accessibility can be increased with simpler, functional and resolved designs. There are some changes in spatial characteristics in street networks. In order to examine this change, the maximum, minimum, average, standard deviation, count values were evaluated. All of the integration and connectivity values in the current zoning plan are given in Table 3.

Table 3. Current and zoning plan connectivity and integration values

	Current plan values		**Zoning plan values**	
	Integration value	**Connectivity value**	**Integration value**	**Connectivity value**
Max	1,14	10	1,26	7
Avg	0,68	3,14	0,88	3,42
Min	0,38	1	0,44	1
Std Dev	0,16	1,68	1,17	1,55
Count	205	205	108	108

As a result of the analyses, an increase is observed in the integration and connectivity value and the accessibility level of the zoning plan of the neighborhood compared to the current plan. While the integration value increased by 30% in the zoning plan, the connectivity value increased by 9%. Compared to the current plan, connectivity decreased while integration increased in standard deviation values in the zoning plan. In

the master plan, a lower standard deviation in the link value usually means that the data is more accessible or predictable. On the other hand, the integration value increase in the master plan improved the neighborhood design in terms of pedestrian and vehicle use and public land use. Although the average value of the connectivity value increased, its maximum value decreased. The reason for this decrease is the lower number of axis lines. It was seen that one of the most important factors supporting accessibility in neighborhoods is the street network model. Street network with more intersections, route options, and more connections have a higher level of integration. The combination of the connectivity value, which ensures the connectivity of the streets and the integration value, which indicates the intersection of the streets, guides the evaluation of the accessibility level. It was observed that there are similar axes between the regions where the accessibility values of the streets are high in both plans. The streets with high accessibility values in the current plan have been effective in forming the zoning plan.

This study differs from other studies in that it evaluates the correlation of connectivity and integration values on the current and future plans to design an accessible street network in neighborhoods. The study findings of Alalouch *et al.,* (2019) provided an analytical framework through which master plan proposals for new areas in the city can be assessed in terms of how land-use distribution may change as a result of the proposed street network. Street network accessibility provides information to study many topics. There are many researches on investigating street network accessibility of neighborhood. Jabbari *et al.,* (2021) assessed the condition of accessibility and connectivity provided by streets network to pedestrians' walkability by using historical documentary technique and space syntax analyses. It shows that the street network affects the distribution of people in terms of pedestrian movement flows and that access to these movement flows is highly correlated with the walkability of the neighborhood pedestrian movement flows and that the access to these movement flows is highly correlated to the neighborhood walkability (Bielik *et al.,* 2018). The other study results show that relational properties of street layout and design explain walking behaviour (Baran *et al.,* 2008). It is clear that street network analysis in neighborhoods contributes to accessibility. Li *et al.,* (2021) stated that there is an effect and relationship between the accessibility structure and its spatial vitality of the street network in their studies. The research findings of Lebendiger & Lerman (2019) also show the significant role of spatial accessibility analysis in transit planning. There is also a need to clarify how the street network characteristics should be designed. Rifaat *et al.,* (2012) stated that the design philosophy of a disconnected, curvilinear street network results in the creation of a series of physical barriers to movement between different parts of the city and neighborhoods. While it is stated that the curved design of the streets in the neighborhood to increase the pedestrian safety and accessibility value is effective (Perry, 1929), it was found that the culs-de-

DOI: 10.15320/ICONARP.2023.257

sac streets in the study area reduce the connectivity value of the roads. Due to the diversity of the topographical structure in the neighborhoods, it is not possible to apply this subdivision in certain regions. Although grid or curved street arrangements are considered on the zoning plan, regions with slopes in the three-dimensional structure of the land are a limiting factor for accessibility. For this reason, future studies that consider the slope factor in the street network design gain importance.

According to the neighborhood street network classification developed by Marshal & Garrick (2010), the study area has transformed into the grid system in proposed plan. In this study, it was revealed that the linear, connected and grid street network support accessibility. On the other hand, while assessing street network this classification is useful for reseach. Kim & Sohn (2002), in their urban street analysis results in different areas using space syntax theory, concluded that urban configuration affects the physical formation of cities. In his research, Has (2022) compared the route change of historical places in the Erzurum City Center and their present and past accessibility and integration due to the expansion of the city, and determined that the place, which is a valuable commercial building today, has not lost its feature in the past and today. In the study of Günaydin & Yücekaya (2020b), it was found that as the city grows, the values measuring the integration and connectivity relationship decrease. In the study of Şahin Körmeçli (2023) evaluating the Çankırı city accessibility, it was seen that the city center has high accessibility, and the city needs development in different directions. Topçu & Southworth (2014) evaluated the livability of residential areas in nine different grid street models of San Francisco neighborhoods and emphasized that accessibility, comprehensibility levels and density criteria are inversely proportional to the degree of livability in the study areas. This study, compared to other studies, concluded that the characteristic features of the street network affect the accessibility of the neighborhood, and as the neighborhood design is developed in master plans, accessibility increases, which in turn affects urban development. It is practical to examine this classification in terms of revealing different subject in other studies in determining the character of the street network. Although the adopted model has been used effectively, it may not be the optimal choice. This is one of the limitations of the research.

CONCLUSION

Residential areas are designed away from the center in order to solve the density problem that occurs in city centers with the increasing population as a result of rapid urbanization. There is a need for accessible and sustainable design of residential areas, which are located far from the city center. The street network, which is one of the most important factors shaping the urban form, should be examined within the neighborhood. Neighborhood units that have emerged to solve transportation problems are the best observation areas for this. The

Esentepe Neigborhood, which is located at a different point from the center of the city of Çankırı, which was selected as the study area, was evaluated with the current plan and the zoning plan of the street network by space syntax method, and the results of the accessibility level were compared. As a result of the study, the level of accessibility in the zoning plan increased compared to the current plan. The creation of simple axes that intersect with each other in the zoning plan, in a certain rhythm, i.e. intervals, increased the accessibility of the space. It was observed that the accessibility value decreased as you move away from the center in the neighborhood. The long and uninterrupted streets passing through the middle of the neighborhood expanding from the center and connecting to each other have a high potential in terms of accessibility. On the other hand, it was revealed that culs-de-sac streets in the area have a low level of accessibility and continuity in the zoning plan cannot be provided. Connectivity and integration values guided the layout of the neighborhood's accessibility and land uses. It has been determined that the integration and connection values have increased in the zoning plan when compared to the current plan. Increasing integration and connection values in the zoning plan will be effective in increasing land use by increasing the accessibility of the neighborhood street network. According to the street network design, the high accessibility in the center has shaped the location of land uses more intensively in the center. In the zoning plan, it is seen that land uses such as housing, trade, education, sports and park areas are located in areas with high integration and connection values. It has been determined that the current condition of the streets is a guide in neighborhood design and that it would be beneficial to determine land use decisions in advance in terms of creating accessible neighborhoods. It was found that the current state of the streets is a guide for neighborhood designs and that it would be beneficial to determine land use decisions in advance to create accessible neighborhoods.

As Çankırı has a single-centered urban macroform, the number of residences in the center is increasing. The city is open to development with axes in different directions connecting to the center. Settlements like the Esentepe Neighborhood connected to the city center and similar to satellite cities should be evaluated in terms of accessibility. This study is based on the hypothesis that the characteristics of the street network have a significant impact on neighborhood accessibility. In this respect, the space syntax method was used to answer the research question of how the street network of the neighborhoods should be designed accessible. Designing every neighborhood in cities as accessible will contribute to the sustainability and livability of the city as a whole. The smallest design units for the sustainability of cities are neighborhoods, so if each neighborhood is designed to be accessible, both walkable and livable cities will be created. This study contributes to determination of the change before and after a design study to be realized in the city in the future. It also proposes a model for the sustainability of cities with an

DOI: 10.15320/ICONARP.2023.257

evaluation made by looking at the relationship between the city as a whole and the neighborhood scale.

Street network classification is one of the major factors that determine the use of space in neighborhoods. Increasing the level of accessibility by using the space syntax method tool while creating street networks in residential areas is important to create livable cities. This study uses the space syntax method to contribute to the database for the development of urban morphology. The space syntax method has been a guiding tool for the creation and evaluation of residential areas in an accessible way by solving the mathematical structure. The method has an important place in identifying and solving post-design problems by analyzing spaces with different characteristics. Topçu (2009) stated that the space syntax method represents an important development in terms of obtaining a more meaningful result by examining the relationship between economic structure and spatial configuration instead of the theme of urban design, pedestrian mobility and morphology. Space syntax offers a range of analytical techniques to represent and analyze urban topology to explore the connection between the city form and its function, and analyze urban topology (Lebendiger & Lerman, 2019). In this context, this method is a good method evaluation for the solution of the problems in cities whose dynamism is constantly changing.

As a matter of fact, it is stated that livable cities are accessible, usable, shared and integrated spaces where social groups and all individuals come together freely and comfortably (Günaydın & Yücekaya, 2020). In order to ensure livable cities, it is necessary to develop sustainable street design in the neighborhood, which is a physical design tool. The development of the obtained street design criteria in the neighborhood units of local governments in different cities will contribute to social cohesion in societies by increasing the livability of cities. Evaluating street accessibility at the neighborhood scale in large cities and developing design guidelines can contribute to urban sustainability.

While the current plan is generally discussed in the studies based on the transportation model in the creation of sustainable neighborhoods, in this study it is important to evaluate the development plan and examine its contribution or deficiencies to the future spatial characteristics. The study will create new ways for other studies for examining the contribution of the sustainable transportation model to spatial characteristics, studying the use of space according to accessible regions and social interaction in neighborhoods. The research proposes an evaluation model by comparing the current and zoning plans with the space syntax in order to evaluate the development of cities in the future and to create an accessible transportation model.

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Resume

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ICONARP
International Journal of Architecture and Planning
Received: 09.06.2022 Accepted: 10.08.2023
Volume 11, Issue 2/ Published: 28.12.2023
Research Article *DOI: 10.15320 /ICONARP.2023.258 E- ISSN:2147-9380*
ICONARP

Determination of Environmental Ethics Approaches of Urban and Regional Planning Students

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Abstract

Urban planners who are environmentally conscious and aware will take action to take responsibility, inform, and control. Raising environmental awareness is essential in urban planning education to understand environmental problems. Therefore, it is necessary to educate urban planning students on environmental ethics.

This study investigates the environmental attitudes and behaviors of urban and regional planning students, who will shape the environment in the future within the context of the value-belief-norm theory. Moreover, to find clues that will shape environmental education in the course curriculum. The study included 226 students from the Department of Urban and Regional Planning in the Faculty of Architecture of Yıldız Technical University (YTU) and Amasya University (AU). Questionnaire data has been evaluated using principal components analysis, correlation analysis, T-test, and ANOVA analysis. According to the study findings, urban planning students have adopted biocentric, ecocentric, and anthropocentric value orientations. The study has found that students with ecocentric value orientation tend to show more pro-environmental behavior.

The study concludes that the student's characteristics also affect how they show pro-environmental behavior and evaluate environmental policies. In conclusion, focusing on ecocentric approaches in urban planning education can positively affect adopting pro-environmental behavior and policies. Additionally, study findings show that students with relatively better economic conditions are more inclined to have a biocentric value orientation. Based on the literature and these study findings, pro-environmental behavior is not a single-dimensional structure caused only by individuals' personal and professional characteristics. People's environmental attitudes and behaviors are shaped by their upbringing, school, friends, and culture. It shows that pro-environmental behavior has a multi-dimensional complex structure, and a conceptual framework can provide guidance to explain these kinds of behavior.

Keywords:
Environmental ethics, environmental policies, new ecological paradigm, pro-environmental behavior

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To cite this article: Altanlar, A., Aktuğlu Aktan, E.Ö., & Erkan, N.Ç. (2023). Determination of Environmental Ethics Approaches of Urban and Regional Planning Students. *ICONARP International Journal of Architecture and Planning,* 11 (2), 650-671. DOI: 10.15320 /ICONARP.2023.258

INTRODUCTION

Environmental ethics has emerged as a critical concern in contemporary urban and regional planning, as it plays a crucial role in shaping sustainable development and responsible decision-making. Understanding the approaches of individuals involved in this field toward environmental issues is essential for fostering a more sustainable future.

Several studies have delved into the intricacies of environmental ethics and its implications for various professional groups. Yücel (2005) conducted a significant analysis of environmental professionals, including academics and higher-level bureaucrats in Türkiye, focusing on their environmental knowledge, attitudes, and behaviors. Surprisingly, the study revealed a concerning disconnect between respondents' environmental knowledge and their actual behavior, despite possessing a moderate level of environmental knowledge. This finding underscores the necessity of investigating how education and awareness influence individuals' environmental ethics and actions.

Furthermore, Gökşen (2021) explored the awareness of environmental problems and environmental attitudes among environmental officers in Ankara-based environmental consultancy firms. The study revealed that participants faced challenges in effectively translating their environmental awareness into tangible behaviors. It also highlighted the influence of variables such as gender and length of service on environmental attitudes, suggesting that factors beyond mere awareness may shape individuals' ethical approaches.

Studies about pro-environmental behavior among university students within the last 20 years found that their education affects their environmental behavior (Talay et al., 2004; Ramirez, 2006; Oğuz et al., 2010; Smith-Sebasto, 1995). This study measures students' environmental ethics approaches and pro-environmental behavior in urban and regional planning departments. Urban and regional planning education aims to educate planners with experience in sustainable spatial development and social welfare, civil participation, and resolution of conflicts. Therefore, like any applied learning, urban planning education includes practical courses focused on problem-solving and theoretical infrastructure (Özkazanç & Korkmaz, 2019, p. 124). With the rising sustainability concerns, planning education has started to include ecological urban development topics such as protecting the natural environment and biodiversity and, more efficient renewable energy sources and more extensive use of recycling systems. Students learn about land use and concepts about people, environment, and economies. They have practical courses on policy and strategy-based planning for spatial development focused on balancing economic growth and development and environmental resources in planning activities in locations of various sizes (neighborhood, district, city, region) (Özcan, 2016, p. 9). In other words, students can experience the urban development process by observing and maintaining usage and protection balance in the urban development process and developing

DOI: 10.15320/ICONARP.2023.258

environmentally friendly policies/strategies. In addition to understanding environmental problems, raising environmental awareness is essential in urban planning education.

Urban planners who are environmentally conscious and aware will take action to take responsibility, inform, and control. Therefore, it is imperative to educate urban planning students on environmental ethics. This knowledge will encourage students to choose production alternatives with the minimum impact on the environment in the spatial plans they will make in their professional lives and have decision-makers accept these plans, which will result in better policies for the environment. This study firstly attempts to understand how effective education in urban planning schools encourages students to adopt an environmentalist or pro-environmental view. Secondly, this study investigates whether students with a pro-environmental view tend to show pro-environmental behavior. Thirdly this study focuses on whether environmental ethics approaches of urban planning students result in differences in their evaluation of environmental policies and strategies. Finally, based on these data, this study recommends developing environmental attitudes and behaviors with urban planning education. Based on the above-given information, the study intends to find the answers to the following questions:

• What components determine the environmental ethics approaches of urban planning students?

• Is there a relationship between the environmental ethics approaches of planning students and how they evaluate environmental policies and pro-environmental behavior? If yes, what is the strength and orientation of this relationship?

• Is there a relationship between the socio-demographic characteristics of planning students and how they perceive environmental policies and pro-environmental behavior? If yes, what is the strength and orientation of this relationship?

• If there is a significant difference between the urban planning students' mean scores for environmental ethics, pro-environmental behavior, and environment policies according to their characteristics, which groups differ from the others?

THEORETICAL BACKGROUND

Relationship between Environmental Ethics and Pro-Environmental Behavior

The "Common Future" report of the Brundtland Commission emphasizes the importance of ethics and morals in dealing with environmental problems (Bozdemir, 2019, p. 39). Environmental ethics, an essential field of practical ethics, is a discipline that studies the moral relationship of human beings to the value and moral status of the environment and its nonhuman contents (Brennan & Lo, 2002). In most general definitions, environmental ethics shapes the relationship between people and the natural environment with discourses about

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today and future generations (Çamur, 2020, p. 244). Understanding how people define their relationship with the outer world, in other words, whether they attach an instrumental value (which they achieve their end goals) to those around them or themselves, is essential to follow discussions about environmental problems. In this regard, it is possible to discuss three environmental ethics approaches: anthropocentric (human-centered), biocentric (life-centered), and ecocentric (nature-centered) (Çamur, 2020, p. 251).

Two important beliefs stand out in the anthropocentric approach. The first is the belief that "humans are the center of everything and the only goal of the universe". The second one is "Only the values of humans are what matters" (Çamur, 2020, p. 251). Therefore, people who advocate an anthropocentric ethical approach want to protect the environment because the environment is indispensable for the survival of humans and for improving the quality of life. According to people who advocate an anthropocentric ethical approach, natural resources should be consumed balanced so that we still have energy in the future and our quality of life is maintained. Similarly, pollution (air, soil, and water pollution) should be prevented because it constitutes a health threat to us. As seen above anthropocentric environmental ethics approach is an ethical approach that promotes the belief that all living and non-living things are meant to be used by people (Thompson & Barton, 1994, pp. 149-150; Erten, 2007, p. 69).

In the biocentric ethical approach, all life forms have intrinsic values (as a set of experiences that are good and our capacity to have them). With this approach, humans are a part of the natural environment and equal to all living beings. All living beings – humans, plants, or animals – have the same rights without being superior to others. Therefore, the biocentric ethical approach is based on the belief that all living beings except humans have ethical values (Thompson & Barton, 1994, pp. 149-150; Bozdemir, 2019, p. 42; Çamur, 2020, p. 251).

The ecocentric ethical approach promotes the opposite of what the anthropocentric ethical approach does. The main idea in the ecocentric ethical approach is that the ecosystem is the only source of life (Gray et al., 2018, p. 130). In other words, the ecocentric ethical approach considers humans and all living and non-living things as a whole in a system. This approach considers all beings worthy of ethical values due to their reason for being (Ergün & Çobanoğlu, 2012, p. 98). In other words, an ecocentric individual prioritizes environmental protection when using water and energy efficiently, recovering or recycling waste (Thompson & Barton, 1994, pp. 149-150; Erten, 2007, p. 69). The reason behind the nature-centered ethical approach is that human-centered and life-centered ethical approaches are insufficient to protect the environment (Birden, 2016, p. 11). While biocentric approaches value ecosystems because they will protect plants and animals, the ecocentric approach focuses more on the ecosystem than individual life forms. In short, while on the one hand, it allows protection of biological diversity,

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on the other hand, it also includes protection of geological diversity (Bozdemir, 2019, p. 43; Çamur, 2020, p. 254).

The literature shows that people's values positively affect them, which results in pro-environmental behavior (Stern, 2000, p. 408; Dunlap et al., 2000; Kollmuss & Agyeman, 2002; Cottrell, 2003). Therefore, understanding the effect of moral principles on pro-environmental behaviors provide essential clues to increase awareness of environmental responsibility.

Studies focusing on the factors that motivate people to show environmental behavior do this under two main categories: economic and ethical motivations. While economic approaches focus on the benefits and costs of pro-environmental behaviors, ethical approaches focus on other dimensions such as values, environmental concerns, moral responsibilities, and social norms (Karayeğen Balent, 2020, p. 148). Therefore, this study is focused on ethical approaches. Studies that investigate environmental concerns and moral norms focus on the relationship between socio-demographic characteristics of people and the likelihood that they will have a moral obligation to protect the environment (Dunlap et al., 2000; Kollmuss & Agyeman, 2002; Cottrell, 2003); on the effects of moral perspectives of individuals on their environmental behaviors; on the effect of environmental information on environmental awareness and behavior styles (Manoli et al., 2019, p. 4; Wong et al., 2018; Pan et al., 2018; Özdemir, 2012; Müderrisoğlu & Altanlar, 2011; Birand, 2016) and on how it affects citizenship and consumption patterns (Turaga et al., 2010). These studies show that people's values positively affect them, which results in pro-environmental behavior. These studies suggest that understanding the effect of moral values on pro-environmental behaviors will provide essential clues to increase awareness of environmental responsibility. Such information will reduce the environmental impact of production processes and create a society with high environmental awareness (Tekeli & Ataöv, 2017, p. 93). Therefore, the scope of this study focuses on identifying the relationship between morals and environmentalism, which motivates urban planning students' behaviors. The study's findings are believed to provide critical insight into the content and scope of urban planning education, which will help urban planning students adopt an ecocentric environmental ethics approach.

Theories that Determine Pro-Environmental Behavior

Pro-environmental behavior includes all kinds of intentions and behaviors that positively affect the resources, energy consumption, or biosphere structure and dynamics (Stern, 2000, p. 408). Some studies on this subject suggest that policies and goals that aim to consume more than nature can be prevented by increasing pro-environmental behavior that supports the idea that people need to consciously reduce their activities that have a negative impact on the natural environment (Kollmuss & Agyeman, 2002, p. 240). Because the increasing motivation for pro-

environmental behaviors is believed to help reduce the environmental impact of production processes and create a society with high environmental awareness (Tekeli & Ataöv, 2017, p. 93).

Stern (2000) classifies pro-environmental behaviors under four categories. These are; (1) environmental activism, such as participating in protests or signing petitions, (2) nonactivist behaviors in the public sphere, such as supporting pro-environmental government policies, (3) private-sphere environmentalism, such as green consumption, purchasing energy-efficient consumer goods, recycling domestic waste and (4) other environmentally significant behaviors which can be examined under the organizational environmentalism such as organizations implementing policies that encourage their employees to reduce energy use or waste production (Stern, 2000, pp. 409-411).

The literature on environmental psychology uses many models to understand and explain pro-environmental behavior. This study will shortly discuss some of the conceptual approaches such as the theory of planned behavior (Ajzen, 1985), norm activation model (Steg & De Groot, 2010), value-belief-norm model (Stern, 2000), and comprehensive action determination model (Klöckner, 2013).

The Norm activation model claims that individuals who blame other people, groups, and organizations, such as industrialization and government, for environmental problems will not feel obliged to be pro-environmental and that pro-environmental behavior can only develop when personal norms are activated. Moral responsibility for pro-environmental behavior is assumed (Steg & De Groot, 2010, pp. 726-729). According to the theory, when people feel they must do something for moral reasons, they exhibit pro-social behaviors in line with their value systems (Sarı, 2020, p. 216). The value-belief-norm model claims that people's values, ecological worldviews, and beliefs play a role in explaining their pro-environmental behavior. Stern et al. (1995) suggest that a causality chain with four variables, including values (biospheric, altruist, and egocentric), beliefs (awareness of the consequences of ecological worldview and taking responsibility), environmental, personal norms and behaviors (environmental activism, non-activist behaviors in the public sphere, private sphere behaviors, organizational sphere behaviors) results in pro-environmental behavior (Stern, 2000, pp. 83-84). The comprehensive action determination model suggests that many pro-environmental behavior styles can be better explained by adding the concept of habit to the planned behavior theory and norm activation model. Therefore, the model consists of five variables: personal choices, intent processes, perceived control/restrictions, habitual processes, social processes, and normative processes (Klöckner, 2013, pp. 1031-1032). This study uses the value-belief-norm model to explain pro-environmental behavior. According to all approaches that use a linear model to explain pro-environmental behavior, environmental awareness, values, and attitudes will develop pro-environmental behavior (Bozdemir, 2019, p. 47). In other words, as environmental awareness

DOI: 10.15320/ICONARP.2023.258

increases, concerns about environmental problems also increase (Karayeğen Balent, 2020, p. 147).

This study focuses on environmental citizenship and environmental activism variables such as joining or contributing to environmental organizations and supporting or accepting environmental public policies to measure urban planning students' pro-environmental behaviors. Because these types of behavior can affect public policies and change the behavior of many people and organizations simultaneously to solve environmental problems (Stern, 2000, pp. 409-411). Considering that planning, in the broadest sense, is to create a systematic series of actions to achieve a specific goal (Ersoy, 2007, p. 10), it is essential to understand how planning students transform theoretical information into practice to determine their opinions about environmental problems. Therefore, this study investigates how urban planning students evaluate the policies and strategies developed to create solutions to environmental problems.

STUDY METHOD

Selection and Method of Sampling

Study data were collected using a questionnaire in December and January of the 2021-2022 fall semester. The Department of Urban and Regional Planning (DURP) students in the Faculty of Architecture at Amasya University and Yıldız Technical University filled out the questionnaire form online. When selecting schools, Yıldız Technical University (YTU), which has had an urban and regional planning department since 1982, and Amasya University (AU), which has had an urban and regional planning department since 2012 as they successfully represent the schools that provide urban planning education. Both universities are state universities. YTU is in Istanbul, which is a large metropolitan city in Marmara Region, which is home to many civilizations with many natural and cultural heritage; AU is a moderate size city in the Central Black Sea Region, which has also been home to different civilizations, with natural and cultural heritage. In the 2021-2022 academic year, there were 590 students: 302 female and 123 male students in YTU DURP and 78 female and 87 male students in AU DURP. The total sample size was 233 for 590 students with a 95% confidence interval and ±0.05 sampling error. However, due to missing and incorrect entries, 226 questionnaires were included in the evaluation.

Questionnaire Form and Content

The questionnaire consists of five parts. The first part contains eight questions about respondents' socio-demographic characteristics, environmental knowledge and information (Figure 1). The second part contains 25 questions to evaluate respondents' environmental ethics approaches. Dunlap et al. (2000) and Özdemir's (2012) studies were used as references to develop the scale. The third part has ten questions to measure the pro-environmental behaviors of the respondents. This part includes pro-environmental activist behaviors (Müderrisoğlu & Altanlar,

2011). The fourth part uses a 12-item scale developed based on the work of Drescher et al. (2017) to evaluate respondents' perceptions of environmental policies. The questionaire's second, third, and fourth parts use a 5-point Likert scale.

Measurement Methods and Techniques

The study method was developed using the norm activation model (Steg & De Groot, 2010) and the value-belief-norm model (Stern, 2000) (Figure 1). Principal Component Analysis-TBA from exploratory factor analysis was used to determine the structural validity of the "environmental ethics approaches", "pro-environmental behavior", and "perception of environmental policies" scales. Kaiser-Meyer-Olkin (KMO) test was done to test the suitability of data structure for factor analysis for the sample size (Çokluk et al., 2010, p. 207). Since the environmental ethics value orientation scale is a multi-factor structure, the varimax rotation method, an orthogonal rotation, was used as the rotation method. Cronbach's alpha reliability test was used to determine the reliability of the scales. Skewness analysis was done to determine whether all data showed normal distribution at a 0.05 significance level. Kurtosis and skewness values within ±2.0 were considered to have a normal distribution (George & Mallery, 2010). Pearson correlation test was done to determine the relationship and strength between the respondents' environmental ethics and pro-environmental behavior and perception of environmental policies scale. One-way ANOVA was done to compare the scores of groups for a single variable, and a T-test was used for independent samples.

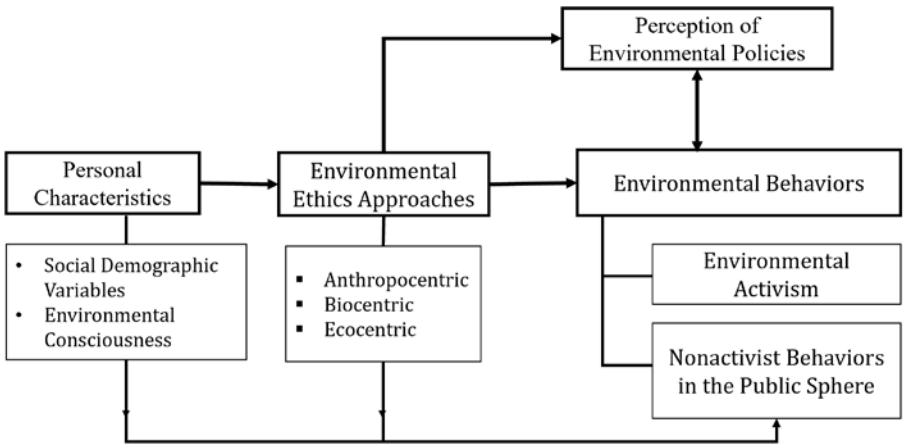

Figure 1. A conceptual model to measure pro-environmental behaviors of urban planning students with environmental ethics approaches

STUDY FINDINGS

A total of 226 questionnaires were included in the study. Students at Amasya University filled 37.6% of these, and those at Yıldız Technical University filled 62.4%. The gender distribution of the respondents is as follows: 64 male (28.3%) and 162 female (71.7%). 71.7% of the respondents are female because 64% of the students attending these two universities are female. To the question, "Do you have a budget for your

DOI: 10.15320/ICONARP.2023.258

hobbies and leisure activities after spending for your basic needs?", 18.6% of the respondents answered yes, 30.1% answered no, and 51.3% sometimes answered (Table 1). To the question "Have you ever had environmental education?", 57.1% of the respondents said yes, and 42.9% said no.

Table 1. Characteristics of Participant

Gender	Frequency	Valid Percent	University	Frequency	Valid Percent
Male	64	28.3	Amasya University	85	37.6
Female	162	71.7	Yıldız Technical University	141	62.4
Total	226	100.0	Total	226	100.0
Age	**Frequency**	**Valid Percent**	**Grade**	**Frequency**	**Valid Percent**
18 to 20	75	33.2	1. Grade	46	20.4
21 to 23	120	53.1	2. Grade	55	24.3
24+	31	13.7	3. Grade	62	27.4
			4. Grade	63	27.9
Total	226	100.0	Total	226	100.0
Can you allocate a budget for your hobbies?			**Which transportation mode do you use most between home and work/school/market?**		
Spending Level	**Frequency**	**Valid Percent**	**Preferred Mode of Transportation**	**Frequency**	**Valid Percent**
Yes	42	18.6	Walking	56	24.8
No	68	30.1	Public transport	154	68.1
Partly	116	51.3	Car	12	5.3
			Other	4	1.8
Total	226	100.0	Total	226	100.0

Results of Factor Analysis on Environmental Attitudes and Behaviors

Table 2 shows the results of factor distribution and reliability analysis of the items of the environmental ethics approaches to scale. KMO value was .863 in the KMO test. Based on this finding, it was concluded that the sample size was "sufficiently good" to carry out a factor analysis. Additionally, when Bartlett's spherical test results were reviewed, the chi-square value was found to be significant ($X^2_{(226)}$=2067.117; p=.000<,01). Therefore, it is possible to claim that data comes from the multi-variable normal distribution. The factor number was set to three when the Principal Component Analysis (TBA) screen plot graph was reviewed. This decision is also meaningful because it was similar to the factor number expected in theory identified in the tool development process. The total variance percentage of the three factors was 59.048, an acceptable variance percentage in social sciences (Çokluk et al., 2010, p. 249). Factor loads of the variables that constitute the three factors were higher than 0.400, and the Cronbach alpha value of each factor is higher than 0.7 (Bursal, 2019, p. 228; Hair et al., 2012). The first factor accounts for 23.853% of the total variance, and it is labeled as "biocentric ethics" since it contains expressions that promote the value and right to live of other living beings; the second factor accounts for 18.466% of the total variance, and it is labeled as "ecocentric ethics" since it focuses on the ecosystem and the environment instead of individual life forms; the third

factor accounts for 16.749% of the total variance, and it is labeled as "anthropocentric ethics" since it contains expressions that human interests have a value on their own (Table 2; Appendix 1).

Environmentalism intends to question production relationships and transform information into action while protecting of the natural environment. Many environmental movements claimed the above goals and defined themselves as environmentalists. The scale used to explain environmental behavior includes "public behavior", such as supporting pro-environmental government policies and "environmental activism", such as participating in mass protests or signing petitions. In the KMO test done to measure environmental behavior, the KMO value was found to be 0.851 ($X^2_{(226)}$=1128,676; p=.000<,01). In the TBA, when items in the first factor had high values whereas these values were low in the second factor and when there was an affinity between the eigenvalue of the second factor and the first factor, it was decided to have a single factor structure (Çokluk et al., 2010, p. 227). The factor accounts for 49.727% of the variance. Load values for all the items in the scale ranged between .615 - .756, and the reliability coefficient of the scale was .881. High scores on the scale indicate that students are willing to show pro-environmental behavior (Table 2; Appendix 2).

The KMO value of the scale developed to allow respondents to evaluate the environmental policies, including the measures and principles adopted to solve environmental problems was .963. ($X^2_{(226)}$=4258.685; p=.000<.01). Since there was a sudden drop in the line graph for the eigenvalue after the first factor, it was decided to have a single factor structure. The factor accounts for 84.532% of the variance. Load values for all the items in the scale ranged between .902 - .946, and the reliability coefficient of the scale was .983 (Table 2; Appendix 3).

Table 2. TBA Analysis and Reliability Analysis Results of the Scales

SCALES	KMO[a]	Number of Items	Factor Loads[b]	Explained Rate of Variance (%)	Eigen-values	Cronbach's Alpha Coefficient(α)[c]
Environmental Ethics	.863	21	.486-.800	59.048	-	.908
-Biocentric	-	10	.486-.748	23.853	4.294	.883
-Ecocentric	-	6	.588-.755	18.446	3.320	.805
-Anthropocentric	-	5	.635-.800	16.749	3.015	.804
Environmentally Friendly Behavior	.851	10	.615-.756	49.727	4.973	.881
Perceiving of Environmental Policies	.963	12	.902-.946	84.532	10.144	.983

[a] If the KMO value is between 0.80-.90, it is good, and above 0.90, it is excellent.
[b] If the factor load value is between 0.55-0.62 is good; 0.63-0.70 is very good; 0.71+ is perfect.
[c] If the Cronbach's alpha value is (α) ≥ 0 .9 it is excellent;** 0.9 > α ≥ 0.8 is good, *0.8 > α ≥ 0.7 it is acceptable (Çokluk et al., 2010).

Relationship between Variable Scores of the Urban Planning Students and Factors

A skewness analysis was done to analyses whether the data had a normal distribution. A kurtosis value of ±1.0 for normal distribution is

DOI: 10.15320/ICONARP.2023.258

considered perfect for most psychometric goals; however, depending on the practice, a kurtosis value of ±1.5 (Tabachnick & Fidell, 2013) and a kurtosis value of ±2.0 is also accepted (George & Mallery, 2010). As seen in Table 3 and Table 4, since skewness and kurtosis values of the variables range within ± 2, a significance level of .05 meets the usual distribution requirement. Similarly, when the normality of the sub-groups created according to the categories of the same independent variable compared to dependent variables is reviewed, skewness and kurtosis values variables range within ± 2 (Table 3). Based on the correlation results between the environmental ethics approaches and pro-environmental behavior and perception of environmental policies scale shown in Table 4, for ecocentric students (r= .175; n=177; p=.02), a weak positive relationship was found between environmental ethics approaches and pro-environmental behavior, but no relationship was found with the perception of environmental policies. No meaningful relationship was found between the pro-environmental behavior scale and the evaluation of environmental policies of the biocentric and anthropocentric students (Table 4).

Table 3. Results of Normality Analysis of Variables and Factors

Variables		Statistic	Std. Error
Age	Skewness	.229	.162
	Kurtosis	-.731	.322
Gender	Skewness	.969	.162
	Kurtosis	-1.071	.322
University	Skewness	-.515	.162
	Kurtosis	-1.750	.322
Grade	Skewness	-.158	.162
	Kurtosis	-1.288	.322
Can you allocate a budget for your hobbies?	Skewness	-.639	.162
	Kurtosis	-.227	.217
Have you received any environmental education?	Skewness	-.827	.431
	Kurtosis	1.4292	.03300
Where did you receive your environmental education?	Skewness	-.227	.243
	Kurtosis	-.747	.423
Which transportation mode do you use most between home and work/school/market?	Skewness	-.639	.162
	Kurtosis	-1.040	.322
Scales			
Biocentric Ethics	Skewness	-1.301	.240
	Kurtosis	1.044	.476
Ecocentric Ethics	Skewness	-.585	.240
	Kurtosis	-.124	.476
Anthropocentric Ethics	Skewness	1.239	.240
	Kurtosis	1.601	.476
Environmentally Friendly Behavior	Skewness	-.184	.240
	Kurtosis	.472	.476
Environmental Policies Perception	Skewness	-.349	.240
	Kurtosis	-1.091	.476

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Table 4. Pearson Correlation Analysis Results of the Scales

		BE	EE	AE	EFB	EPP
Biocentric Ethics (BE)	Pearson Correlation	1				
	Sig. (2-tailed)					
	N	177				
Ecocentric Ethics (EE)	Pearson Correlation	-.062	1			
	Sig. (2-tailed)	.415				
	N	177	177			
Anthropocentric Ethics (AE)	Pearson Correlation	-.041	-.015	1		
	Sig. (2-tailed)	.588	.843			
	N	177	177	177		
Environmentally Friendly Behavior (EFB)	Pearson Correlation	.085	.175*	.095	1	
	Sig. (2-tailed)	.260	.020	.210		
	N	177	177	177	226	
Environmental Policies Perception (EPP)	Pearson Correlation	-.043	.093	-.088	.100	1
	Sig. (2-tailed)	.566	.217	.245	.134	
	N	177	177	177	226	226

** Correlation is significant at the 0.05 level (2-tailed).*

*If Pearson correlation r<0.2 very weak or no correlation, between, 0.4-0.6 moderate correlation 0.6-0.8 high correlation 0.8> very high correlation; **P≤0.01, *0.01<P≤0.05.*

When we looked at the correlation results between personal characteristics and environmental ethics, pro-environmental behavior, and evaluation of environmental policies (Table 5);

- A weak positive relationship was found between the age variable and only pro-environmental behaviors (r = .183; n=177; p=.006),
- A significant relationship was found only between the gender variable and anthropocentric value orientation (r = .192; n=177; p=.010),
- A weak negative relationship was found between the universities they attend and pro-environmental behavior (r = -.187; n=226; p=.005) and evaluation of environmental policies (r = -.189; n=226; p=.004),
- A weak negative relationship was found between environmental education and pro-environmental behavior (r =-.284; n=226; p=.000),
- A weak positive relationship was found between having a budget for hobbies and biocentric environmental ethics (r =.171; n=177; p=.023),
- A weak negative relationship was found between the transportation method used to commute between home and school and anthropocentric approaches (r=-.149*; n=177; p=0.048) and similarly pro-environmental behavior (r=-.150*; n=226; p=0.024),
- No meaningful relationship was found between the school year and environmental ethics approaches, pro-environmental behavior styles, and evaluation of environmental policies.

DOI: 10.15320/ICONARP.2023.258

Table 5. The Relationship between the Socio-demographic Characteristics of the Participants and their Scale Scores

CORRELATION						
Variables		**BE**	**EE**	**AE**	**EFB**	**EPP**
Age	Pearson Correlation	.006	.044	-.054	.183**	.015
	Sig. (2-tailed)	.934	.564	.478	.006	.823
	N	177	177	177	226	226
Gender	Pearson Correlation	-.090	-.109	.192*	-.028	.027
	Sig. (2-tailed)	.234	.147	.010	.679	.689
	N	177	177	177	226	226
University	Pearson Correlation	.040	-.139	-.141	-.187**	-.189**
	Sig. (2-tailed)	.601	.065	.062	.005	.004
	N	177	177	177	226	226
Grade	Pearson Correlation	-.006	.040	-.010	.091	.004
	Sig. (2-tailed)	.934	.594	.898	.175	.950
	N	177	177	177	226	226
Can you allocate a budget for your hobbies?	Pearson Correlation	.171*	-.128	-.130	.016	-.028
	Sig. (2-tailed)	.023	.089	.085	.813	.672
	N	177	177	177	226	226
Have you received any environmental education?	Pearson Correlation	.030	.053	.093	-.284**	-.125
	Sig. (2-tailed)	.695	.487	.218	.000	.061
	N	177	177	177	226	226
Where did you receive your environmental education?	Pearson Correlation	-.042	.073	.076	.091	.075
	Sig. (2-tailed)	.673	.459	.436	.303	.398
	N	106	106	106	129	129
Which transportation mode do you use most between home and work/school/market?	Pearson Correlation	-.080	-.016	-.149*	-.150*	-.106
	Sig. (2-tailed)	.290	.836	.048	.024	.112
	N	177	177	177	226	226

BE: Biocentric Ethics, EE: Ecocentric Ethics, AE: Anthropocentric Ethics, EFB: Environmentally Friendly Behavior, EPP: Environmental Policies Perception

** Correlation is significant at the 0.05 level (2-tailed).*

*If Pearson correlation r<0.2, very weak or no correlation, between 0.4-0.6 moderate correlation, 0.6-0.8 high correlation, 0.8> very high correlation; **P≤0.01, *0.01<P≤0.05.*

Finally, one-way variance analysis (ANOVA) was done to see the differences between the students' personal characteristics and scale scores, and a complementary post-hoc analysis was done to identify the causes of the differences. Since variances obtained from the post-hoc tests done to identify the causes of the difference between pro-environmental scores and age groups were not equal (F=5.322; p=0.006<0.05), "Games-Howel" test was done (Kayri, 2009, p. 56). According to the "Games-Howel" multiple comparison tests, a significant difference was found between the mean pro-environment behavior scores of the students who were 24 and older ($F_{(3-1)}$=.66796911*, P=.004<0.05) and of the students who were 21-23 years old ($F_{(3-1)=}$.66796911*, P=.004<0.05) and of the students who were 21-23 years old ($F_{(3-2)}$=.56617629*, P=.006<0.05) (Table 6). In other words, as the respondents' age increases, they feel more responsible for the environment.

T-test was done to test how the respondents' mean scores for the "environmental ethics approach", "pro-environmental behavior styles", and "evaluation of environmental policies" scales differ according to the gender and university variable. According to the findings, women had more anthropocentric value orientation than men [$F(_{M-F})$= 0.421058; p=.013<0.05] (Table 7). Additionally, as seen in Table 8, students who reported having prior education on the environment adopt more pro-environmental behavior styles [$F(_{Y-N})$= 0.573891; p=.000<0.05].

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Table 6. Results of the Post-hoc (Games Howell) Test of Environmentally Friendly Behavior Scores by Age Groups

Games-Howell				P	95% Confidence Interval	
Age Groups	Age Range	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
18 to 20	21 to 23	-.10179282	.15678426	.793	-.4736198	.2700341
	24 +	-.66796911*	.20461846	.005	-1.1571988	-.1787394
21 to 23	18 to 20	.10179282	.15678426	.793	-.2700341	.4736198
	24 +	-.56617629*	.17407302	.006	-.9872393	-.1451133
24 +	18 to 20	.66796911*	.20461846	.005	.1787394	1.1571988
	21 to 23	.56617629*	.17407302	.006	.1451133	.9872393

Table 7. T-Test Results for Comparison of Environmental Ethics Approaches Scale Scores by Gender Differences

Factors	Gender	N	Mean	Std. Deviation	Std. Error Mean	Levene's Test for Equality of Variances		T-Test for Equality of Means
						F	Sig.	Sig. (2-tailed)
Anthropo-centric Ethics	Female	124	-.1197551	.97372487	.08744308	.004	.013	.010
	Male	53	.3013033	1.02564818	.14088361			.013*

Table 8. T-Test Results for Comparison of the Scores of Environmentally Friendly Behavior Scale of Environmental Education Students

Factors	Have you received environmental education?	N	Mean	Std. Deviation	Std. Error Mean	Levene's Test for Equality of Variances		T-Test for Equality of Means
						F	Sig.	Sig. (2-tailed)
Environ-mentally Friendly Behaviors	Yes	129	.2526801	.97159459	.08554413	.154	.695	.000*
	No	97	-.3212105	.94963615	.09642094			.000

The correlation analysis found a significant difference between the student's scores in pro-environmental behavior and environmental policies scale according to the university they studied (Table 9). According to the study findings, the students in AU showed more pro-environmental behavior compared to the students in YTU [$F_{(AU-YTU)}$ = 0.385793; p=.005<0.05]. The opposite was found for the evaluation of environmental policies; urban planning students in YTU perceive environmental policies more negatively than the students in AU [$F_{(YTU-AU)}$= -0.392736; p=.004<0.05].

Table 9. T-Test Results for Comparison of Scale Scores According to the Universities (Where They Studied)

Factors	University	N	Mean	Std. Deviation	Std. Error Mean	Levene's Test for Equality of Variances		T-test for Equality of Means
						F	Sig.	Sig. (2-tailed)
Environmentally Friendly Behaviors	AU	85	.2470581	.94683693	.10269888	1.143	.286	.005*
	YTU	141	-.1387350	1.00868167	.08494632			.004
Perceiving of Environmental Policies	AU	85	.2499740	.87920687	.09536337	6.830	.010	.004*
	YTU	141	-.1427618	1.05341007	.08871313			.003

DOI: 10.15320/ICONARP.2023.258

DISCUSSION AND CONCLUSION

Environmental challenges faced at every scale in our age call for global and local policy-making and planning to take necessary measures to sustain the habitat we live in. Ecology is a primary interdisciplinary science covering the social and political spheres of these challenges, and planning is crucial to the existence and the remedy of ecological challenges. However, the knowledge gap between planning, ecology and environmental ethics contradicts attitudes towards nature. (Özgür, 2020)

Everything from how we perceive life to behave is defined by our personal beliefs, attitudes, and values. Values are general goals that act like guiding principles in our lives (Bozdemir, 2019, p. 44). Many factors play a role in adopting pro-environmental behavior in theories. Previous studies have shown that environmental behaviors are associated with personal factors such as socio-demographic characteristics, values, beliefs, and norms (Müderrisoğlu & Altanlar, 2011; Stern et al., 1995; Stern, 2000). This study demonstrates the relationship between value orientation and pro-environmental behavior tendencies and perception of environmental policies according to personal characteristics. The literature demonstrates that individuals with egoistic value orientation tend to show less pro-environmental behavior, while people with strong biospheric value orientation tend to show more pro-environmental behaviors (Karayeğen Balent, 2020, p. 158; Kıral Uçar, 2020, p. 806). The study's findings are comparable to the findings of similar studies. This study's findings show that urban planning students are willing to show pro-environmental behavior. Based on the study findings, urban planning students adopt biocentric, ecocentric, and anthropocentric value orientations. These results also show that urban planning education plays an influential role in respondents adopting biocentric and ecocentric value orientations. However, study findings demonstrate that only ecocentric students tend to show pro-environmental behavior. No significant difference was found between respondents' value orientations and perception of environmental policies.

As with similar studies, this study's findings also suggest that environmental attitudes are shaped by socio-demographic values that affect social structure and environmental behavior (Aminrad et al., 2011; Müderrisoğlu & Altanlar, 2011; Sasidharan & Thapa, 1999, p. 60). Stern et al. (1995) reported that women are better at understanding the importance of the environment for social welfare, personal well-being, and for the world to be a better place (Stern et al., 1995). This study shows that women tend to show more pro-environmental behavior than men. Additionally, as the mean age of the respondents increases, they tend to have more pro-environmental behavior.

Some studies suggest significant differences in people's environmental attitudes according to their place of residency (Sasidharan& Thapa, 1999, p. 60). Furman (1998, pp. 528-529) reported that people living in cities are more interested in environmental

problems than people living in rural areas. Cary (1993) reported that being away from environmental problems made it difficult to understand these problems. This study supports these findings. According to the study findings, students' environmental attitudes differ according to the university they attend and the city they live in. The study findings show that urban planning students in a moderate size city (AU) have a higher tendency to show pro-environmental behavior compared to urban planning students attending a university in a larger city (YTU). Furthermore, more students studying in a large city (YTU) reported that environmental policies are insufficient to protect the environment than the urban planning students studying in a moderate size city (AU).

The literature shows that early experiences in the natural environment and environmental education affect the development of values in adulthood (Yaban, 2020, p.305). Studies focused on environmental education suggest that students who have more courses on environment support life-centered attitudes (Müderrisoğlu & Altanlar, 2011, p. 160). Environmental experiences, especially in childhood, are a determining factor in developing ecological identity. Yaban (2020, p.305) reports that teenagers who spend more time in nature during their childhood have positive perceptions about nature and choose activities such as nature walks compared to those who spend time in their garden before age ten. Keleş (2007) showed that science and technology teacher candidates had increased environmental awareness and sustainable living after completing their courses on ecological footprint, and increasing awareness levels had a positive effect on the attitudes and behaviors of teacher candidates (Keleş, 2007, p. 101). As with similar studies, this study also demonstrates that students who receive environmental education before their bachelor's degree tend to show more pro-environmental behavior (Wong, 2003; Morgil et al., 2004).

Additionally, study findings show that students with relatively better economic conditions are more inclined to have a biocentric value orientation. Based on the literature and these study findings, pro-environmental behavior is not a single-dimensional structure caused only by individuals' personal and professional characteristics. It can be suggested that people's environmental attitudes and behaviors are shaped by their upbringing, school, friends, and culture. Those upbringings show that pro-environmental behavior has a multi-dimensional complex structure, and a conceptual framework can provide guidance to explain these kinds of behavior. In conclusion, focusing on ecocentric approaches in urban planning education can result in more positive outcomes for adopting pro-environmental behavior and policies. In other words, as theoretical and practical courses in urban planning education cover economic, social, cultural, political, natural, and built environments, it is impossible to omit values and ethical approaches from the curriculum. If the long-term goal of urban planning education is to improve and maintain environmental quality, information on its own will

DOI: 10.15320/ICONARP.2023.258

not be sufficient. An effective education program that will help people develop ethical rules should be designed. However, an education program emphasizing environmental values is believed to increase urban planning students' knowledge and awareness. It can be suggested that students who adopt ecocentric and biocentric approaches can be more effective in creating sustainable plans and providing guidance to decision-makers to implement policies aiming to achieve this. Providing education within this framework and including more courses on environmental values as a priority will play an influential role in developing and implementing policies that are effective in environmental protection and the prevention of environmental problems. Thus, it can be possible for urban planning students to develop a holistic approach to ecology and natural resources management. By supporting an education program that helps students to have ecocentric value orientations, students can take action to prevent the destruction of the natural environment by people and provide information to and warn decision-makers and society about dangers, despite all kinds of economic and political conditions in their social and professional lives.

This study has some limitations. In 2021, there were 33 universities in Türkiye with urban and regional planning departments. However, this research only surveyed urban and regional planning students from two state universities. Therefore, the results obtained from this study cannot be generalized to all students, but they can provide some insights.

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DOI: 10.15320/ICONARP.2023.258

APPENDICES

Appendix 1. Environmental Ethics Approaches (Value Orientations) Factor Analysis Results

Components		Factor Load[a]	Explained Rate of Variance (%)	Eigenvalues	*Cronbach's Alpha Coefficient (α)[b]
	Environmental Ethics Scale		59.048	-	0.908
Biocentric Ethics	Every living being has its right to preserve and maintain its existence.	.748	23.853	4.294	0.883
	We need to treat animals at least as well as we treat humans.	.729			
	Animals have feelings like humans.	.728			
	Other living beings want to live as humans do.	.687			
	Humans are severely abusing the natural environment.	.684			
	The main reason behind the deterioration of nature is a consumption-dependent lifestyle.	.667			
	Those who do not love other living beings also do not love humans	.658			
	The earth is like a spaceship with very limited room and resources.	.600			
	If things continue on their present course will soon experience a major ecological catastrophe.	.545			
	The balance of nature is very delicate and easily disturbed.	.486			
Ecocentric Ethics	Human ingenuity will ensure that we do not make the earth unlivable.	.755	18.446	3.320	0.805
	A simple life in harmony with nature is better than a modern life dependent on technology.	.680			
	Global warming can only be prevented with the renunciation of lifestyles resulting in the exploitation of nature	.632			
	The main reason for the deterioration of nature is the desire for steady progress.	.618			
	We are approaching the limit of the number of people that the earth can support.	.601			
	When humans interfere with nature, it often produces disastrous consequences.	.588			
Anthropocentric Ethics	The so-called ecological crisis facing humankind has been greatly exaggerated.	.800	16.749	3.015	0.804
	Humans have the right to modify the natural environment to suit their needs.	.794			
	Humans were meant to rule over the rest of nature.	.718			
	The existence of living beings not useful to human beings is not important.	.675			
	Plants and animals are living beings that exist to serve humans.	.635			

[a] If the factor load value is between 0.55-0.62 it is good; 0.63-0.70 is very good; 0.71+ is perfect.
*[b] If Cronbach's alpha value is (α) ≥ 0.9 it is excellent; ** 0.9 > α ≥ 0.8 is good, *0.8 > α ≥ 0.7 is acceptable (Çokluk et al., 2010).*

Appendix 2. Environmentally Friendly Behavior Patterns Factor Analysis Results

Environmentally Friendly Behavior Scale	Factor Load[a]	Explained Rate of Variance (%)	Eigenvalues	*Cronbach's Alpha Coefficient (α)[b]
I donate money or paid membership dues to a conservation organization.	.734	49.727	4.973	.881
I enroll in a course for the sole purpose of learning more about environmental issues.	.753			
I talk to others about environmental issues.	.756			
I watch TV programs about environmental problems.	.702			
I read publications that I can do to help solve environmental issues.	.711			
I write to our elected officials expressing my opinions on environmental problems.	.656			
I investigate our elected officials voting record on environmental issues.	.699			
I vote for a politician due to his/her record on protecting the environment.	.615			
I use legal measures to stop events I thought would damage the environment.	.704			
I report environmental crimes to the proper authorities.	.709			

[a] If the factor load value is between 0.55-0.62 is good; 0.63-0.70 is very good; 0.71+ is perfect.
*[b] If Cronbach's alpha value is (α) ≥ 0 .9 is perfect ;** 0.9 > α ≥ 0.8 is good, *0.8 > α ≥ 0.7 is acceptable (Çokluk et al., 2010).*

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Appendix 3. Environmental Policies Perception Scale

Environmental Policies Perception Scale	Factor Load[a]	Explained Rate of Variance (%)	Eigenvalues	*Cronbach's Alpha Coefficient (α)[b]
Measures were taken to protect the ecosystem.	.946	84.532	10.144	.983
Measures taken against climate change.	.932			
To carry out studies to prevent air pollution.	.929			
Measures were taken against environmental pollution due to industrial and domestic waste.	.929			
To protect and manage forests to ensure their sustainability.	.928			
Sustainable management of wetlands (waterways, shore, lake, etc.)	.919			
Conservation and control of green areas (parks, gardens, groves, meadows, etc.) ensure their continuity.	.911			
Measures to control population growth.	.911			
Measures were taken against the pollution of clean and potable water resources.	.910			
Protecting endangered plants and animal species.	.910			
Promoting natural heritage conservation	.905			
Conservation of biodiversity.	.902			

[a] *If the factor load value is between 0.55-0.62 is good; 0.63-0.70 is very good; 0.71+ is perfect.*
[b] *If Cronbach's alpha value is (α) ≥ 0.9 is perfect; ** 0.9 > α ≥ 0.8 is good, *0.8 > α ≥ 0.7 is acceptable (Çokluk et al., 2010).*

Resume

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DOI: 10.15320/ICONARP.2023.258

ICONARP
International Journal of Architecture and Planning
Received: 06.01.2023 Accepted: 06.11.2023
Volume 11, Issue 2/ Published: 28.12.2023
Research Article *DOI: 10.15320 /ICONARP.2023.259 E- ISSN:2147-9380*
ICONARP

Investigating the Barriers to Implementation of Green Roofs in Izmir, Turkey

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Abstract

As a sustainable approach to urban environmental management, green roofs are becoming more and more popular. They have been discovered to help reduce the urban heat island effect, insulating against noise and heat, managing stormwater, and eventually reducing climate change. Despite its established advantages and widespread use in most developed countries, green roofs have just recently gained popularity in the Izmir building sector. Izmir, a fast-growing city that may profit from green roofs, seems to have little idea of its potential. This study aims to determine the barriers to the widespread adoption of green roofs in Izmir. For this purpose, qualitative research was carried out and semi-structured interviews with government officials from different backgrounds such as architecture, landscape architecture, urban planning, and engineering were carried out to gather the primary data. Although there are prospects for the adoption of green roofs, the study revealed that these roofs are not common in the study region due to expense, technical difficulties, a lack of understanding, and standards. In light of this, it was also discovered that for the local sector to progress, government authorities must provide incentives and change regulatory settings to better promote the use of green roofs, while industry organizations must offer educational initiatives. Moreover, it is crucial to enhance technicalproficiency and conduct research related to green roofs' proven benefits in the context of Izmir.

Keywords:
Green roofs, sustainability, qualitative research, barriers

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To cite this article: Doğmuşöz, B.B. (2023). Investigating the Barriers to Implementation of Green Roofs in Izmir, Turkey. *ICONARP International Journal of Architecture and Planning,* 11 (2), 672-691. DOI: 10.15320 /ICONARP.2023.259

INTRODUCTION

Rapid urbanization is leading to environmental issues in cities. These problems can be listed as water and air pollution, lack of water supply, loss of green spaces, etc. (Keeley et al.,2013). These issues are getting worse with the negative effect of climate change and global warming. Several measures have been attempted by municipal officials to address these problems and promote urban resilience. Many cities, for example, have developed strategies to transform themselves into sustainable cities by increasing green spaces, mitigating urban flooding events, and designing environmental-friendly structures (Tassicker et al., 2000). However, such initiatives might not be enough the meet urban areas' needs. More efficient strategies are required for sustainable, resilient, and healthy urban environments. Green roofing systems have been recognized as an environmentally friendly and long-term solution for enhancing the built environment and addressing major urban challenges (Shafique et al., 2018). Green roofs have been increasingly popular in recent years, particularly in Northern Europe and North America (Kohler, 2006). Among them, Germany is regarded as a clear leader in the usage of green roofs. Li and Yeung (2014) attribute Germany's leadership role in the usage of green roofs to favorable government policy in the form of laws, municipal subsidies, and financial incentives for green roof adoption. Green roofs are also being used in new construction on flat-roof buildings in other European nations and towns. The Swiss city of Basel has the world's largest number of green roofs per capita, thanks to a mix of financial incentives and construction regulations (Kazmierczak and Carter, 2010).

Green roofs (GRs) are well-known for their capacity to contribute to the environment and cities by mitigating urban heat island effects, reducing air pollution, and improving air quality (Susca et al., 2011; Goudarzi and Mostafaeipour, 2017; Gwak et al., 2017; Oguzturuk et al., 2018). Furthermore, green roofs provide economic benefits in terms of increased property value and energy savings (Mahdiyar et al., 2016). Extensive green roofs (EGR) and intensive green roofs (IGR) are the two most common forms of GRs (Figure 1.). Because only a few species of plants can be planted on extensive green roofs, they require little maintenance during their lifetime (Gargari et al., 2016). Furthermore, an EGR has a reduced installation cost and requires no extra structural support. On the other side, IGRs, such as roof gardens, can provide recreational spaces for the public, particularly in areas where parkland is scarce (Gargari et al., 2016).

DOI: 10.15320/ICONARP.2023.259

Figure 1. Examples of Intensive Green Roof (left) and Extensive Green Roof (right) (Gargari et al., 2016)

Although green roofing may help alleviate urban floods, reduce energy costs and improve environmental performance, their implementation is not so common (Zhang and He, 2021). Some study has focused on barriers in various countries with different climatic conditions and socio-economic position, while others have concentrated on other elements of GR installation. Barriers in the literature related to green roof installation are listed in the table below (Table 1).

Table 1. Barriers to Green Roof Implementation

Perspectives	Barriers	References
Socio-cognitive barriers	Lack of awareness and knowledge	Tabatabaee.et. al., 2019; Shafique. et al., 2018;Vijayaraghavan, 2016; Curry and Larsson, 2014; Yuen and Hien, 2005
Technical barriers	Lack of technical knowledge	Berardi et al., 2014;Hendricks and Calkins, 2006
	Lack of technical staff	
	Structural uncapability	Jim and Tsang, 2011; Berardi et al., 2014; Shafique et al., 2018
	Risk of failure	Berardi et al., 2014; Shafique et al., 2018
Cost barriers	High initial cost	Berardi et al., 2014; Chen et al., 2019; Hendricks and Calkins, 2016; Mahdiyar et al., 2018; Williams et al., 2010; Zhang et al., 2012
	High maintenance cost	Chen et al., 2019; Mahdiyar et al., 2018; Williams et al., 2010; Xiao et al., 2014; Zhang et al., 2012
Lack of government policy	Lack of policy pressure	Peck et al.,1999; Townshend, 2007; Vijayaraghavan, 2016; Williams et al.,2010
	Lack of incentives	Sanmargaraja et al., 2019; Teotonia et al., 2020
Lack of benefit assessment		Carter and Keeler, 2008; Nurmi et al, 2013

Some barriers have been certainly discussed in the literature. High initial and maintenance costs have been identified as the most significant

barriers (Chen et al., 2019; Mahdiyar et al., 2018; Williams et al., 2010; Zhang et al., 2012). Many developers often focus on the high cost of installation, ignoring the long-term benefits.

According to various research, the lack of awareness about the benefits of green roofs is mostly discussed as a barrier (Wong et al., 2005; Wilkinson et al., 2015). Even though green roof technology benefits the environment and cities, many stakeholders either do not know about or do not recognize these benefits. Many architects and developers are hesitant to design and build roof gardens, partly because inhabitants might not like them, which would result in a waste of space. This issue emphasizes the need of raising public awareness of and favorable attitudes concerning green roofs (Yuen and Hien, 2005).

Another barrier is related to structural limitations. Most buildings are not suitable for a green roof installation because of additional dead and live loads on buildings (Jim and Tsang, 2011; Shin and Kim, 2019). Additional to these barriers, some technical barriers have been discussed. Although green roofs can mostly be installed in different climate conditions, there might be some issues related to the plant adaption process, complexity in the maintenance process, and potential leakage problems during its lifespan (Berardi et al., 2014, Vahdati et al., 2017; Shafique et al., 2018). Furthermore, a lack of technical knowledge and expertise related to installation and maintenance is another barrier discussed in the green infrastructure literature (Berardi et al., 2014). Since green infrastructure is different from traditional stormwater management techniques, they require a new set of installation, operation, and maintenance strategies (Keeley et al., 2013). It means that technical staff with technical knowledge of green infrastructure are key elements to its successful implementation.

Major significant challenges to implementation were noted as a lack of government policy and government incentives (Zhang et al., 2012). Another research supports the same conclusion, claiming that favorable government policy and incentives are the main reasons for Germany's high percentage of green roof adoption (Liu and Yeung, 2014). Governmental regulations can control stakeholders' actions in both mandatory and optional ways. The most efficient approach to quickly bring the GRI into reality might be through mandatory rules that incorporate requirements, guidelines, and standards (Zhang et al., 2019). Additionally, without adequate direction and assistance from the government, private enterprises do not show a willingness to undertake GR initiatives (Tassicker et al., 2016).

GR application includes a wide range of stakeholders, including designers, engineers, urban planners, contractors, building operators, private property owners, and government agents (Zhang and He, 2019). Adaptation to green roofs needs action at all levels from the global to the local (Urwin and Jordan, 2018). For instance, green roofs also offer a variety of benefits to property owners on a personal level such as energy savings, increasing aesthetic value, etc. A study conducted by Dogmusoz

DOI: 10.15320/ICONARP.2023.259

(2023) demonstrated that the long term benefits of a green roof outweighed the installation cost based on benefit cost analysis. Given the size of private property, local governments might work with the private sector to obtain enough green roofs for stormwater retention, particularly in regions where populations are high, (green) space is limited, and traditional sewage systems have reached their capacity limitations. They all have a critical role in the implementation of green roof policies and technologies. Understanding these participants' attitudes, knowledge, and preferences toward green roofs is crucial for a green roof project to achieve its goal.

This study focused on government agents' side because they play an important role to overcome financial barriers. As mentioned, the government can provide incentives and also, regulations which are important for wide installation. Moreover, the government appears to need to play a more active role in encouraging societal actors to install green roofs on their structures (Mees et al., 2012).

The existing barriers to GR adoption must be thoroughly examined separately for each country (Brudermann and Sangkakool, 2017) because there are legislative, human-related, climate-specific, and cultural barriers that have to be investigated for any region. There are not many studies in the City of Izmir related to green roofs. Most studies focused on the benefits, but barriers to its installation are mostly ignored. Only a few research have directly and partially addressed this subject in the context of the City of Izmir. As a result, any research in this direction might be seen as a big step forward. Understanding the perception, knowledge, and attitudes of green roof involvers toward green roofs can affect their success. This paper seeks to fill this gap by reporting on new research examining government officials' perceptions of green roofs in the city of Izmir.

METHODOLOGY

Study Area

There are several reasons for choosing Izmir as a study area. Firstly, the city has a significant history of urban flooding and water pollution. In Izmir, rapid urbanization increased population and an insufficient infrastructure system with the consequences of global climate change have led to urban flooding, decreased water quality, and changed water dynamics (Kutluca, 2006). The city's population has been gradually growing and has already reached 4 million people as a result of migration from other counties. New structures were built to accommodate the growing population. For instance, in the Karşyaka district, 50.000 new buildings were built between 1987 and 1995 (Figure 2.). More soil became vulnerable to storm runoff as a result of the increasing construction.

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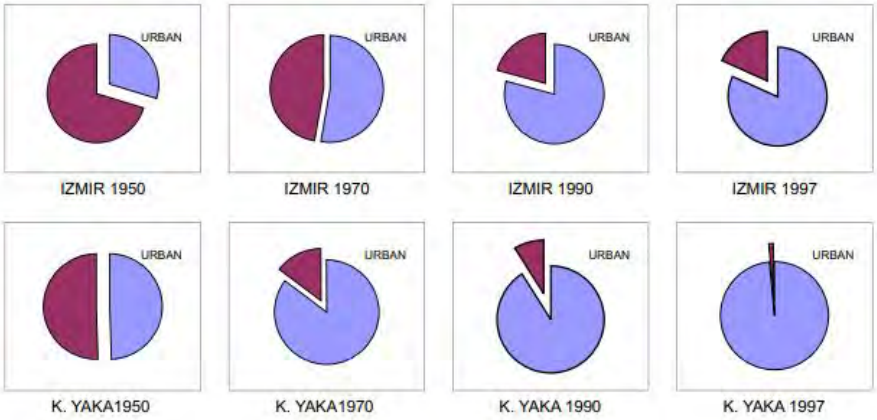

Figure 2. Urban Population Growth Rate in Comparison with the Izmir Province, and the Karsiyaka District by Census Results, 1950-1997 (SIS, 2001)

Secondly, the city of Izmir has made substantial efforts over the past ten years to improve its environmental performance, via the establishment of strategies and investments in green infrastructure. The Izmir Metropolitan Municipality (IBB) has indicated a willingness to handle its current and future urban environmental concerns with a more integrated strategy. Green roofs were defined as one of these strategies. To improve the ecology of the city, break the negative effect of climate change, reduce sudden urban flooding and create a natural environment in highly dense areas, the zoning regulations have been reorganized with a sustainable environmental understanding in new buildings. Finally, policymaking related to the sustainability and resilience of the city of Izmir has now entered into municipal planning and redevelopment processes. For this purpose, the use of green roof systems is now required for buildings with larger than 60 thousand square meters.

Research Design

The study was conducted during three stages as shown in the methodology process diagram (Figure 3). To begin, academic literature was used to identify the commonly regarded barriers to the building of green roofs, followed by an examination of legislation and guidelines in existence to assist the use of green roofs, and finally an evaluation of green roofs in Izmir. Following, interviews were conducted with government officials and finally, results were analyzed, and planning recommendations were developed.

Interviews

To answer the main inquiry of this paper, semi-questioned interviews were used as a method of data collection. When time restrictions prevent persons from being questioned more than once, semi-structured interviews are widely utilized. The order and wording of the interview questions were not predetermined; rather, the respondents' replies determined the path of the discussion and its conclusion. They allow for more probing and follow-up questions than unstructured interviews (Bernard, 2011). Because of their great time-management abilities,

DOI: 10.15320/ICONARP.2023.259

Bernard (2011) claims that this form of interviewing works particularly effectively when interviewing high-level bureaucrats and elite members of society. This might be handy when interviewing municipal employees. Interviews may help reveal specific in-depth information about people's motives and behaviors, as well as put other facts into context.

Interviews were conducted (ranging from 15-25 min) in this study to capture government officials' perceptions and perceived barriers to implementing green roofs in Izmir. The goal of these interviews was to obtain a better understanding of key actors' opinions before providing recommendations for the adoption of green roofs. Throughout the study, semi-structured interviews were employed to encourage respondents to speak freely and allow for the emergence of new points of view. Digital recordings of the interviews were made. The study was supervised by an Institutional Review Board (IRB). The interviews were recorded, transcribed, and coded so that important information could be retrieved from them.

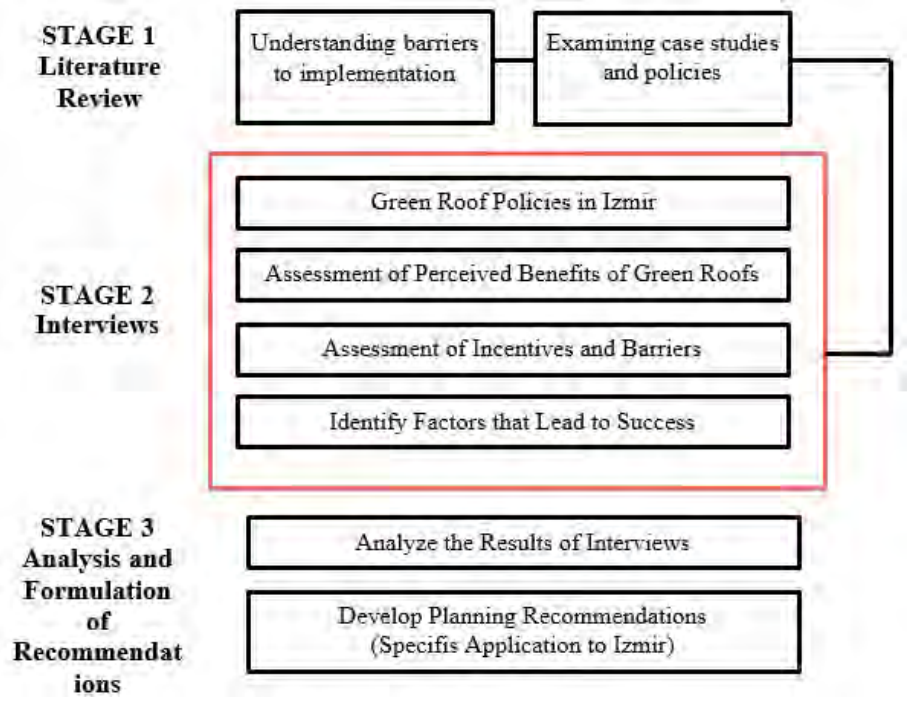

Figure 3. Research Design of the Study

Sample

The sample consisted of eleven individuals each with practical or theoretical experience or no experience of green roofs in Izmir. Through an examination of the literature, several relevant organizations with an interest in green exterior policy or design, including private companies, non-governmental organizations, and local governments, were identified as being involved in supporting or creating green roofs. This study focuses on barriers at the government level. Since then, municipals were contacted through phone numbers and/or email addresses to arrange a meeting for interviews. A subjective evaluation of people's opinions about green roofs was the goal of the interviews.

Each municipality has a different department related to green roof projects. The interviewees were chosen from a variety of backgrounds such as architecture (7), landscape architecture (1), urban planning (1), and engineering (3) with varying levels of experience or no experience with a green roof. There is no specific department related to green roofs. In each municipality, different units manage the work on green roofs such as the urban design department, zoning, and urban planning department. Interviews were conducted with four different municipalities: Izmir Metropolitan Municipality, Municipality of Karsiyaka, Çiğli, and Gaziemir. Among these municipalities, Gaziemir municipality has the only municipality building with a green roof application (Figure 4.)

Figure 4. The Building of Municipality of Gaziemir

By interviewing government officials, this research aims to learn more about their awareness toward green roofs, their knowledge about benefits of green roofs and more importantly, barriers to implementation in Izmir.

RESULTS

The results of the interview are depicted in Table 2. The cost of installing and maintaining green roofs, education/awareness among practitioners, and the role of government in its adoption, for example through the setting of national policies or the development of incentive schemes, are all mentioned as key factors that affect the commercial viability of green roofs. Detailed interview results are further explored in this part.

The majority of participants generally connected green roofs with some form of environmental benefits, largely because their ability to reducing air pollution and urban heat island effect. Additionally, most people agreed that green roofs were a good idea if properly implemented.

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Table 2. Results of Interviews

Perceived Benefits	Barriers	What should do
Ecosystem (4)	Cost (10)	Incentives (10)
Increase the amount of green space (4)	Lack of Awareness (5)	Policy (6)
Isolation (4)	Lack of technical staff (5)	Education (5)
Urban Heat island (3)	Lack of evidence related to its benefits (4)	Proven data (4)
Climate change reduction (2)	Standards (3)	Star system (1)
Decrease urban flooding (2)		
Aesthetics (2)		
Increase resilience (1)		
Recreational benefits (1)		

Perceived Benefits of Green Roofs

The literature has suggested that green roofs have lots of benefits to cities including mitigating climate change's negative effects, reducing urban heat islands, decreasing urban flooding, improving aesthetics, and increasing biodiversity (Oberndorfer et al., 2007). Results from interviews indicated that participants are mostly aware of the benefits of green roofs. They were mostly aware of their ecological benefits, contribution to green areas, and providing isolation to the building.

Interviewee 2: *Green roofs have many variety of benefits and the most significant one might be the provision of biodiversity. They provide habitat for urban wildlife.*

Interviewee 3*: Implementing green roofs will create greener cities which is environmentally healthy. I mean they can provide green space at dense urban areas by transforming unused roof spaces into a roof garden.*

Interviewee 7: *It (green roof) provides an additional layer of insulation to the building. It would, in my opinion, improve energy efficiency and reduce heating and cooling costs.*

Interviewee 6*: It (green roof) would help in lowering bills and energy efficient.*

The heat island effect in urban areas can be reduced by using green roofs in urban areas. Green roofs provide shade, absorb heat from the atmosphere and lower air and roof surface temperatures. Reduced urban heat island effect was second most mentioned benefit.

Interviewee 3*: Green spaces have replaced with buildings in cities. This raises the temperature, which is referred to as heat island effect. Green roofs can mitigate urban heat island effect in Izmir, which is a problem.*

Interviewee 1*: Urbanization and climate change are the main problems of cities which cause urban heat island effect. Green roofs might be effective in the reduction of the urban heat island.*

Interviewee 10*: Impervious surfaces in Izmir can have a negative effect on the urban climate, which in turn increases the severity of the urban heat island. Lowering the surface temperatures of the roofs may be crucial to*

deal with urban heat island effect. I think this can be achieved by replacing traditional roof surfaces with green roofs.

Following these benefits, mitigating climate change, decreasing urban flooding, and aesthetics benefits were the third discussed benefits by the interviewees. Green roofs can reduce the amount of stormwater runoff and improve the quality of water that returns to water bodies after storm events (Mentens et al., 2006). Less than half were aware of and valued the green roofs' capacity to reduce stormwater flows.

***Interviewee 8**: I think implementing green roofs can prevent flood events in cities by reducing the amount of stormwater runoff (decreasing urban flooding).*

***Interviewee 5**: Green roofs can improve the visual quality of cities (aesthetic benefits).*

***Interviewee 7:** Green roofs serves as a tool for coping with climate change by decreasing surface runoff amount and decreasing temperatures in cities (mitigating climate change).*

Finally, the least mentioned benefit was the recreational benefit of green roofs. Even if green roofs provide a space for recreation, this feature was not highlighted enough in the interviews, except for one interviewee.

***Interviewee 3:** Green roofs can increase green areas in cities and provide recreational areas for citizens. Roof tops are good options for urban areas since there is a lack of space to create green spaces on ground.*

Some benefits of green roofs were never mentioned by interviewers such as the reduction of air pollution benefits, increased rooftop lifespan, etc. Most respondents demonstrated a high level of awareness and understanding of the potential benefits of green roofs. However, a few felt unsure about their effectiveness.

***Interviewee 7:** We already have a green roof in this building but it looks messy now because of low maintenance. Although green roofs have lots of benefits, the key point is to maintain it. If we do not keep it well maintained, we cannot benefit from their advantages.*

Barriers

In this study, the word "barrier" is used to describe any current or anticipated difficulties experienced in achieving widespread installation of GRs. This section presents barriers to the implementation of green roofs from the perspective of local government. In this study, installation costs were determined as the most significant barrier. Ten out of the eleven interviewees named cost as the main obstacle to the installation of green roofs. On the other hand, the lack of application examples and required maintenance were considered to be the least critical barriers. The key factors that affect the implementation of green roofs include the cost of installation, practitioner education and awareness, and the role of governments, such as through the establishment of national policies or the development of incentive schemes.

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Cost

In the literature, there are some persistent barriers to GR adoption, such as high installation costs, which have consistently been listed as one of the major obstacles to all types of green roofs for new buildings (Wilkinson and Feitosa, 2015). When asked what has been the most significant impediment to the adoption of local green roofs, ten of the eleven interviewees named installation cost as the most significant barrier.

Interviewee 3: *The cost of installing a green roof is more expensive than the cost of creating a regular roofing system. No one wants to pay more for green roofs. In my opinion, this (cost) is the most significant barrier to its installation.*

Interviewee 7: *Building contractors are very important stakeholders in green roof projects. They mostly may just be interested in how much they will pay more for green roofs, not benefits provided by them (green roofs). This way of thinking undervalues the long term economic advantages of environmental and individual benefits.*

Interviewee 4: *Obviously, I can say that the high initial cost of installing green roof acts as a barrier to its widespread adoption in Izmir. I think nobody shows willingness to pay for it.*

Interviewee 10*: Even if they provide numerous benefits, their installation is not very common in Izmir. Actually, I do not know any finished or ongoing green roof projects in Izmir. I just know that installing green roofs cost a lot. The high initial cost might prevent its adoption.*

These opinions related to cost barrier supports the existing literature which emphasized that cost is the most significant barrier.

Lack of awareness

Wider acceptance appears to be hindered by a lack of knowledge, awareness, and experience (Wilkinson et al., 2015). When asked what the barriers affecting the implementation of green roofs in Izmir, four of eleven interviewees emphasized that the perception towards green roofs was important. The interviewees' comments revealed that green roofs are, in some way or another, viewed negatively by the local building sector and the public.

Interviewee 1: *People are scared of something new. Change typically terrifies individuals away unless they are truly aware of its benefits and not enough knowledge. Public is very important in the implementation of new technologies such as green roof because they mostly generate demand. There is not enough demand.*

Interviewee 2: *From my experience, building contractors thought that green roofs were not effective enough… they were not convinced or not know about the benefits of green roofs.*

Interviewee 8. *Perception and awareness toward green roofs is the key element to its implementation. If we change the perception in a positive way, it might increase its wider acceptance.*

Interviewee 7: *Green roofs are not being promoted well. While there may be awareness, I do not believe it will be driven by planning.*
Interviewee 4: *Despite the fact that green roofs clearly benefit the environment, many building owners either did not know about or did not recognize these benefits.*

According to Rosasco and Perini (2019), the key stakeholders must support the inclusion of green roofs in building designs, especially landscape architects. The interviewees, however, emphasized the importance of a client's suggestion in green roof projects. The client was identified as public. Public perception is also a critical barrier. Many developers are hesitant to design and build roof gardens, partly because inhabitants might not like them, which would result in a waste of space (Zhang and He, 2019). This issue emphasized the need to chancing public awareness of and positive attitudes concerning roof gardens (Yuen and Hien, 2005).

Interviewee 5: *I think inclusion of public in green roofs is very important. If they really wants it, then it will happen.*
Interviewee 6: *Practice will be framed by perspectives, thus it is crucial that we should change people's perceptions toward green roofs in a positive way.*

Lack of technical knowledge and guide

The design, installation, operation, and maintenance phases of green roof strategies are crucial to its performance. Because of this, stakeholders should have an understanding of requirements. One of the requirements is to have a technical team that knows its operation and maintenance (Zhang and He, 2021). Five of eleven interviewees also agreed that the lack of technical support and knowledge to install and maintain green roofs is one of the significant factors in implementation.

Interviewee 5: *There is no technical guide related to its implementation. We mostly follow the installation examples in Europe but not consider different weather condition, or kmlkşkki*
Interviewee 1: *Since there are not enough green roof applications, there are no specific standards*
Interviewee 3*: Even if we have an understanding of green roofs, how about technical staff?*
Interviewee 7: *Green roof systems require expertise for the installation. However, there is a lack of expertise in government.*

Lack of evidence related to its benefits

There are not enough examples of green roof installation and since then, no data have been provided on how efficient green roofs are. According to Meulen (2019), if there is reliable evidence analyzing the costs and advantages of green roofs, policymakers are likely to show more willingness to integrate them into building rules and planning guides. Studies on how well this technology performs over the long term

DOI: 10.15320/ICONARP.2023.259

are developing as green roof becomes increasingly common. Although there is plenty of information showing that a green roof has a favorable short-term influence on the amount and quality of urban stormwater, there is still not enough longitudinal research and evidence related to its multifunctional benefits. Four of eleven interviewees agreed that since there is a lack of sufficient application examples, its acceptance is not very common.

Interviewee 5: *I suppose if people see great examples of green roofs in our country, the demand will increase. The government may install green roofs to their own buildings, then the market might start to want it.*

Interwiewee 4: *The government can play a crucial role in the business, particularly when it came to carrying out demonstration projects in public spaces to relieve the current worries surrounding green roofs.*

Interviewee 1*: There is a number of examles around the world but not in Turkey. Since there are not enough examples in our country, we cannot be sure of their benefits.*

Interviewee 3: *Governments and people are hesitant to adopt green roofs because of uncertainty about its efficacy.*

Lack of technical guide

According to Mahdiyar et al. (2020), stakeholders in the green roof industry are cautious of potential failures due to a fear of the unknown and a lack of direction from building practice about green roofs. Only a few nations now have standards and regulations governing green roofs. For example, Germany, which is a leader in green roof technology, created one of the first regulations in 1990. The German standard '*Planning, execution and maintenance of green areas on the roof*" was developed by the Research Society for Landscaping and Landscape Development. This guideline played an important role in the success of green roofs in Germany (Walker, 2014). Five of eleven interviewees agreed that lack of technical guidance is a barrier to green roof installation.

Interviewee 5: *Since it (green roof) is a new technology in Turkey, there is no guide related to how to install, operate and maintain it. This is a bit discouraging.*

Interviewee 1: *Although there are examples (green roof application) or guide related to its installation in Europe or other countries, we cannot directly take this guide and apply in Turkey. We need our own standardization.*

What Needs to Change

When asked how to overcome the challenges to wider acceptance of green roof technologies, ten of the eleven interviewees cited the role of incentives by government as a possible approach, while six interviewees mentioned the importance of government policy in supporting the sector.

Government policy

In literature, government policy is always the most effective method for putting urban sustainability ideas into action (Zhang and He, 2021). The role and influence of governments in encouraging the local green roof sector are not thoroughly discussed in the current literature. Unlike many other advanced nations, Turkey has few national-level legislation or regulations governing the installation of green roofs. Based on the results, although the development of new legislative frameworks does have value in advancing the installation of green roofs, typically seems to have less impact than the type of government-driven change: incentives. Six of eleven participants agreed that the government role in installation is very important.

Interviewee 10: *The issue is that there is no policy and legislative in Turkey for green roof implementation. The lack of policy is a barrier to the broad use of green roofs. We must first overcome this barrier.*

Interviewee 11: *Government policies would encourage more individuals to install green roofs which would increase market competition and drive down prices.*

Interviwee 5: *I keep thinking how to promote green roofs… One is to build more of them. This is possible thorough adjusting policy setting.*

Interviewee 1: *There is a policy regulation in İzmir related to green roofs. Green roofs on buildings over 60 thousand square meters has been made mandatory. However, it is a huge area so the government should require it for new small developments as well.*

Interviewee 7: *Installing green roofs on new structures should be mandatory through legislation, planning guidelines or making changes to the building zone.*

Interviewee 2: *To enable that [implementation of green roofs], the local government must put the required regulations into place.*

The idea that the implementation of policy change would increase the acceptance of green roofs is also supported in this study. According to most interviewees, the policy change would pay the way for its wide installation. Four of the interviews also make a connection between the change in policy and installation cost.

Interviewee 1: *Government policy setting would encourage more people to put green roofs up and therefore more people enter the market and they (green roofs installation cost) become cheaper.*

Interviewee 7: *The market will start to want it if people get more aware of it or, I suppose, if they see amazing instances of what that space (roof space) can be. I think that's crucial to realize because without policy, you really rely on the market to drive it.*

Government intencives

Financial incentives were discussed in literature as a way to overvome financial barriers to the implementation of green roofs. In developed countries, government mostly provide incentives to new developments if they install green roofs. For example, in Stuttgart, since 2008, there has

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been an incentive scheme with a sizable budget in place; enterprises and residents are given a subsidy of €30 per square metre, which should cover around half of the installation expenses. Six of eleven participants agreed that incentives would play an impportant role in the installation of green roofs in the context of Izmir.

Interviewee 1: *If the government offered incentives, green roofs would become increasingly common.*

Interviewee 4: *Government incentives, in my opinion, would be useful.*

Interviewee 11: *To increase the installation of green roofs, you should provide a number of incentives.*

Interviewee 6: *Incentives that can cover installation cost may increase people's interest in green roof projects.*

Prooven data

The lack of knowledge and information on return on investments may decrease the adoption of green roofs (Nurmi et al., 2006). Rayner et al. (2010) stated that until reliable data is analyzing the costs and advantages of green roofs, policymakers are likely to be hesitant to integrate them into building rules and planning guidelines.

Interviewee 1: *In order to convince owners and contractors to really spend, it is important to use benefit-cost analysis technique to balance its high initial cost. In other words, economic research should be used to estimate all potential environmental, economical and social advantages.*

Interviewee 10: *Cost evaluations are necessary to demonstrate the sustainability and benefits of this strategy (green roof).*

This highlighted the importance of proven data in the adoption of green roofs. If government officials, the public, or building contractors can be informed about the long-term benefits of green roofs through scientific research, the success of green roof implementation might increase (Zhang et al., 2019).

Education

Education was discovered to be another significant factor affecting the application of green roofs in the Izmir building sector. Five out of the nine respondents stated that education has a large scope and power for enhancing the existing situation of the regional green roof business when asked whether there was a workable strategy to offset the issues posed by green roof technology in Izmir. Through the course of conducting interviews, it was revealed that the word "education'' mostly used for increasing awareness of public and government officials.

Interviewee 3: *People may have different attitudes and perceptions toward green roof systems. It is crucial to convince people to accept and use the green roofs, and change their negative attitudes into positive through education.*

Interviewee 4: *Public' interest might motivate building contractors to design and construct green roofs, which might have a domino effect on contractors, then designers and engineers.*

Interviewee 7: *Local governments and communities might organize educational seminars and workshops to present green roofs' benefits to increase public's awareness.*

Star system

One participant commented on the effectiveness of the star rating system in encouraging the use of green roofs in Izmir. For instance, to receive a high BREEAM (Building Research Establishment Environmental Assessment Method) grade in the UK, such as BREEAM "Excellent", developers were found to be explicitly incentivized to spend extra money designing a green roof into a structure.

Interviewee 1: *A star system unique to Turkey can be developed. Buildings with higher scores are sold at higher prices. In this way, building owners may rise the price of structures with GR layers to make up for the higher initial cost. Since the contractors will receive a financial return, they try to fulfill the criteria (designing a green roof into the building) for getting a star.*

CONCLUSIONS AND RECOMMENDATIONS

During the past few years, municipal administrations in Turkey have begun to take notice of green roofs. The development laws of metropolitan municipalities, particularly Izmir, include green roof initiatives. It is reasonable to assume that the implementation of green roofs will be increased on Turkey's agenda shortly given the growing national and international practices and research on urban green infrastructure in general, and green roofs in particular. The green roof technology has the potential to, when applied appropriately, be a sustainable method of development in Izmir. This was demonstrated by instances of working green roof systems and established literature. Despite the advantages, green roofs in the Izmir building sector have not yet reached their full potential. To better understand the barriers to adoption and the growth opportunities, this article examined and compared the views of government officials.

The cost was determined to be the biggest obstacle to the broad adoption of green roof technologies in the Izmir building sector. Across the local construction sector, the cost is also commonly seen as a major barrier to the implementation of green roofs. To promote the building of green roofs, government action is necessary. Governmental agents could offer financial incentives in addition to pressuring owners and building contractors to adopt green roof systems. Incentives and support from the government are listed as important for its widespread adoption. Overall, these strategies can lessen the financial obligations of government, business owners, and contractors to maximize the benefits of green roof systems, and spread their use across society. Moreover, the initial cost of green roof might decrease as the number of green roofs increases.

DOI: 10.15320/ICONARP.2023.259

The importance of policy setting was also supported in this study. During the investigation, it became clear that there is a noticeable absence of policy at all levels of government in Izmir. Even if the policy-barrier overcame, implementing green roofs in a consistent manner is restricted to the knowledge of individual site consultants and developers. Once people start to demand them for whatever reasons, it becomes the responsibility of the decision-makers to promote the usage of green roofs. The government can emphasize the significance of green roofs through legal means. Even if people are aware of the advantages of green roof benefits, it is difficult to integrate newly offered technology for sustainable projects. At that point, policy regulations are the key factor for their installation.

It was conclusively determined through the study process that the Izmir construction sector (in its whole) sees green roof technology with skepticism and anxiety. The interviewee's comments revealed that green roofs are, in some way or another, viewed negatively by the local building sector. Since then, the importance of education related to green roofs were highlighted by interviewees. It was discovered that for the local sector in green roofing technology to advance in the future, every stakeholder group—from project managers to subcontractors to clients—generally needs some kind of further education regarding green roofs. Another concern is that many urban land use planners lack experience and may be unable to evaluate such a project. An option for hiring a green roof specialist is to have a team of urban professionals such as planners, landscape architects, ecologists, engineers, and urban designers.

Overall, various stages of action may be needed if authorities want to enhance the adoption of green roofs. Firstly, a series of policy decisions regarding the distribution of benefits and, consequently, a just distribution of costs and subsidies. The second and third points refer to significant preliminary work regarding awareness and understanding concerning building-level costs, risks, and benefits and, finally, several exemplar projects to illustrate their viability and effectiveness. There is still a lot of work to practically understand green roofs, especially targeting various stakeholder groups. Barriers should be removed for green roofs to succeed and for wider acceptance. The existing corpus of research and interviews, taken together, clearly shows the necessity for government help in the form of policy settings. As green roof technology becomes more common practice, regulatory settings can cut the cost of green roof technology indirectly. There might be a need for additional research into the effects of policy changes on the cost of green roofs in Izmir, an analysis of the role of industry bodies in the promotion of green roofs, and a lifecycle cost-benefit analysis of green roofs in the Izmir context. These studies would all be of significant value to the local green roof industry.

ICONARP – Volume 11, Issue 2 / Published: 28.12.2023

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Resume

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DOI: 10.15320/ICONARP.2023.259

ICONARP
International Journal of Architecture and Planning
Received: 15.03.2023 Accepted: 22.08.2023
Volume 11, Issue 2/ Published:28.12.2023
Research Article *DOI: 10.15320 /ICONARP.2023.260 E- ISSN:2147-9380*
ICONARP

A Research on Biophilic Design Patterns: The Case of AGU as a Biophilic Campus

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Abstract

Examining the biophilic elements in education campuses, which are a smaller-scale representation of urban areas, would be an example of urban-scale human–nature improvements. In this context, this article aims to analyze the biophilic elements in Abdullah Gul University (AGU) Sumer Campus and 3 education buildings for the interaction tendency between nature and humans. This examination encompasses two processes, first, taking photographs through on-site observation and applying a survey. On-site observation and photography included author-collected evidence of biophilic elements on campus. A questionnaire was conducted to analyze the awareness of biophilic elements among the occupants of the AGU education buildings and campus. It was determined how many biophilic design principles exist in buildings and how aware the occupants are of these principles. Due to this detection, the potentials and shortcomings of the AGU education buildings and campus were brought to light in terms of biophilic design. In the research, the AGU campus and 3 main education buildings, which have significance in the historical spatial memory of the city of Kayseri and are in the restoration process, were chosen as a case. Buildings under restoration within the campus were excluded. In addition, 14 biophilic patterns identified by Browning, Ryan, and Clancy constitute the scope of this study. The research can be applied to other university campuses in the city of Kayseri. This awareness in education buildings will also lay the groundwork for the spread of biophilic criteria on an urban scale.The research treats education campuses and buildings as a small representation of the urban scale. With the analysis of biophilic elements, the AGU campus has original value in defining it as an example of a biophilic campus.

Keywords:
AGU Sumer Campus, biophilic campus design patterns, education buildings

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To cite this article: yılmaz, Ş.E., & Ayten, A. M. (2023). A Research on Biophilic Design Patterns: The Case of AGU as a Biophilic Campus. *ICONARP International Journal of Architecture and Planning,* 11 (2), 692-715. DOI: 10.15320 /ICONARP.2023.260

INTRODUCTION

Increasing population brings rapid urbanization. There is a need for living units and buildings to accommodate the increasing population in cities. According to United Nations data, most of the world 's population lives in urban centers (Siebring, 2020; URL-1, 2018). Therefore, they consume 40% of the world 's primary energy resources and are responsible for around 50% of the total greenhouse gasses emitted (Santamouris et al., 2018). Rapid urbanization also creates various environmental problems, such as the urban heat island effect, air pollution, and water pollution, and harms both nature and living things as well as human health and psychology (Roös, 2021).

Required planning policies are researched to reduce environmental problems caused by construction in modern cities, to save energy, and to reduce health risks for living things. In this context, urban designers, planners, architects,, and municipalities have primary shared responsibility (Grazuleviciute-Vileniske et al., 2022; Russo & Cirella, 2017).

While the problems brought about by rapid construction stand on one side, human beings should interact with nature. The main reason for this need is human beings' genetic connections with nature dating back hundreds of thousands of years and their tendency toward nature (Beatley, 2016; Zhong et al., 2022).

In this sense, biophilia is a research area that can offer solutions for the strategies that stakeholders will develop against urban problems (Downton et al., 2016; Rosenbaum et al., 2018). Biophilia can contribute to various levels of environmental and spatial problems from a well-being perspective. Various biophilic design applications exists at the biophilic urbanism, biophilic campus, and building scales. The biophilia hypothesis is applied especially in hospital and education campuses (Soderlund, 2019).

The analysis of biophilic elements in education campuses in terms of the area they cover in cities will be useful both in terms of examining education buildings and in analyzing the contribution they will provide on an urban scale. In particular, university campuses are like a small representation of the city. For this reason, biophilic design applications can be prioritized in university campuses, which are one of the areas where the residents of the city spend time (Abdelaal, 2019).

Within this framework, this research examines the Abdullah Gul University (AGU) Sumer Campus in Kayseri's city for the research, first, the literature was searched. Then, the AGU campus was examined on the basis of 14 patterns determined by Browning, Ryan, and Clancy (Browning et al., 2014). The research method was carried out in two stages. The first qualitative method was tabulated by observations and photographs. The second was the survey, which could be expressed quantitatively. Through the survey research, the opinions of AGU campus users were consulted and numerical data about biophilic design were

DOI: 10.15320/ICONARP.2023.260

tabulated. In the conclusion section, there was a discussion about the potentials, shortcomings, and suggestions of the study.

LITERATURE REVIEW OF BIOPHILIC DESIGN

The concept of biophilia was first coined by the German psychologist Erich Fromm (Barbiero & Berto, 2021; Soderlund, 2019). E.O. Wilson, a biologist, defines biopihilia as an innate emotional connection that people feel toward other living organisms. Based on Wilson 's definition, biophilia can be expressed as "love of life" and "desire to be close to living systems" and "perceiving living systems with the senses" (Downton et al., 2016; Soderlund & Newman, 2015; Tabb, 2020; Wilson, 1984).

Beatley (2016) stated that biophilia helps explain why people are happier and more relaxed in proximity to the natural environment (Beatley, 2016). It can also help explain questions such as why some areas, such as urban parks, are more favored in the city or why people prefer some interiors over others (Açmaz Özden, 2019; Kellert et al., 2008; Pedersen Zari, 2019).

Biophilic urbanism, on the other hand, is based on urban-scale representations and the dissemination of biophilia. Kellert (2016) stated that the aim of biophilic urbanism is to make the natural world experience an integral part of ordinary city life and to improve the disconnection of contemporary cities from nature. encompasses various ecological systems. It has many applications at the scale of buildings and city parks, such as resource extraction from urban areas, waste management, reducing pollutants, and increasing green elements (Kellert, 2016). Newman (2014) described one of the most common examples of biophilic urbanism in Singapore.

Similarly, biophilic design advocates creating built environments using natural systems to positively contribute to human health. It has been stated in many scientific studies that health and wellness increase in built environments designed with natural elements (Zhong et al., 2022). With the effect of technology and industrialization, urban areas are being built rapidly, and human interaction with nature decreases because of this construction. To solve this problem, biophilic design represents an innovative approach based on living, working, and learning in natural environments. According to this approach, architects, urban planners, and designers incorporate natural elements into urban planning, buildings, and interiors (Downton et al., 2017; Kellert, 2016)

Biophilic elements such as urban forests, river systems and lakes, urban parks, and green roofs and walls can also contribute to sustainability (Arof et al., 2020). Studies have shown that green elements allow spaces to increase attractiveness and make people physically active (Beatley, 2020). Elements such as vegetative elements, green roofs, and green facades used to shade the facades both contribute to energy saving and provide solutions to urban environmental problems (Makram, 2019).

Biophilic design encourages the inclusion of natural environments in built environments (Kellert, 2005; Soderlund, 2019). Kaplan (1995)

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reported that there are two theories on this subject in the environmental psychology literature. Stress reduction theory and attention restoration theory (Kaplan, 1995). These theories state that some places can be stressful and some places can be relaxing. Spaces, expressed as the theory of regaining attention, become more attractive because they distract people from mental fatigue and have a healing effect (Gillis & Gatersleben, 2015). Following these principles, Lee and Park (2018) stated that biophilic design is beneficial in improving human health problems such as reducing stress and increasing cognitive creativity (Lee and Park, 2018).

Mehaffy et al. (2020) identified 10 titles related to biophilic design patterns. 1. Sunlight 2. Color 3. Gravity 4. Fractals 5. Curves 6. Detail 7. Water 8. Life 9. The representation of Nature 10. Organized complexity (Mehaffy et al., 2020). In addition, names such as Christopher Alexander, Judith Heerwagen, Racher and Stephen Kaplan, Stephen Kellert, and Roger Ulrich have suggested specific titles for biophilic design elements (Browning et al., 2014).

In addition, Browning et al. (2014) provided another framework to examine in detail the nature-design and nature-health relationships in all built environments. Compared with other studies, 14 basic biophilic design criteria were defined in a systematic and detailed manner. Their work provides a basis for using the human-nature connection as a tool to increase well-being in the built environment (Browning et al., 2014).

Those who work and live in built environments need to relax by being inspired by their surroundings. They also demand that the natural spaces they like to be in be more productive and healthier (Gautam, 2017; S. R. Kellert & Calabrese, 2015). Browning et al. (2014) conducted detailed research examining the relationships between nature design and nature health. Nature health titles were grouped into three categories: stress reduction, cognitive performance and emotion, mood, and preference. These titles were associated with nature-design titles in their research in detail and presented as a matrix (Browning et al., 2014).

In this study, the subject of nature health will not be covered in detail, and nature design titles are limited to the examination. According to Browning et al. (2014), nature–design relations are based on 3 main topics. These titles, which are also the limits of this study, are nature in space, natural analogies, and nature of space (Browning et al., 2014).

Nature in space: Subtitles under this main title relate to nature's direct or temporary existence. The plant and water elements, natural sounds, fragrances, and other natural elements in the space are related to nature in the space. The interaction of nature in space depends on the perception of natural factors through multiple senses (Browning et al., 2014).

Natural analogies: This about the connotations of living and inanimate nature. This principle is based on using these elements in spaces by using the knowledge of the materials, textures, colors, shapes, and sequences of the assets in nature (Browning et al., 2014).

DOI: 10.15320/ICONARP.2023.260

Nature of space: This title is about spatial configurations in nature. These relationships depend on one 's admiration for dangerous or mysterious things in nature. Features such as dark views and interesting places are the criteria in this section (Browning et al., 2014). The framework defined by Browning et al. (2014) under 3 main headings is indicated in the table below in more detail with 14 subpatterns (Browning et al., 2014).

Table 1. Patterns and principles of biophilic design, adapted from Browning et al. (2014)

Nature in Space Patterns describes the presence and contact with natural, literal features and phenomena	P1- Visual Connection with Nature P2- Non-Visual Connection with Nature P3: Non-Rhythmic Sensory Stimuli P4- Thermal and Airflow Variability, P5- Presence of water, P6- Dynamic and diffuse light, P7- Connection with Natural Systems;
Natural Analogues addresses natural complexity, geometry, and materials used or imitated in art and architecture	P8- Biomorphic Forms & Patterns, P9- Material Connection with Nature P10- Complexity and Order;
Nature of Space Patterns refers to psychological references to open and closed space configurations	P11- Prospect, P12- Refuge, P13- Mystery, P14- Risk/Peril

BIOPHILIC APPROACHES ON CAMPUS DESIGNS TO SUPPORT BIOPHILIC URBANISM

Education campuses are potential improvement areas. A self-sufficient, waste-managed, accessible, user-friendly campus design has the potential to contributed to biophilic urbanism and environmental sustainability on a large scale. Campuses are not only academic learning and research areas but also important areas for cities. Urban and social textures coexist on these sites and a natural landscape character is created. They are also urban interfaces that express a common accessible space between architecture and urban design. The urban interface expresses the design of accessible spaces in living public spaces, facades, and interiors arranged adjacent to the outer frame of the building (Almusaed, 2011; Modrzewski & Szkolut, 2016).

Moderewski et al. (2016) researched the campuses in Poznan and analyzed them in terms of biophilic elements Poznan campuses, which is a biophilic campus study, also examines the relationship between the city and campus (Modrzewski & Szkolut, 2016).

Another biophilic campus work is the framework presented by Abdelaal (2019). He argues that people need innovative and sustainable spaces in terms of mental, psychological, and creative development on education campuses. University campuses can attract international businesses and researchers to create innovative and vibrant communities. Abdelaal (2019) offers a model that proposes creative

university campuses to combine biophilic design principles with sustainable development goals (Abdelaal, 2019).

In another study, Elmashharawi presented an analysis of biophilic design on the Ozyegin University campus and educational spaces (Elmashharawi, 2019). Many more studies have demonstrated the potential of biophilic design factors considering innovative and sustainable solutions for the development of educational spaces.

In 2013, the Global Biophilic Cities network was established under the leadership of Timothy Beatley. 15 cities in the world are partners of this network, and some metrics have been determined. The most widely known example of biophilic urbanism in the world is Singapore. Biophilic urbanism is practiced at all scales they set their motto as Singapore, a city in the garden. Biophilic design practices, which have spread to the city scale in Singapore, cover many dimensions. Rooftop logic in buildings has been applied and is widespread in various scales such as vertical gardens, hospitals, and education campuses (Newman, 2014; Siebring, 2020).

Another study examines biophilic urbanism in the Netherlands. The study mentions that the number of organizations conducting research on biophilic design has increased and that municipalities are also working on this issue. In cities and countries such as Portland, Oregon, Spain, San Francisco, and Edmonton, Canada, biophilic elements have been successfully applied in urban park areas, transportation, and neighbourhood scales (Siebring, 2020).

The scope of this work is biophilic patterns in university campuses and education buildings. To support this argument, AGU Sumer Campus and three main education buildings, which are close to the city center in Kayseri and ranked 33rd in the “sustainable cities and communities” list according to Times Higher Education 2020, were chosen for analysis based on 14 patterns.

MATERIAL AND METHOD

This research investigated how biophilic design patterns could bring benefits at the campus scale and aimed to analyze the patterns in university campuses that are part of the city to adapt them to the urban scale. To support this argument, AGU Sumer Campus, which is close to the city center in Kayseri and ranked 33rd in the “sustainable cities and communities” list according to Times Higher Education 2020, was chosen for analysis (URL-2).

This study aims to compare and analyze the 3 main education buildings on the AGU campus according to 14 basic biophilic design patterns determined by Browning et al. (2014). First, a preliminary analysis was created using on-site observations and photographs. Second, a questionnaire was applied to understand the awareness of the users of these 3 education buildings about biophilic patterns and to understand their ideas about these patterns.

DOI: 10.15320/ICONARP.2023.260

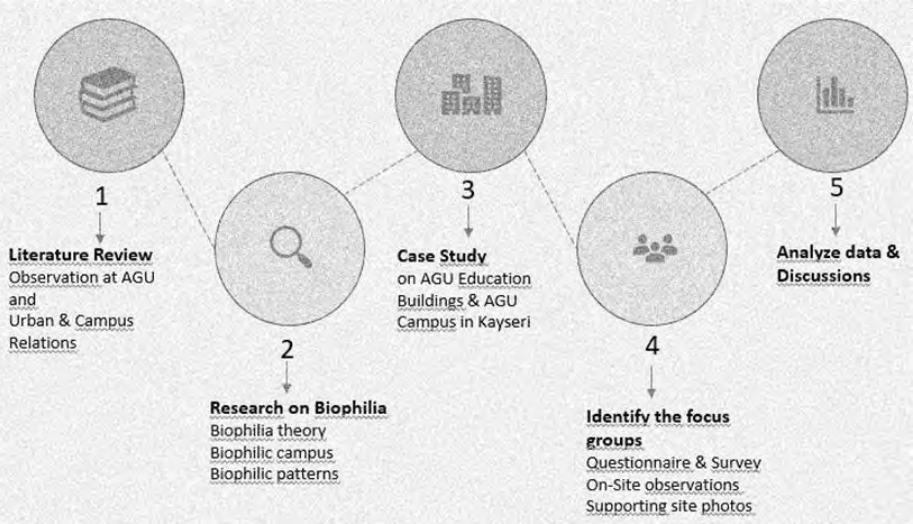

Figure 1. Research method diagram (developed by author)

In this survey, 14 different questions were prepared based on the 14 patterns (Browning et al., 2014). These questions were directed to focus groups, the departments of the participants, and the buildings where they spent the most time to learn the opinions of the users in the educational buildings. The questions were sent to different users, including academics, students, and administrative staff, through Google forms, and they were asked to be answered.

This questionnaire is answered on the basis of the Likert scale. A scoring system from 1 to 5 was used for each of the 14 questions in the questionnaire. This system is defined as 1: strongly disagree 2: disagree 3: undecided 4: agree 5: strongly agree. In addition, the snowball sampling method was used in the distribution of this questionnaire. The results were analyzed in the SPSS program and their mean values were determined. Data entry into SPSS includes 14 responses from each participant for each building. After the data entry process, values above 3, which is the mean value, support the participants' agreement about biophilic factors, whereas values below 3 indicate that they disagree.

Preliminary Information on The AGU Campus

There are four universities in Kayseri as Erciyes University, Nuh Naci Yazgan University, Abdullah Gul University, and Kayseri University (Figure.2). Abdullah Gul University is the restoration project of the Sumer Textile Factory Campus, which was one of the most important industrial centers for Kayseri in the post-republic period and contributed to the modernization and structuring of the city at that time (Asiliskender, 2013; Ayten, 2017). As this campus affected the transformation of the city in the post-republic period, it can be the pioneer of biophilic urbanism in Kayseri today and to develop the city in line with the principles of sustainability. AGU Sumer Campus is the 33rd ranked public university in the world in terms of “sustainable cities and communities” according to Times Higher Education (URL-2; URL-3).

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In fact, AGU was designed as two campuses, one is the Sumer Campus and the other is the Mimar Sinan Campus, which is approximately 15 km from the city center (URL-4). However, due to certain reasons, the Mimar Sinan Campus has not yet started to operate within AGU. Therefore, Sumer Campus, which has been in service since its establishment (October 2014), will be examined. After the restoration process Sumer Campus started education in 2013. However, the restoration process in other buildings on the campus is still ongoing, step by step.

Figure 2. AGU Sumer Campus, 2: AGU Mimar Sinan Campus, 3: Erciyes University Campus, 4: Kayseri University Campus, 5: Nuh Naci Yazgan University Campus, 6: City Center 7: Kayseri Train Station, 8: Kayseri Bus Terminal, 9: Kayseri Erkilet Airport (taken from Google Earth 23.09.2021)

According to information from the school administration, there are approximately 2800 students and 400 academic and administrative staff at AGU. It has an area of approximately 28 ha. This makes the campus a relatively small-scale campus for Kayseri's city.

AGU Sumer Campus is located close to the city center, and it is easily accessible in terms of transportation hubs such as bus station, train station, and city airport. In addition, Mimar Sinan Park and Inonu Parks, which constitute the important green areas in the city center support the need for green areas in the city center and the AGU campus supports this green zone too (Figure.3).

The campus has a large landscape with perennial trees and natural open spaces. It has 3 main entrances used for both pedestrians and vehicles. The functions of the building blocks on the campus are as follows: education blocks, student affairs building, staff and student accommodation units, presidential museum and library, guesthouse, and technical units whose restoration process continues. Almost all of these units are based on the restoration of the remaining structures from the old textile campus (Figure.4).

Within the scope of this study, we examined the biophilic elements in the interiors of the education units where most of the time is spent on. 3 main education buildings (Figure.4), (Steel, great storehouse, and

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research laboratory building) in AGU were analyzed to evaluate the campus according to biophilic design criteria (Figure 5).

Figure 3. AGU Sumer Campus, 2: Kayseri City Square, 3: Mimar Sinan urban park, 4&5: open green parks (taken from Google Earth dated 24.08.2021)

Figure 4. Steel building, 2: great storehouse building, 3: research laboratory building, 4: President Museum & Library, 5: Student Affairs, 6&7: under restoration building blocks, 8: water element, A&B&C: campus

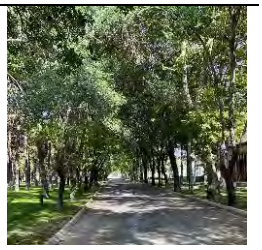
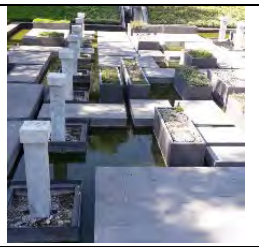
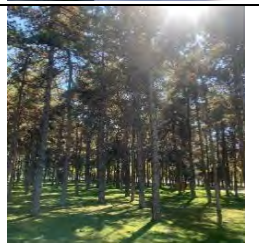
Figure 5. Three main education buildings: left: steel building (URL-5), middle: great storehouse building, right: research laboratory building (URL-6) entrances (taken from Google Earth dated 24.08.2021)

Analysis of The AGU Campus and Education Buildings

AGU "campus" evaluation according to biophilic design patterns

AGU Sumer Campus has 3 main education buildings (Figure.4 and Figure.5). In addition, there are education buildings that are currently under restoration. The campus has dense perennial greenery and an abundance of trees.

Table 2. Evaluation of AGU campus according to 14 patterns (all photos taken by author except defined references)

Patterns	Explanation	Photo
P1	Natural elements are already in open spaces. A direct visual connection with nature is easily provided.	
P2	Artificial elements are not needed because of the presence of natural elements. There are no artificial plants or artificial pattern elements and like that.	
P3	Natural sounds and smells are available on campus. Natural bird sounds and the diversity of plants on campus support this pattern. For users, aromatic plants are attractive on campus and increase movement and interaction in those areas. Many plants and fruit trees, such as the lavender plant, also contribute to the fragrance. In addition, it is a campus away from noise in terms of natural sound, so it creates a meditative effect and calms down.	
P4	Although the campus is colder in winter with northerly winds, the wind and trees provide coolness for the summer . In addition, the increasing presence of vehicles and exhaust gasses on campus negatively affects the quality of campus air.	
P5	There is only one water element in the campus. In addition, despite the design of water elements in the direction from the entrance(C) (Figure.4.) to the steel building in the renovation plan of the campus, there is no water element in the current situation.	
P6	Dynamic and diffuse light elements are present on campus. The shadows of trees and leaves and the shadows of buildings support this pattern.	
P7	Natural areas are easily accessible. There are 3 controlled entrances on campus. Off-campus and on-campus transportation is easily provided for both pedestrians and vehicles	

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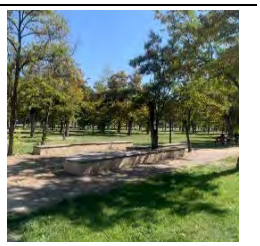
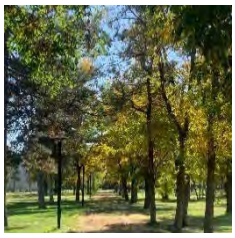
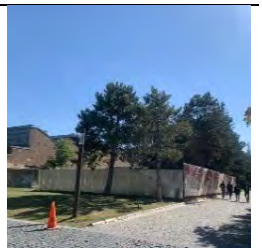
P8	It is possible to observe natural forms and textures on campus. The textures of tree trunks, leaves, natural plants, and animals such as turtles, birds, and foxes support this pattern.	
P9	There are natural materials on campus. The garden includes wooden seating elements, natural stone building materials, and the structures of plants include natural materials. In addition, materials such as andesite, basalt, and black stone are also used in buildings.	
P10	There are elements of order and complexity on campus, such as rows of trees, plants, and building layouts.	
P11	Although the campus itself may seem difficult to contact outside the campus, it is actually part of the city. For off-campus users, for example, the AGU campus provides a wide prospect for viewing from the surrounding residential blocks.	 Source: (URL-5)
P12	There are no specially designed individual study areas in the open areas of the campus, but working environments are created by sitting on the grass, especially in summer.	
P13	The water element and the open landscape next to it can be given as examples for the spaces that will support this element on campus. This area can feel attractive and mysterious as it is relatively far from educational buildings and among the trees.	
P14	Because the campus is currently a restoration area, the risk element may be evaluated for buildings under restoration.	

Evaluation of "educational buildings" according to biophilic design patterns

For the analysis of biophilic elements in AGU education buildings building interior images were first used. The interior functions are

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specific to buildings; therefore, not every space is available in every building. To evaluate the education buildings, three tables were created for three main headings (1. nature in the space, 2. natural analogs 3. nature of the space). In these tables, biophilic patterns are supported by photographs as much as possible. Photos of some patterns are not possible; therefore, they are expressed with additional explanations.

The evaluation of nature in space patterns

P1: For this pattern, which represents the direct visual connection with nature, the large glass elements in the steel building, the great storehouse, and the research laboratory building provide direct visual contact with nature.

P2: Steel buildings and storehouse buildings do not have direct visual contact with nature, but this pattern is supported by decorative stone elements inside the building using natural elements. For the laboratory building, wooden finishing elements may remind us of contact with nature.

P3: Since this pattern represents natural sounds and smells, they are not directly in buildings. However, natural sounds and smells are rarely felt through window openings.

P4: Thermal air flow and ventilation principles are provided both mechanically and naturally in all 3 buildings. While ventilation is provided by both the entrance doors and window openings on the ground floors, thermal comfort is provided by mechanical elements.

P5: There are no water elements in all 3 buildings. Access to the water element on campus is approximately the same distance for all three buildings.

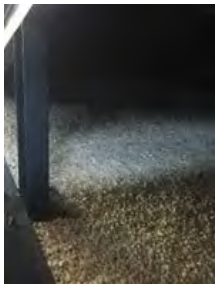
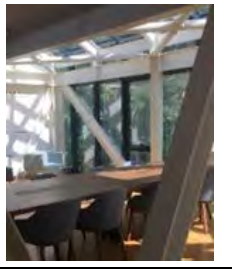
P6: In all 3 buildings, changing and dynamic natural light and shade are provided by both skylights and window openings. In addition, artificial lighting elements can be changed with pendant elements in corridors, and lighting elements can be selected according to the function of the space in some spaces.

P7: Buildings have easy access to natural areas. Since they are not high-rise buildings and have long corridors, there are many entrance doors on the ground floor, especially for steel buildings and large storehouse buildings. Thus, the possibility of access to natural areas is high.

DOI: 10.15320/ICONARP.2023.260

Table3. Representation of nature in space patterns by photos (all photos taken by author)

Nature in space Patterns *describe the presence and contact with natural, literal features and phenomena*

Patterns	Steel Building	Great storehouse building	Research Laboratory Building
P1- Visual Connection with Nature			
P2- Non-Visual Connection with Nature			There are no natural elements in this building. However, the wood floor finishing element may feel a non-visual connection with nature.
P3: Non-Rhythmic Sensory Stimuli	It depends on scents and sounds, and there are no natural sounds and scents in each building.		
P4- Thermal and Airflow Variability			
P5- Presence of water	There is no natural or artificial water element in the interior design.		
P6- Dynamic & Diffuse Light			

P7- Connection with Natural Systems			

The evaluation of natural analogues

P8: There are forms of natural stone and wood textures in the steel building. The brick elements used for the great storehouse building and the wood and decorative stone elements in the interior support this pattern. The wooden elements and circular form elements used for the research laboratory building also support this pattern.

P9: It includes natural stone and wood materials in the steel building, decorative stone and brick materials in the storehouse building, and wooden and natural materials in the laboratory building.

P10: For all three education buildings, the order element is especially clearly felt by the structural column elements.

Table 4. Represent natural analog patterns by photos (all photos taken by author)

Natural analogs address *natural complexity, geometry, and materials used or imitated in art and architecture*

Patterns	Steel Building	Great storehouse building	Research Laboratory Building
P8- Biomorphic Forms and Patterns			
P9- Material Connection with Nature			
P10- Complexity and Order;			

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The evaluation of the nature of space patterns

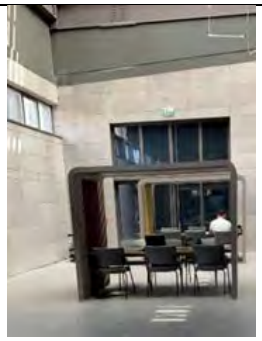
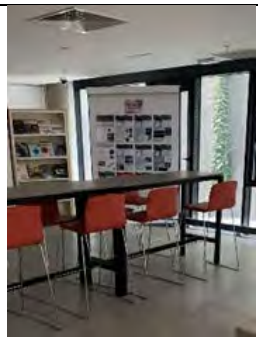
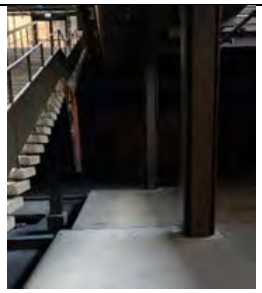
P11: AGU Education buildings have low floors compared to the surrounding buildings and provide a sense of privacy due to the density of trees on the campus. However, the buildings have a prospect in the city.

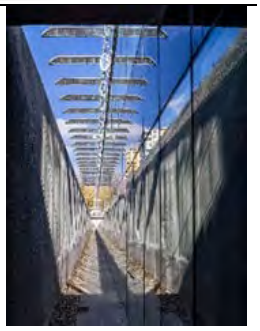
P12: Individual study areas are available in all three buildings. Individual study units serve their users in corridors.

P13: In a steel building, the conference room often looks mysterious, in a dimly lit area at the bottom of a large staircase. In the large warehouse building, the units at the end of the long corridor can feel mysterious. The circular staircase for the laboratory building makes it feel mysterious with its high parapet.

Table 5. Represent nature of the space patterns by photos (all photos taken by author except defined references)

Nature of Space Patterns ***refers to psychological references to open and closed space configurations***

Pattern	**Steel Building**	**Great storehouse building**	**Research Laboratory Building**
P11- Prospect	 Source: (URL-5)	 Source: (URL-5)	 Source: (URL-6)
P12- Refuge			
P13- Mystery			 Source: (URL-7)

P14- Risk		No photos matching the risk definition were found.	 Source: (URL-7)

P14: Although there are security measures in all buildings in general, the section in the garden with depth in the steel building serves as the indoor garden of the workshops however, campus users are not always adults, but sometimes children. The same deep space is also available in the laboratory these regions support the risk pattern.
After these evaluations, a questionnaire was administered to learn the opinions of AGU campus users about biophilic patterns.

SURVEY RESULT AND DISCUSSION

General Information

According to information from the administration, there are approximately 2800 students and 400 academic and administrative staff at AGU, and 252 participants answered the questions. 25 academics, 223 students, and four administrative staff participated in the survey. Preparatory students were not included because they were not present at the school during the online education process. The survey was applied to 3 education buildings (Figure.4 and Figure.5). Campus-scale evidence was supported by photographs and observations (Table 2).
The percentage results, including participant profiles are as follows.

Table 6. Percentages of survey respondents and building users.

Focus groups	Attendance rate
Academics of Engineering	%9,9
Students	%88,5
Administrative	%1,6

The fact that more answers were received from the student population, which is large in terms of user density, supports the accuracy of the study. Moreover, the departments and percentages of the participants, as well as the percentages in which building they spend most of their time, are shown in the tables below.

Table 7. Represents the percentages of survey participants and building users to which faculty they belong.

Departments	Attendance rate
School of Engineering l of Engineering	%48,4
School of Life and Natural Science	%13,5
School of Architecture	%21,8

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Faculty of Management Science	%9,5
School of Humanities and Social Sciences	%5,2
Faculty of Educational Science	%1,6
School of Physical Education and Sport	%0

Table 8. Represents the percentage in which building users spend most of their time.

Education Buildings	**Frequency of presence in the building**
Steel Building Engineering	%53,2
Great Store House Building	%33,7
Research Laboratory Building	%13,1

42 responses of each of the 252 participants, that is, a total of approximately 10584 values, were entered into SPSS. The average values for each building were analyzed in SPSS and the results are listed in Table 9. Table 9 shows the values over 5 points based on the Likert scale. The interpretation of the data in the table is explained in detail in the pages that follow the table.

P1 For the "class" category of P1, the lab building received the highest score (3.8), and the large warehouse building received the lowest score (2.8). In other words, the visual connection with nature can be interpreted as classrooms, with the strongest connection in the laboratory building and the weakest connection in the large warehouse building. For the "office" category, the steel building has a stronger communication with nature with a score of 3.2 compared to the great storehouse building with a score of 2.7. The offices in the great storehouse building do not have visual contact with nature. For the "corridor" category, the laboratory building has the highest score and the steel building the lowest. But all of them are above 3. Corridors are places where visual contact with nature is provided the meeting rooms in the steel building are a place where visual contact with nature is weak, with a score of 2.8. The 3-storey "library" in the steel building was evaluated as a place where visual contact was quite good, with a score of 3.8. However, the rooms in the basement of the library do not receive light; however, the other two floors provide a direct visual connection with nature thanks to the large glass elements. "Conference rooms" scored below 3 points in the steel building and the large warehouse building. However, as a function requirement, these spaces may not be expected to connect with nature. The "dining hall" in the great storehouse building supports the existence of the P1 pattern with 3.2 points. Finally, it was shown that visual contact with nature is easily achieved with a score of 3.3 for "laboratories" in the laboratory building.

P2 For the "class" category of the P2 pattern, only the laboratory building was evaluated above 3. Elements that will remind students of nature in classrooms are the wooden material on the floor in the laboratory building. In the classes in other buildings, the elements

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supporting this element are not visible. On the other hand, in “offices”, users gave less than 3 points and evaluated that there is no element to remind nature. “Corridors” scored 3 and above in all three buildings. The presence of elements reminiscent of nature in the corridors was supported. It is understood from the score below 3 that this pattern does not exist in the meeting rooms in the steel building. The existence of this pattern is supported by the “library” in the steel building. this pattern does not exist in “conference rooms”. This pattern does not exist in the “dining hall” in the storehouse building. In the labs in the research lab. building, this pattern was evaluated positively with 3 points.

Table 9. Represent survey results according to 14 questions based on 14 patterns. Average values over 5 points based on the Likert scale are shown.

PATTERNS	STEEL BUILDING						GREAT STOREHOUSE BUILDING						RESEARCH LABORATORY BUILDING	
	class	office	corridors	meeting rooms	library	conference rooms	class	office	corridors	conference rooms	dining hall	class	corridors	laboratories
P1. Visual Connection with Nature	3,4	3,2	3	2,8	3,8	2	2,8	2,7	3,1	2,3	3,2	3,8	3,3	3,3
P2. Non-Visual Connection with Nature	2,6	2,8	3	2,5	3	2,3	2,8	2,7	3	2,4	2,8	3,2	3,1	3
P3. Non-Rhythmic Sensory Stimuli	3	2,9	2,9	2,7	3,1	2,4	2,8	2,7	3,1	2,4	3,1	3,5	3,1	3
P4. Thermal and Airflow Variability	2,9	3	3,2	2,9	3,3	2,7	2,8	3	3,3	2,9	3,1	3,2	3,3	3,2
P5. Presence of water				2,4					2,7				2,9	
P6. Dynamic and Diffuse Light	3,4	3,3	3,2	2,9	3,6	2,2	3	3	3,4	2,5	3,6	3,7	3,5	3,4
P7. Connection with Natural Systems				3,2					3				3,3	
P8. Biomorphic Forms & Patterns				3,2					3,3				3,2	
P9. Material Connection with Nature	interior		exterior				interior			exterior			interior	exterior
	3		3,4				3,2			3,5			3,2	3,2
P10. Complexity and Order		3,4						3,4					3,4	
P11. Prospect		3,2						3					3,4	
P12. Refuge	interior		exterior				interior			exterior			interior	exterior
	3,7		2,9				3,6			2,7			3,6	2,9
P13. Mystery		3,2						2,8					3	
P14. Risk/Peril		3						2,6					2,8	

DOI: 10.15320/ICONARP.2023.260

P3 Since the score is above 3 in the "classrooms" in the steel building and the lab building, natural sounds, and smells were evaluated positively. "Offices" were below 3 points, and offices in the steel building and storehouse building were weak in terms of the P3 pattern. "Corridors" were evaluated as being more than 3 in the storehouse building and the lab building. "Meeting rooms" were rated negative below 3 points. "Library", on the other hand, was evaluated as positive with a score of 3.3. "Conference rooms" were rated negative for P3 in both buildings.

P4 It was evaluated above 3 only in the "classrooms" in the lab building. In other words, the classrooms where thermal comfort is best felt are in the lab building. In the "offices", the thermal comfort for the steel and storehouse building was evaluated as equal to three points. The thermal comfort of the "corridors" was evaluated more than 3 times for all three buildings. For the meeting room, this pattern remained below 3. Thermal comfort for "library" scored above 3 and was rated comfortable. In the "conference rooms", the value was again below 3 and thermal comfort was not found to be sufficient. Thermal comfort for the "dining hall" was evaluated positively over 3 times. Thermal comfort was evaluated positively for "labs".

P6 In all three buildings, dynamic and diffusing light is sufficient for "classroom", "office" and "corridor" spaces. Light comfort is insufficient for "meeting rooms" and "conference rooms". Light was also evaluated as comfortable for "dining halls" and "labs".

The evaluation of the interior volumes, which are separated according to their spatial functions in terms of 5 patterns, is as follows:

"Classes" in steel buildings are positive for 3 of 5 patterns. It is positive for 1 of 5 patterns in the storehouse building. It is also positive for 5 of 5 patterns in the lab building. Therefore, the most suitable classroom spaces in terms of biophilic design are in the research laboratory building. "Offices" are positive in steel buildings for three of 5 patterns. In the storehouse building, it is positive for 2 of them. The offices in the steel building can be interpreted as being more suitable than those in the storehouse building in terms of biophilic design criteria. In "corridors", steel building is positive for 4 patterns. 5 patterns are positive for storehouse and laboratory buildings. Therefore, it can be said that the corridors in the storehouse and lab building are more biophilic.

P5 There is no water element in the interior of all three buildings. The survey results confirm this. As for P5 and P7, the following patterns were evaluated for the whole building in general instead of separating them according to different functions.

P7, P8, P9, P10, and P11 patterns were rated 3 and above 3 for all three buildings. All three buildings were evaluated positively in terms of their connection with natural systems, biomorphic forms and patterns, use of natural materials, complexity, and order and prospect.

P12 For P12, the existence of individual workspaces indoors was verified with a value above 3 in all three buildings, while all three buildings were rated below 3 for outdoor spaces.

P13 For P13, the steel building was rated positive with a score of 3.2. Then, the laboratory building was evaluated positively with 3. However, the storehouse building remained below 3.

P14 For P14, only the steel building reached the value of 3. This means that according to occupant risk factor is mostly belonged to steel building.

Results

In accordance with the results of the survey, 37 of the 103 units scored below 3 points and 66 of them scored above 3 points. On a building basis, steel building was below 3 points out of 4 of 14 patterns. Great storehouse building is below 3 points from 6 and research laboratory building is below 3 points for 2 patterns. In other words, on the building scale, all buildings were rated above 3 points for most patterns. This shows that biophilic design patterns mostly exist in educational buildings.

In the study comparing three university campuses in Poznan, they were evaluated according to 14 criteria. Metrics were determined for the patterns, and their results are listed. The presence of green spaces in some of the campuses, and the presence of water elements and other patterns in some of them, led them to be defined as biophilic campuses (Modrzewski & Szkolut, 2016). In the study examining the Ozyegin University campus, it is argued that there are 6 patterns, and the campus and buildings are a good example of biophilic design (Elmashharawi, 2019).

CONCLUSION

The interaction between the built environment and people is becoming increasingly important today. Therefore, in urban planning and design, there is a transition from the Anthropocene to a more environmentally sensitive period. Biophilic design, which is one of the design principles that supports this, is an area that designers are responsible for and can increase the quality of the environment and building.

This study is expected to reveal the importance of biophilic design to support sustainable development goals. The use of biophilic elements in university campuses and educational buildings in the city of Kayseri will both increase human-nature interaction for user efficiency and thus contribute to sustainability by preventing constructions consisting of only concrete, with the increase in the use of natural elements in built environments.

It may be the right choice to start from university campuses, which are part of the city, to implement biophilic design at the city scale. University campuses are one of the practical environments where success will be tested when applying biophilic design elements.

DOI: 10.15320/ICONARP.2023.260

This study on the future projection of the study can also be evaluated in other university campuses in Kayseri city and compare the results. Strategic planning can be prepared by determining the contribution of the study to economic, social, and environmental sustainability. In addition, from another perspective, how to analyze the city of Kayseri with biophilic design factors can be investigated.

In this context, this research also sets an example for the analysis of biophilic design elements on a campus in the restoration process. Because of the case study, it is understood that biophilic elements based on 14 patterns increase the spatial quality of this campus and educational buildings.

In conclusion, the fact that AGU is a biophilic campus also reveals the benefits it brings to the urban environment and people. Considering the AGU campus, the results show that it meets the definition of a biophilic campus in almost all the patterns. Thus, it seems correct to describe the AGU campus as a "biophilic campus". Consequently, the analyses confirm that AGU is a biophilic campus. The potentials, shortcomings, and recommendations determined because of these analyses are also listed in Table 10.

Table 10. This table presents potentials, shortcomings, and recommendations.

Potentials	Shortcomings	Recommendations
✓ It can make a positive contribution to the environmental impact of built environments.	✓ Implementation of biophilic patterns can be challenging due to their historical value for the AGU campus. Implementation of some items may be difficult as the restoration process continues on campus.	✓ Because biophilic elements will increase the comfort and efficiency of the users in AGU, they should be considered by the managers.
✓ It can contribute to increasing the mental and work efficiency of its users.		✓ The relationship between biophilic elements and occupants should be investigated and new suggestions should be developed.
✓ The concept of a biophilic campus may become widespread. In this way, the application area can be expanded to other university campuses.	✓ Biophilic design patterns can be costly regarding decorative elements in the interior.	✓ Benefits of biophilic urbanism should be revealed and cost efficiency should be investigated.
✓ It can set an example for biophilic urbanism.	✓ After the application of biophilic design elements, the conditions required for their maintenance and control may be difficult.	✓ Considering the AGU campus as a biophilic campus should encourage the city of Kayseri, its municipalities,, and administrators to cooperate in terms of biophilic urbanism and campus.
✓ It can support sustainable development goals.		
✓ It can contribute to the literature for future biophilic design studies.	✓ Because two educational buildings (steel building and greatstorehouse building)	

✓ The AGU campus can offer different potentials for human-nature interaction with the rich green space it offers.	on the AGU campus were used as adaptive reuses at the end of the restoration process, they may have been weak in terms of some biophilic criteria.	

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DOI: 10.15320/ICONARP.2023.260

ICONARP
International Journal of Architecture and Planning
Received: 17.04.2022 Accepted: 16.08.2023
Volume 11, Issue 2/ Published: 28.12.2023
Research Article *DOI: 10.15320 /ICONARP.2023.261 E- ISSN:2147-9380*
ICONARP

Evolution of Production Spaces: A Historical Review for Projecting Smart Factories

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Abstract

Factories are transforming not only mechanically and technologically but also architecturally due to emerging developments in the industry and fabrication: This new process, called the Second Machine Age or Industry 4.0, a new model is designed in production by providing the human-machine partnership over a virtual network. It is aimed that the machines used in production and the people participating in different stages of production can work in different spaces. In time, jobs that require human power will be replaced by robots, and a new order is being considered where there will be no people in production spaces, and they can work in the virtual environment. Production for human beings is mostly from material production to digital production; labour will turn into digital labour. For this reason, it is thought that production spaces will turn into smart factories with only machines and production robots and no workers. And now the question is: what is a smart factory?

The revolutions in the industry history started with the invention of the steam engine; then, new technological revolutions were experienced with the use of electricity in production, the development of automation systems and internet-based systems. While technology and production tools are constantly changing, these developments also affect production spaces. Factories are also transforming to keep up with these rapid and continuous physical and fictional innovations. This study focuses on the architectural evolution of factories by following the technological revolutions of the industry. It examines the main criteria in the process of change and transformation of factories and spatial reflections of the revolutions. It establishes a relationship between production technology and the needs of the production spaces and seeks references from past samples. The study aims to review the historical background for generating a projection to new production spaces and to be a new discussion for future factories.

Keywords:
Factory, industrial building, industry and architecture, industry 4.0, production space

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To cite this article: Pekdemir Başeğmez, M.,& Asiliskender, B. (2023). Evolution of Production Spaces: A Historical Review for Projecting Smart Factories. *ICONARP International Journal of Architecture and Planning,* 11(2), 716-733. DOI: 10.15320 /ICONARP.2023.261

INTRODUCTION

Machines becoming the pioneers of production, the change of energy from steam power to electricity, the use of mass production, the control of production from screens with computerized systems, technological revolutions have been experienced in the industry and production spaces have constantly changed to respond to different needs with these developments. Each technological development has created different needs in the spaces. The new industrial revolution, Industry 4.0, indicates a radical transformation process will occur in the production spaces. The revolution, which will change many production methods, describes a timeless and spaceless production model with machine-human cooperation. Time, space and human relations constantly change in the transforming and renewing world. In parallel with the innovations in the industry from the past to the present, architecture has both been affected by the process and has affected the process. Especially in the last period, internet technologies and digitalization have created excitement in architecture and every field.

The last industrial revolution, defined as digitalization in production, has brought about many economic and social changes. With innovations such as the revolution that changed many common production methods, internet-based systems, and the cooperation between machines and humans, a transformation has begun in and around the production space. The place of the smart factory is also a new field of study for the architectural discipline. One of the remarkable works in this field is Nina Rappaport's idea of a Vertical Urban Factory. Rappaport looks for alternative spaces in the city for new production spaces and argues that production can be moved to multi-storey buildings, which will happen with new financial, real estate, technological, and managerial strategies. Rappaport defines the typology of the vertical urban factory as a multi-storey factory and says that the production process can flow from the top down or the bottom up (Rappaport, 2019). It has been pointed out that the new industrial revolution created hybrid spaces in another work. The spatial proposal for the new industrial revolution is to place high-compact industrial zones between high-density residential blocks and create a 'super urban symbiosis' that bridges the gap between work and life. The Vertical Urban Factory project indicates that the new industrial revolution has created hybrid spaces. It points out that common industrial areas will be formed from a factory model per company, as in previous factories (Lane & Rappaport, 2020). Furthermore, smart factories, where mobile workers are connected to production virtually, will provide organic, real-time production, unlike the modern assembly line. It will offer a spatial economy rather than an isolated heterotopia (Rappaport, 2009). The basis of this idea is not mass production but small production batches.

As well as the new production spaces, it is discussed where these spaces will be and how they will re-establish a relationship with cities. Tali

DOI: 10.15320/ICONARP.2023.261

Hatuka defines the concept of production close to the city, fed by the city-industry dynamic, as New Industrial Urbanism (Hatuka, 2021). Hatuka argues that the new technological evolution has changed the physical structure of the factory, distribution processes, innovation networks, and access needs. The new industrial urbanism is not a very new concept. During the first industrial revolution, many people worked in or near where they lived. However, mass production has led to spatial divisions. The distances between living and working areas have increased.

In contrast, Hatuka is researching new industrial cities based on these developments, not how the city will be affected by Industry 4.0, questions how cities will embrace the new industry. The basis of this new concept is Industry 4.0, industrial ecosystem and industrial ecology. Industry 4.0 refers to digitalization and innovations such as artificial intelligence, autonomous machines, biotechnology, and digitalization between production processes and consumption. The industrial ecosystem refers to higher energy efficiency, cleaner and quieter industrial processes resulting from these innovations. It aims to encourage the innovation and growth of the region and manufacturers by locating product-oriented grouping and production at various points. On the other hand, industrial ecology draws attention to environmental issues, sustainability, energy efficiency and waste reduction while creating industrial zones. Proximity, integration and improved accessibility are essential for developing a new industrial system.

In smart factories, new jobs require high qualifications, especially those defined in the management department. In the production hall of the factory, the work of human labour decreases or even ends completely. The workflow requires a scenario, and human-machine interaction is a part of this scenario. Marta Pieczera describes three models of human-machine interaction in production: automation, specialization, and hybrid (Pieczara, 2020). Since Industry 4.0 brings together architecture and other disciplines, the question of what a new generation factory will be like will undoubtedly be discussed for a long time. The production facilities, offices, shipping and storage areas differ according to the sector. Pieczara states that this triple model has been scripted to meet basic needs.

Julia Reisinger, Iva Kovacic and Patrick Hollinsky also provide a systematic design guide for flexible industrial buildings (Reisinger, Hollinsky, & Kovacic, 2021). In this study, parameters for building design according to Industry 4.0 requirements have been prepared. Researchers focus on goals, parameters, planning processes, success factors and recommendations. As a result, this study also forms a basis during the project development phase.

With the innovations provided by internet technologies, physical, spatial and temporal boundaries have disappeared. In general, while research on the digital infrastructure of smart factories has concentrated, spatial studies are more limited. In this context, the study questions smart factories through architectural terminology, mainly focuses on the

evolution of the factory and aims to contribute to this evolution process. The article is structured as follows: first of all, the four technological revolutions of the industry and the factories corresponding to these revolutions are examined through a literature review. While choosing these factory buildings, the focus is on the functional design of the production spaces, regardless of industry or production, and the production technology of the period is taken into account. It also has examined the innovations in the production spaces and smart factories that have emerged today. Second, morphological analyses have been made and coded in the production spaces. The effects on factory architecture in four industrial revolutions are presented based on the literature review and analysis. Technology, production methods, design criteria of the factory, and functional planning have discussed the evolution of the factory in the whole process. Finally, architectural possibilities for the factory of the future are discussed. This study aims to develop a historical background for designing new production spaces to summarise the whole process since the industrial revolution.

EVOLUTION OF FACTORIES

The word "factory" emerged in Europe about a hundred years before the revolution in the 1600s. Individually produced products took their final form in a different place, and this building where the product was assembled was defined factory (Marsh, 2019). After the Industrial Revolution, factories began to be built rapidly in which machines mostly shelter, workers enter and leave at a particular hour, raw materials are stored, products are produced, and a significant amount of energy is constantly spent. A systematic and planned production process has been entered, and production has increased rapidly with the inclusion of machines. Although the product may differ slightly according to the sector or geography, the essential architectural elements that define the design of the factory are similar. The factory was organized around the energy source, machines, production flow and workers in its simplest form.

The most remarkable invention of the revolution, which started in England in the middle of the 18th century and spread rapidly to Europe and North America, became the steam engine and the most significant power source in production. As the way of production changes, the need for machines has increased over time, and even type, weight, and size have changed. The old workshops were insufficient for the new production, and new buildings were designed to suit the needs. 18th-century factories were described as square brick buildings with bare walls, a monotonous form, and limited embellishments (Marsh, 2019). In these factories, the priority was not architectural aesthetics but functionality.

The factory began to change physically with each new technology in production. At the beginning of the 20th century, Henri Ford's system for the automotive industry caused a new and effective revolution. This

DOI: 10.15320/ICONARP.2023.261

method, called Fordism, adopted standardization as a principle at every production stage. In this system, which Ford designed to speed up the construction of the Model T, he described each step of production and divided it into eighty-four parts. Thus, Ford planned the whole system by assigning employees for each step. Henri Ford paved the way to give more space to machines in production with this assembly line he built. He implemented this system using Frederick W. Taylor's management system (Freeman & Soete , 2004). Frederick Winslow Taylor defined process management by calculating the movement and time required to perform a task and developed Taylorism's management style. Thanks to Fordism and Taylorism, machines started to partner with human labour in the new factories. Production was programmed with machine-human cooperation. Factories were designed according to the size and width of the assembly line required for production and the machines used. The location of factories has also been decided by the procurement of raw materials and the transportation of products. In addition, the new materials used in the buildings, the construction technique, and the architectural style made the factory buildings the leading structures of the period.

In the second half of the 20th century, computer and automation technology have made production control more accessible. Unlike the previous production line, the system could be controlled by a computer, not an individual. Although it was considered a great innovation, computers were not fast enough to compete with humans initially. First, existing buildings for robots to speed up production had to comply with this new organization. Technological infrastructures like floor and wall sensor systems and visual guidance signs have developed. In addition, there was a rapid increase in consumption with the effect of globalization in this period. The factories started to spread worldwide.

In the 21st century, the relationship humans establish with machines precedes other human relations in production. In order to keep up with the fast rhythm of daily life, many jobs in the industry are left to machines. Over time, the machine has ceased to be a tool for doing the job and has become the main element that does the job. Thanks to the opportunities provided by Industry 4.0, humans will be able to move away from the factory as production processes can be controlled remotely. As a result, it is thought that the details of human comfort in production will gradually decrease. Considering that cities and settlements exist with production, the economic, sociological and architectural role of the factory in every revolution is remarkable. For this reason, besides the technological features of future factories, their spatial transformation is also critical for the built environment.

The First Industrial Revolution: The Birth of the Factory

The birth of the factory has been based on replacing human power with machine power. In the past, individual workshops were used with traditional production methods, but over time, it was seen that these

ICONARP – Volume 11, Issue 2/ Published: 28.12.2023

places could not respond to the changing production methods and needs. The industrial revolution was a breaking point for production and consumption. New inventions have replaced traditional production methods, and production and consumption have increased more than ever. In this process, radical changes were experienced in social life. One of the most significant results of the revolution was forming a new working class, who left agricultural activities and came from the countryside and spent most of their time in the factory. According to Eric Hobsbawm, the transformation of nobles into manufacturers and peasants into factory workers in return for wages began to change people's lifestyles and needs (Hobsbawm, 1996). Edward Thompson argues that the working class is a self-forming process in environmental and human relations. Thompson examined the end of life in the village due to production relations in the city, the struggle to exist against the bourgeoisie, and the process of finding a place in the city (Thompson, 1966). Another of the fundamental things that changed with the revolution was time. In pre-modern societies, time was organized with daily work in mind; time is organized not as minutes, hours, days, or months but as sunrise and sunset, seasonal changes. Everyday life starts with the sunrise and ends with the sunset; star movements, precipitation-drought times, and seasonal weather conditions have shown how to determine the time. This routine in social life forms the basis of tradition, and time is a determining factor for this cycle (Giddens, 1991). In the 18th century, changes in daily life practices and work remuneration became necessary. The use of clocks, especially in public spaces, has begun to increase. David Harvey explains that the changes in time are determined by the changes in space (Harvey, 1992). This age forced all people to live together, and new settlements began to be built. Every society or geography affected by the industrial revolution had to keep up with this innovation.

When Thomas Newcomen invented the first steam engine in 1712, this technology was used to drain coal mines. Later, James Watt developed this technology and made it an essential part of the industry. However, since the steam engine is hot, noisy, and dangerous, the factories have affected the whole environment where they are located. On the one hand, while new cities were formed around the factory, on the other hand, problems began to be experienced in these cities. There was an intense migration from the countryside to the newly established cities, and the rapidly increasing population caused poor living conditions. Modern urban studies began to solve these problems in the cities. It has begun planning and building, reconsidering factory and worker housing (Benevolo, 1971). With the planning of industrial areas, healthier settlements were designed for the population migrating from rural to urban areas. While creating these settlements, the diversity of transportation, infrastructure, and social facilities has been essential to the planning.

DOI: 10.15320/ICONARP.2023.261

The factory, which started to become an essential part of life with the revolution, was also one of the main problems of urbanization. The dwelling and transportation of workers were essential factors for the location of the factory. For this reason, not only the factory but also the environment was designed. A direct relationship was established between the physical locations of factories, houses, and public spaces. It was quite new in those years that the employer also solved the housing problem for the workers. As a solution to these and similar problems, company towns emerged during this period. Their environments were similar, as manufacturing often required similar needs like water power. The company towns, built quickly with significant capital, differed from other towns. In the towns initially built in America, there were houses, shops, schools, and even chapels, which was the plan of companies. The population of the towns was usually one or two thousand, and the workers who lived here often established their own culture. The company determined the working hours, daily activities, and the rules in the town to maintain the social order and expected the residents to follow the rules (Garner, 1992). One of the first company towns, the Saltaire Factory, was an industrial village built in England between 1851 and 53. Architects Henry Lockwood and William Mawson designed the outside of the factory and the town where residences, schools, hospitals, and religious sites are located. The factory was located close to the railway and canal. Comfort was considered for the workers, and the inside of the factory was well-heated and ventilated. More than three thousand people were working at different ages with different skills and different wages. The residences were separated from the factory by rail. Most of the workers lived in the newly built village. The houses were close together, and it was a very dense area (Styles, 1990). The whole process for the factory was carefully organized. The main divisions of the manufacture of alpaca were sorting, washing, drying, plucking, combing, drawing, roving, spinning, weaving, dyeing, pressing, finishing, and folding. The fact that all these steps were gathered in the same building made Saltaire a model. The village consisted of factories, 800 residences, 45 almshouses, institutes, baths, churches, and parks (Dewhirst, 1960).

Figure 1. Saltaire Factory

In the same years, George M. Pullman worked with architect Solon Beman and landscape architect Nathaniel Barrett for the company town he would establish south of Chicago. Firstly, the factory was built in the town. The administrative offices were located in front of the factory.

There was a machine shop, drying rooms, a pattern shop, a blacksmith shop and a water town. Unlike existing company towns in the U.S.A., Pullman wanted to create a better environment for its employees. Everyone, from managers to workers, was intended to live in this town and benefit equally from public services and planned recreation areas. It was planned to improve the unhealthy conditions in the industrial areas (Buder, 1967).

Figure 2. Pullman Factory

The Second Industrial Revolution: Modern Factory

The second industrial revolution developed especially with mass production and assembly line. As the production style changed, the machines used in the factories also diversified and became new parameters that determined the size of the space, the ceiling height, and the area's width. The pioneer of the assembly line in the early 20th century, Ford needed a new factory to manufacture the Model T. For this, he worked with architect Albert Khan in Highland Park, north of Detroit. Khan designed a four-story main building and a one-story production building. The priority was for the workers to receive natural light and modern ventilation and heating systems. Ford wanted to provide a clean working area and set up the assembly line in 1913, and in a short time, like a year, all assembly was done on a moving line and opened the doors of the factory to everyone to show this work to the whole world (Pollard, 1995). After this work, the industrial areas in Detroit, designed by Albert Kahn, Julius Kahn, and Earnest Wilby, set the standards of Fordist production for the whole world.

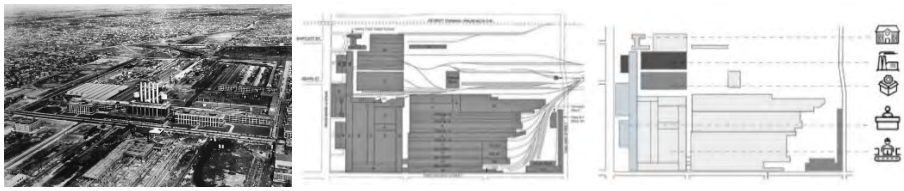

Figure 3. Highland Park Ford Factory

Peter Behrens' A.E.G. Turbin Factory attracted attention due to the designed details for changing demands and technologies in the industry. Behrens designed the A.E.G. factory and all the designs, from the brand's font to the product designs. The spatial needs of the factory were determined by Oscar Lasche, A.E.G.'s production manager. Large spaces were needed for the vast engines at the A.E.G. production facility. The production hall was supposed to house two large cranes in height and width used to assemble the turbines.

Moreover, it needed to arrive wagons at the building for transport. Side halls were designed for storage and other works. This building, designed

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with reinforced concrete and steel structure, became a pioneer for industrial buildings and modern architecture (Aitchison, 2016).

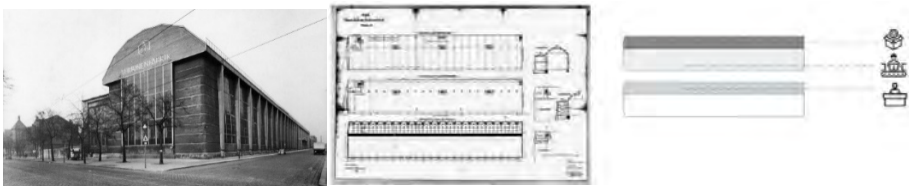

Figure 4. AEG Turbine Factory

One of the pioneering buildings of modern architecture and factories was the Fagus Factory in Alfeld. The factory consisted of multiple buildings that housed different functions such as production, storage, and office. Eduard Werner designed the planning of the building and the offices. Later, Walter Gropius and Adolf Meyer were commissioned to enlarge the main building and renovate its façades. The most significant contribution of the architects was the design they made for the office building. The building was described as a new union of art and technology. The design soon became the new face of international style (Darley, 2003).

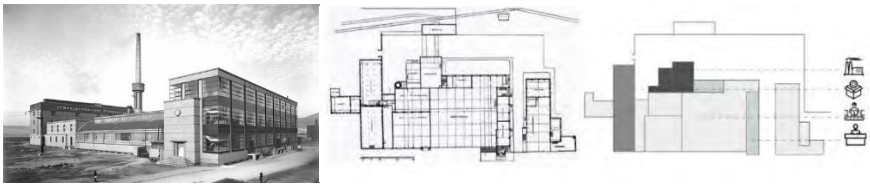

Figure 5. Fagus Factory

Fiat Factory, designed in Italy in the same years, was a modern interpretation of Ford's mass-production model. In the factory, designed as five floors, raw materials were entered from the ground and included in production on each floor. There was a test track in the attic for the cars out of production. It was the largest automobile factory in its period, and production has continued for many years (Cook, 2015).

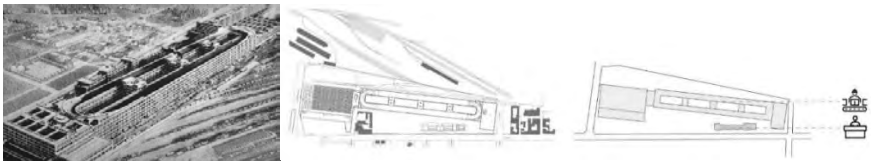

Figure 6. Fiat Factory

The Van Nelle Factory, opened in Rotterdam in 1923 to package foodstuffs such as tea, cocoa, and coffee, was also built as a storeyed factory. The works and production steps in the factory determined the design of the building. Consisting of a curvy administration building and an eight-story production structure, the building had a modern look with curtain walls, cross conveyor belts, concrete floors, white ceramic tile walls in the interior, and stainless-steel handrails. In addition, it was planned to make an open production to the outside with its transparent façade. It was also desired to create a healthy environment for employees (Darley, 2003).

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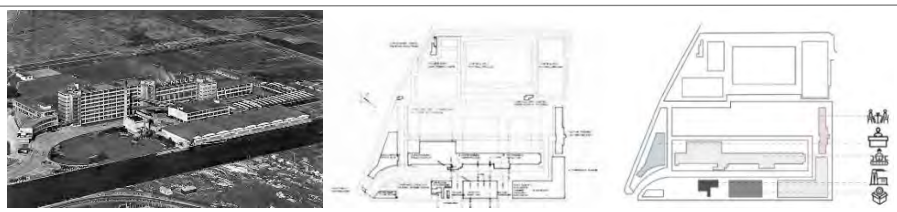

Figure 7. Van Nelle Factory

The Third Industrial Revolution: Factory as Sales Tool

The industry has undergone many changes since the first revolution. Many specific industries, such as service, research, and logistics, have developed from primary industries, such as agriculture, mining, and manufacturing. Thanks to advances in globalization, technology, and transportation, the impacts of the industry have changed dramatically. The first reflection of this is seen in the built environment. In the second half of the last century, the speed of production technology led to the emergence of new consumption culture over time and dragged humanity to new orders in daily life. Consumption has overtaken production over time. With this change, Fordist production left its place in post-Fordist production. David Harvey says that this transition lacks flexibility in production (Harvey, 1992). The idea of flexibility and the search for new life have become popular and have determined the new steps of capitalism. While this transformation was designing new production systems, it did not finish industrial production; moreover, it caused it to grow with more significant percentages. Toyota Motor Company developed the just-in-time model in production to avoid waste or excess stock in its warehouses. Toyota engineers developed the 'Andon Boards' digital board to monitor the production process and analyze the situation (Rappaport, 2009). This sign board allowed the workers to easily see the problems on the production line and develop quick solutions. By the 1970s, computer controls and C.N.C. machines were fully involved in production, and workers began to use the systems that ran them, not the machines that produced them. Managing machines from smaller machines changed worker activities and job descriptions. After the linearity of the Fordist production model, different spatial organizations and modules began to be tried, like R&D areas, "solar system" layouts, "mainstreet" spines for increased personnel interaction, the "fractal," housing the management near the workers, centralizing break areas, developing communal entries for both workers and management. Labourers are being called "partners" and "team players" rather than "workers." (Rappaport, 2009). Thus, new factories were re-mechanized with workstations and computers. Workstations also reduced the indoor mobility of the workers. Similarly, computers work on modelling, quality control, problems, solutions, and production capacity. In this way, workers could work with robots and manage many jobs remotely.

In this period, when production was composed of materials, new steps were taken in information, communication, and service. Negri and Hardt explained this as immaterial labour. With this thought, production started to eliminate spatial and temporal limitations. Labor has crossed

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factory boundaries. The distinction between mental and manual labour has changed over time (Hardt & Negri, 2001). Negri and Hardt also criticized the disciplinary attitude of the Fordist regime and expressed their troubles and argued that the Fordist order turned society into a factory, which was normalized. Globalization has accelerated this process considerably. Internet and telecommunication shortened the distance between producer and consumer. Asian countries, affluent in raw materials, have started to become new centres of industry where production is intense. The number of production structures increased and became industrial zones or parks.

The convergence of the factories and the creation of a campus or a region positively affects the exhibition and marketing of the products and the logistics benefits. As a production campus, Vitra Campus, located in Weil am Rhein, Germany, is a remarkable example, thanks to its design. When the old site of the Vitra factory burned down in 1981, the company wanted to design a brand-new campus. It becomes a place where Vitra's designs and buildings are exhibited. First, Nicolas Grimshaw designed two factories. The factories were built with prefabricated elements and covered with aluminum facade elements. Later, the campus is enriched with the designs of names such as Zaha Hadid, Tadao Ando, Frank Gehry, Herzog & de Meuron, SANAA, Alvaro Siza, and Kean Prouvé. One of the remarkable factories belongs to Frank Gehry. The building entrance door resembles the Frank Gehry design museum next to the factory. The factory includes production halls, storage, test rooms, and offices. Windows of the factory are designed so that visitors can see the production process (Vitra Campus, 2021).

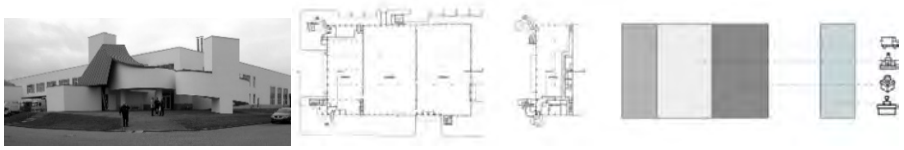

Figure 8. Vitra Faactory

While the factories were designed, the type and size of the production were the priority, but it pioneered the architecture of many factory periods. Coop-Himmelblau argues that industry is a culture and that this can emerge with a multidimensional design, even with economic and functional constraints. The Funder Werk Factory building, designed by Coop-Himmelblau in Austria, has entirely different details for a factory. The production section is designed as a head-body with offices and laboratories. On the facade of the building, which is a paper-coating factory, chimneys, transparent roof detail, and red facade elements increase the visibility of the building aesthetically as well as their static functions (Funder Werk, 2021).

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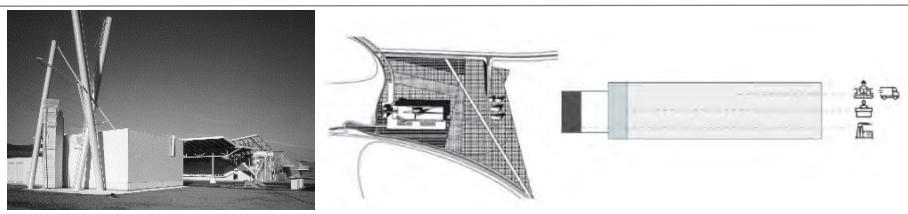

Figure 9. Funder Werk Factory

The fact that the factories are visible or noticeable is also effective in marketing the products produced. Henn Architecture has produced exhibitable with the Transparent Factory designed in Dresden. The main goal of the automobile manufacturing company is to show customers and visitors how the automobile is produced. For this, the factory building has been designed to be completely transparent. Production steps can be followed on every building floor, and the product can be tested in the same building. In addition to production, this factory is planned to be used for some facilities like exhibitions and concerts (Glaserne Manufaktur, 2021).

Figure 10. Transparent Factory

The Forth Industrial Revolution: Smart Factory

Industry 4.0, the most popular concept of the new industrial revolution, was introduced by the German National Academy of Science and Engineering (Acatech) at the Hannover Fair in 2011. The technology describes a smart manufacturing model that is digitalized and customized according to customer needs, enabling simultaneous communication and connection between people, machines, and products. A flexible production model is aimed at this technology. The transformation from uniform production to personalized production and direct participation of users in production will be provided. This system, which Germany established to expand production borders, is accepted as the fourth industrial revolution worldwide. Although many studies on the subject are still conceptual, systems such as plan, design, manufacturing, operation and maintenance are being developed for production (Kang, et al., 2016). Thanks to production technologies and devices, information and communication systems, and data integration, it aims to make factories more efficient, safer, and environmentally. These factories will produce with the Internet of Things (IoT) technologies. In IoT technology, sensors and artificial intelligence drive production and maintenance; mobile and augmented reality devices provide information processing and productivity to employees; cloud computing systems enable data to be shared and stored. Cyber-physical systems are also a new generation of technology that combines computer applications and physical systems.

DOI: 10.15320/ICONARP.2023.261

It enables human-machine partnership and helps decision-making processes.

Unlike the old production methods, everything without production is moved out of the factory in smart production technology, and production is left only to machines. Every step that manages production is performed in a virtual network. Information is received, stored and controlled. Communication with machines is provided over the network. The most significant difference between smart and other methods is that production can be done flexibly, not on a production line. Machines can be programmed according to product, need and process. These new production spaces are defined as smart factories. In addition to the definition of smart factory, there are also definitions such as U-Factory (Ubiquitous Factory), the factory of things, the factory in the real-time frame and the intelligent factory of the future (Hozdić, 2015). Nina Rappaport says that factories are the key to unravelling the spatial logic of society (Rappaport, 2017). Rappaport defines the factory as predictive, not prescriptive, and explores the need for sustainable growth for two centuries of industrialization and urbanization; and also summarizes this period as the consumption of production. She argues that production still determines the social organization and that consumption is a difficult concept and is not the only economic factor of post-industrial society.

One of the first examples of the fourth revolution, The Trumpf Smart Factory in the U.S.A., designed by Barkow Leibinger, consists of a factory and exhibition space. The designers aim to transform high-tech machinery and production processes into exhibitions by constructing two completely different functions in the same building. The design aims to experience Industry 4.0 technology from product design to production and delivery. The factory, designed as two large volumes, was built in a green area. One of the rectangular buildings is planned as a production hall and the other as an office, café, and auditorium. A particular viewing area, '*skywalk',* was created for visitors by designers inside the production hall (Trumpf Smart Factory, 2021).

Figure 11. Trumpf Smart Factory

Smart technologies are used intensively in China, and the number of smart production facilities is also increasing. The Future Stitch Smart Factory, located in the economic development zone in Haining in 2018, is one of the first examples. For the factory, production workshops and a visit circulation that allows the exhibition of the process from raw material to product are designed on each floor. The galleries to the east and west create an experience for the bottom-up production process and

activities. There are a basketball court and a roof garden. The factory entrance door is common for both administrative staff and visitors. Stairs and corridors are designed outside the building, creating temporary open spaces for employees (Future Stitch Smart Factory Azl Architects, 2021).

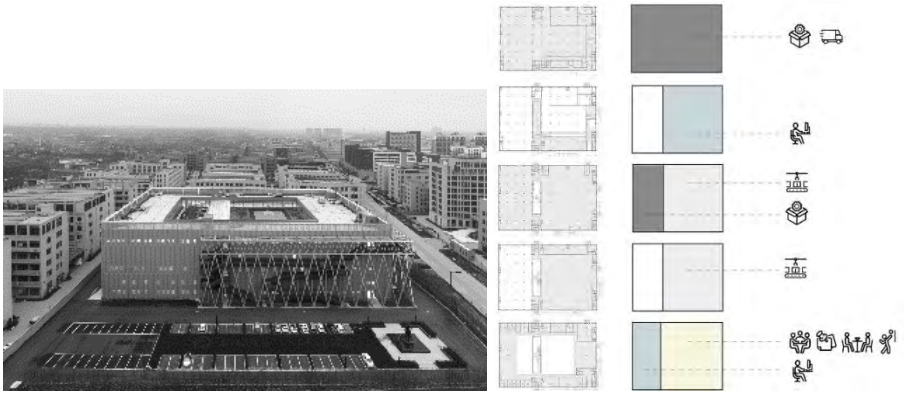

Figure 12. Future Stitch Smart Factory

Another smart factory, The Plus Furniture Factory, built in Norway, draws attention to both sustainable goals and aims to produce with new technology. In this factory where the furniture will be produced, it has been aimed to use smart robots, driverless trucks, and tablet computers to manage the factory. The factory consists of four main halls connected in the centre: a warehouse, a colour workshop, a wood workshop, and an assembly workshop. Logistics offices and exhibition space are connected to all halls in the center. This area has been designed transparently and has turned into a courtyard open to all visitors, where the production process is also exhibited. Coloured sensor maps were designed for robots on the factory floor, and these maps were considered clues to guide visitors through the production process (Sustainable Furniture Factory, 2021).

Figure 13. The Plus Furniture Factory

MORPHOLOGICAL CODING IN THE PRODUCTION SPACES

Since the Industrial Revolution, the factory has established relationships with people, machines, and cities and pioneered architecture and urban development. It is seen that they have undergone critical changes not only in terms of technology but also environmental and spatial in the short history of the factories. Although the use of the steam engine was the turning point of the industry, the use of new energy sources and technologies in a short time accelerated the progress in production. The use of electricity has increased mechanization and laid the groundwork for computer and automation systems. Nowadays, the internet, cyber-physical systems and robotics technologies create smart production systems integrating with automation systems (Table 1). One of the most

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important contributions of the new system is that it enables flexibility in production. The production process is managed with digital data from the beginning to the end. Therefore, smart products, smart production, and smart factory are the innovative concepts of this revolution.

While production is moving from workshops to factories, it causes some difficulties both in production spaces and its surroundings, but this has been one of the most critical planning data for the cities of the 20th century. Factories were initially conceived as a part of the company town with their housing areas, schools, hospitals, and social areas, and later pioneered the establishment and growth of larger cities with residential areas. In the second half of the 20th century, the number of factories increased, and the factories started to create their production campuses or regions to meet the increasing consumer demand. Nowadays, smart factories have trying to reconnect with the city.

Table.1 Industrial Revolutions and Factories in Evolution

	1. industrial revolution	**2. industrial revolution**	**3. industrial revolution**	**4. industrial revolution**
period	late 18.th / early 19. th century	late 19. th / mid 20. th century	second half of 20. th century	early 21. th century / -
technology	water power, steam power	electricity	computer and automation	Internet of Things, cyber-physical systems, robotics
production methods	mechanization	mass production	automation	digitalization
place of factory	company town	city, industry park	industry zone, industry park	city
design criteria of factory	transportation, raw materials, technical infrastructure	production line, machines, manufacturing equipment, management, production, storage, physical strain, health/safety	process design, manufacturing method, assembly method, logistics method	exhibiting the product and production process
functional planning	production, management, storage	production, management, storage	production, management, storage	re-creation, production, management, storage

At the beginning of the industrial revolution, the factory was defined as the place where product assembly was made, and it was located close to the railway for raw material supply and product shipment. Production, storage, and management steps were designed as different buildings in the factories established in the company towns. With the need for faster and more diverse production, the second industrial revolution led to a process where company towns gradually decreased, and more individual factories were built. The production and management departments built

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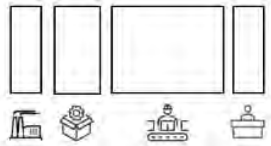
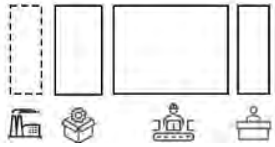
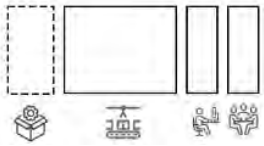
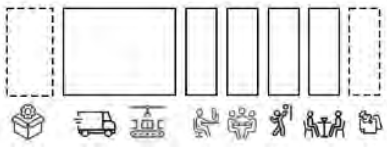
the factory, and the additional production steps were designed in the production hall. Mass production enabled the factory interior to be designed more planned. The steps of production and the dimensions of the machines to be used formed the physical data of the space. In addition, in this period, new construction techniques and materials were tried in the factory buildings, and the factories became the leading building of the period. In the third revolution of the industry, the factory started to provide new functions besides its function (Table 2). The fact that the production can now be exhibited has started to change/transform the factory buildings and their environment. Humans have been included in the process not only as a producer but also as a viewer.

Table.2 Industrial Revolutions and Production Spaces

1.industrial revolution		engine house storage production hall offices
2.industrial revolution		engine house storage production hall offices
3.industrial revolution		storage production hall offices cafe / common space
4.industrial revolution		storage production hall/shipping offices cafe / common space sport hall exhibition

Exhibiting and displaying the production that started with Ford has also become the basic design approach of the factories of the new era. Similarly, the changing production and consumption relations have transformed new production spaces. The last revolution of the industry tends to transform the factory completely. Since the production process can be controlled remotely, the factory would only belong to the machines. Leaving production to machines alone will lead to significant changes in production spaces. When the first samples are examined, spatial diversity in factories draws attention. Common areas, co-working spaces, exhibition spaces, and even more daily activities such as sports have been added to the production spaces. This newness in spaces suggests that production and factories will become a part of daily life again.

DOI: 10.15320/ICONARP.2023.261

CONCLUSION

Since the first revolution, critical changes have been observed in technology, production method, place of production, factory design criteria, and functional planning. Although the fourth revolution is still in-process, the effects of the change in the industry are remarkable when the examples of smart factories designed are examined. Unlike the previous ones, it is seen that new functions not directly related to the production process have been added to the factory buildings. The human being has been removed from the place as a producer and invited as a consumer. For this reason, alternative spaces have been proposed for meeting production and consumption demand and establishing direct contact with the consumer. The product exhibit and production process have been the main criteria of architectural designs. Thanks to the remote, unmanned production technology, it can be thought that the management and office parts will also leave the factory in time. Moreover, new functions can be added to the factory in the same way.

Factories have been the reflection of technology and even the conditions of the economy in architecture. Therefore, discussing the recent and future innovations and aims of manufacturing is essential for understanding the architecture of this transformation. How the production spaces of the future will be, how they will relate to their surroundings, and how they will affect cities is one of the new fields of study for architecture. In conclusion, this study examines the functional evolution of the factory and intends to provoke new discussions for future factories by projecting the features of production spaces.

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Resume

Merve Pekdemir Başeğmez holds a bachelor's degree in architecture from Erciyes University Kayseri in 2015, and has been working as a PhD researcher at Abdullah Gül University School of Architecture since 2017. Her primary research interests are industrial architecture, production spaces, developments in the industry and their spatial reflections on architecture, industry and city relations, architectural history, design and theory.

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DOI: 10.15320/ICONARP.2023.261

ICONARP
International Journal of Architecture and Planning
Received: 28.08.2022 Accepted: 28.09.2023
Volume 11, Issue 2/ Published: 28.12.2023
Research Article *DOI: 10.15320 /ICONARP.2023.262 E- ISSN:2147-9380*
ICONARP

Thermal Performance Evaluation of TIM Combined with Residential Windows in Different Climatic Regions in Iran

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Pari Alavi **
Farzaneh Fazel ***
Seyed Saman Ghaffari ****

Abstract

Windows play a significant role in the increase and loss of heat from the building envelope and determine the quantity, quality, and distribution of daylight. A strategy that involves incorporating transparent insulating materials into a double-glazed window offers the potential to provide combined improvements in thermal and daylighting performance. The thermal properties of transparent insulation materials in windows depend on various factors, such as the type of insulation material, thickness, geometry and insulation structure, location, and orientation of the window, among others. The aim of this research is to optimize three criteria: "thickness," "location of transparent insulation relative to window layers," and "direction of the wall with transparent insulation of the building window." The goal is to minimize thermal loads and reduce energy consumption in residential buildings. To achieve this, a real model was selected, and Design Builder software was used to measure the "heating load," "cooling load," and the sum of these two loads as the "total thermal load" for all three criteria in three cities of Iran with different climates: Tehran (moderate climate), Ahvaz (warm climate), and Tabriz (cold climate). The results of the research showed that for the city of Tehran, 3-inch insulation in the middle of the double-glazed window and the south front is optimal. For the city of Tabriz, 5-inch insulation on the inner surface of the window and the western front is optimal. And for the city of Ahvaz, 3-inch insulation on the outer surface of the window and the eastern front is optimal. It is worth noting that the annual heating load and total annual heating load for all three criteria have the highest values in Tabriz city. Therefore, it is recommended to use HSNPS insulation in transparent windows to reduce energy consumption in Tabriz (cold climate).

Keywords: *Transparent insulation materials (TIM), thermal performance, energy saving, daylight, residential building*

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To cite this article: Ghouchani, M., Alavi, P., Fazel, F., & Ghaffari, S.S. (2023). Thermal Performance Evaluation of TIM Combined with Residential Windows in Different Climatic Regions in Iran. *ICONARP International Journal of Architecture and Planning,* 11 (2), 734-753. DOI: 10.15320 /ICONARP.2023.262

INTRODUCTION

Energy consumption in the construction sector accounts for about 40% of the total energy consumption in most countries (Bravo Dias et al., 2020; Chae et al., 2014). Therefore, optimizing energy consumption in this sector is especially important. In addition, optimizing energy consumption reduces fossil fuels and greenhouse gas emissions (Maftouni and Motaghedi, 2020; Chen et al., 2019). Comprehensive attention to residential use design, such as daylight and building openings, leads to space creation with maximum thermal comfort, which also leads to the desirability of the space.

Feeling satisfied with the quality of an environment has a positive effect on the relationship between residents. Based on studies conducted in the field of providing thermal comfort using daylight in space, the physical factors of the environment can be a suitable tool to create a balanced space. Therefore, designers can provide the ground for improving the quality of spaces by predicting and designing various activities, involving special physical considerations, and controlling the light entering the space to provide thermal comfort (Bakhtyari and Fayaz, 2019). Factors affecting the daylight in a building are the size and location of the window and the glass material (Pilechiha et al., 2020).

Today, glass is one of the components of a building, and in addition to beauty, its correct performance against climate change, humidity, temperature, and mechanical and thermal shocks are also significant parameters (Aburas et al., 2019; Peng et al., 2019). So that for each of these factors as a capability, certain standards have been upgraded according to climatic conditions and the type of building, and even the installation conditions and the type of framework affect its performance (Darvish et al., 2020).

Glass has made the shape of modern and contemporary buildings more aesthetic performance. In addition, it sometimes provides daylight and is resistant to annual climate change. Desert glass, for example, transmits heat slowly and solar radiation quickly (Huang et al., 2021; Acosta et al., 2016). Two important guidelines followed by glassmakers in Europe are (Shaik et al., 2022):

- Production of layered glass with high efficiency: creating a triple layer or solar radiation control glass to save energy.

- Better communication with the consumer: To ensure these products have the best advantage, an energy label is installed on window glass, which changes according to weather conditions (The energy label provides an indication of the energy efficiency (and other key features of products) to help you make an informed choice when making a purchase, and for future reference).

Window glass plays a dual role in the building. A thermal insulation function that provides reduced energy consumption for heating, air conditioning, and natural light. It also ensures adequate sound insulation levels. These requirements can be met using special materials with high thermal insulation and light transmission properties (Tong et al., 2021).

DOI: 10.15320/ICONARP.2023.262

Using transparent insulation in a transparent building wall can create thermal comfort for people.

Applying traditional insulation equipment (e.g elevated polystryrene (EPS), extruded polystyrene (XPS) and mineral fibre products) to the building envelope is a commonplace and mature exercise to develop thermal resistance (Harish and Kumar, 2016). Novel insulation technology, which include Vacuum Insulation Panels (Huang and Niu, 2015) and aerogel (Jia et al., 2018) can offer the specified thermal resistance, the use of layers which can be much thinner than traditional insulation substances and, as a result, lessen the thickness of the building shape. among the various additives that shape constructing envelopes, window systems, which can be liable for as tons as 60% of the overall strength consumption of a constructing (Jelle et al., 2012), are highly essential elements. that is because home windows structures make a contribution to both heat gain and heat loss thru the constructing envelope and additionally decide daylight hours distribution and daytime availability (Sun et al., 2017a). A method that entails the mixing of transparent insulation materials within a double-glazing unit offers the capability to deliver combined enhancements in thermal, sun and daytime performance (Sun et al., 2018a).

Transparent insulation materials (TIM) were originally designed for pleasant collectors to increase the amount of insulation in the collectors while not drastically reducing the solar energy transmission (Čekon and Čurpek, 2019). These materials can have two key properties simultaneously; A) Insulation against heat loss, b) Conduction of solar energy (Amein et al., 2021).

Today, these materials are used passively in the construction industry. These materials are used in the walls of houses to insulate and absorb solar energy simultaneously. The house walls act as a heat reservoir that absorbs solar radiation, converts it into heat, and slowly returns it to the indoor environment. In recent years, with the development of transparent insulating materials, they have been used in windows, walls, skylights, roofs, and high-performance collectors. These materials function similarly to opaque insulators. However, these materials can transmit daylight and sun energy, reducing the need for artificial lighting and heating (Zhou et al., 2019). These materials can transfer heat through conduction and radiation (Ammar et al., 2021).

Thermal and optical properties of transparent insulation materials depend on the type of materials used, their structure, thickness, quality, and integrity (Paneri et al., 2019). These materials usually have a hexagonal, capillary, or cellular structure. Materials such as aerogels, granules, or integrated silica can improve insulation. Depending on the structure and type of materials used, their arrangement can be classified as follows (Figure 1).

The arrows in these diagrams represent the sun's rays and the direction of these rays as they pass through the transparent insulation layer. The parallel mode of absorption, which is the best (Sun et al., 2017),

reflects the most rays into the interior of the building While minimizing the amount of radiation reflected in the outside environment.

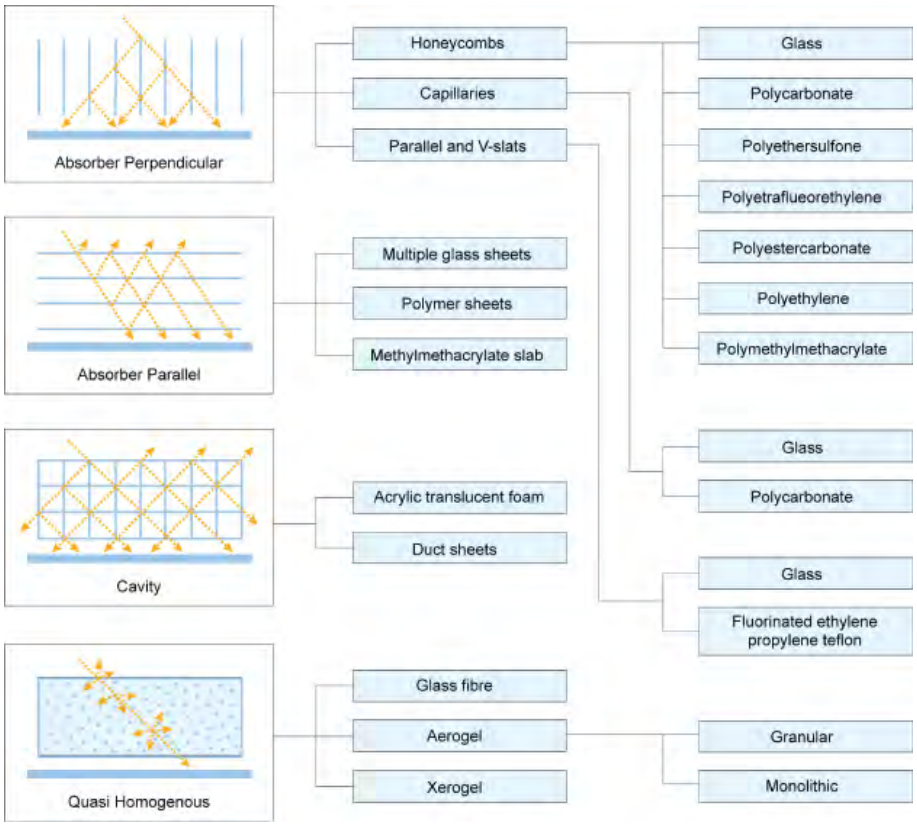

Figure 1. TIM geometry types with material and heat losses associated (Paneri et al., 2019).

The most used parallel absorber mode consists of glass or plastic plates parallel to the absorber (Sun et al., 2016). One of the disadvantages of this method is the reduction of solar reception and the reduction of solar radiation through several plates. The cell walls will be perpendicular to the adsorbent surface in the vertical adsorbent mode. This increases its reflection by the walls, resulting in more radiation reaching the absorber surface. The cavity structure is also a combination of the previous two methods. In this case, we will see a decrease in the transmitted radiation coefficient and heat transfer. The final state also includes transparent aerogel insulation materials and glass fiber. Clear silica airgel and matte carbon airgel are usually used (Buratti et al., 2017). The transparent insulation used in this research is hollow silica nanoparticles (HSNPs).

Their thermal insulation characterizes transparent insulation materials (TIM) due to the use of trapped or vacuum air layers between transparent walls to limit heat transfer (Sun et al., 2018b). Trapped air has excellent thermal insulation properties due to its low heat conductivity. Transparent insulation can be considered a material with a hexagonal structure added between the distance of two walls (Paneri et al., 2019). Although these materials are transparent to the sun, they are also good thermal insulators. Heat transfer rate and solar radiation transmission coefficient are two parameters used to classify these

DOI: 10.15320/ICONARP.2023.262

materials (Wong and Eames, 2015). These materials can transmit short-wavelength radiation and, at the same time, prevent the passage of long-wavelength radiation. Therefore, short-wavelength solar radiation can pass through these materials, and these materials block the passage of long-wave heat radiation. The solar energy that collides with these materials is reflected and then reaches the absorber surface due to reflection inside the material (light refraction phenomenon). Also, these materials have a higher heat resistance than standard glass due to their lower conductivity (Sun et al., 2018c).

The heat transfer in the hexagonal structure of these materials is usually by radiation and conduction, and no convection occurs (Wong and Eames, 2015).

Fibrous materials and gaseous foam plastics provide some insulation due to low thermal conductivity but are not transparent (Cai et al., 2016).

A nano-spaced polymer film consisting of hollow silica nanoparticles (HSNPs) dispersed in polyurethane (PU) provides a good thermal insulation matrix and is transparent. HSNPs with siliceous shells and nano-sized hollow interiors are composed of a core-shell structure prepared by the sol-gel reaction of silicon alkoxide (TEOS) (Abdul Mujeebu et al., 2016). One of the advantages of using HSNPs is that the quasi-vacuum state in the nanospace is formed when the size of space is close to the average length of the free path of air molecules in space (Fuji et al., 2015). Therefore, heat tends to be transferred along the siliceous crust of HSNPs rather than through other materials in the film. Scattered HSNPs clothing in the film is the key to transparency and good thermal insulation.

Wong et al. (2012) simulated the performance of TIM glazing that incorporated a 22 mm polymethyl methacrylate (PMMA) capillary slab on a south-facing façade. The annual results they predicted for the climate of London showed that when compared to standard double glazing, daytime internal temperature swings were reduced, and up to a 6.1% heating energy saving in the winter could be achieved. In a study by Sun et al. (2016), transparent plastic sheets formed between glass panels to create transparent and parallel insulation (PS-TIM) have been proposed as a strategy for heat transfer between double-glazed window panels. The results show that the aspect ratio of 0.35 can reduce CONVECTION. The PS-TIM structure can also reduce thermal conductivity by 35 to 46% compared to similar double-glazed glass without PS-TIM.

Hao et al. (2018) designed and assessed a new TIM product made of SPACER fabric composite. This product offers more flexibility and less weight than traditional TIMs. The results show that the stable shrinkage temperature of SPACER fabric composite can be up to 98°C at ambient temperature and up to 32°C at 1100 W/m2. Therefore, SPACER fabric composite is extremely useful in transparent insulation materials. The paper by Paneri et al. (2019) provides an overview of TI systems and materials (TIM) by identifying TI systems based on geometry, materials used, and overall heat losses in these geometric designs. The results of

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this study show that in existing TIM technologies, TI systems containing aerogels have the lowest heat transfer (U-value) and better solar transfer (g-value) at a lower thickness than other TI systems.

Research by Perkska et al. (2020) Energy efficiency of a transparent insulated solar wall (SW-TI) with honeycomb insulation made from modified cellulose acetate for different climatic conditions in Poland, different coatings orientations, and Different insulation thicknesses were analyzed. The monthly thermal balance obtained using the proposed model presents results after calculating the heat gain for opaque building coatings with transparent insulation in PN-EN ISO 13790: 2008. Research by Wang et al. (2020) introduces the basic principles of thermal and optical properties of silica aerogels and highlights their adjustability through artificial control and processing.

"In addition, the use of silica aerogels in transparent thermal insulation windows is discussed." ("(PDF) Thermal Conductivity Performance of Silica Aerogel after ...") Sun et al. (2018) present the first step in developing a new intelligent window system that enhances energy efficiency and a bright indoor environment by integrating a transparent insulation material structure (TIM) with a thermo-tropic material Achieves. The annual simulation results predict that by carefully selecting the properties of the thermos-tropic material, the TT PS-TIM window system installation can save up to 27.1% Compared to a typical double-glazed window under the modeled climate of Rome.

Research of the thermal and optical performance of TIMs contained in the cavity of double-glazed constructed home windows is fairly short. Lien et al. (1997) researched overall performance of glazing with incorporated capillary TIM in terms of daylight hours distribution and visible connectivity as well as energy consumption of its software on a row residence. Simulation effects confirmed that changing a part of a traditional wall with a TIM wall led to annual strength savings of between sixteen% and 20%. Moreover, they counseled that visual connectivity is related to the thickness of the structure as well as the gap and attitude between the observer and the glazing system. Growing distance from the window results in an increased variety of vision, and increasing the thickness of cloth has consequences of a lower variety of imaginative and prescient. larger diameter capillaries also result in a bigger obvious vicinity. Wong et al. (2012) conducted a laptop simulation of TIM-glazing using a 22 mm PMMA capillary slab on the south dealing with façade. The results for a complete calendar 12 months confirmed that during evaluation with popular double glazing, daylight inner temperature swings have been reduced and, while mixed with thermal mass, sun protection and herbal air flow techniques, TIM-glazing has the ability to reduce heating energy load in winter and overheating in the summer season. In the research of Zhang et al. (2021), to reveal the discrepancy between the test theory and the experimental heat transfer process when measuring translucent thermal insulation materials using the HW method, the heat transfer process with transient conduction and

DOI: 10.15320/ICONARP.2023.262

radiation is simulated numerically. Numerical analysis shows that TC thermal insulation materials with low extinguishing capability measured using the HW method at high temperatures were overestimated.

Insertion of TIM material may also block and scatter daytime transmitted through the window (Garnier et al., 2015). This prevents robust direct daylighting and undesired glare, ensuing in a greater at ease and uniform distribution of sunlight hours into the occupied area and therefore diminishes the requirement for shading devices (Sun et al., 2017a). The predictions from the research via Sun et al. (2017b) suggest that the inclusion of Playstation -TIM systems stepped forward the luminous surroundings through decreasing the hours of over illumination and in so doing ended in a more uniformed illumination of the working plane for distinct climates (i.e. Stockholm, London, Beijing, Hong Kong and Singapore). But, the reduced solar and visible transmittance also extended the predicted strength required for area heating and synthetic lights, whilst the solar radiation and/or out of doors illuminance become lower. Novel switchable glazing is some other capability system supposed for software in buildings, providing the capability to improve both energy and daylighting performance (Zhang et al., 2019; Aburas et al., 2019. This is completed especially thru its ability to alter sun and daylight transmittance in response to the various outside surroundings (Flor et al., 2018).

The thermal properties of TIM in windows depend on various factors such as the type of insulating material, thickness, geometry and structure of the insulation, location and orientation of the window, etc. (Paneri et al., 2019). Most of the previous research on TIM has focused on its application in solar collectors. In the field of its application in building windows, two criteria, "type of insulation material" and "insulation geometry and structure" have been investigated, and other criteria affecting the performance of TIM in building windows have not been evaluated. The innovation of the present research is the simultaneous analysis of three criteria: 1) comparison of the cooling load, heating and the total load of using transparent insulation based on the location inside, in the middle and outside of the window, 2) comparison of the cooling load, heating and the total load of using transparent insulation for four directions different in residential building, 3) comparison of cooling load, heating load and total load comparison for different thicknesses of transparent insulation, in three different climates (Tehran, Ahvaz and Tabriz cities in Iran).

Therefore, the aim of the current research is to investigate the thermal comfort conditions with regard to the placement of the transparent insulating layer in the windows of the building and to analyze the changes in temperature and energy consumption for all three criteria in a case study by answering the following questions:

1. What is the best placement of TIM in the window for each climate in order to minimize thermal loads?

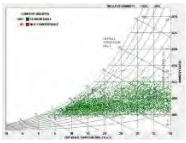
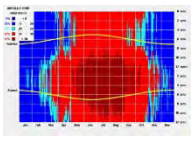
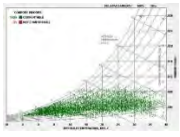
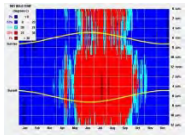
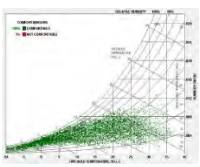
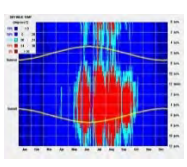
2. What is the best TIM thickness for each climate in order to minimize thermal loads?

3. What is the best orientation of window with TIM for each climate in order to minimize thermal loads?

RESEARCH METHOD

Solar radiation is also considered to achieve thermal comfort by analyzing climate data. Design Building simulator software has been used to simulate and analyze all information and data. Researchers have widely welcomed this software due to its graphical environment, air conditioning design, CFD, and other capabilities, and its validation has been examined by ANSI / ASHRAE 140-2014 standard (Bakhtyari and Fayaz, 2019). On the other hand, the analysis of thermal conditions in the building of the case is considered the same for all three climates. Therefore, the relative errors are equal in all stages and do not have a significant effect on the total energy demand. 4 spaces in 4 different directions based on the use of transparent insulation in the sample glass of low-density residential buildings in three cities of Tehran (temperate climate), Tabriz (cold climate), and Ahvaz (warm and humid climate) are analyzed. This study focuses on the optimization of three criteria: "thickness", "location of transparent insulation relative to the window layers" and "direction of the wall with transparent insulation of the building window" to minimize thermal loads and reduce energy consumption in residential buildings.

Table 1. Geographical and climatic characteristics of the cities considered for analysis.

City Name	Latitude	Longitude	Above sea level	Construction group	Range of comfortable conditions in the city	The annual temperature of the city
Ahvaz	31.28	48.72	1200	Buildings with high energy consumption and its predominant thermal requirement are cooling		
Tehran	35.41	51.19	1120	Buildings with medium energy consumption		
Tabriz	38.05	46.17	1361	Buildings with high energy consumption and predominant thermal requirement are heating		

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This analysis is based on the measurement of "heating load", "cooling load" and the sum of these two loads as "total thermal load" of indoor air temperature and annual energy consumption. Three criteria of heating, cooling, and air temperature are considered to achieve thermal comfort. Finally, the results of the studies are compared, and an optimal example is presented in line with the purpose of the research, as shown in (Table 1).

(Figure 2) shows the plan of the 3rd floor (due to the lack of heat loss from the floor and ceiling) of a residential complex located in Tehran. The height of the floor, regardless of the thickness of the ceiling, is 2.90 meters, and the thickness of the ceiling is 0.35 meters. The window's height, OKB, and width are 1.5, 1.2, and 1.5 meters, respectively (Figure 2).

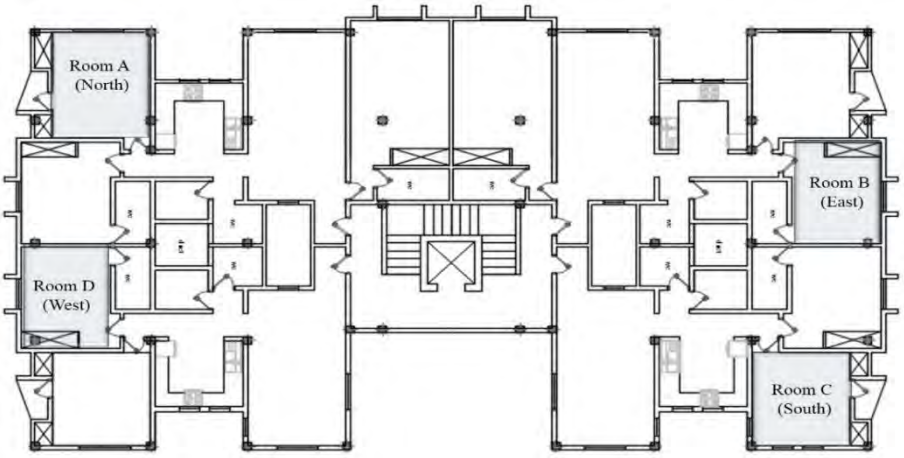

Figure 2. Residential complex plan

The characteristics of the studied spaces in this research are presented in (Table 2).

Table 2. Specifications of the spaces under study in the plan

Space	Floor area (m2)	Exterior wall area (m2)	Wall opening area (m2)
Room A (North)	25	12.5	4.5
Room B (East)	19	16.2	11.6
Room C (South)	20	11	4.5
Room D (West)	19	16.5	11.6

The thermal characteristics of the materials forming the walls are shown in (Table 3).

HSNPs transparent insulation has a conductivity of 0.019 W / m.K, a specific heat capacity of 1900 J / kg.K, and a density of 1540 Kg / m3. This study investigated different thicknesses of 1, 3, 5, and 7 inches for this insulation. The windows have a thermal break aluminum frame (heat transfer coefficient k=1.8) with double glazing (the thickness of each glass is 4 mm, and the distance between the two glasses is 8 mm), and the

type of glass is unbreakable, the characteristics of which are defined according to the software standard. (Figure 3)

Table 3. Thermal characterizations of components

Components	Layer name	Conductivity W/m.K	Specific heat capacity J/kg.K	Density Kg/m3	Thickness Cm
External wall	Brick facade	1.1	840	1920	3
	Cement mortar	1.15	920	2000	2.5
	Brick	1.0	840	1100	3
	Plaster and soil	1.15	840	1000	2.5
	Plaster	0.7	1000	1300	0.4
	Oil color	0.1	1500	1000	0.1
Ceilings and floors	Cement tile	1.4	1000	3000	3
	Cement mortar	1.15	920	2000	2
	Concrete	0.34	840	1300	5
	Roof block	0.76	840	1920	30
	Plaster and soil	1.15	840	1000	2.5
	Plaster	0.7	1000	1300	0.4
	Oil color	0.1	1500	1000	0.1
HSNPs transparent insulation		0.019	1900	1540	0.5

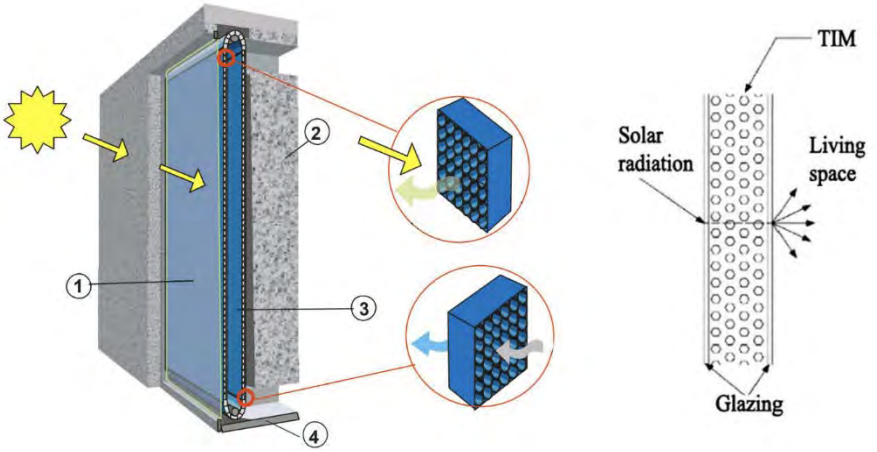

Figure 3. Configurations of TIM in window systems: (1) glazing, (2) wall, (3) TIM, (4) aluminum frame (Szyszka, 2022)

The lighting of the above building with a brightness of 500 Lux and a luminance coefficient of 0.72. The heat energy of active electrical equipment operation in a residential environment is assumed to be 52 watts per square meter. The natural airflow penetration into the building through the entrance door, windows, and other vents changes the air temperature and humidity ratio. Therefore, the rate of temperature change is assumed to be 0.7 times the air exchange rate per hour.

RESULTS

One way to reduce energy consumption in buildings is to use thermal insulation on windows. Because windows significantly contribute to the increase and loss of heat from the building enclosure and determine the

DOI: 10.15320/ICONARP.2023.262

quantity, quality, and distribution of daylight emitting into space. One potential answer to enhance window performance is to use a transparent Insulation fabric (TIM) in building windows (Sun et al., 2018b). TIM seeks to provide resistance to warmness drift without hindering the transmittance of sunlight relative to a non-transparent insulation fabric. A decrease in thermal transmittance (i.e. U-fee) of a TIM decreases undesired warmth losses from the internal space to the external environment, and for that reason reduces the construction's heating load (Paneri et al., 2019).

To evaluate the effect of using HSNPS transparent insulation, the annual thermal loads were compared in two modes of "use of insulation" and "non-use of insulation". To investigate this, the thickness, location of the insulation, and direction of the transparent wall of the building are assumed to be constant. Therefore, the comparison of thermal loads in the case of using insulation with a thickness of 3-inch and in the inner part of the glass to the north with the case of not using insulation is shown in (Table 4).

Table 4. Comparison of thermal loads in two modes "use of insulation" and "no use of insulation"

Thermal load	No insulation			Use insulation		
	Tehran	Tabriz	Ahvaz	Tehran	Tabriz	Ahvaz
Cooling	88614	59994	339579	24894	8532	97200
Heating	457542	680968	680967	156006	220482	62478
Total	546156	740961	740961	180900	229014	159678

To determine the optimal thickness of HSNPS transparent insulation, the location of the insulation and the direction of the transparent wall of the building are assumed to be fixed. The thickness of the thermal insulation in four thicknesses of 1, 3, 5 and 7 inches and in the inner part of the north-facing glass has been checked, which is as described in Table 5 (the reasons for choosing these numbers as different thicknesses for analysis, the presence of HSNPS transparent insulation with These thicknesses are in the market) (Table 5).

Table 5. Comparison of thermal loads in different thicknesses

Thickness insulation	Thermal load	Tehran	Tabriz	Ahvaz
1	Cooling	25779	14434	195960
	Heating	276507	349687	85833
	Total	302286	364122	281793
3	Cooling	19899	6356	70686
	Heating	113691	161568	45679
	Total	133591	167924	116365
5	Cooling	11405	3743	45085
	Heating	74369	102227	28631
	Total	85774	105970	73715
7	Cooling	8553	2970	32848
	Heating	52807	75557	20968
	Total	61360	78527	53816

According to the results of the above tables, the percentage of reduction of thermal loads due to the placement of different thicknesses of transparent HSNPS insulation can be obtained as follows:

Percentage of improvement = ((amount of heat load in the state of using insulation) / (amount of heat load in the state of without insulation) – 1) * 100

The formula shows the percentage of thermal load reduction for northern glass in (Table 6).

Table 6. Percentage reduction of thermal loads using different thicknesses transparent insulation

Thickness insulation	Thermal load	Tehran	Tabriz	Ahvaz
1	Cooling	68.77	73.66	41.02
	Heating	38.37	47.18	50.96
	Total	43.31	49.32	44.47
3	Cooling	75.21	86.72	76.8
	Heating	72.9	73.98	72.5
	Total	73.26	75.01	75.31
5	Cooling	84.51	90.95	84.12
	Heating	81.23	82.43	81.64
	Total	81.76	83.12	83.26
7	Cooling	87.63	92.19	87.61
	Heating	85.8	84.29	85.75
	Total	86.1	86.72	86.96

To determine the best placement of HSNPS transparent insulation, the thickness and direction of the transparent wall of the building are assumed to be fixed. Therefore, the comparison of thermal loads in the case of using 3-inch insulation and in three positions inside, in the middle, and outside of the north-facing glass is described in (Table 7).

Table 7. Comparison of thermal loads in different placement positions

Thermal load	placement position	Tehran	Tabriz	Ahvaz
Cooling	Interior	18236	6356	70686
	Middle	19899	6356	70211
	Exterior	135491	6534	70924
Heating	Interior	113691	161568	45679
	Middle	112088	161450	45916
	Exterior	112266	160261	45382
Total	Interior	133591	167924	116365
	Middle	130324	167805	116127
	Exterior	23225	166795	116305

Also, the percentage of reduction in heat loads in different situations for each city is as described in (Table 8).

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Table 8. Percentage reduction of thermal loads using different placement positions transparent insulation

Thermal load	placement position	Tehran	Tabriz	Ahvaz
Cooling	Interior	77.04	86.12	76.8
	Middle	75.21	86.72	77.74
	Exterior	72.93	86.23	76.94
Heating	Interior	72.9	74.87	72.5
	Middle	73.24	74	72.37
	Exterior	73.2	73.98	72.65
Total	Interior	73.26	75.01	75.31
	Middle	73.85	75.03	76.35
	Exterior	71.58	75.96	74.32

Another component of insulation optimization is determining the location of insulation in 4 geographical directions in a way that results in the greatest reduction in thermal loads. In this case, the insulation thickness (3-inche) in the inner part of the glass is considered fixed and the results of this section are described in (Table 9).

Table 9. Comparison of thermal loads for insulation in different directions

Direction	Thermal load	Tehran	Tabriz	Ahvaz
East	Cooling	38448	16416	106866
	Heating	134838	200124	50652
	Total	173286	216540	157518
North	Cooling	24894	8532	97200
	Heating	156006	220482	62478
	Total	180900	229014	159678
South	Cooling	44280	14202	92556
	Heating	105462	176850	57132
	Total	149742	191052	149688
West	Cooling	36072	16092	115992
	Heating	137754	187812	50490
	Total	173826	203904	166482

Also, the percentage of reduction of thermal loads in different directions for each city is described in (Table 10).

Table 10. Comparison of percentage reduction of thermal loads for insulation in different directions

Thermal load	Direction	Tehran	Tabriz	Ahvaz
Cooling	East	65.15	68.10	69.42
	North	69.74	83.20	69.23
	South	65.50	70.75	73.86
	West	68.75	71.87	67.17
Heating	East	67.09	66.50	66.12
	North	63.92	65.59	63.49
	South	68.04	66.65	49.12
	West	65.11	68.53	66.63
Total	East	66.68	66.63	68.44
	North	64.86	67.02	67.23
	South	67.33	67.00	68.17
	West	65.93	68.83	67.01

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DISCUSSION

According to the outputs of the previous section, the following results can be extracted.

• **Location of TIM:** Based on the analysis and results of the previous section, the answer to the first question of the research (what is the best location of TIM in the window for each climate in order to minimize thermal loads?) is as follows:

For the city of Tehran, placing transparent HSNPS insulation on the inner surface of the glass has the maximum reduction in annual cooling load. Placing insulation in the middle of double glazing has the maximum reduction in heating load and total annual heat load. Placing insulation on the outer surface of the glass has the minimum reduction in total annual heat load. For the city of Tabriz, placing transparent HSNPS insulation on the glass's inner surface has the greatest annual heating load reduction. Placing insulation in the middle of double glazing has the maximum reduction in annual cooling load. Placing insulation on the outer surface of the glass has the least reduction in total annual heat load. For the city of Ahvaz, placing transparent HSNPS insulation on the inner surface of the glass has the maximum reduction in annual heating load. Placing insulation in the middle of double glazing has the maximum reduction in cooling load and total annual heat load. Placing insulation on the outer surface of the glass has the minimum reduction in the total annual heat load (Figure 4).

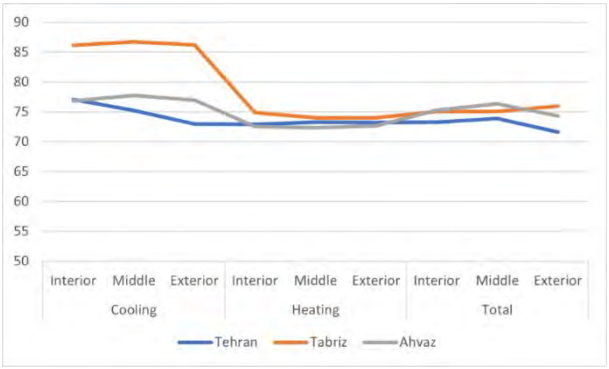

Figure 4. Comparison of the placement of TIM in three cities

In the general comparison based on Figure 4, the highest percentage of changes belongs to the reduction of the cooling load by placing the HSNPS transparent insulation in the middle of the double-glazed glass in Tabriz city. Also, the lowest percentage of changes belongs to the reduction of the total thermal load by placing transparent HSNPS insulation on the outer surface of the glass in Tehran.

• **TIM thickness:** Based on the analysis and results of the previous section, the answer to the second research question (what is the best TIM thickness for each climate in order to minimize thermal loads?) is as follows:

According to the results, adding 2 inches to the insulation thickness (converting 1 inch to 3 inches) in different cities reduces the thermal load

DOI: 10.15320/ICONARP.2023.262

by about 40 to 50 percent. This percentage will increase as the insulation thickness increases to 5 inches. Nevertheless, from this point onward, the reduction of thermal loads does not have significant changes as the thickness increases (Figure 5).

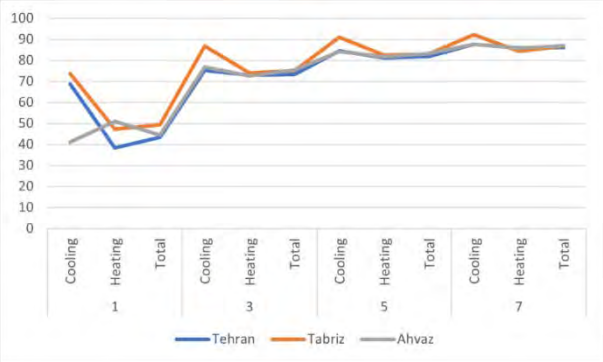

Figure 5. Comparison of the TIM thickness in three cities

Therefore, the thickness of the insulation should be selected as the optimal thickness, which in addition to the acceptable reduction of thermal loads, is also economically viable. The optimal insulation thickness is selected so that the difference between the percentage of improvement of that thickness and the percentage of improvement of the maximum thickness (7 inches) is not more than 10%. According to this issue, Tehran's optimal thermal insulation thickness is 3 inches. For Tabriz, the optimal thickness of thermal insulation is 5 inches; for the city of Ahvaz, the optimal thickness of thermal insulation is 3 inches.

• **The direction of the window has TIM:** Based on the analysis and results of the previous section, the answer to the third question of the research (what is the best direction of the window with TIM for each climate in order to minimize thermal loads?) is as follows:

The best place for HSNPS transparent insulation in the glass (windows) of rooms with different fronts, which has the greatest reduction in cooling load in Tehran, were the north, west, south, and east windows, respectively. This was also the same in the city of Tabriz. In Ahvaz, the windows were south, east, west, and north, respectively. The best location for insulation, which has the greatest reduction in heating load in Tehran, were the south, east, west, and north windows, respectively. In Tabriz, the windows were west, south, east, and north, respectively. Ahvaz had western, eastern, northern, and southern windows, respectively. The best location for insulation, which has the maximum reduction in total annual load of Tehran, were the south, east, west, and north windows, respectively. In Tabriz, they were western, northern, southern, and eastern windows, respectively. In Ahvaz are the east, south, north, and west windows (Figure 6).

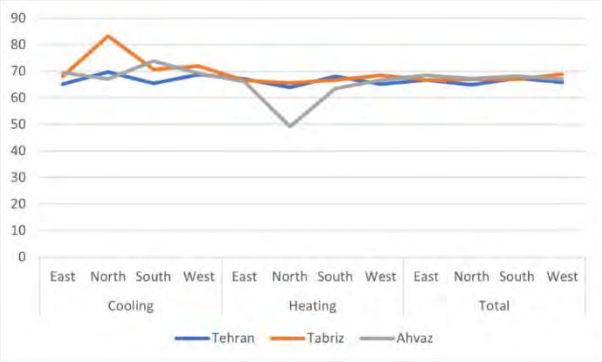

Figure 6. Comparison of the direction of the window has TIM in three cities

In the general comparison based on Figure 6, the highest percentage of changes belongs to the reduction of the cooling load by placing the HSNPS transparent insulation on the northern front of Tabriz city. Also, the lowest percentage of changes belongs to the reduction of the heating load by placing the HSNPS transparent insulation on the south face of Ahvaz city.

CONCLUSION

The use of transparent insulation is to create resistance to heat flow without blocking solar radiation from non-transparent insulation material. Less heat transfer of a TIM reduces undesirable heat losses from indoor to outdoor environments and thus reduces the heating load of the building. The thickness and placement of this insulation should be optimized.

The research results show that the change percentage of improvement in the cooling load is more than the heating and total annual loads in Tehran. In Tabriz, the change percentage in cooling and heating loads is more than the total annual load. In Ahvaz, the change percentage of improvement is high all three times. The annual cooling load in Ahvaz and the annual heating load in Tabriz have a maximum amount. Also, the total annual load is maximum in Tabriz and minimum in Ahvaz. Therefore, the use of HSNPS insulation in transparent walls was necessary to reduce energy consumption in the city of Tabriz. Also, the results show that for the city of Tehran, 3-inche of insulation in the middle of the double-glazed window and the south front, for the city of Tabriz, 5-inche of insulation on the inner surface of the window and the western front, for the city of Ahvaz, 3-inche of insulation on the outer surface of the window and the eastern front as are optimal modes.

It is necessary to mention that the obtained results are limited to the analysis of case samples in three selected cities and based on the input parameters of the software. According to the results, it is suggested that initially, the optimal insulation thickness should be calculated economically in the design of building windows; in the next step, the location of insulation and the fronts that include the most energy waste should be determined according to the climatic conditions and the materials used. Also, in cases where the building is used intermittently

DOI: 10.15320/ICONARP.2023.262

(such as office buildings), it is necessary to perform separate calculations and decide on the insulation utilization of windows. Because, in some cases, in buildings with intermittent use, the ratio of people's attendance is different at different hours of the day, and the use of insulation may increase the annual energy consumption.

One of the main reasons for heat loss in buildings is opening the windows to restore thermal comfort and receive fresh air when the heating and cooling systems are on. It is necessary to identify the actual behavioral pattern of users through field studies and consider it as an input in the software. Also, some parameters, such as the wind speed around the building and the amount of radiation received, have a direct relationship with the features around the building. The coefficients related to the wind and its reflection should be controlled according to the location of the building in relation to the surrounding context.

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Resume

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DOI: 10.15320/ICONARP.2023.262

ICONARP
International Journal of Architecture and Planning
Received: 21.10.2022 Accepted: 28.09.2023
Volume 11, Issue 2/ Published: 28.12.2023
Research Article *DOI: 10.15320 /ICONARP.2023.263 E- ISSN:2147-9380*
ICONARP

Developing a Model Proposal to Evaluate the Authenticity of Traditional Housing; Malatya Case Study

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Bahtiyar Eroğlu **

Abstract

Anatolia has been used as a settlement area by many civilizations throughout history due to its geopolitical and geographical features. Traditional houses in Anatolia convey the thousands of years of culture and identity of the region where they are located, with their unique architectural style. In this respect, traditional houses appear as the most important cultural heritage values that convey information such as the social, cultural, economic and architectural style of the period. Historical textures have been in change and transformation in the Malatya region, as in every region of Anatolia. However, Malatya has largely lost its traditional houses and texture due to many reasons such as rapid urbanization, unconsciousness, rent, and the destructive effect of time.

In this study, which was prepared by addressing this problem, Fuzzy Logic and AHP (Analytical Hierarchy Process) analysis system was used in order to evaluate the authenticity of civil architectural examples located in traditional tissue pieces in the urban area of Malatya and to protect these structures. Thus, it is aimed to develop an authenticity assessment method together with the experts of the subject (conservation experts, architectural historians, art historians). It is aimed to determine the authenticity of the buildings numerically and proportionally with the authenticity evaluation model developed with a systematic setup. Ahmet Kökçü House, located in Yakınca Neighborhood, was chosen as the study area due to reasons such as the fact that it largely preserved its traditional texture as a field study and faced extinction as a result of the rapid urbanization of Malatya's central city wall reaching the border of Yeşilyurt district. With the authenticity assessment model developed in this context, the authenticity of the building was determined by experts and suggestions were made for the preservation of the building.

Keywords:
Cultural heritage, authenticity, traditional Malatya houses, analytical hierarchy process (ahp), fuzzy logic

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To cite this article: Şahin, M., & Eroğlu, B. (2023). Developing a Model Proposal to Evaluate the Authenticity of Traditional Housing; Malatya Case Study. *ICONARP International Journal of Architecture and Planning,* Volume 11 (2), 754-780. DOI: 10.15320/ICONARP.2023.263

INTRODUCTION

Culture takes place in the lives of people and societies throughout their lives, shaping and transforming the societies under its influence. Identities of people are also shaped according to the cultural environment in which they live. As societies and groups around the world increase and diversify, the cultures they live in also diversify and differentiate. Cultural heritage; It is an important factor that connects people to a place, society or region, acts as a bridge for the transfer of knowledge and skills between past and future generations, and ensures that societies are sustainable by developing and transforming their common values and norms (Çakırca, 2010). In this context, evaluation criteria have been established in order to better understand the value of cultural heritage and to protect it more effectively. In order to define and compare the values of cultural heritage, evaluation criteria such as historical, document, aesthetic, socio-cultural, scientific, spiritual, authenticity have been determined, these criteria have changed in the historical process and their order of importance has changed. Today, it is seen that the importance of authenticity value has increased, especially in studies conducted in the context of cultural heritage. Traditional houses, which constitute a large part of our cultural heritage and are immovable cultural assets, are important values that have increased their importance until today and should be preserved and transferred to future generations.

Like many regions of Anatolia, Malatya has a rich cultural heritage with its historical structure and traditional texture that has survived to the present day. In order to understand the architecture, identity, cultural change and transformation of Malatya in the historical process, it is necessary to analyze the traditional house and texture well. Traditional houses are the most important architectural elements that tell us about the construction technique, materials and features, socio-cultural environment and experiences of the period. For this reason, understanding and protecting traditional houses is very important for our future generations. However, over the years, civil structures disappear for many reasons or their authenticity is damaged as a result of interventions and practices, and they can survive until today. It was emphasized that the architectural authenticity of these structures, which have survived until today, should be determined and studies should be carried out to protect them. It is aimed to rank, evaluate and compare the structures within themselves by revealing their values in the context of authenticity before they disappear, which constitute an important part of the cultural heritage. In this context, the logical decision making method has been adopted to evaluate the authenticity criteria of traditional houses; Fuzzy Logic analysis method and AHP (Analytical Hierarchy Process) analysis method were used to make this analysis more objective. In this study, with the help of AHP (Analytical Hierarchy Process) analysis method, it was ensured that the authentic weights of the evaluation

DOI: 10.15320/ICONARP.2023.263

criteria were determined among each other. In short, an evaluation model was created by supporting the AHP analysis method and the Fuzzy Logic method in the evaluation model created for the evaluation of the authenticity of traditional houses.

In this context, unlike other studies; This study increases its importance as there is no such study in the context of evaluating the authenticity of the AHP (Analytical Hierarchy Process) and Fuzzy Logic Analysis method together with the creation of a more objective evaluation model during the creation of the authenticity evaluation model, and in the context of the evaluation of the authenticity of the district of Malatya, Yakınca Neighborhood and especially traditional houses. As a result of the study, it is aimed to develop a model that can be applied in every region of Anatolia of this authenticity evaluation model, which was created to evaluate the authenticity of traditional houses in the province of Malatya, and to make suggestions for the protection of the structures. After revealing the authenticity of traditional houses, it is thought to contribute positively to their preservation.

CULTURAL HERITAGE VALUES AND THE CONCEPT OF AUTHENTICITY

Societies can communicate with each other by living in harmony, sharing and mingling with each other thanks to their cultures (Karkın & Karaburun, 2012). Factors such as beliefs, customs and traditions, customs, lifestyle, social life, habits that make up the culture; It continues to shape and change people, the built environment and places throughout history. The phenomenon of space itself has been in a change and transformation with the changing cultures in the process (Yazgan, 2016). In this context, it can be stated that culture is everything abstract and concrete that human beings reveal, design and shape, and it is an endless interaction in which the factors formed from these phenomena shape people and their environment (Turgut, 1990). In this context, the importance of cultural heritage values is obvious, especially in the context of telling the cultural identity, experience and conditions of the period to future generations.

The concept of cultural heritage and the value attributed to it; It has varied and differed according to the past, experiences, traditions and customs of people or societies, and the way of perception and understanding(Bülbül and Urak, 2020). Overview of cultural heritage values; In the process, with the development and transformation in the concept of cultural heritage, it has differentiated and diversified according to the perspectives of people, societies and institutions. Cultural heritage values have been discussed socio-culturally, and it has been stated that there is a deep relationship between people and societies and their ties with their past (Zancheti et al., 2009). In the process, definitions and statements were made on the scope and criteria of cultural heritage values. Value criteria have been established to better

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understand and evaluate the importance of cultural heritage. These value criteria differed and varied according to the period, region or study area; importance rankings were made among the value criteria. The change in the definition and scope of cultural heritage in societies over time has led to differentiation in cultural heritage values.

Cultural Heritage Authenticity Concept and Criteria

With the 19th century, the concept of protection and its diversity expanded beyond the monument, and with the 20th century; Today's conservation architecture understanding has begun to emerge, covering all kinds of cultural and natural heritage such as building communities, civil architecture, tangible and intangible heritage, industrial heritage, historical, archaeological and cultural landscape. In this context, basic concepts and values such as historical value, aesthetic value and historical document value, authenticity value have also diversified within the scope of diversity and protection of cultural heritage (Aslan, 2016). After the Venice Charter, many international conferences, papers and studies were held in the context of cultural heritage. While aesthetic, historical, scientific and social values were mainly included in the previous periods, the value of authenticity came to the fore in the late 1980s and increased its importance among heritage values in the 1990s. In the process, authenticity was followed by moral and spiritual value (Binan, 1999; Ahunbay,2014 Korumaz, 2015).

The criterion of authenticity as architectural heritage values was first included in the World Heritage Committee in 1977; In the process, two important conferences were held on the concept of authenticity in the context of World Heritage, the value of authenticity in the international declaration and convention, in Bergen in January 1994 and then in Nara in November 1994 (ICOMOS, 1994). At the conference held in Bergen in 1994, conservation theories and criteria were decided as; authenticity in form, authenticity in material, authenticity in technique, authenticity in function, location in the city (Jokilehto, 2003; (Jokilehto, 1994; Ulukan, 2014; Bülbül, 2016).

When the studies on authenticity are examined, it is seen that the authenticity criteria are similar. In this context, while determining the authenticity criteria in the study, in addition to the evaluations made by international institutions and organizations such as UNESCO, ICOMOS, the Council of Europe, ICCROM and the experts of the subject, the authenticity criteria and definitions were taken as reference by taking the authenticity criteria in the NARA Declaration on authenticity issued in Japan in 1994 was created (ICOMOS, 1994).In order to evaluate the authenticity of traditional houses, a total of 6 criteria were determined as material authenticity, form and shape authenticity, construction technique (workmanship), authenticity of use and function, authenticity of urban environment and location, and authenticity of the spirit and identity of the building form and shape

DOI: 10.15320/ICONARP.2023.263

METHODS USED IN THE STUDY

Generally, the decision-making process on a subject takes two approaches. The first of these; It is a rapidly developing, non-objective decision-making process that is based on feelings and emotions, which is expressed as an intuitive decision-making process. The second approach is the logical decision-making process. This method includes decisions made in line with an analytical and systematic calculation. In this context, the logical decision making method has been adopted to evaluate the authenticity criteria of traditional houses; Fuzzy Logic analysis method and AHP (Analytical Hierarchy Process) analysis method were used to make this analysis more objective (Figure1).

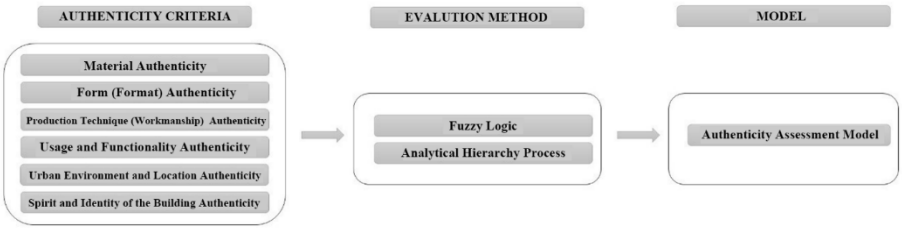

Figure 1. Shows the stages of the authenticity assessment model

In this study, thanks to the AHP analysis method, it was ensured that the authentic weights of the evaluation criteria were determined among each other.

Fuzzy Logic Analysis Method

Many of the situations and problems faced by human beings in the world are complex and difficult. Unlike the Aristotelian logic of computers, people can produce solutions by making approximate and uncertain approaches to the solution of this complexity (Şen, 2004). The concept of logic is described as pure, unchangeable, prime. Doğan argued that logic is concerned with the theories of philosophical and linguistic forms rather than its relationship with existence (Doğan, 1999). Classical and symbolic logic are separated from each other in the scope of the value given to the symbolic character. These two logics consist of symbolic and emblematic characters rather than semantic contents (Grünberg, 2003). Fuzzy Logic analysis method, which is against classical logic, is used in many disciplines and fields today. Fuzzy Logic was first introduced by Lotfi Zadeh (Zadeh, 1965). In this context, Zadeh; He dealt with some of the problems of philosophy and produced studies on how machines can think. The Fuzzy Logic method introduced by Zadeh revealed new solutions to classical logic and linguistic problems that came from Aristotle (Zadeh, 1965). This method is used to solve multidimensional and complex problems by bringing the uncertainty of a problem or a complex process to a certain state. The Fuzzy Logic method, which emerged against the definite sets and propositions of classical logic; It provides consistent and meaningful decision making by using uncertain and uncertain concepts (Altaş, 1999). In its simplest sense, it is a method that reveals numerical data from verbal expressions using the theory of fuzzy sets (Keskenler & Keskenler, 2017).

Against the bivalent logic of classical logic, an alternative supported by technology has been developed. Fuzzy Logic argued that there may be intermediate values for Aristotle's criteria of 'true' or 'false' or instead of '0' and '1' numbers (Ertuğrul, 1996). In Fuzzy Logic, modeling is done using linguistically average 84 data such as few, frequent, medium, low, many, a lot. Thus, it enables the data that emerges in the modeling of problems and events to present more realistic data (Nabiyev, 2010; Palabıyık & Çolakoğlu, 2012).

In Fuzzy Logic, results are obtained by applying logic rules and applications in a flexible and fuzzy way. The transfer of these symbolic and flexible expressions to machines is based on a mathematical basis. This mathematical basis is the theory of fuzzy sets (Elmas, 2003). Fuzzy set theory is the main core of Fuzzy Logic. Fuzzy set theory digitizes the uncertainties in people's perceptions of thought and linguistic expressions. In this context, with this method, it allows to make mathematical models in which every value can be expressed in accordance with the way people think (Zadeh, 1965; Zadeh, 1968; cited in Küçükyağcı, 2019). In Fuzzy Logic systems, unlike classical logic, system behaviors are divided into two and consist of four interconnected parts (Şen, 2009) (Figure2).

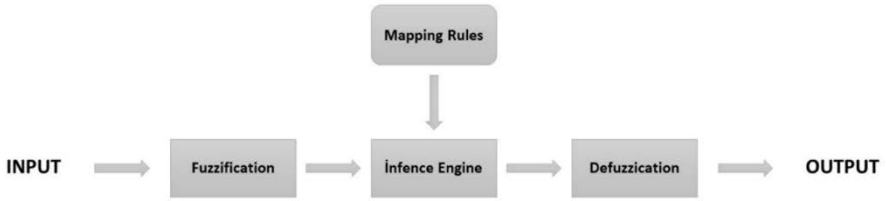

Figure 2. General fuzzy system diagram (Toprak, 2004)

The fuzzy logic approach essentially consists of blurring, fuzzy inference system (fuzzy inference engine) and clarification phases (Alcı & Karatepe, 2002; Ellen, 1996; Kandel & Langholz, 1993; Şen, 2004; Baykal & Beyan, 2004). Basically, the Fuzzy Logic process consists of blurring, fuzzy inference and defuzzification. In the system consisting of inputs and outputs, a model is created by creating an If-then rules base. Since the value ranges of this created system are uncertain and flexible, more meaningful and precise measurements and evaluations can be made. The Fuzzy Logic method, which has an advantage with this structure, is used in many fields (Elmas, 2011; Keskenler and Keskenler, 2017; Solak and Alaybeyoğlu, 2017).

Analytical Hierarchy Selection Method from (MCDM) Multiple Criteria Decision Making Methods (AHP)

Models were developed using multi-criteria decision-making (MCDM) methods to evaluate the priorities of complex and difficult-to-decision criteria; these models have met the priority decision-making needs in many areas such as political, financial, engineering and scientific (Mcintyre and Parfi, 1988; Bouyssou and Vincke, 1997; Wong, 1999). This method is expressed as the whole of techniques that allow people to

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choose step by step criteria with more than one criterion (Yaolin, 2006). Today, many MCDM methods are used to solve complex problems.

This method, in complex decision problems, by determining the relative importance of decision alternatives and criteria; It is a decision-making method that enables the decision mechanism to work. The AHP method is a more preferred method among many other methods in terms of including both objective and subjective elements (Timor, 2011). The AHP method developed by Saaty (1977) enabled people to create their own decision-making mechanisms, enabling them to make more effective decisions. The better people understand and understand the criteria with complex characteristics in the evaluation process, the clearer and more accurate their decisions will be. AHP is a method that enables the detection of complex problems during decision making and provides a systematic solution to the problems (Figure3). Thanks to this method, it systematizes an evaluation method and reveals the system structure hierarchically in order to determine the relationship between the criteria that make up the system and their effects on the system (Evren and Ülengin, 1992; Deniz, 1999).

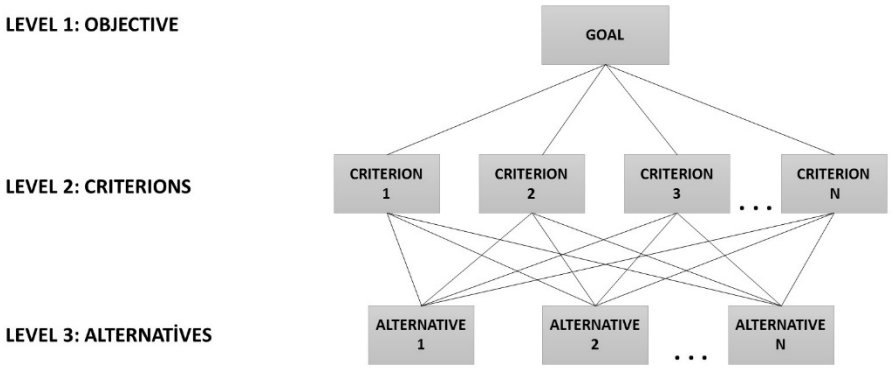

Figure 3. The hierarchical scheme of the problem in the AHP method (Cheng, C.H., 1999; Timor, 2011; Satty, 1980; Satty, 1988; Saaty, 2003).

It is aimed to determine the degree weights by making pairwise comparison matrices of the determined criteria. By creating a hierarchical structure for both subjective and objective data, AHP ensures that each criterion determined by the decision makers is ranked in importance. In this context, AHP determines the relative importance order by making a pairwise comparison of each criterion determined for the solution of the problem. After the hierarchical model structure can be determined, pairwise comparisons should be made in order to reveal the authentic degrees of all criteria within themselves (Dey, 2001; Saaty, 1980; Saaty, 1988). Since the pairwise comparison is the most important step of the analytic hierarchy process, the values obtained in the AHP are expressed in matrixes. In this process, while creating the pairwise comparison matrix and comparing the criteria; Judgments such as "equally important", "moderately important", "strongly important", "very strongly important", "definitely more important" are used (Dey, 2001; Saaty, 1990; Saaty, 2003; Timor, 2011; Ekinci, 2014).

In this context, the solution of a problem in the analytic hierarchy process consists of three main constructs, respectively; It can be

described as creating a hierarchy model structure for solving the problem, determining the degree weights by making pairwise comparison matrices of the determined criteria, and selecting and ranking the alternatives using decision matrices (Saaty, 1980; Saaty, 1988). Thus, the effect weights of the determined criteria can be determined and the best alternative can be selected. In this study, the effect of the authenticity criteria determined using the AHP method on traditional houses and their order of importance is to determine.

FORMATION SCHEME AND IMPLEMENTATION OF THE AUTHENTICITY ASSESSMENT MODEL

It is necessary to preserve and revitalize historical heritage values for the preservation of traditional structures and their transfer to future generations and for cultural continuity. Therefore, the goal of protection is; should revive the cultural heritage while evaluating its architectural, historical, environmental, visual and aesthetic features (Semerci and Gümüş, 2017). The traditional structures in the study area; Since they have similar historical, document, aesthetic and cultural values, it is aimed to evaluate the traditional houses in the study area and scope within the scope of authenticity value. In the light of these data, an evaluation model consisting of Fuzzy Logic and AHP analysis methods was developed in the presence of experts in order to reveal the authenticity values of the buildings in the context of the protection of traditional houses; Evaluations were made by experts in the field of study. Thanks to this evaluation model, it is aimed to divide the traditional houses into two separate sections as interior space and architectural façade, and to enable them to be evaluated in a way that reveals their authenticity in numerical and qualitative data. Bülbül (2016) and Ulukan (2014) benefited from Zadeh's Fuzzy Logic and Fuzzy Cluster Theory in their studies. In the works of Bülbül(2016) and Ulukan(2014), he divided the authenticity criteria (design/form, material, construction technique, function, location and environment, identity and spirit of the building) into 6 groups and evaluated these criteria by dividing them into certain value ranges. The authenticity criteria used to create this method and the application stages of the methods are given. In order to determine the authenticity criteria of the cultural heritage to be used in the study, the authenticity criteria determined at the Nara Conference (ICOMOS, 1994) were used(Figure4). In order to understand the values of historical buildings and to make correct determinations, it is necessary to perceive and comprehend the evaluation criteria well. As the authenticity criteria of cultural heritage in the study; The criteria of material, form (form), construction technique (workmanship), use and function, urban environment and location, spirit and identity of the building were adopted.

DOI: 10.15320/ICONARP.2023.263

Figure 4. It shows the architectural authenticity criteria determined by reference to the Nara Declaration (1994) within the scope of the study(ICOMOS,1994; Lemaine and Stovel,1994).

In the study, the model table created to determine the authenticity values of the building, accompanied by the authenticity criteria, consists of the following stages (These stages are explained in detail with the tables).

1. Definition of the authenticity criteria that make up the model, value ranges and formation of the systematic,
2. Making the definitions of the degrees of authenticity and authenticity values within themselves in order to establish the decision-making mechanism that constitutes the main skeleton of the model,
3. Selecting the Mandalin decision-making method of the Fuzzy Logic model to be used in the model, creating the input and output sections,
4. Entering the value ranges of the criteria determined for the evaluation model together with the groupings made into the system one by one,
5. Creating a rule database with the criteria of the Fuzzy Logic method used in the model, (As the rule database will directly affect the result of the study, it should be created correctly by experts.)
6. While creating the rule database, the AHP method was used to determine the authentic weights of the authenticity criteria in order to make the study more authentic and quantitative. (Thanks to the AHP method, the authentic weight values of these criteria are determined and a rule data table is created, which provides more accurate results). Evaluation of the authenticity of traditional houses with on-site experts, accompanied by the model created(Figure5).

The operation flow of the authenticity assessment model, which was created by using Fuzzy Logic and AHP analysis methods in the study, is given in the diagram below.

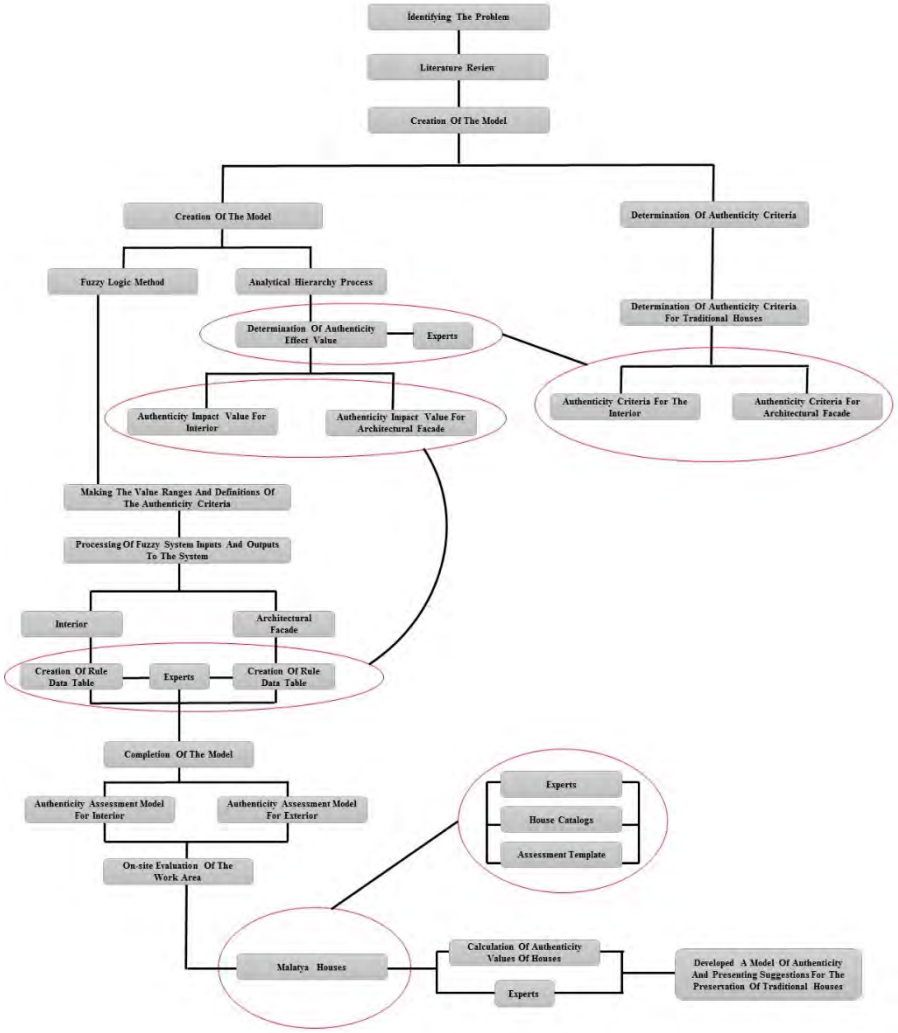

Figure 5. The scheme of operation of the methods used in the study

In the study, the model table created to determine the authenticity values of the building, accompanied by the authenticity criteria, consists of the following stages.

In the first stage: In the scope of the study, on-site evaluations will be made by the experts in order to compare and measure the authenticity of traditional houses. In this context, in order to be able to evaluate the general authenticity of the buildings more clearly, the authenticity assessment was made in two parts, the interior space and the architectural façade. In this context, it is aimed to divide the traditional houses into two parts and evaluate the authenticity evaluation criteria in the table below (Table 1).

Table 1. Authenticity evaluation criteria for traditional houses

AUTHENTICITY ASSESSMENT CRITERIA	
ARCHITECTURAL FACADE CRITERIA	**INTERIOR ARCHITECTURAL CRITERIA**
• Material Authenticity	• Material Authenticity
• Form (Format) Authenticity	• Form (Format) Authenticity
• Production Technique (Workmanship) Authenticity	• Production Technique (Workmanship) Authenticity
• Urban Environment and Location Authenticity	• Usage and Functionality Authenticity
• Spirit and Identity of the Building Authenticity	• Urban Environment and Location Authenticity
	• Spirit and Identity of the Building Authenticity

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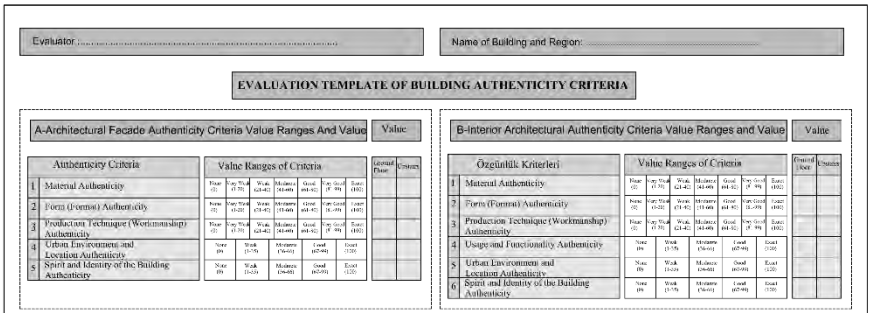
Zadeh's Fuzzy Logic and Fuzzy Clustering Theory was used for the value ranges of the determined authenticity criteria, and the evaluation criteria were divided into certain degrees (Zadeh, 1965). In this context, the authenticity value criteria; material authenticity, form (shape) authenticity and construction technique (workmanship) authenticity criteria: None (0), Very Little (1-20), Little (21-40), Moderate (41-60), Good (61- 80) Very Good (81-99), Full (100) 7 divided into sections. With authenticity value criteria; criteria of use and function authenticity, urban environment and location authenticity, and building spirit and identity: None (0), Less (1-35), Moderate (36-66), Good (67-99), Full (100) 5 divided into sections.

In the second stage: At this stage of the study, the definition and value ranges of Material Authenticity Value, Form (Format) Authenticity Values, Construction Technique (Workmanship) Authenticity Value, Use and Function Authenticity Value, Urban Environment and Location Authenticity Value and Spirit and Identity of the Building. Within the scope of the study, on-site evaluations will be made by the experts in order to compare and measure the authenticity of traditional houses. In this context, in order to be able to evaluate the general authenticity of the buildings more clearly, the authenticity assessment was made in two parts, the interior space and the architectural facade. In this context, it is aimed to evaluate the traditional houses by dividing them into two parts (Table2).

Table 2. It shows the specificity criterion value ranges for traditional houses to evaluate the architectural facade and interior authenticity.


Evaluator: .....

Name of Building and Region: .....

EVALUATION TEMPLATE OF BUILDING AUTHENTICITY CRITERIA

A-Architectural Facade Authenticity Criteria Value Ranges And Value | Value

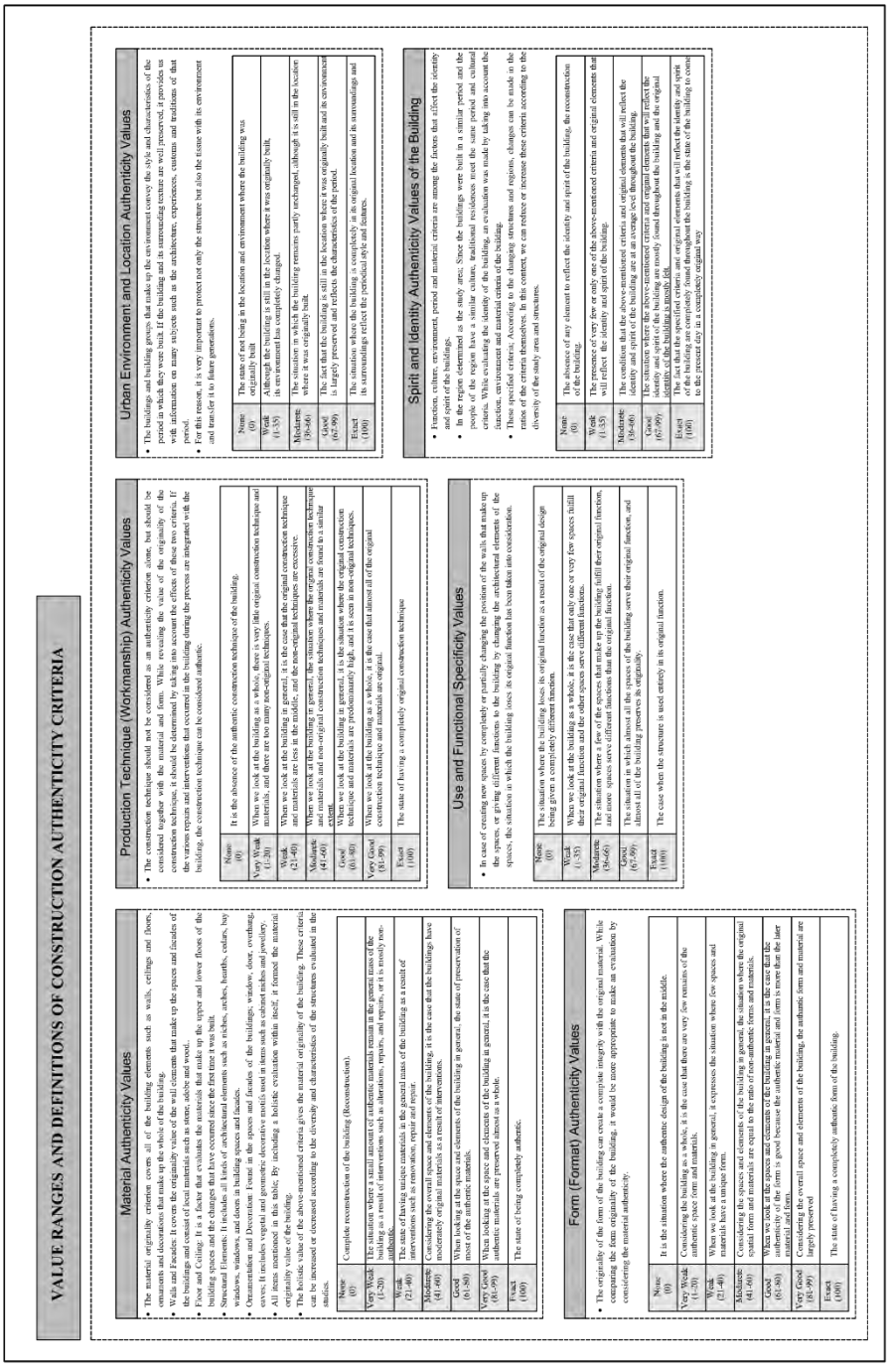
	Authenticity Criteria	Value Ranges of Criteria						Control Phase	Updates
1	Material Authenticity	None (0)	Very Little (1-20)	Little (21-40)	Moderate (41-60)	Good (61-80)	Very Good (81-99)	Exact (100)	
2	Form (Format) Authenticity	None (0)	Very Little (1-20)	Little (21-40)	Moderate (41-60)	Good (61-80)	Very Good (81-99)	Exact (100)	
3	Production Technique (Workmanship) Authenticity	None (0)	Very Little (1-20)	Little (21-40)	Moderate (41-60)	Good (61-80)	Very Good (81-99)	Exact (100)	
4	Urban Environment and Location Authenticity	None (0)	Weak (1-35)	Moderate (36-66)	Good (67-99)	Exact (100)			
5	Spirit and Identity of the Building Authenticity	None (0)	Weak (1-35)	Moderate (36-66)	Good (67-99)	Exact (100)			

B-Interior Architectural Authenticity Criteria Value Ranges and Value | Value

	Özgünlük Kriterleri	Value Ranges of Criteria						Control Phase	Updates
1	Material Authenticity	None (0)	Very Little (1-20)	Little (21-40)	Moderate (41-60)	Good (61-80)	Very Good (81-99)	Exact (100)	
2	Form (Format) Authenticity	None (0)	Very Little (1-20)	Little (21-40)	Moderate (41-60)	Good (61-80)	Very Good (81-99)	Exact (100)	
3	Production Technique (Workmanship) Authenticity	None (0)	Very Little (1-20)	Little (21-40)	Moderate (41-60)	Good (61-80)	Very Good (81-99)	Exact (100)	
4	Usage and Functionality Authenticity	None (0)	Weak (1-35)	Moderate (36-66)	Good (67-99)	Exact (100)			
5	Urban Environment and Location Authenticity	None (0)	Weak (1-35)	Moderate (36-66)	Good (67-99)	Exact (100)			
6	Spirit and Identity of the Building Authenticity	None (0)	Weak (1-35)	Moderate (36-66)	Good (67-99)	Exact (100)			

A detailed explanation of the authenticity criteria and value ranges has been made so that more accurate decisions can be taken during the evaluation phase of the buildings. In this context, authenticity evaluation tables have been created in order to enable the on-site evaluation of traditional houses (Table 3). Experts evaluated the structures in situ with these tables.

Table 3. Shows detailed descriptions of the value ranges of the authenticity criteria for assessing the architectural facade and interior authenticity of traditional houses.



In the third stage: At this stage, the authenticity criteria, the methods chosen for the evaluation of the authenticity of traditional houses, the functioning systematic of the methods used, and the chronology of the model's formation began to be explained.

- Since we can choose intermediate values instead of clear expressions such as yes or no, black or white, long or short, not authentic or authentic in evaluation situations that cannot be expressed in clear numbers numerically,
- Because it allows obtaining numerical expressions using verbal expressions.

DOI: 10.15320/ICONARP.2023.263

• Fuzzy Logic method was chosen in the study because the decisions are taken as a result of the opinions of the experts and the errors can be easily corrected during the decisions or during the results by means of the return in the rule table and it allows easy changes in the new entries and rule table (Figure 6).

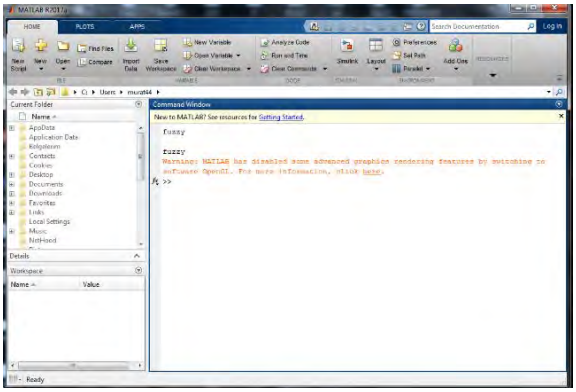


Figure 6. Area showing the location and opening window of the Fuzzy Logic system in Matlab2017a program

In the fourth stage: At this stage, the Fuzzy Logic program was used within the matlab program. In the Fuzzy Logic analysis method, in order to evaluate the authenticity of traditional houses, the criteria to be used are divided into two main categories: interior space and architectural façade. The grouping and value ranges of the authenticity criteria determined in these categories were determined. With this method, a three-stage system was created to create the architectural façade and interior authenticity evaluation model of traditional houses. The operating scheme and grouping of the criteria determined in the Fuzzy Logic system are explained in detail in the table below (Table 4).

Table 4. shows the value ranges of the structure specificity criteria in the rule database in the Fuzzy Logic method and the application stages of the grouped criteria in the system.

VALUE RANGE OF CONSTRUCTION AUTHENTICITY CRITERIA TEMPLATE

A-Architectural Facade Authenticity Criteria Value Ranges

Stage 1 Originality Criteria	Value Ranges of Criteria	
1 Material Authenticity		1.Authenticity Value
2 Form (Formal) Authenticity		
3 Production Technique (Workmanship) Authenticity		
Stage 2 Originality Criteria	**Value Ranges of Criteria**	
1 Urban Environment and Location Authenticity		2.Authenticity Value
2 Spirit and Identity of the Building Authenticity		
Stage 3 Originality Criteria	**Value Ranges of Criteria**	
1 1.Authenticity Value		General Authenticity Value
2 2.Authenticity Value		

B-Interior Architectural Authenticity Criteria

Stage 1 Originality Criteria	Value Ranges of Criteria	
1 Material Authenticity		1.Authenticity Value
2 Form (Formal) Authenticity		
3 Production Technique (Workmanship) Authenticity		
Stage 2 Originality Criteria	**Value Ranges of Criteria**	
1 Usage and Functionality Authenticity		2.Authenticity Value
2 Urban Environment and Location Authenticity		
3 Spirit and Identity of the Building Authenticity		
Stage 3 Originality Criteria	**Value Ranges of Criteria**	
1 1.Authenticity Value		General Authenticity Value
2 2.Authenticity Value		

After determining the value ranges of each criterion in the groupings created to evaluate the authenticity of the interior and architectural Façades of traditional houses and the stages of their operation into the system, the criteria of the determined authenticity values were entered in the input section in the Fuzzy Logic system. The value ranges of each criterion were entered into the system step by step, and the input part of the method was formed. In the same way, the criteria in the grouping were entered into the system by creating an output section with similar logic. These processes were carried out separately for architectural

façade authenticity criteria and interior authenticity criteria. In the Fuzzy Logic method, examples of the input and output criteria determined for the interior and architectural façade are indicated with visuals (Figure 7).

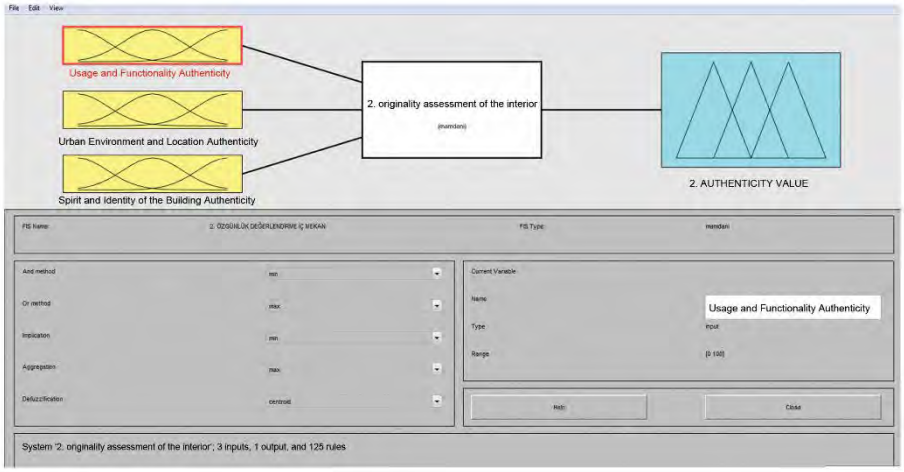


Figure 7. The 2nd authenticity value stage of the interior, which is one of the authenticity criteria determined in the Fuzzy Logic system, shows the input-input and output sections.

At this stage, the interior and architectural façade authenticity criteria are entered into the system one by one in the input and output section. After this process, the number of values and ranges of the criteria specified in figures 7 and 8 are specified in the system. (Figure 8).

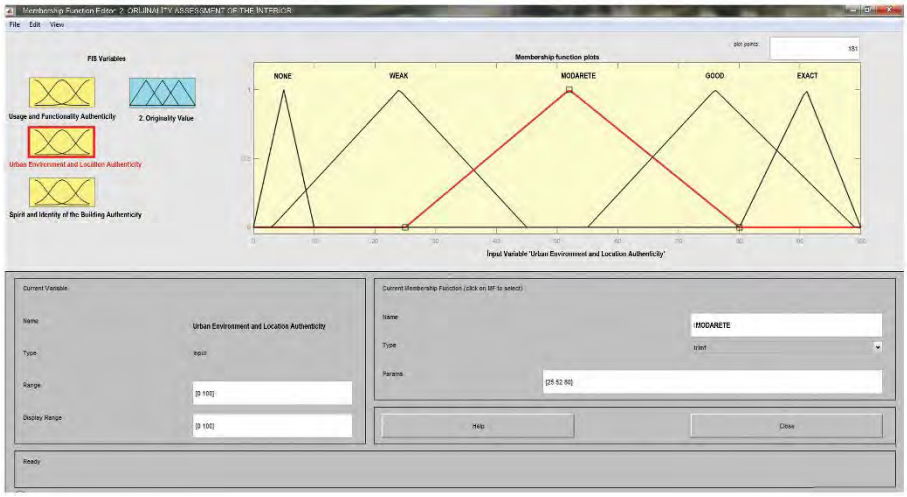


Figure 8. An example showing the value ranges of the input criteria in the Fuzzy Logic system, where the values are entered verbally and numerically

This process is done for all the criteria in the input and output sections. Then, the value ranges of each criterion were processed into the Fuzzy Logic system in line with the expert opinion. This stage coincides with the fuzzy and defuzzification houses, which are the stages in the Fuzzy Logic method. In this context, in short, the input and output criteria and value ranges of the model are processed into the system.

In the next stages, after processing the input criteria of the Fuzzy Logic system, the value ranges of the criteria in the output section and the data are entered (Figure9).

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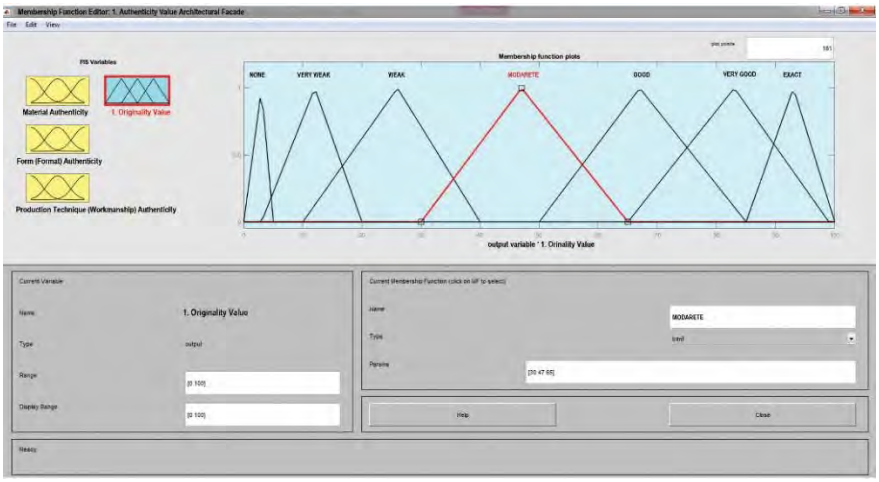


Figure 9. An example showing the value ranges of the output criteria in the Fuzzy Logic system, where the values are entered verbally and numerically

At this stage, after the criteria and values are processed in the input section, the rule table should be processed for each criterion and its values. In this phase of the system, a separate rule table was created for the groupings made in accordance with the criteria determined. In this context, the rule table of the criteria created for the interior and architectural façade authenticity model has been determined(Table 5). As can be seen in the table below, the authenticity evaluation criteria are evaluated in groups, and the authenticity evaluation rule shows the operation scheme.

Table 5. shows the architectural façade and interior authenticity value criteria and the rule table that will be applied in the Fuzzy Logic analysis method of these criteria.

BUILDING AUTHENTICITY EVALUATION CRITERIA RULE TEMPLATE

A-Architectural Facade Authenticity Criteria				B- Interior Architectural Authenticity Criteria			
Stage 1 Originality Criteria	Material Authenticity Form (Format) Authenticity Production Technique (Workmanship) Authenticity	Rule Table (343 Rules)	1.Authenticity Value	Stage 1 Originality Criteria	Material Authenticity Form (Format) Authenticity Production Technique (Workmanship) Authenticity	Rule Table (343 Rules)	1.Authenticity Value
Stage 2 Originality Criteria	Urban Environment and Location Authenticity Spirit and Identity of the Building Authenticity	Rule Table (25 Rules)	2.Authenticity Value	Stage 2 Originality Criteria	Usage and Functionality Authenticity Urban Environment and Location Authenticity Spirit and Identity of the Building Authenticity	Rule Table (125 Rules)	2.Authenticity Value
Stage 3 Originality Criteria	1.Authenticity Value 2.Authenticity Value	Rule Table (35 Rules)	General Authenticity Value	Stage 3 Originality Criteria	1.Authenticity Value 2.Authenticity Value	Rule Table (35 Rules)	General Authenticity Value

This stage is the most important stage of the Fuzzy Logic method and the authenticity assessment model. The probabilities of each criterion in the rule table divided into phases, which are determined according to the value ranges, should be processed one by one into the system. At this stage of the system, the AHP method comes into play in order to make a more quantitative and authentic evaluation while creating the rule table systematically.

In the fifth stage: At this stage, the authentic value weights of the criteria were determined by using the AHP method to create a rule table with a certain systematic in the authenticity evaluation model. As a result of these values, a rule table was created. In this way, it is aimed that the model that will emerge will make more objective and correct decisions. In this context, it was decided to take the opinions of the experts on the subject, accompanied by the evaluation template created to find out the authenticity criteria determined for the interior and architectural façade

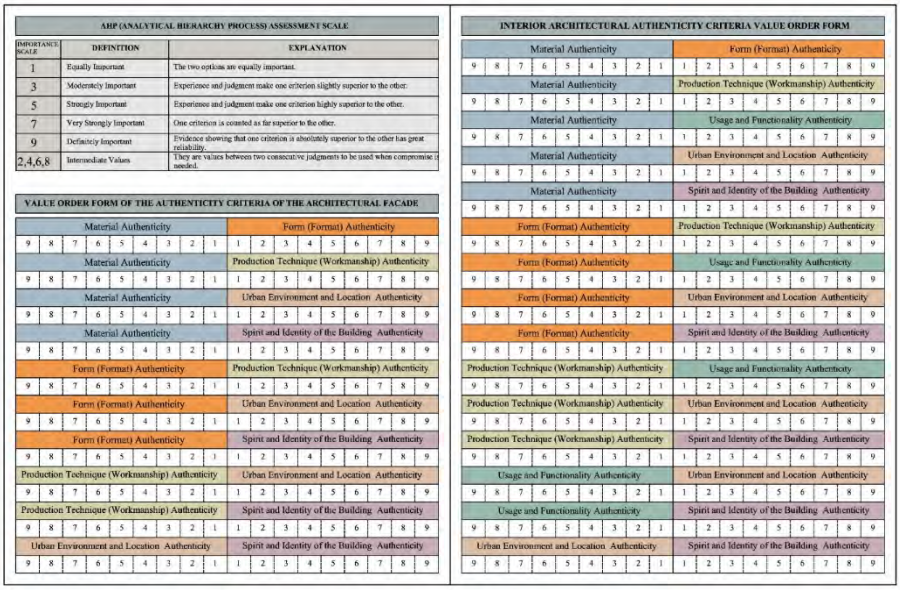
and the weight of the effect on the general authenticity of the traditional houses. The purpose of using the AHP method has been tried to be explained with the following tables(Table 6).

Table 6. An example showing the decision-making phase in the Fuzzy Logic system when the authenticity of the form changes in the rule table and the other criteria remain the same.

An example showing the case when Form authenticity is good when calculating the 1st Authenticity Value of the Structure in the rule table in the Fuzzy Logic method									
Material Authenticity	Form (Format) Authenticity	Production Technique (Workmanship) Authenticity	None	Very Weak	Weak	Modarete	Good	Very Good	Exact
Good	Good	Very Weak	None	Very Weak	Weak	Modarete	Good	Very Good	Exact
An example showing the case when Form authenticity is Very good when calculating the 1st Authenticity Value of the Structure in the rule table in the Fuzzy Logic method									
Material Authenticity	Form (Format) Authenticity	Production Technique (Workmanship) Authenticity	None	Very Weak	Weak	Modarete	Good	Very Good	Exact
Good	Very Good	Very Weak	None	Very Weak	Weak	Modarete	Good	Very Good	Exact

As stated in the example table 5, when creating the rule table in the Fuzzy Logic analysis method, in a situation where one of the authenticity evaluation criteria is different and the others are the same, how to determine whether the value result is the same or not. In this context, the authenticity criteria; It was decided to make the rule table with this systematic, by determining whether there is an equal effect on the general authenticity value of a building. At this stage of the study, instead of making the rule table according to the current knowledge and perception of the experts, the authentic weights of each criterion were calculated by using the AHP method. In this context, the authenticity criteria were evaluated in two separate sections as the architectural façade authenticity criteria and the interior architectural authenticity criteria, by creating a template using the AHP method(Table 7).

Table 7. The template created to determine the authentic weight values of the Authenticity Criteria with the AHP analysis method



AHP (ANALYTICAL HIERARCHY PROCESS) ASSESSMENT SCALE

IMPORTANCE SCALE	DEFINITION	EXPLANATION
1	Equally Important	The two options are equally important.
3	Moderately Important	Experience and judgment make one criterion slightly superior to the other.
5	Strongly Important	Experience and judgment make one criterion highly superior to the other.
7	Very Strongly Important	One criterion is counted as far superior to the other.
9	Definitely Important	Evidence showing that one criterion is absolutely superior to the other has great reliability.
2,4,6,8	Intermediate Values	They are values between two consecutive judgments to be used when compromise is needed.

VALUE ORDER FORM OF THE AUTHENTICITY CRITERIA OF THE ARCHITECTURAL FACADE

Material Authenticity									Form (Format) Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Material Authenticity									Production Technique (Workmanship) Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Material Authenticity									Urban Environment and Location Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Material Authenticity									Spirit and Identity of the Building Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Form (Format) Authenticity									Production Technique (Workmanship) Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Form (Format) Authenticity									Urban Environment and Location Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Form (Format) Authenticity									Spirit and Identity of the Building Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Production Technique (Workmanship) Authenticity									Urban Environment and Location Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Production Technique (Workmanship) Authenticity									Spirit and Identity of the Building Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Urban Environment and Location Authenticity									Spirit and Identity of the Building Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9

INTERIOR ARCHITECTURAL AUTHENTICITY CRITERIA VALUE ORDER FORM

Material Authenticity									Form (Format) Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Material Authenticity									Production Technique (Workmanship) Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Material Authenticity									Usage and Functionality Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Material Authenticity									Urban Environment and Location Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Material Authenticity									Spirit and Identity of the Building Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Form (Format) Authenticity									Production Technique (Workmanship) Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Form (Format) Authenticity									Usage and Functionality Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Form (Format) Authenticity									Urban Environment and Location Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Form (Format) Authenticity									Spirit and Identity of the Building Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Production Technique (Workmanship) Authenticity									Usage and Functionality Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Production Technique (Workmanship) Authenticity									Urban Environment and Location Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Production Technique (Workmanship) Authenticity									Spirit and Identity of the Building Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Usage and Functionality Authenticity									Urban Environment and Location Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Usage and Functionality Authenticity									Spirit and Identity of the Building Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Urban Environment and Location Authenticity									Spirit and Identity of the Building Authenticity								
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9

In the context of the template created within the scope of the study, 30 experts were asked about the effect of interior and architectural façade

DOI: 10.15320/ICONARP.2023.263

criteria on authenticity, and the authenticity effect values of the criteria were determined. The effect value weights of the authenticity criteria determined as a result of the evaluation were tabulated and used in the formation phase of the rule table in the Fuzzy Logic system (Table 8).

Table 8. shows the results of the authenticity effect weights of the architectural façade authenticity criteria by the experts using the AHP method.

Impact Values Of Architectural Facade Authenticity Criteria		
Arrangement	Authenticity Criteria	Impact Values
2	Material Authenticity	0,25
3	Form (Format) Authenticity	0,24
1	Production Technique (Workmanship) Authenticity	0,30
5	Urban Environment and Location Authenticity	0,07
4	Spirit and Identity of the Building Authenticity	0,14

In this context, in accordance with the purpose of the study with the AHP method; In the accompaniment of the data of the experts of the subject, the impact weights of the architectural façade authenticity criteria of traditional houses were revealed (Table 9).

Table 9. shows the results of the authenticity effect weights of the interior architectural authenticity criteria by the experts using the AHP method.

İmpact Values Of The İnterior Authenticity Criteria		
Arrangement	Authenticity Criteria	Impact Values
2	Material Authenticity	0,23
3	Form (Format) Authenticity	0,20
1	Production Technique (Workmanship) Authenticity	0,26
4	Usage and Functionality Authenticity	0,13
6	Urban Environment and Location Authenticity	0,06
5	Spirit and Identity of the Building Authenticity	0,12

In this context, in accordance with the purpose of the study with the AHP method; In the light of the data of the experts of the subject, the effect weights of the interior and architectural façade authenticity criteria of traditional houses were revealed. After calculating the value weights of the authenticity criteria with the AHP method, the average value of each criterion in each row in the rule table in the Fuzzy Logic system was calculated by multiplying the authentic value weights and the resulting rule value was obtained. In this way, while the rule database was created in the authenticity evaluation model, it was created in accordance with the specified systematic(Table 10). For example; To calculate the value of the 50th rule line of the 1st authenticity evaluation rule table in the architectural façade authenticity evaluation model; ((material authenticity effect value x material essence. value range avg.)+(form form authenticity effect value x form shape essence. value range avg.) +(construction technique workmanship authenticity effect value x construction technique workmanship essence value range avg.)) / ((sum of effect values of criteria)) = ((0.25x70.5) + (0.24x50.5) + (0.30x10.5)) / ((0.25+0.24+ 0, 30)) = **41,639.**

Table 10. During the creation of the architectural façade authenticity evaluation rule table with the Fuzzy Logic Method; An example showing the calculation of the value range by taking into account the value weights of the criteria determined by the AHP method

Rule order	Material Authenticity	Form (Format) Authenticity	Production Technique (Workmanship) Authenticity	Average value of the row	1. Authenticity value range						
	Good (61-80)	Modarete (41-60)	Very Weak (1-20)								
50	(Impact value)x (Good value avg.)	(Impact value)x (Modarete value avg.)	(Impact value)x (Very Weak value avg.)	Average Value	None (0)	Very Weak (1-20)	Weak (21-40)	Modarete (41-60)	Good (61-80)	Very Good (81-99)	Exact (100)
	(0,25x70,5)	(0,24x50,5)	(0,30x10,5)	(41,639)							

In this context, a rule table was created by applying these processes to each rule in the arid table of the authenticity assessment model created by using the Fuzzy Logic method.[1] As a result of the processing of these created rules into the system, the rule database was completed and the system was enabled to work (Figure10).

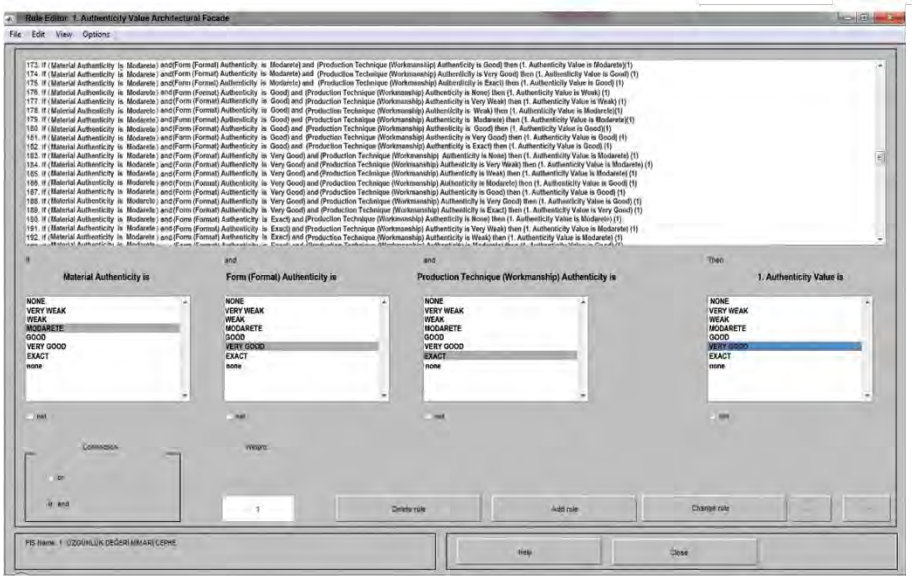


Figure 10. An example showing the stage where each probability of the criteria and value ranges in the rule table in the Fuzzy Logic system is processed separately into the system.

Thus, for example, by determining the effect value of material authenticity criteria and construction technique or urban environment and location criteria on the authenticity of traditional houses, more objective decisions were made by experts.

In the sixth stage: In the Fuzzy Logic system, the authenticity model of interior and architectural Façades and the authenticity evaluation model were completed by creating the rule table as specified. After the rule table was completed, the authenticity assessment model was created. Each floor of the interior and architectural Façades of the traditional houses to be evaluated was evaluated separately and the architectural façade authenticity values and interior architectural authenticity values of each floor were calculated. In this context, the values of the authenticity criteria determined by examining the structures of each house on site by experts were processed into the model and the general authenticity values of the building were calculated (Figure11).[2]

[1] For the formation stages of the authenticity model created by using Fuzzy Logic and AHP method in the study and the rule table forming the main fiction of the study, see (Şahin, 2021).

[2] For the data of the rule table in the Fuzzy logic method, which is the main element of the authenticity evaluation model, see(Şahin, 2021).

DOI: 10.15320/ICONARP.2023.263

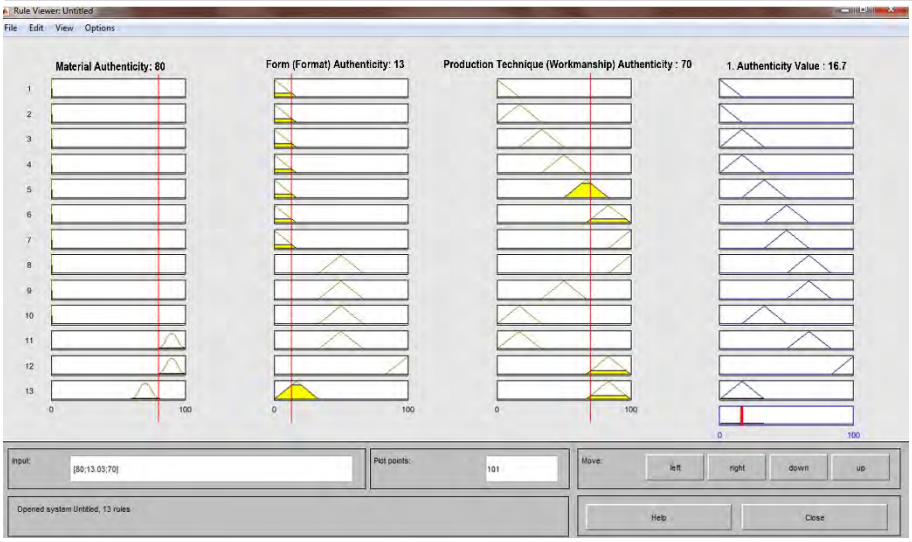


Figure 11. An example showing the result of the 1st uniqueness value as a result of the given values of the authenticity criteria in the authenticity evaluation model

Thanks to the evaluation model created within the scope of the study, the interior and architectural façade authenticities of the traditional house in the study area were determined and their numerical values were revealed.

EVALUATION OF THE AUTHENTIC ANALYSIS OF AHMET KÖKÇÜ HOUSE IN THE STUDY AREA

Due to its geographical and topographic features, trade routes have been established and developed by various societies and groups throughout history in Anatolia, and the infrastructure of today's cities has been established at the intersections of these roads (Tuncer, 2007; Bayram, 2003). These established cities have been the places where all kinds of activities such as socio-cultural, architectural, economic and commercial activities took place and were shaped by those societies and the region. In this context, Malatya region stands out as the best examples of this formation and development (Demirbağ and Fırat, 2013). Yakınca region, which is the study area, is a neighborhood of Yeşilyurt district(Figure12). Yesilyurt district's campus history M.S. It is thought to date back to the Byzantine Period between 395-697. The settlement of Turks in this area started in the Dulkadiroğlu Principality period between 1378-1399 (Temiz, 1990; Külahçı and Temiz, 1993; Aytaç, 2015).

Figure 12. It shows the locations of Yeşilyurt district and Yakınca Mahallesi campuses.

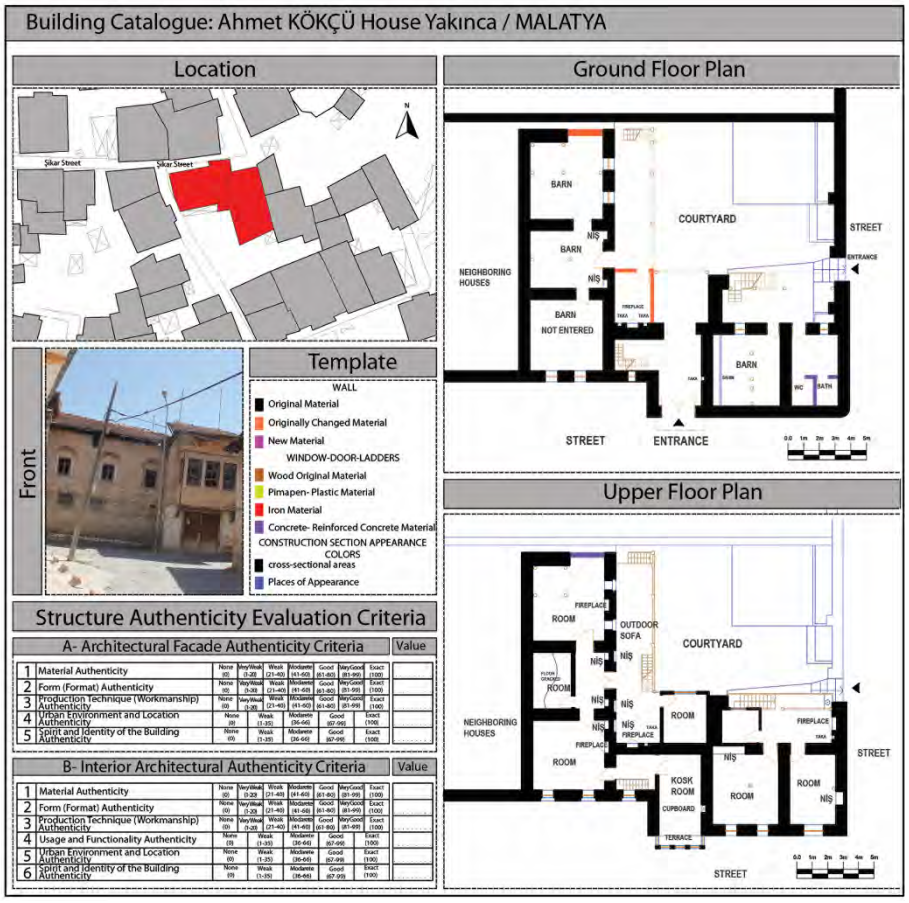
Yeşilyurt and Yakınca houses stand out as examples that best reflect their cultural heritage, as they have preserved their authenticity and texture in the context of street texture. The construction dates of these traditional houses are XIX. midcentury to XX. It is dated to the first quarter of the century. [1](Temiz, 1990; Külahçı ve Temiz, 1993).

[1] For detailed information about the general characteristics of Malatya Yeşilyurt Houses that make up the study area, see (Şahin, 2021).

Evaluation of Ahmet Kökçü House

In order to evaluate the Ahmet Kökçü House within the scope of the study, the floor plans were created by taking the surveys of the ground and upper floor plans of the building. In the floor plans created, it was made in accordance with the needs and conditions of the period; Architectural elements such as cupboards, jewellery, niches, hearths, cedars, doors, and windows have been elaborated in detail. Every region including the interior, courtyard, garden and exterior, including the architectural elements in all spaces of the building, is illustrated. In this context, a building evaluation catalog was created including the site plan, floor plans, interior, architectural façade pictures and general information of the building (Table 11).

Table 11. Ahmet Kökçü House Architectural Evaluation Analysis and Building Catalog



XX. The building, which is dated to the first quarter of the 19th century, consists of a ground floor and an upper floor. On the ground floor of the building, spaces such as rooms, warehouses and barns were designed to meet the needs of the period. On the upper floor of the building, spaces

DOI: 10.15320/ICONARP.2023.263

were designed to serve two families, and the rooms were designed according to the needs and conditions of the period; Architectural elements such as cabinets, niches, jewellery, hearths and cedars were frequently used. The building has a space organization in which the inner sofa and the outer sofa are used together(Figure13).

Figure 13. Shows interior pictures of Ahmet Kökçü House.

The outer sofas are designed to serve two families by connecting the courtyard with a staircase. Although there is only one entrance from the street, the structures designed to serve two families indoors are frequently encountered in Yakınca houses. The building has two entrances with a wooden double-winged door, one from the front and one from the courtyard on the side. In the courtyard of the building surrounded by a high wall, there are architectural elements such as a hearth, a niche and a fountain for the users to spend some of their time.
From the ground floor entrance on the front of the building, a connection is provided from the iwan to the upper floor, the back courtyard and the outer sofa stairs. The building, which was built in an adjacent order and corner, has a room-length overhang on the front façade facing the street and above the iwan. While the main walls of the building, which is positioned on a stone foundation, were built with a mud brick masonry system, the protrusion and interior walls were made of mud brick and wooden materials using the civet technique. Today, the building, which maintains its authentic function, is not actively used. The building has not undergone any intervention or approach in the context of conservation(Figure14)

Figure 14. Views from Ahmet Kökçü House

In order to evaluate the authenticity of the interior and architectural façade of Ahmet Kökçü House, the interior and architectural Façades of the building were examined in detail by making on-site observations, with the building catalog (Table 11) and the building evaluation form (Table 2-3) created in the company of experts. While the authenticity of the building is evaluated by experts, each floor on the interior and architectural façade includes the hearth, tandoor, sofa, door, window; A special, general evaluation was made for each floor, covering the architectural elements such as walls, floors, ceilings, and the whole of the materials. The evaluations of the experts are detailed in the table below (Table 12).

Table 12. shows the values of the authenticity criteria evaluated by experts on the ground floor and upper floor architectural Façades and interiors of Ahmet Kökçü House.

Ahmet Kökçü House- Ground Floor- Yakınca/Malatya							
Architectural Facade Authenticity Evaluation							
Architectural Facade Evaluation	Expert A	Expert B	Expert C	Expert D	Expert E	Expert F	Expert G
Material Authenticity	95	90	98	97	90	90	95
Form (Format) Authenticity	95	85	95	95	95	95	90
Production Technique (Workmanship) Authenticity	95	90	95	95	90	95	90
Urban Environment and Location Authenticity	95	90	95	97	90	97	97
Spirit and Identity of the Building Authenticity	95	95	98	97	95	97	97
Interior Authenticity Evaluation							
Indoor Evaluation	Expert A	Expert B	Expert C	Expert D	Expert E	Expert F	Expert G
Material Authenticity	95	80	95	95	90	95	95
Form (Format) Authenticity	95	90	98	90	85	90	90
Production Technique (Workmanship) Authenticity	90	90	95	97	90	90	90
Usage and Functionality Authenticity	97	85	95	90	90	97	97
Urban Environment and Location Authenticity	97	95	95	97	95	97	97
Spirit and Identity of the Building Authenticity	95	95	98	97	95	97	97
Ahmet Kökçü House- Upstairs - Yakınca/Malatya							
Architectural Facade Authenticity Evaluation							
Architectural Facade Evaluation	Expert A	Expert B	Expert C	Expert D	Expert E	Expert F	Expert G
Material Authenticity	95	90	95	97	90	95	95
Form (Format) Authenticity	95	90	95	95	95	95	90
Production Technique (Workmanship) Authenticity	95	90	95	95	95	95	90
Urban Environment and Location Authenticity	95	90	95	97	95	97	97
Spirit and Identity of the Building Authenticity	95	95	95	97	95	97	97
Interior Authenticity Evaluation							
Indoor Evaluation	Expert A	Expert B	Expert C	Expert D	Expert E	Expert F	Expert G
Material Authenticity	95	85	95	95	90	95	95
Form (Format) Authenticity	95	90	95	90	90	90	90
Production Technique (Workmanship) Authenticity	90	90	95	97	90	90	90
Usage and Functionality Authenticity	95	95	95	85	95	97	97
Urban Environment and Location Authenticity	97	95	95	97	95	97	97
Spirit and Identity of the Building Authenticity	95	95	95	97	95	97	97

When the authenticity data of Ahmet Kökçü House, determined by the experts with the on-site authenticity criteria, were processed in the authenticity evaluation model developed, the authenticity values of the interior and architectural Façades were revealed for each floor of the building. These determined authenticity values are expressed in tabular form(Table 13).

Table 13. Authenticity values in the authenticity assessment model of Ahmet Kökçü Evi

Evaluation of the Originality of Ahmet Kökçü House - Yakınca / Malatya									
Experts		Expert A	Expert B	Expert C	Expert D	Expert E	Expert F	Expert G	Ave.
Architectural facade authenticity values	Ground floor	82.5	81.3	82.5	82.1	81.3	82.4	81.1	81.9
	Upstairs	82.5	81.3	80.7	82.1	81.2	82.5	81.1	81.6
Interior authenticity values	Ground floor	84.8	82.9	84.9	84.4	82.9	82.9	82.9	83.6
	Upstairs	84.8	82.9	82.3	84.4	82.9	82.9	82.9	83.3

As a result of the authenticity values that emerged, although the interior authenticity value of Ahmet Kökçü House was slightly higher, the interior and architectural façade authenticities were found to be similar in general and it was determined numerically and proportionally that they preserved their authenticity at a very good level. On the ground floor of the building, a space was created by using unique materials for only one room in the process, while in another room; Kitchen, WC, bathroom spaces have been added using today's materials. These kind of additions and changes have negatively affected the authenticity of the building. It is understood that the building has preserved its authenticity value very well as a result of factors such as the fact that there is almost no intervention on the exterior of the building, the building maintains its authentic function, and the surrounding of the building has been preserved to a great extent. The building has a unique position in terms of its spatial setup, architectural elements, material properties, façade and ornamental features.

DISCUSSION AND CONCLUSION

Traditional houses, which form an important part of the cultural heritage, provide data on many cultural norms such as the architectural style of the period, terms and conditions, construction techniques. Traditional Turkish house; It is one of the architectural examples that

DOI: 10.15320/ICONARP.2023.263

transfers the rich material and structure of the period and the region to future generations, shaped according to the cultural diversity, geographical and climatic conditions. These residences are healthy, useful and low cost, but perishable buildings. This is the main reason why they wear out over time. The main element of preserving the authenticity of buildings is through constant maintenance. Preserving these valuable cultural heritages and transferring them to future generations in an authentic way has become a subject that increases its importance day by day. traditional residences; It is gradually disappearing in our age due to many reasons such as rent, unplanned urbanization, wear of the material, neglect and unconsciousness, or it can survive until today by losing its cultural heritage values as a result of interventions and practices. Malatya central region has lost its traditional texture and identity to a great extent. The Yakınca Region, which constitutes the scope of the study, is one of the rare regions that has largely preserved its traditional texture and identity. This cultural texture reflecting the traditional housing culture of Malatya; It disappears due to reasons such as rent, irregular settlement, unconsciousness(Figure 15).

Figure 15. It shows the organic texture of Yakınca District and the location of Ahmet Kökçü House.

Looking at the site plan in Figure 15, it is understood that the Yakınca region has survived to the present day by preserving its organic street texture and identity. These cultural heritage values need to be protected with a holistic approach[1]. This rich culture and values of traditional houses have been tried to be conveyed and examined in the context of Malatya traditional houses. In order to reveal the architectural values of traditional houses, which constitute an important part of the cultural heritage, an evaluation model was developed based on the criteria of authenticity values, and the authenticity of the buildings was evaluated.
As a result, with the evaluations made, it has been revealed that the Ahmet Kökçü House in the Yakınca Neighborhood has largely preserved its authenticity. In this context, as a result of the field study, in the light of the data obtained from the authenticity assessment model, it has been revealed that all kinds of interventions applied to the structures greatly damage the authenticity. It has been determined that practices such as street rehabilitation, restoration, re-functioning and landscaping applied to the buildings damage the authenticity of the buildings.

[1] Survey drawings of a total of 20 houses in figure 15 were made and their authenticity was evaluated. For detailed information, see (Şahin, 2021).

In the study, as a result of the application of the authenticity evaluation model, which was created by using AHP and Fuzzy Logic analysis methods, in the evaluation of the authenticity of traditional houses, the following suggestions about the system were developed:

• Using the AHP method, which is a part of the authenticity evaluation model, the impact weights of the authenticity criteria for traditional houses were determined in the presence of experts, and the effect on the general authenticity of the buildings on the interior and architectural Façades was calculated. In this context, the impact weights of the said criteria, accompanied by experts in the subject; It can be easily recalculated and integrated into the model as a result of variables such as the subject, scope, field and experts studied.

• As a result of the developed authenticity assessment model, it is possible to evaluate the authenticity of traditional houses in every region of Anatolia.

• The authenticity assessment model developed; authenticity value criteria, value ranges, definitions, impact values and rule database forming the main backbone of the model; The system can be reconfigured by changing the factors specified by the experts as a result of variables such as the subject, area and scope to be studied. Thus, using this model in all kinds of traditional and monumental structures, the authenticity of the structures can be evaluated.

From this point of view, the suggestions developed after the data revealed in the light of the field studies carried out with the authenticity assessment model are as follows:

• Traditional houses need to be protected in a sustainable way, with minimal intervention to the façade, space and architectural elements, preserving their authentic functions and environmental texture as much as possible. Every intervention applied damages the authenticity of the structures. As can be seen in the study, the authenticity of the Ahmet Kökçü House in the Yakınca Neighborhood, which has seen almost no intervention, has been determined to be very high.

• In this process, where the residential periphery of the city of Malatya extends rapidly to Yeşilyurt district and Yakınca District, local administrators and relevant institutions should take steps to protect these structures in a holistic way, before the traditional texture and structures in the Yakınca District are destroyed and lose their authenticity.

As a result, it is thought that the evaluation model developed within the scope of the study can be used and applied for historical and traditional buildings in every region of Anatolia, and it will lead to similar studies in the context of traditional houses within the scope of the study area.

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Resume

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