ARCHITECTURAL SCIENCES AND URBAN/ENVIRONMENTAL STUDIES - II

Editors
Dr. Mert ÇAKIR
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PREFACE

It is with great pleasure that we welcome you to the book, titled **"Architectural Sciences and Urban/Environmental Studies -II."** This volume, like its predecessor, represents the culmination of extensive research, insightful analysis, and a collective dedication to advancing our understanding of the complex and evolving realms of architecture, urban planning, landscape architecture, and environmental studies.

In this book, you will find contributions from a diverse group of scholars, practitioners, and researchers, each offering their own unique perspectives and insights into the complex web of relationships that define our built and natural environments. These contributions span a wide range of topics, from sustainable design practices and the reimagining of urban spaces to the exploration of innovative materials and technologies that are shaping the future of architecture.

As the editors of this volume, we are honored to have had the opportunity to curate a selection of outstanding contributions from scholars, researchers, and practitioners who are at the forefront of these disciplines. Their work encapsulates the diverse and ever-expanding landscape of architectural and environmental studies, providing readers with a comprehensive exploration of the latest trends, innovations, and critical perspectives that define these fields today.

In the pages that follow, you will encounter rigorous research, innovative ideas, and visionary proposals. We hope that these contributions will not only inform and inspire you but also spark meaningful conversations and collaborations among scholars, practitioners, and policymakers. By bringing together bright minds in architectural sciences, urban planning, landscape architecture, and environmental studies, we aim to contribute to the advancement of knowledge and the creation of sustainable, resilient, and aesthetically pleasing built environments.

One of the fundamental goals of this book series is to foster interdisciplinary dialogue and collaboration. It is our hope that the diverse perspectives and approaches presented in these pages will encourage readers to think critically, engage in meaningful discourse, and inspire new avenues of research and practice. The intersection of architectural sciences and urban/environmental studies offers a wealth of opportunities for innovation, and the insights shared in this volume have the potential to shape the future of our built environment in profound ways.

We extend our heartfelt gratitude to all the authors who have contributed their time and expertise to this volume, as well as to our reviewers and the publishing team for their invaluable support in bringing this project to fruition.

We also extend our appreciation to Prof. Dr. Atila Gül (the general coordinator of the architectural sciences book series), whose unwavering support and expertise have been instrumental in bringing this book to fruition.

Lastly, we want to thank you, the readers. It is your curiosity, passion, and commitment to these fields that make the pursuit of knowledge in architectural sciences, urban planning, and environmental studies a continually rewarding endeavor. We hope that **"Architectural Sciences and Urban/Environmental Studies -II"** serves as a valuable resource and source of inspiration for your own explorations and contributions to these vital disciplines.

Thank you for joining us on this exciting and enlightening journey.

EDITORS
Dr. Mert ÇAKIR
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October, 2023

CONTENTS

Green Infrastrucutre Systems for Urban Resilience

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1. Introduction

The world population is increasing rapidly. Most of this population lives in cities. According to the 2018 population data of the United Nations, more than half of the world lives in cities. In the 1950s, this figure was 30%. In 2050, this figure is expected to be 68%. (United Nations, 2019). Already (mid 2023) 4.6 billion people worldwide (world population approximately 8 billion) live in towns or cities. This figure is 57% of the world's population (URL-1).

This rapid increase in population causes more use of terrestrial areas by people. The places where human use is most intense are cities today. Cities cover less than 2% of the earth's surface. The figure is apparently quite small, but the power of this number to affect the world is quite high (United Nations, 2023). Because it consumes 75% of the world's resources (Madlener & Sunak, 2011). The United Nations Human Settlements Program (UN-Habitat) expresses this effect as follows: "It consumes 78% of the world's energy and produces more than 60% of the world's green gases. The gradual reduction of green spaces is exacerbating the problem". Limiting global warming to 1.5 degrees Celsius “will require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings) and industrial systems,” according to the Intergovernmental Panel on Climate Change Report. Pollution, often associated as a byproduct of urban landscapes, is linked to climate change (United Nations, 2023). But other problems are increasing in cities. For example, faulty land uses, decrease in biodiversity, forest fires, land-housing price increases, inability to feed underground water resources and disasters caused by the spreading/scattering of cities more than normal (Habibi & Asadi, 2011; Demiroglu et al., 2014a; OECD, 2018; Cengiz et al., 2019; Demiroğlu et al., 2019; Demiroğlu & Karadağ, 2021; Yanık & Öztürk Kurtaslan, 2022). A recent report by the United Nations International Strategy for Disaster Reduction (UNISDR) reveals that natural disasters have killed 1.3 million people over the past 20 years, and 4.4 billion more have been injured, left homeless or in need of emergency assistance (United Nations, 2023). Most of these disasters occur in cities.

Today about 31% of the 31% of the global urbanized surface is potentially exposed to earthquakes. In the last 40 years, earthquakes have occurred with an increase of 145%. 42% of the total population living in these countries live in dangerous areas. Exposure to other hazards such as hurricanes, volcanoes and floods follow similar trends. In the last decade, natural disasters have affected more than 220 million people. By 2030, natural disasters could cost cities around the world three times more damage than they do today (European Commission, 2023).

Nowaday, predicted or unpredictable, man-made or natural disasters and situations necessitate cities to be more resilient. In this study; The contribution of green infrastructure systems, which is one of the urban planning approaches, to urban resilience has been examined. The study consists of three parts. In the first part, the concept of resilient urban; in the second part, the green infrastructure system, in the third part, the contributions of green infrastructure to iurban resilience was examined. In the fourth chapter, conclusions and recommendations are given.

2. Urban Resilience

2.1. The Concept of Resilience and Urban Resilience

The concept of resilience is a broad concept. Different disciplines evaluate and use the concept from their own perspective (Ersavaş Kavanoz, 2020). Therefore, physics, psychology, sociology, ecology, environment, etc. many disciplines use the concept of resistance. In the use of the concept, the concepts of *"maintaining", "healing" and "seeking balance"* are key points of their framework (Chelleri, 2012).

The metaphor of "*resilience*" emerged at the end of the last century. It has been used as a means of reaching sustainable cities in urban and regional planning (Acierno, 2015). The combined use of the concept of city and resilience is based on ecology. The combined use of the concept of city and resilience is based on ecology. The combined use of the concept of city and resilience is based on ecology. The combined use of the concept of city and resilience is based on ecology. The combined use of the concept of city and resilience is based on ecology (Ersavaş Kavanoz, 2020). Because the city/urban is an ecosystem/is the techno ecosystem. Resistance, on the other hand, has definitions related to the stance of both the individual and the system against events other than the current situation.

In ecology, Holling was the first to use the concept of resistance in 1973. According to Holling (1973), *“Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist. In this definition resilience is the property of the system and persistence or probability of extinction is the result. Resistance should not be confused with stability. Stability, is the ability of a system to return to an equilibrium state after a temporary disturbance. The more rapidly it returns, and with the least fluctuation, the more stable it is. In this definition stability is the property of the system and the degree of fluctuation around specific states the result”*. However, criticism of the definition led Holling in 1996 to divide resistance into two classes. These: static "engineering" resilience and dynamic "*ecological*" resilience. Static "*engineering*" resilience; is the ability of a system to revert to its previous state. Dynamic "*ecologica*l" resilience; it is about the ability to return to the previous state and maintain the basic functions of the system (Meerow & Nevell, 2016).

When speaking of ecological resilience, it is important to emphasize the concept of environmental resilience as well. Concepts emphasize the same thing with a slight difference. Ecological resilience and environmental resilience are synonymous when describing how an ecosystem resists invasive species by limiting their survival, reproduction rates and overall population growth. The difference is that the expression of environmental resistance includes the effects of both living and non-living factors that help maintain the trophic and biological organization of an ecosystem in the face of the emergence of a stressor (Kamiya et al., 2023). Here, abiotic factors related to environmental resistance are described in more detail.

To understand the concept of resilience in ecology, the inter related concepts of vulnerability (V), *resilience (R)*, and *adaptation (AC)* are very important. Vulnerability; It is used to mean that sensitive systems are exposed to intense pressure (stress/danger/discomfort) and cannot be adapted and exposed to deterioration/change (Adger, 2006; Birkmann & Wisner, 2006; Gallopin, 2006; Golobič & Žaucer, 2010; Aretano, 2015; Vaillant et al., 2016). Other available definitions of the concept are mostly are variants of the basic definition. Resilience is the ability of a species and/or its habitat to recover from stress and disturbance. Resilience and resistance concepts are also different. Resistance is the capacity of an ecosystem to maintain (or remain largely unchanged) its basic structure, processes and functioning despite stresses, disturbances or invasive species (URL-2). Adaptation capacity; It is the ability of a system to heal under pressure, reorganize and develop itself, and cope with the effects of deterioration (Metzger et al., 2006; Vaillant et al., 2016).

The concept of *"resistance"* in the field of ecology, natural disasters-risk management, hazards, adaptation to climate change, engineering, energy systems, planning, etc. His emphasis on issues has influenced urban ecologists and urban theorists. Especially; Disturbances due to climate change or hazards and disasters have brought resilience of cities to the agenda (Leichenko, 2011; Meerow et al., 2016; Sharifi, 2020; Glaeser, 2022). Thus, resistance began to be used to express urban resilience.

Meerow et al. (2016) identified 25 different/basic definitions in a meta-analysis of the urban resilience literature. They noted that roughly half of the definitions are presented in the context of a particular threat (for example, climate change or flood), while the other half refer to the flexibility of an urban system to respond to all risks. Urban resilience is portrayed in definitions in a uniform way as a desirable goal, a stance. They noted that more than half of the definitions emphasized a high level of general adaptive capacity as opposed to adaptability. From this point of view, they evaluated the definitions in detail. As a result of the evaluations, he concluded that the concept of resilience for cities is a controversial concept and not well defined. He noted that existing definitions are “inconsistent and underdeveloped in terms of incorporating important concepts found in both resilience theory and urban theory.” Within the framework of the current situation, he made the following definition in a flexible and inclusive way to include different perspectives, conceptual tensions and allow development (Meerow & Newel, 2016).

According to Meerow and Newell (2016) "urban resilience refers to the ability of an urban system-and all its constituent socio-ecological and socio-technical networks across temporal and spatial scales-to maintain or rapidly return to desired functions in the face of a disturbance, to adapt to change, and to quickly transform systems that limit current or future adaptive capacity." After Meerow et al., (2016), Ribeiro and Pena Jardim Gonçalves (2019) conducted a meta-analysis of the urban resilience literature in 2019, examining and discussing new concepts (Table 1).

Table 1. Definitions of urban resilience (Ribeiro & Pena Jardim Gonçalves, 2019)

Scientific Area(s)	Definitions of urban resilience	Author(s)
Agricultural and biological sciences;	Resilience is the degree to which cities tolerate the change before reorganizing around a new set of structures and processes and depends on the ability of cities to maintain their eco-systemic and human functions simultaneously.	Alberti et al. (2003)
Engineering;	A resilient city is a sustainable network of physical systems and human communities.	Godschalk (2003)
Agricultural and biological sciences;	It is recommended that resilience only be used in a restricted sense to describe specific system attributes relating to: (i) the amount of disturbances a system can absorb and remain within the same state or domain of attraction and (ii) that the system is able to self-organize.	Klein et al. (2003)
Environmental science; social sciences;	Resilience is the ability of a system to adjust to changing conditions.	Pickett et al. (2004)
Social sciences;	Urban resilience is the ability of a city to recover from destruction.	Campanella (2006)
Business management and accounting; psychology;	Urban resilience refers both to design changes (structural, architectural, spatial planning) and to management and governance measures that aim to prevent or mitigate the physical and social vulnerability of urban areas, to protect life, property and the economic activity of the city.	Coaffee and O'Hare (2008)
Environmental science;	Resilience is the ability of a socio-ecological system to sustain a given set of ecosystem services in the face of uncertainty and change for a community.	Ernstson (2008b)
Environmental science; social sciences;	Urban resilience means extending the concept of resilience from technical systems to social systems, particularly to cities, and their ability to recover and continue to provide their main functions of life, commerce, industry, government, and social gathering in the face of calamities and other hazards.	Hamilton (2009)
Environmental science; social sciences;	From a resilient perspective, governance can be thought as a propositional collective action to sustain and improve a regime, or to trigger a transition from the system to a preferable regime.	Ernstson et al. (2010)
Environmental science;	A resilient system is a system that can tolerate disturbances by means of characteristics or measures that limit its impacts, reducing or neutralizing damages and disturbances, and allowing the system to respond, recover and adapt quickly to such disturbances.	Wardekker et al. (2010)
Environmental science; social sciences;	Resilience is the ability of systems to organize and recover from changes and disruptions without change to other states-that is, systems that are "safe to fail."	Ahern (2011)
Business management and accounting; energy; engineering; social science;	Urban resilience usually refers to the ability of a city or urban system to resist a wide range of shocks and tensions.	Leichenko (2011)
Earth and planetary sciences; social sciences;	In the case of urban adaptation to climate, a resilience-based approach encourages practitioners to consider innovation and change to help recover from tensions and shocks that may or may not be predictable.	Tyler and Moench (2012)
Engineering; social sciences;	Urban resilience to flooding is a city's ability to tolerate flooding and reorganize if physical damage and socio-economic disturbances occur to prevent death and injury and maintain current socio-economic identity.	Liao (2012)
Environmental science; social sciences;	Although urban resilience usually refers only to the ability to maintain functions and structures, it must be framed in the visions of resilience (system persistence), transition (incremental system change), and transformation (system reconfiguration).	Chelleri (2012)
Social sciences;	Resilience is the ability of an urban asset, location and / or system to provide predictable performance.	Brugmann (2012)
Business management and accounting; social sciences;	A climate-resilient city is one that can resist climate stress, respond effectively to climate-related risks, and quickly recover from residual negative impacts.	Henstra (2012)
Business management and accounting; social sciences;	Resilience is the ability of an individual, community, or institution to respond dynamically and effectively to changing climatic conditions, continuing to function at an acceptable level.	Brown et al. (2012)
Agricultural and biological sciences;	Resilience is the ability of a city to absorb disturbances while maintaining its functions and structures.	Lu and Stead (2013)
Business management and accounting; social sciences;	Resilience is the ability of populations and urban systems to resist a wide range of hazards and stresses.	Romero-Lankao and Gnatz (2013)
Agricultural and biological sciences; environmental science; social sciences;	Urban resilience is the ability of a city to persist without qualitative changes in its structure and function, despite the disturbances.	Wu and Wu (2013)
Engineering; social sciences;	A more comprehensive definition of a resilient city emphasizes a community's overall ability and ability to withstand stress, survive, adapt and recover from a crisis or disaster, and move forward quickly.	Wagner and Breil (2013)
Environmental science;	Resilience refers to a set of urban ecosystems that provide benefits to livelihoods and urban well-being.	McPhearson et al. (2015)
Social sciences;	Urban resilience refers to the ability of an urban system and all its socio-ecological and sociotechnical networks to maintain or rapidly return to the desired functions in the face of a disturbance and adapt to change, and to rapidly transform systems that limit capacity adaptive current or future.	Meerow, Newell, and Stults (2016)
Agricultural and biological sciences;	Urban resilience can be defined in evolutionary terms as a proactive vision for planning, policy formulation, and strategic direction in which communities play a vital role in resilient place modelling through their active learning ability, robustness, capacity for innovation and adaptability.	Mehmood (2016)
Engineering;	Resilience is the ability of individuals, communities, institutions, companies, and systems in a city to survive, adapt, and grow regardless of the type of chronic stress and acute shocks to which they are subject.	Spaans and Waterhout (2017)

They also identified four cornerstones of urban resilience within the definitions: resilience, recovery, adaptation, and transformation. In this context, they defined urban resistance as follows; urban resilience, the capacity of a city and its urban systems (social, economic, natural, human, technical, physical) to meet the first damage, from a disturbance (shock, natural disaster, changing weather, disasters, crises) or disruptive events), adapting to change and systems that limit current or future adaptability (Ribeiro & Pena Jardim Gonçalves, 2019).

Ribeiro & Pena Jardim Gonçalves (2019), Figure 1, he presents a flowchart representing the concept of urban resilience and translating the way the concept emerged. A resilient urban system becomes a conceptual tool that must always be evaluated in terms of its “ability to resist, sustain, heal, adapt or transform” in the face of a range of disturbances, the effects of which tend to destabilize the system's equilibrium.

While the term *"resilience cities"* often refers only to the capacity to maintain functions and structures, he argued that urban resilience should be framed within views of resilience (system permanence), transition (system gradual change), and transformation (system restructuring).

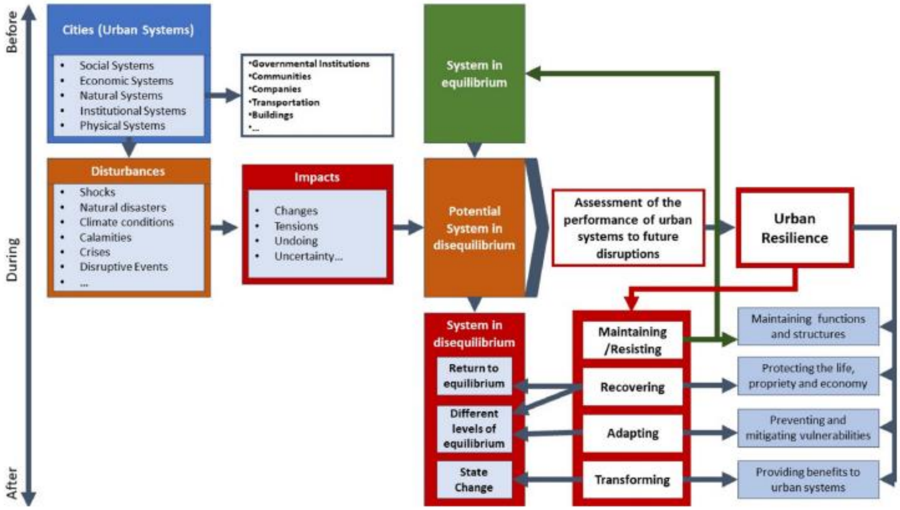

Figure 1. Urban resilience (Ribeiro & Pena Jardim Gonçalves, 2019)

As a result, urban resilience takes into account strategies for mitigating and adapting to social, economic and environmental challenges that occur after a disaster (Mehmood, 2016). Because *"resilience cities are cities that have the ability to absorb, recover and prepare for future shocks (economic, environmental, social and institutional)"* (OECD, 2023). *A resilient urban is one that is ready for all possibilities, while protecting and improving people's lives* (European Commission, 2023). Therefore, resilient cities are supportive of sustainable development, well-being and inclusive growth (OECD, 2023). For this reason, the concept of resilient urban is used quite frequently in today's sustainable development discourses. Because the resilience of cities to ecological, socioeconomic and political uncertainties is important (Grum & Grum, 2023). The concept of the resilient urban is important in this respect.

2.2. Urban Resilience Framework

Urban resilience is expressed today together with sustainability and smart cities. Because they are not separate concepts/approaches. It has become one of the most influential contemporary concepts influencing the thinking and actions of urban policy makers, international financial institutions, community groups and activists worldwide (Leitner, et al., 2018). The goal is always the same, "*how to make urban resilient*".

Resilience represents an abstract concept such as sustainability, so it can be difficult to identify specific ways of planning for resilience. For example, *"what should cities be resilient to?" or "how can cities, as complex systems, be resilient in their entirety?"* Also, building a capacity for resilience can be a daunting task given the many components, processes and interactions that take place within and beyond the boundaries of a urban (Desouza & Flanery, 2013). Identifying or measuring urban resilience means drawing the framework of urban resilience. However, an effective and comprehensive method for measuring the resilience capacity of a urbanis still missing (Manca et al., 2017). Nevertheless, scientists produce many studies on this subject. Indicators are generally determined in studies to reveal resistance. Indicators are generally similar (Suarez et al., 2016; Sajjad et al., 2021; Anelli et al., 2022;

Zeng et al., 2022). For example, Sharifi and Yamagata (2016) identified 19 indicators of urban resilience. These; redundancy, diversity, efficiency, robustness, interdependence, adaptability, resources, independence, ingenuity, inclusion, integration, etc.

The most effective work in determining urban resilience is the project of the Rockefeller Foundation in 2013, which returns to the main source of other studies. On the 100th anniversary of its foundation, the Foundation unveiled the 100 Resilient Cities (100RC) project with $100 Million Foundation funding. Rockefeller described the 100RC as "*dedicated to helping cities around the world become more resilient to the physical, social and economic challenges that are a growing part of the 21st century."* 100 RC (Resilient Cities) defines the meaning of urban resilience as “the capacity of individuals, communities, institutions, businesses and systems in a city to survive, adapt and grow, regardless of the type of chronic stress and acute shocks they experience” (Rockefeller Foundation & ARUP, 2015). Chronic stresses are those that weaken the fabric of a urban on a day-to-day or cyclical basis (Examples include high unemployment, inefficient public transport systems, rampant violence, and chronic food and water shortages). On the other hand, acute shocks create a different effect (for example earthquakes, floods) (Leitner et al., 2018).

Every urban is unique. Therefore, the way resistance manifests itself manifests itself in different ways in different places. The City Resilience Framework provides a lens through which the complexity of cities and the many factors that contribute to a city's resilience can be understood. On the basis of this perspective; The Rockefeller Foundation, together with British consulting firm ARUP, developed the City Resilience Framework (CRF) or the Flexible City Index (Figure 2). Examined at Figure 2, a set of targets has been defined for each framework/subsystem (in yellow). For example, for Health and Wellbeing, these objectives are: (a) Minimal human vulnerability; (b) Diverse livelihoods and employment; and (c) Effective measures for safeguarding human health and life. In contrast, a total of 52 indicators were determined for each target. For example, indicators that measure performance against the Minimum Human Vulnerability target are access to skills and training, business development and innovation, financing mechanisms, and livelihood protection.

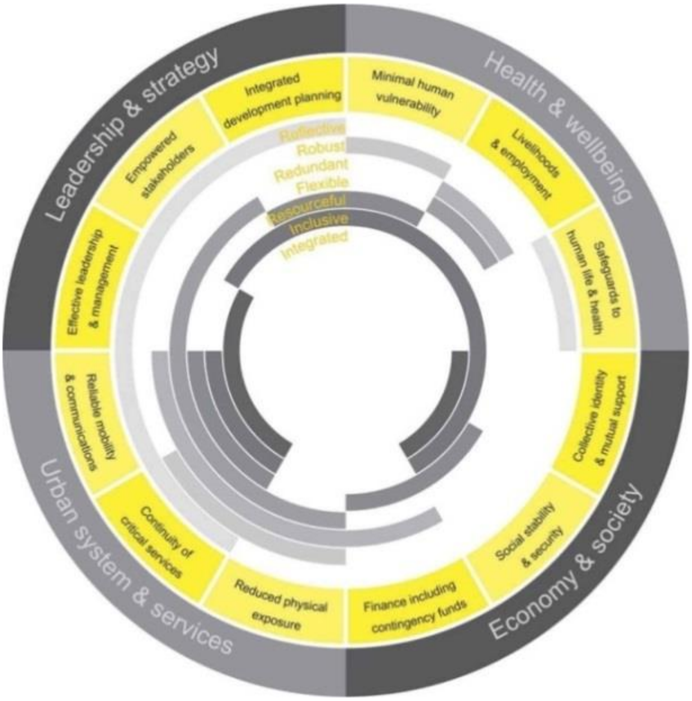

Figure 2. The city resilience wheel (Rockefeller Foundation & ARUP, 2015)

The index has four frames, 12 goals, 52 indicators and 156 variables. The Framework refers to an urban system that includes four subsystems and goes beyond ecological aspects: Health and Wellbeing, Economy and Society, Infrastructure and Ecosystems, and Leadership and Strategy. Each frame has 12 goals (Table 2). Under each objective, seven qualities of urban governance are defined: flexible, redundant, robust, resourceful, reflective, inclusive, integrated (Table 3) (Rockefeller Foundation & ARUP, 2015; Leitner et al., 2018).

Table 2. Resilient city goals (Rockefeller Foundation & ARUP, 2015)

Goals	Scope
Minimal human vulnerability	This relates to the extent to which everyone's basic needs are met.
Diverse livelihoods and employment	This is facilitated by access to finance, ability to accrue savings, skills training, business support, and social welfare.
Effective safeguards to human health and life	This relies on integrated health facilities and services, and responsive emergency services.
Collective identity and community support	This is observed as active community engagement, strong social networks and social integration.
Comprehensive security and rule of law	This includes law enforcement, crime prevention, justice, and emergency management.
Sustainable economy	This is observed in sound management of city finances, diverse revenue streams, and the ability to attract business investment, allocate capital, and build emergency funds.
Reduced exposure and fragility	This relies on environmental stewardship, appropriate infrastructure, effective land use planning and enforcement of planning regulations.
Effective provision of critical services	This results from diversity of provision, redundancy, active management and maintenance of ecosystems and infrastructure, and contingency planning
Reliable mobility and communications	This is enabled by diverse and affordable multi-modal transport systems and information and communication technology (ICT) networks, and contingency planning.
Effective leadership and management	This relates to government, business and civil society and is recognizable in trusted individuals, multi-stakeholder consultation, and evidence-based decision-making.
Empowered stakeholders	This is underpinned by education for all, and relies on access to up-to-date information and knowledge to enable people and organizations to take appropriate action.
Integrated development planning	This is indicated by the presence of a vision, an integrated development strategy, and plans that are regularly reviewed and updated by cross departmental groups.

Table 3. Qualities of urban governance (Rockefeller Foundation & ARUP, 2015; Leitner et al., 2018)

Qualities of urban governance
1. Flexible: – willing and able to adopt alternative strategies in response to changing circumstances
2. Redundant – spare capacity purposively created to accommodate disruption
3. Robust – be a well-conceived, constructed, and managed system
4. Resourceful – recognize alternative ways of using resources
5. Reflective – use past experiences to inform future decisions
6. Inclusive – prioritize broad consultation to create a sense of shared ownership in decision making
7. Integrated – bring together a distinct range of systems and institutions

It is important to measure and increase resistance. But the questions of “who”, “what for”, “when”, “where” and “why” complicate the process. Meerow et al., (2019) expressed this as 5 W that needs to be answered when revealing urban resistance. 5W; Who, What, When, Where, Why (Table 4). He expressed the interrogation system as follows: “Let resilience be accepted as a desirable situation. But what determines what is "desirable" and "for whom"? Urban resilience is driven by who sets the agenda, whose resilience is prioritized, and who benefits or loses as a result”. There are no right or easy answers to these questions. But if we hope to build truly resilient cities, tackling them collectively through an inclusive and open discourse is essential (Meerow et al, 2019).

Table 4. Fundamental questions related to urban resilience (Meerow et al., 2019)

Questions to Consider		
Who?		Who determines what is desirable for an urban system?
		Whose resilience is prioritized?
		Who is included (and excluded) from the urban system?
What?	T	What perturbations should the urban system be resilient to?
	R	What networks and sectors are included in the urban system?
	A	Is the focus on generic or specific resilience?
When?	D	Is the focus on rapid-onset disturbances or slow-onset changes?
	E	Is the focus on short-term resilience or long-term resilience?
	O	Is the focus on the resilience of present or future generations?
Where?	F	Where are the spatial boundaries of the urban system?
	F	Is the resilience of some areas prioritized over others?
	S	Does building resilience in some areas affect resilience elsewhere?
Why?	?	What is the goal of building urban resilience?
		What are the underlying motivations for building urban resilience?
		Is the focus on process or outcome?

3. Green Infrastructure System

3.1. Green Infrastructure Concept

The Green Infrastructure system has its origins in Frederick Law Olmsted's idea of connecting urban parks in North America in the mid-1800s. The aim of this idea has been to "*create multi-functional green spaces and preserve the sustainability of biodiversity*". The first use of green infrastructure as a term was in 1994. Florida local authorities have used the term green infrastructure to emphasize that natural and ecological systems are just as important as gray infrastructure in the development of land conservation strategies (Firehock, 2010). The green infrastructure group, established under the leadership of the USDA Forest Service and Conservation Fund, defined green infrastructure as a natural life support system in 1999

(Benedict & MacMahon, 2012). Green infrastructure is defined in many studies as a means of establishing a link/system between existing green spaces (Davies et al., 2015).

Green infrastructure is a network that is strategically planned and managed to preserve the functions of natural ecosystems and provide various benefits to the community (Benedict & McMahon, 2002; Benedict, 2006; Hellmund & Smith, 2006; Lancaster Country Planning Commission, 2009; Firehock, 2010; Naumann et al., 2011; Çetinkaya, 2013; Çetinkaya & Uzun, 2014). It is a strategically planned and developed network (Natural England Green Infrastructure Guidance, 2011). Also, this network points to a landscape-scale ecological conservation plan approach driven by a broad public process (McDonald et al., 2005). This approach is a necessary ecological framework to ensure environmental, social and economic sustainability. It also differs from traditional approaches to open green space planning. It focuses on conservation values and actions aligned with land development, growth management and established infrastructure planning (Benedict & McMahon, 2012). Green infrastructure, depending on the requirements and scale; multifunctionality is also expressed with the concepts of connectivity and integration (Boverket, 1992; Benedict & McMahon, 2006; Niemelä & Breuste, 2011; Pauleit, 2011). Therefore, green infrastructure is a multifunctional resource for the communities it serves (Natural England Green Infrastructure Guidance, 2011).

Many definitions of green infrastructure have been made since its use as a term, based on its tasks, contributions and characteristics. Definitions are generally similar. Basically, the definitions we encounter most are given in this study. The Council for Sustainable Development (1999), in its Towards a Sustainable America Report, identified green infrastructure as *one of five strategic areas as a comprehensive approach to sustainable community development (*Benedict & Macmahon, 2012). According to Thomas & Littlewood (2010), green infrastructure is a widely accepted and impressive policy concept that spatial planning institutions use in regional strategy production in countries such as England. It is also used as a management system (Hoşgör, 2005). The European Commission's official definition of green infrastructure is as follows: "A strategically planned network of natural and semi-natural areas with other environmental features designed and managed to provide a wide range of ecosystem services (Hudeková et al., 2018). Benedict & McMahon (2012) stated that definitions of green infrastructure focus on four ideas. These;

1. Connecting parks for people,
2. Conserving biodiversity and connecting natural areas to prevent habitat fragmentation,
3. Identification and protection of interconnected open space systems to benefit wildlife and benefit a sustainable future,
4. Working on today's green road movement.

Green infrastructure reflects a holistic approach of natural, semi/natural and “man-made” green spaces interlinked at different scales. The scale extends from the local level (from the structural environment of the urban and municipality) to the rural. It has an understanding that green areas, which are perceived as urban or rural, are integrated with a consistent system. Green infrastructure is a network/interconnected system that connects man-made green areas in settlements, semi-natural and natural areas and a variety of natural ecosystems, special greenery elements, linear greenery elements, natural and semi-natural water and wetland elements (Hudeková et al., 2018).

3.2. Functions of Green Infrastructure Systems

The green infrastructure system has seven key principles that will provide moderate benefit to the natural and cultural landscape. These are (McQueen & McMahon, 2003):

1. “Green infrastructure should serve as a skeleton for conservation and development.
2. The planning and design processes of green infrastructure should be established before development plans.
3. Connections are key components.
4. Green infrastructure should be multitasking at different scales.
5. Green infrastructure should be built in line with land use planning theories and practices.
6. Green infrastructure is an important public investment.

7. Green infrastructure requires the participation of various stakeholders.

The functions of the green infrastructure system can be grouped into three groups. These; Environmental and ecological functions, social, societal, health and economic functions, structural and aesthetic functions. These functions are explained in detail below.

Environmental and ecological functions: Green infrastructure systems make eight fundamental contributions to the ecological system. These; (1) improving air quality and microclimate in urban environments, (2) influencing the hydrologic cycle, feeding water resources and improving water quality, (3) promoting biological diversity, (4) influencing natural processes such as soil erosion, (5) supporting regulatory ecosystems (eg soil forming processes, decomposition of harmful substances, etc.), (6) biological treatment, (7) flood-disaster control, (8) climate change mitigation and adaptation. These contributions stem from the plants that are the cells of the green infrastructure system and the green areas that are the texture of it. Plants; It interferes with photosynthesis-respiration, carbon dioxide and heavy metals, decomposes wastes, and takes part in the continuity of the food chain. On the other hand, green areas direct/manage precipitation waters, control sediment flow, prevent heat islands, direct wind flow, reduce energy need, provide thermal comfort (roof gardens, etc.), create permeable surfaces, feed underground waters, provide habitats. It contributes to the ecological structure with its regulatory, resource-providing, cultural and supporting ecosystem services in the ecosystem. (Yang et al., 2005; Güçlü, 2009; Center for Neighborhood Technology, 2010; Foster et al., 2011; Gaffin et al., 2012; Jaber, et al., 2012; Jennings et al., 2012; Özeren, 2012; Avrupa Komisyonu Bildirimi, 2013; Demuzere et al., 2014; Demiroğlu, 2014b; Demiroğlu & Karadağ, 2015; Conservation Advisory Council, 2015; Green Infrastructure Guide, 2015; Cannop et al., 2016; Shakouri, 2016; Karadağ & Demiroğlu, 2016; Semiz, 2016; Rakhshandehroo et al.,2017; Demiroğlu et al., 2018; Hudeková et al., 2018; Hepcan, 2019, Gultekin et al., 2019; Karadağ et al., 2019; Uzun & Aydın, 2019; Öztürk Kurtaslan, 2014; Öztürk Kurtaslan et al., 2019; Erkek et al., 2020; Karadağ et al., 2020; Moradpour & Hosseini 2020; Öztürk Kurtaslan et al., 2020; Qui et al., 2021).

Social, societal, health and economic functions: The green infrastructure system provides 13 basic socio-economic contributions. These; They are social interaction-democracy-learning spaces, positively affect population health, affect social sustainability, promote recreation-tourism and provide recreational services, contribute to crime prevention, promote safe and sustainable transportation, increase property-land value, promote local food production, resource-providing, It reduces energy consumption, improves awareness by increasing human-nature interaction, provides economic contribution by reducing disaster risk, and is an active component of disaster management (Green Infrastructure Guide, 2015; Demiroğlu et al., 2017; Hudeková et al., 2018; Gultekin & Ozdede, 2018; Nas & Gultekin, 2019; URL-3)

Structural and aesthetic functions: Green infrastructure systems provide four basic contributions, both structurally and aesthetically. These are to determine the urban structure by creating fragmentation, division and unification in the urban, to create the spirit of a place and add identity, to increase the visual richness of a place, to create the landscape character (Hudeková et al., 2018).

3.3. Green Infrastructure Planning

The potential of green infrastructure planning to combine the ecological and social dimensions of the landscape is widely recognized. Due to its holistic approach, it is thought to be more effective and powerful than nature conservation or traditional open-green space planning. From this perspective, green infrastructure planning is particularly suitable for urban areas because they are developed areas characterized by the dynamic interaction of ecological and social systems together.

According to Dreher & Moore (2012), green infrastructure planning is defined in three typologies. These (Kambites & Owen, 2006; Mell et al., 2013);

1. Landscape-based green infrastructure: The definition of this typology according to the US conservation fund; Strategically planned and managed natural lands, used landscapes and other open spaces provide different functions and benefits for human

beings as a network. Accordingly, green infrastructure is a network that covers areas such as natural lands, rivers, wetlands, forests, grasslands, and provides balance together with ecological functions.

2. Biodiversity-based green infrastructure: Green infrastructure plans focused on preserving habitat and biodiversity make up this group. To preserve biodiversity, parks and other green spaces are also designated as part of the network.
3. Nature-based alternatives to gray infrastructure: This typology was created to describe applications that use green infrastructure products, technologies and natural systems. Permeable pavements, green roofs, rain gardens, and seedy vegetation, as the U.S. Environmental Protection Agency says, include applications that filter soil and water, or recycle stormwater runoff. In addition, these technologies, which effectively hold water and filter precipitation, have positive aspects such as filtering air pollutants, reducing energy consumption, and reducing the effects of heat islands.

According to McQueen & McMahon (2003) and Benedict (2000), the urban green infrastructure system should be developed with seven basic principles.

1. It should provide a skeleton function for protection and development.

2. Planning and design processes should be established before development plans.
3. Connections are key components.
4. It should have multiple functions at different scales.
5. It should be done in line with land use planning theories and practices.
6. It is an important public investment.
7. It requires the involvement of various stakeholders.

Basic approaches to the development of green infrastructure plans and the governance process are important (Table 5).

Table 5. Principles of green infrastructure planning (Benedict & McMahon, 2006; Kambite & Owen, 2006; Hansen & Pauleit, 2014)

Approaches to the development of plans	
Integration	Green infrastructure planning considers urban green spaces as a type of infrastructure and aims to integrate and harmonize these green spaces with other urban infrastructure (eg built structures, transportation infrastructure and water management system) physically and functionally.
Multi-functionality	Green infrastructure planning considers the ecological, social and economic/abiotic, biotic and cultural functions of green spaces and aims to combine them.
Connectedness	Green infrastructure planning encompasses the physical and functional connections between green spaces of different types and scales.
Being multi-scale	Green infrastructure planning can be used for studies at different scales, from single plot to local, regional and national. Green infrastructure must function in harmony at multiple scales. Green infrastructure planning covers all types of (urban) green and blue areas; public and private green spaces such as natural and semi-natural areas, water surface, parks and gardens.
Approaches to the governance process	
Strategic management	Green infrastructure planning aims to provide long-term benefits, but is also flexible for changes over time.
Social inclusion	Green infrastructure planning supports planning and management that is communicative and socially inclusive, involving stakeholder collaboration.
Interdisciplinary	Green infrastructure planning is based on knowledge from different disciplines such as landscape ecology, urban and regional planning and landscape architecture and is developed in collaboration with different local authorities and stakeholders.

4. Green Infrastructure System for Urban Resilience

Urban resilience is difficult to measure because of its multidimensionality. Various factors are mentioned in the literature regarding the measurement of urban resilience. These can also be expressed as basic characteristics of resilience. For example; diversity, flexibility, redundancy, inclusiveness, adaptive governance (which is related to flexibility), innovation, modularity, connectivity, regenerative ability, and equitability, etc. None of these factors focus on green infrastructure. However, focusing on the social and ecological dimensions of resilient systems (Zuniga Teran, et al. 2020) will clearly reveal the relationship of green infrastructure to resilience. Because some of the socio-economic indicators of urban resilience overlap with the contributions of the green infrastructure system to the city.

The contributions of green infrastructure are clear for urba in the literature. But it is difficult to quantify the direct benefits of these contributions to urban resilience. Therefore, Zuniga Teran, et al. (2020) evaluated the contributions of green infrastructure to urban resilience on the basis of Coupled Infrastructure Systems (CIS). CIS recognizes that functional infrastructures are the building blocks of interactions between people and their environment. It also suggests that there are feedback effects from such interactions.

Zuniga et al. (2020) evaluates the impact of the green infrastructure system on urban resilience at policy, performance, connectivity and social scales (Table 6). Green infrastructure nurtures policies, urban resilience at performance, connectivity and social scales. In this contex; the policies and management structure developed for green infrastructure strengthen the institutional structure. With the participatory approach, this process is carried to a social dimension. It provides social awareness by increasing the awareness of the relationship between nature and human. Its ecological and economic benefits make positive contributions to the urban's economy and ecology. In particular, using hybrid systems (grey-blue-green) ensures the operation of continuous connections and social networks that can help cities to recover quickly, in times of disasters (Zuniga Teran, et al. 2020). Anderies et al. (2016) is developed the four dimensions to measure the performance of the CIS. These *(1) soft infrastructure, which we refer to as policy (2) built infrastructure (or hard), which we refer to as performance; (3) natural, which we refer to as connectivity, and (4) social.*

Table 6. Overview of the four dimensions to assess urban resilience from green infructture systems (Zuniga Teran et al., 2020)

Dimension	Type of resilience	Description
Policy	Institutional	Types of regulations, policies, initiatives, and programs that promote the implementation of GI in cities
Performance	Climate, economic and ecological	Metrics used to assess the impacts of GI on the reduction of floods and the resilience of water infrastructure systems
Connectivity	Climate, economic and ecological	Methods used to evaluate the connectivity of GI systems
Social	Climate and economic	Ways in which social resilience related to GI can be assessed in cities

Urban resilience focuses on three issues, as stated by Acierno (2015). These are sustainability, cohesion, territorial risks. Because the events that make endurance difficult; climate change, hydrogeological risk, flood risk, coastal erosion, desertification, urban heat island, scarcity of energy resources, increase in urban population, etc. In this context, it is necessary to reduce land consumption, develop green infrastructure, increase slow mobility, reduce urban sprawl, etc. for resilience in spatial planning (Acierno, 2015). Green infrastructure systems feed into many of these principles.

One of the most important problems of today's cities is climate change. Green infrastructure systems are very important for cities that are resistant to climate change (Leichenko, 2011; Gaffin et al., 2012; Demuzere et al, 2014; Hepcan, 2019; Demiroğlu et al., 2021a; Demiroğlu et al., 2021b; Pamukcu-Albers, 2021).

The contribution of green infrastructure systems can be clearly demonstrated on the basis of sustainable urban water management. This contribution is very important in terms of urban resilience (Demiroğlu et al., 2016; Sharma et al., 2023).

Fu et al., (2021) on the basis of scenarios involving different exapmle design in green infrastructure, put forward the contribution of green infrastructure system to urban resilience with a scoring system. In the study, the green infrastructure system' contributions at environmental, social and economic scales were evaluated (indicator: runoff, water quality improvement, land use diversity, Increase recreational area, green infrastructure construction cost, creating green employment, decreasing gray infrastructure cost-abating the same amount of runoff).

Wu et al. (2020) stated that the key to resilience is "*maintaining the sustainability of the ecosystem*". He emphasized the contribution of green infrastructure systems to urban resilience, especially in cities whose livelihoods depend on natural resources, resource-based cities (such as mining). He made this clear in the city of Wu'an, whose in areas outside the city's green infrastructure system have reduced ecological resilience. It also destroyed the contribution of green infrastructure. This situation has shown the limiting, controlling and guiding power of green infrastructure. Although it is emphasized that green infrastructure can be effective in controlling urban sprawl, extensive evaluations are required to reveal the direct impact.

Although it is stated that green infrastructure can be effective in controlling urban sprawl, thus contributing to urban resilience, according to Vargas-Hernández & Zdunek-Wielgołaska (2021), comprehensive assessments are required to reveal the direct impact.

Green infrastructure systems can contribute to the social resilience of urban. Many of the green infrastructure components have acted as shelters for city dwellers during the Covid 19 pandemic. Thus, it has increased social resilience by contributing to people's physical and mental health (Pamukçu-Albers et al., 2021; Fagerholm et al., 2022). Lee et al., (2021) stated that urban food resilience can be beneficial when they examine their food-friendly green infrastructure-based plans on the basis of flood scenarios.

Resilience is important for sustainable cities. In this sense, green infrastructure is a tool (Hellmund & Smith 2006; Demiroğlu et al., 2014a; Cengiz et al., 2017).

5. Conclusion

21st century man; economic reasons, opportunities, education, innovation, etc. immigrating to cities for reasons. But city life is difficult. Because cities consist of a complex network system and events have the chain effect. Today, the system/city is constantly growing with increasing population. This growth weakens the prediction of chronic and sudden events. And the urban is getting more stressful every day. Because the city is an organism. This uncontrolled growth bothers him. However, what is desired is controlled and planned growth. It is resilience and flexibility in the face of events. This means the resilience of cities.

The city is a complex and socio-ecological system created and directed by man. The sustainability of this system depends on its resilience. Urban resilience is a prerequisite or a tool to achieve sustainability. Sustainability or rational development consists of process-oriented actions, not result-oriented. In other words, sustainability is a goal, resilience is the ease in achieving these goals, it is identifying the obstacles.

Urban resilience is the continuation of the life cycle of the urban in the face of chronic and sudden problems, adapting to the new situation and maintaining its existence by developing it. Increasing urban resilience is the main goal in the planning of cities. Urban resilience depends on microclimate, air quality, access to healthy water, healthy living, disaster risk reduction. The qualities expressed here are the contributions of the green infrastructure system to the city and are the objectives of the planning system. Green infrastructure systems are a planning approach that offers nature-based solutions to the urban It refers to ecological principles and natural processes.

The green infrastructure system solves the sustainability and durability of the city by integrating with nature. It observes natural processes and adapts. In this sense, green infrastructure systems both simplify the complex city system and offer natural approaches to the solution of problems. Their solutions are multifunctional. While the green infrastructure system routinely improves the urban with its contributions to the urban, it turns into a solution tool in times of disaster.

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Review of the Literature on Risk Communication Methods in the Context of Natural Disaster Risks and Recommendations for Urban Planning

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1. Introduction

The research aims to develop method proposals for a participatory urban planning approach in the face of disaster risks. For this purpose, the research explores discussions in risk communication and participatory approaches to natural disasters. In order to explain the starting point of the research, we will first answer why community cooperation is essential in disaster risk reduction and disaster risk management.

Contemporary disaster risk reduction and disaster risk management adopt a resilience approach. In this way, producing community-centered, proactive solutions against disasters and developing the organizational structure come to the forefront. The main goals are organizing, producing, disseminating risk information, and developing the necessary technological and managerial infrastructure. Being organized and collaborating with the community to produce and share risk information is crucial, for the general public still needs to gain more technical knowledge (Liu et al., 2018, p. 2).

In community-centered studies, it is important to identify all the limitations in establishing a relationship with society. The challenges of developing community cooperation in disaster risk reduction and management can be summarized as follows:

- Lack of social experience, financial resources, the country's general political attitude, and technological capacity are among the issues that restrict society's access to contemporary risk management discussions. For this reason, international cooperation becomes essential, especially for underdeveloped and developing countries.

- Disasters can lead to immense anguish and adversity for society. Experiencing a disaster can completely upend people's lives and result in trauma. People who have not directly experienced disasters can also develop fear and anxiety. For this reason, it is crucial to be sensitive when relating to those who have experienced disasters.
- The best way to prepare those directly or indirectly affected by disasters is through collaboration between local people, administrators, institutions, and non-governmental organizations. In order to cooperate effectively, everyone must be aware of and take responsibility.
- Those who respond directly to disasters are people who are still alive, but those who do not care about disasters or have different priorities are still the same people. Constant communication is required to develop risk perception and encourage proactive action without increasing anxiety levels.
- Geographic and cultural differences can cause varying responses to disasters. It is not possible to generalize on this issue. However, one can use experiences as a guide to

understand the situations that may arise. Therefore, it is essential to examine various examples worldwide to create a road map.

The study aims to understand the tools and positive and negative aspects described in the literature and develop recommendations for effective urban planning and disaster management through collaboration with local communities. In other words, the objective of the research can be defined as the search for a method of an urban planner who lives and researches in a developing country and believes that urban planning should establish a relationship with society in disaster risk reduction.

The subject focuses on the process of knowledge production and the communication necessary for information sharing rather than just sharing information. Under the umbrella of risk communication, there are examples of theoretical discussions related to various types of risks and social characteristics. Different disciplines refer to areas of expertise such as communication, business, information technologies, health, and disaster management. The discipline of urban planning is also included in this scope. In urban planning, approaches that adopt social organization and communication with society can take various names, such as participatory, collaborative, and dialogue urban planning. This research views risk communication as an inclusive concept and identifies foregrounding issues in defining communication methods with the community for urban planning.

1.1. Information Production and Risk Communication for the Development of Resilience in the Face of Disaster Risks

In our age, it has become increasingly important to produce and share information about the various risk factors that societies, settlements, and economies may face due to their sensitivity to natural and technological threats. The third priority of the United Nations Hyogo Framework Plan of Action (2005-2015) is to use knowledge, innovation, and education to build a culture of security and resilience. In the Sendai Framework Action Plan, the first action is to understand disaster risk, and the second is to strengthen disaster risk governance. These definitions emphasize the importance of risk communication and management approach that tries to include all segments of society to produce disaster risk information and the development of resilient societies that can manage risk (Özyetgin Altun, 2023). Every country and every society have a diverse history of management, culture, habits, and risk issues. They must develop methods to follow these roadmaps, emphasizing the production and sharing of risk information.

The production of risk information could be defined as risk analysis and risk assessment. Risk assessment includes the probability and magnitude of the threat, identifying areas that are susceptible to the threat, and assessing the physical, spatial, sociocultural, economic, and managerial vulnerability and capacity in these areas. (UNISDR, 2009, p.26). Risk communication also involves providing accessible and understandable information and the information production process to all segments of society.

From the perspective of the discipline of communication, Yakut (2008, p.17) defines risk communication as "In contemporary disaster management, risk communication is the activity of ensuring all kinds of information flow about risk between all relevant segments of the society (central and local government, public institutions, private organizations, non-governmental organizations, neighborhood groups, family, individuals) before-during-after the possible disaster, announcing the necessary measures to the relevant segments and ensuring cooperation for decision-making and implementation activities to be carried out on issues related to the adoption of the necessary measures."

From the perspective of Urban Planning, Balamir (2018, p.116) defines risk communication as "the process of managing the information and communication mechanisms with transparency and accuracy that the management units should carry out without causing panic for the society to perceive the risks correctly and reliably. For this purpose, keeping information about the locations where different types of hazards are likely to occur open to the public is considered useful."

In summary, the purpose of risk communication is not only the transfer of disaster risk information but also includes issues such as education, awareness, and sanctions for society to develop suitable behavior patterns in risk management.

At the same time, the issue of risk communication uses different tools to achieve different goals before, during, and after a disaster. Pre-disaster risk communication involves training, announcements, and information sharing to encourage preventative behavior and reduce harm. However, risk communication during and after the disaster adds a different dimension. Disaster sequence communication, also called crisis communication, aims to improve and direct the lives of people affected by disasters or to inform the public. In our age, risk communication is mainly established through social media, mass media, or reports prepared by public institutions (Ilgın et al., 2023, p. 44-45).

1.2. Participatory Urban Planning, Disaster Risks and Resilient Community Development

Participatory urban planning refers to the role of various stakeholders in planning decision-making and implementation processes (Healey, 1997; Innes, 1995, 1996, 1998). The concept of stakeholder refers to civil society organizations and the public, from international platforms to local organizations, varying on the size of the planned area, the scale of the plan, and the subject of the planning.

Urban planning is a technical tool for assessing risk and producing spatial decisions. In addition, the planning process is considered a tool for other dimensions of disaster risk reduction and management, namely communication and information flow, public education, and raising awareness (Tran et al., 2009; Jha et al., 2013; Shaw et al., 2016). The participatory planning approach questions the content of the information in the communication, who the stakeholders are, how they contribute to the process, how they participate, and the distribution of the benefit obtained (Healey, 1997; Innes, 1995, 1996, 1998). The aim is to organize various rights holders in planning processes, to ensure balance in benefit, and to realize issues such as knowing the responsibilities of the participants.

In disaster risk management, the concepts of polyphony, information sharing, solidarity, and organization come to the forefront. The realization of these issues coincides with the participatory urban planning approach. In developing a resilient society, solidarity, information sharing, and organization come to the forefront. For this reason, cooperation with society comes to the fore in producing spatial disaster risk reduction decisions in cities, and cooperation and organization are also necessary. For this reason, it is clear that risk reduction decisions produced through a participatory and collaborative planning process can be beneficial if this approach is maintained.

However, in undeveloped and developing countries, planning cannot be used as a powerful tool, and therefore, it cannot take an active role in disaster risk management and resilient society development. The characteristics of the social structure and the political approach also play an essential role.

In disaster risk management, it is necessary to adopt the principles of harm reduction socially, develop behavior patterns in this direction, and develop awareness (Özyetgin Altun, 2023). Land use plans for cities are designed to minimize risk by planning. However, land use plans alone are not sufficient. Local people, managers, investors, and politicians should make decisions considering the issues that may pose risks (Banba, 2017, p. 14-16). For this reason, the opinions of disaster risk management experts in the field are also important. It is important to note that urban land use decisions cannot be made by local people or only by investors (Banba, 2017; Özyetgin Altun, 2017, p. 61-62). It is important that society is aware of the risk situation and takes the risk appropriately. (Banba, 2017; Özyetgin Altun, 2023, p. 98). For this reason, establishing risk communication is one of the common points of urban planning and disaster risk management.

The achievements of participatory processes are the following (Özyetgin Altun, 2023, p. 101):

- "Transferring risk information about the environment in which individuals live,
- Providing individuals with experiential, memorable hazard and risk information about the environment they live in,

- Conveying to individuals what kind of spatial measures they should take regarding the risk issues of the environment they live in,
- Discussing how these measures can be developed in the short, medium and long term,
- Ensuring that individuals who participate in the decision-making process are critical for accepting and implementing their decisions."

2. Material and Method

The main risk issues for cities and settlements that require communication across society can be listed as natural disasters, environmental pollution, climate change, and public health. In this context, there is an extensive literature, and this research focuses on the literature on natural disasters. This research is conducted using the literature review methodology. The literature constituting the research material consists of researches that adopt risk communication and participatory planning approach to develop social resilience in the face of natural threats that pose a threat to settlements. The intersection of risk communication and participatory urban planning is vital to understanding and discussing urban disaster risks through urban space. (Figure 1). In this context, this research discusses four approaches to risk communication strategy.

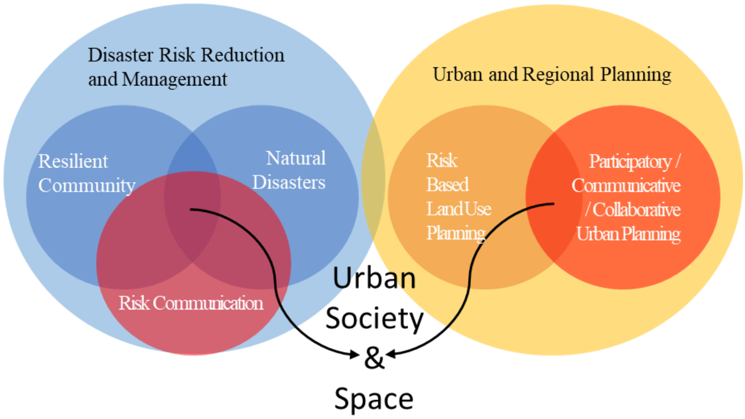

Figure 1. The system used in literature review

The first approach is the town-watching method applied on a local scale. This method corresponds to the earliest studies. Another method is collective mapping, which can be manually and digitally produced. The third is the method of making a profit through games. Finally, international examples of multiple strategies combined were examined. In examining the examples, it is necessary to emphasize that there is a pre-disaster preparation stage and harm reduction concern.

The method of research is an in-depth examination. The content analysis technique being used, the research was examined in the following categories: subject, scale, target audience, disaster experience of the community, organization of the method, strengths and weaknesses, and the relationship of the methods with urban planning. As a result, suggestions have been provided for developing a participatory urban planning approach.

3. Findings and Discussion

3.1. Risk Communication Strategy and Participatory Action Tools

Risk communication that aims to include all segments of society has dichotomies (Figure 2). The first is that the technically defined risk information does not coincide with the spontaneous social risk perception or the individual acquired or learned by experience (Smith, 2013, p. 155-158). These two situations are not entirely opposite (Smith, 2013, p. 155-158). Risk perception can be perceived and measured individually; individual risk perception generally describes society's attitudes and behaviors toward risk (Kellens et al., 2012). Technical risk definitions aim to shape social perceptions, attitudes, and behaviors. Risk perception may vary according to age, culture, ethnicity, geography of residence, etc. However, the information that is technically produced may not always align with the information that is perceived. This misalignment can result in not considering the necessary risks and not considering society enough during decision making processes.

Figure 2. Word cloud of risk communication dichotomies

However, society's sense of trust in technically produced risk information or the infrastructure that produces this information comes to the fore (Smith, 2013, p. 158; Fornale et al., 2023). Smith, 2013, p. 159 highlights the unfair manipulation of risk perception by the media and politicians. Özyetgin Altun (2023, p. 105) similarly exemplifies that risk information is directed through the media in a way that worries the public. This situation can cause reactions such as the devaluation of information or being given too much importance.

Platforms where information is shared can also be effective in issues such as the perception of risk and the strengthening of trust. Sharing risk information on social media, which has become widespread recently, is identified as a dangerous issue.

Finally, the information conveyed should be able to go beyond spreading fear and anxiety. For this reason, it is considered necessary that the information can be reduced to the expressions that society can perceive and that it can offer solutions.

In order to solve these and similar dilemmas, Yakut (2008) recommends that risk communication strategies be defined in the risk analysis process. The four main issues recommended to be adopted for risk communication are:

- To be able to place the issue of risk communication in the risk analysis process, which is the first stage of disaster risk reduction and management,
- To develop a risk communication strategy in order to carry out risk communication systematically and continuously,
- To ensure that the risk communication strategy has a purpose, principles, plan and program,
- Analyze how to communicate risk effectively.

3.1.1. Town watching

Town watching is one of the methods used for social organization against disaster risks in cities. It was described by urban planners in Japan in the 1970s (Shaw & Takeuchi, 2009, p. 54). The town-watching method is a method applied on a local scale. It aims to identify safe and dangerous areas and liberation routes in the physical environment where they live to improve local people's harm-reduction behaviors (Shaw & Takeuchi, 2009, p. 54). It is open to the participation of every social sub-group, such as the local community, managers, specialists, young people, and the elderly. In order for the local community to take part in the disaster management system, it enables them to identify the hazards in their living environment by visiting and observing the environment they live in in a direct, face-to-face dialogue with experts (Shaw & Takeuchi, 2009, p. 54; Ogawa et al., 2005; UNDRR, 2007). Then, hazard maps are created collectively with the detected elements. In the last step, the problem and the source of the problem are defined, and solution proposals are developed (Ogawa et al., 2005; UNDRR, 2007).

A town-watching hazard analysis training from Kocaeli, Turkey was examined. The university, which specializes in disaster management, is an awareness development training carried out within the scope of the disaster preparedness training project in partnership with the national and local administration (Gerdan & Özdemir, 2017). Pieces of training were given to disaster volunteers in the context of earthquake danger. The aim is to enable the residents to comprehend the physical danger, vulnerability, and risk factors in the settlement where they live, that is, in their living environment (Gerdan & Özdemir, 2017). The project is repeated periodically, and the number of volunteers receiving training increases (Kocaeli Municipality, 2023).

3.1.2. Collaborative mapping

Collaborative risk mapping outputs are obtained as a result of the town-watching method. There are also different methods for risk mapping.

Liu et al. (2018) describe one such example in which risk maps in the context of flooding are based on the vulnerability and capacity assessment tool developed by The International Federation of Red Cross and Red Crescent (IFRC). Mapping was carried out in a five-day workshop, and people with previous volunteer work on disaster risks, volunteers, and experts attended the workshop. The maps are first drawn manually and then digitized. Liu et al. (2018) say the mapping process facilitated communicative communication socially. At the end of the study, the feedback received from the participants is that map production is useful.

Hagemeier-Klose and Wagner (2009) describe the flood hazard maps produced by web mapping services on flood hazards. In producing these maps, adhering to the theoretical framework, a workshop was organized with the participation of experts and local people, and maps were produced. These maps include different scenarios and support the increase of knowledge and awareness of users (Hagemeier-Klose & Wagner (2009).

3.1.3. Serious games

Serious games are designed with the aim of educating players (Abad et al., 2020). Serious games are seen as an effective catalyst for discussing complex and political issues in urban planning (Abad et al., 2020; Ampatzidou et. al., 2018). It is emphasized that games have a softening effect on revealing unspoken, harsh, and intricate topics that reveal the strengths and weaknesses of the system (Abad et al. 2020; Solinska-Nowak et al., 2018). Solinska-Nowak et al. (2018) examined 45 non-commercial games produced for risk reduction and classified the games based on their subject and system. Nearly half of the games are face-to-face multiplayer ones, with live communication between players. Then come single-player computer games. Abad et. al. (2020) study explains the important issues of designing board games; they emphasize that they attach importance to aesthetics, dynamism, and mechanism. The design of the game, called "Risk assessment model simulation for emergency training exercise (RAMSETE)", was carried out with ESPREsso think tank workshops (Abad et. al., 2020). The games aim to integrate climate change adaptation policies and disaster risk reduction policies (Abad et al., 2020).

The Solinska-Nowak et al. (2018) study shows that the vast majority of games are associated with flood danger. Then comes the earthquake danger. Games with multiple dangers and climate-related games are also included in the list.

3.1.4. Multiple strategies and international organizations

The model developed by Zurich Flood Resilience Alliance (ZFRA) (Flood Resilience Portal, 2013), realizes risk communication between global and local scales. The model has three types of communication. The first is an application that allows communication with society, which is called the heart of the model. This application is defined as a tool that measures social resilience and offers solutions to the community for disaster risk management and resilient community development (International Institute for Applied Systems Analysis, 2023; Laurien, 2020). This tool also allows data entry and mapping of individuals over the internet (UNDRR, 2018). Data entries are carried out by local volunteers, local governments, and national and international non-governmental organizations. The application developed in Nepal, Peru, and Mexico is thought to greatly contribute to the development of social resilience (UNDRR, 2018).

The second step of the model is to communicate the positive outcomes obtained in primary care to decision-makers and to support resilient community development in policy making (Flood Resilience Portal, 2013). In the third step, studies are carried out on legal structuring, funding, and policy production (Flood Resilience Portal, 2013). These studies are carried out to develop draft laws to be transferred to decision-makers, and to develop plans, policies, and strategies.

If we look at the general functioning of the model, it is seen that it has developed through gaining experience in many cities with the application tool designed in 2013 (The Zurich Flood Resilience Measurement for Communities -FRMC). Later, the data set was developed, and the application was updated in order to perform risk analysis on issues such as heat waves and fires due to climate change (Climate Resilience Measurement for Communities - CRMC) (Flood

Resilience Portal, 2013). With this application, spatial risk information is produced and shared with society.

It is noted that the Solinska-Nowak et al. (2018) study mentioned above was produced under the ZFRA. The ZFRA's production of digital risk maps shows that they have developed multiple strategies and methods.

3.2. Discussion

This research has examined examples from international organizations that combine risk communication strategies and methods in disaster risk management, town watching, collaborative mapping, serious games, and different methods. Examples being considered, the subject, scale, and target audience, the disaster experience of the society, the organization of the method, strengths and weaknesses, and the relationship of the methods with urban planning have also been discussed.

3.2.1. Subject

When the method examples are considered, it is seen that the hazard of flooding and climate change is slightly more prominent than other types of natural threats. Then comes the threat of earthquakes. This is likely due to the dominance of climate change research in recent years, with flood hazards primarily affecting European and Asian countries.

3.2.2. Scale and target audience

In terms of risk management, the main objective is to ensure positive development in the current risk perceptions of the participants in line with the contemporary risk management. Therefore, it is important to improve participants' perceptions of the environment in which they live. In other words, it is important that they have knowledge of the environment in which they have lived and gained experience, and they may be at risk. Therefore, when it comes to local people, the scale of risk communication is local, and micro-level, it is necessary to evaluate it on a neighborhood basis. Different tools must be developed to design scales that remain above this.

From this point of view, town-watching and collaborative mapping methods can directly inform the local people. However, serious games remain on a higher scale. Rather than examples that directly relate to the living environment, it is seen that the target audiences are voluntary, expert, and policy-makers. In fact, developing policy and strategy targets multiple audiences for educational purposes. Since international organizations use various methods together, it can be observed that they remain predominantly on a local scale but with an international experience.

3.2.3. Community's disaster experience

Examples being considered, it could be argued that the community's disaster experience was of great importance. In most cases, disaster damage reduction and management training are provided to participants before the application, except in serious games. For this reason, it could be assumed that gamification can help individuals without disaster experience develop better perceptions of the situation.

3.2.4. Management organization

It has been observed that research and international organizations play a significant role in implementing the methods, based on the type of organization that adopts them. These organizations are known to undertake projects that contribute significantly to the development of these methods. This situation makes international organizations question how they communicate with the locals since local governments often lack expert teams, technology, and policy cohesion. Local volunteers support the establishment of bonds of culture and trust. On the other hand, local organizations or administrations make less effort to communicate, while international organizations or research projects play a more significant role. In this sense, the town-watching is considered to be a method that more local administrations apply.

3.2.5. Strengths and weaknesses

All the methods examined were based on the aim of communicating the issue of risk. In other words, rather than simply presenting expert information to the public and expecting them to comprehend and absorb it, it is more effective to discuss the causes and consequences of risks, as well as potential solutions and escape routes, in order to ensure that the information is fully understood and internalized.

Local dialogue can be established through collaborative mapping and town watching, apart from international organizations implementing multiple methods. Although serious games allow access to many people, it is unlikely to fully align with local culture and language. For this reason, local experts definitely require an adaptation process.

It is stated that during the implementation phase of the town-watching method and collaborative mapping, international organizations mostly work with local volunteers, which may have both positive and negative effects. It is crucial to develop the volunteer system in disaster management. However, it is impossible to apply such methods if there are no volunteers or a low number. Theoretically, being able to communicate directly or indirectly with all segments of society will lead to more constructive results. However, with the methods examined, it can be seen that the expected results have yet to occur. Although digital tools offer advantages for mass access, they cannot be effective solutions if local communities lack access to and proficiency in using them.

3.2.6. The relationship between methods and urban planning

In no method is the emphasis on urban planning fully made. Of course, it is not possible to make a full comment on this issue because there is no explanation of what the areas of expertise of volunteer, expert, local employees are included in the stakeholder definitions of the methods. In the context of international organizations, a stage is defined to ensure communication with decision-makers. At this stage, urban planners can play a role.

Locally produced city monitoring and common mapping issues are seen as methods that can aid local planning studies. The identified issues will guide the plan decisions, making it easier for the public to adopt them.

4. Conclusion and Suggestions

Developing resilience to disaster risks requires community cooperation. Research on risk communication in relation to the production and sharing of risk information is gaining great importance. Effective risk communication requires information that is tailored to different segments of society, easily comprehensible, not alarming, solution-oriented, and able to clearly express the benefit-cost dilemma.

In the process of risk analysis for risk communication, developing a risk communication strategy is the first step. In strategic thinking, it is essential to implement risk reduction and management strategies that encompass risk information production, target all segments of society, convey positive information, and strengthen risk perception. Stakeholder engagement at all levels is key to developing effective risk reduction and risk management strategies.

Within the scope of the research, four methods that are part of the risk communication strategies developed by various organizations in the literature have been analyzed and discussed. Town watching, collaborative mapping, serious games, and multiple methods used by international organizations are the analyzed methods. It could be argued that these methods represent a more advanced approach to establishing risk communication for flood and climate change hazards. The methods are primarily intended for a local audience. Gamification and multi-method are popular techniques used by organizations to engage multiple audiences. It has been determined that disaster volunteers play a crucial role in risk communication.

As a result, recommendations have been developed for evaluating these methods in urban planning.

In relation to the local, town watching and collaborative mapping are easily integrated into urban planning.

- In the planning process, an active relationship should be established between the disaster risk reduction process and access should be provided to the public through non-governmental organizations and volunteers. Urban planners receive extensive training in mapping. Both manual and digital map production, database management are among the areas of expertise for urban planners. Producing maps at various scales that bring together various emotions, thoughts, concepts, abstract and tangible entities is at the core of planning education. For this reason, urban planners should definitely be experts in the field of map production in communication with the society.

- Games that appeal to the local can be produced. The plan can help develop strategies and create environments where managers and the public can discuss these strategies together.

This research has analyzed different examples of risk communication. As a result, proposed are the methods for developing participatory processes of urban planning in disaster risk reduction and the contributions that urban planners can make to these methods. This research can serve as the basis for locally-led participatory planning experiences.

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Urban Sustainability Assessment Tools and Utilization Opportunities on University Campuses

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1. Introduction

Today, the acceleration of population growth, urbanization and industrialization increases the human intervention on natural resources and thus the concerns about the continuity of natural resources. As a result, especially after the 1990s, the search for solutions to ensure the sustainability of natural resources has accelerated.

Sustainability is a concept put forward in this sense, and it appears as the understanding of seeking solutions to environmental problems and increasing social and economic welfare. The concept of sustainability, which encourages the continuity of natural assets and the use of future generations without hindering their use, is a concept that has been frequently mentioned by many sectors today.

The concept of sustainability was defined as *"meets the needs of the present without compromising the ability of future generations to meet their own needs"* in the Our Common Future Report published by the United Nations (UN) World and Environmental Development Commission for the first time in 1987. The aim of the sustainability approach is to achieve self-sufficient societies and cities. It helps to ensure the continuity of systems and processes by making changes in the thinking and living styles of societies without reducing the quality of life.

With the definition and purpose of the concept of sustainability in the 1987 Brundlant Common Future Report, new concepts began to emerge for cities as well. One of them is the concept of urban sustainability. Sustainable urbanization; while meeting the basic needs of people in the urbanization process, it does not harm the environment, and the most appropriate use of urban resources allows the citizens to increase and improve their quality of life (Erdinç, 2016). There are many steps taken on sustainability and urban sustainability in the world and in Türkiye. There are agreements made in order to ensure stability on sustainability, published statements, and evaluation tools developed by many institutions, organizations and states (Koçak, 2022). Universities are the most important institutions that act as role models in ensuring sustainability in cities. In addition, the most efficient way of planning the campus areas of the universities allows them to contribute to the city in which they are located in economic, environmental and social dimensions; at the same time, it can provide important benefits in the cyclical process of the university as an institution (Demiroğlu et al., 2017).

The aim of this study is to evaluate the possibilities of using assessment tools for urban sustainability in university campuses. In the study, first of all, the concept of sustainability and the definition of this understanding on an urban scale are given. In order to ensure sustainability in cities, the necessity of considering economic, environmental and social dimensions and the tools developed to ensure urban sustainability are mentioned. In addition, by emphasizing the necessity of planning university campuses, which act as a role model for ensuring sustainability in cities, it is given information about the basic principles that should be in order to increase the level of contribution to the city where it is located. At the end of the study, the evaluation tools that universities can apply to ensure their sustainability and the features of these tools are detailed.

2. Sustainability and Urban Sustainability Concepts

Sustainability, which originally comes from the Latin word 'Sustinere', means to continue, to provide, to continue (Tıraş, 2012). The concept that has started to appear frequently in recent years; It aims to increase environmental welfare, regulate, improve and maintain people's living conditions (EPA, 2017). The concept of sustainability is based on the idea of stopping the degradation by taking the necessary measures to stop the deterioration of the environment. It was fully defined for the first time in the Report of Our Common Future published by the United Nations (UN) World and Environmental Development Commission in 1987 and continues to be the subject of many researches in the literature. In this report, two key words of the concept of sustainable development are stated as “needs and limitations”. Needs refer to meeting the needs of even the lowest part of the society at a reasonable level, while limitations refer to the limited use of natural resources to transfer them to future generations (Blewitt, 2008). Although this definition is the most frequently used definition that explains the basic understanding of the concept of sustainability for the first time, it also formed the basis of definitions found in different sources over time. When the concept of sustainability is considered as a top title, it can be said that it is a concept with economic, environmental and social dimensions (Öztürk Kurtaslan, 2014). Barbier (2017), who first mentioned these three dimensions of sustainability, states that it can only be achieved by realizing these three dimensions at the same time (Barbier & Burgess, 2017). Thus, we can say that the understanding of sustainability is an understanding that offers solutions for the protection of nature and natural resources, increasing the welfare of people and increasing the income level, creating suitable socio-cultural environments for people, reducing the negative effects of urbanization and rapid industrialization on societies and the environment.

According to Spindler (2013), all objectives developed to ensure sustainability should include some common principles. These;

Ensuring Justice for Future Generations: While meeting the needs of today, plans should be made by considering the usage needs of future generations.

Renewal Capacity: Nature should be allowed to renew itself.

Conciseness Law: The use of renewable resources should be encouraged.

Reducing Risks: Potential risks threatening nature and the continuity of natural resources should be minimized.

Absorption Capacity: Adequate emission generation should be allowed without exceeding the limits of nature.

Creating Ecological and Economic Value: Conservation of ecological features and biodiversity should be encouraged.

The concept of urban sustainability, on the other hand, is a concept that has started to take place frequently on the world agenda as a result of the increasing urbanization and population rate with the acceleration of industrialization in recent years. Sustainable cities are cities that can meet the welfare of people physically and economically at a reasonable level, and are open to change and development without harming the natural environment. (Tezgör, 2021; Alrawi & Qasim, 2022; Kovalenko & Anfilov, 2022). The aim of urban sustainability is to ensure a balanced development in every sector by increasing economic power, participation, local governance and capacity building. Thus, sustainable cities take care of social and economic interests, and enable continuity in change by obtaining clean environment and clean energy (Bayram, 2001; Commission of the European Communities, 2009). In order to develop cities in a sustainable way, it is necessary to encourage the inhabitants of the region to use clean and renewable energy, to protect natural water resources, to provide healthy living conditions for all living things, to minimize all environmental pollution factors and to increase recycling by keeping solid waste production at a minimum. In addition to all these, while providing economic welfare, a social and reliable environment should be provided where people live in justice, equality, freedom and solidarity (McCormick et al., 2013; Demiroğlu at al., 2014; Demiroğlu & Karadağ, 2015; Cengiz et al., 2017; Gargiulo et al., 2018).

3. Studies on Urban Sustainability in the World and in Türkiye

The first studies to ensure sustainability were started in the agriculture, architecture and economy sectors. (Aydin & Tufan, 2018). Later, with the rapid development of industrialization, increasing migration from rural to urban areas and population growth began to challenge the existing capacities of the cities. This situation has led to increased pressure on natural resources. With the effect of climate change, the concept of sustainability in urban areas has become the common denominator of the world agenda and many agreements and studies have been signed in order to achieve it. The Athens Agreement, signed in 1933, is the most important document in which the basic characteristics of sustainable urban development are determined in the early period. On the other hand, the 1972 UN Environment Conference was held for the first time with the coming together of states on the subject of environment. With this conference, the basic principles of sustainable development were determined. With the HABITAT I conference held in 1976, the effects of cities on climate change began to be mentioned for the first time. With the UN Environment Program and the World Conservation Strategy carried out in 1980, it was started to be mentioned that urban sustainability should be ensured and that social and economic development and nature protection should be included in the planning by considering them together. The Brundland Report on Our Common Future is one of the important documents in which sustainability is defined comprehensively for the first time. (Mutlu, 2002; Ertan, 2008; Eş, 2008; Karakurt Tosun, 2009; Erdinç, 2016; MEUCC, 2021). Rio Summit held in 1992; It is another important study gathered with the aim of increasing environmental awareness in the global public and producing solutions to environmental problems. As a result of the conference, five important documents such as UN Framework Convention on Climate Change, Rio Declaration, Agenda 21, Forestry Principles and Biological Diversity Convention were adopted. (Uzmen & Arar, 2001; Yıldırım & Öner, 2003; Kaya, 2007). With the Aalborg Charter, which was accepted at the First European Conference on Sustainable Cities and Towns in 1994, a guide document was prepared to ensure social, economic and environmental sustainability in cities. (Çolakoglu, 2019). In 2015, the Sustainable Development Goals, adopted in line with the UN 2030 Agenda and Sustainable Development Goals, are one of the most important urban sustainability studies that call for action to eradicate poverty, protect the world, and ensure prosperity, and which is still valid today.

Although Türkiye started environmental studies as a result of the 1972 UN Environment Conference, the concept of sustainability was mentioned for the first time in policy and implementation documents in the 2000s. Although the concepts of 'sustainable development' and 'sustainable economy' were encountered for the first time in these documents, concepts such as 'sustainable cities', 'sustainable agriculture', and 'sustainable energy' became important and frequently used concepts in different sectors (Erdinç, 2016).

The development of the concepts of sustainability, environment and urbanization started to gain momentum with the establishment of the State Planning Organization on September 30, 1960 in Türkiye. Another issue that contributes to Türkiye’s urban sustainability activities is the development plans prepared. These documents, which include state policies that provide economic, social and environmental developments, are based on the country's economy and industrialization. There are 11 development plans that have come into force in Türkiye so far. However, it is not possible to fully encounter the issues of sustainability and urban sustainability in all of these plans. Especially in the periods when the 1st and 2nd five-year development plans were prepared, our country was subjected to radical changes in many areas with the proclamation of the republic. The sector most adversely affected by this situation is the environment.

Rapid industrialization, industrialization in agriculture, increase in employment and socio-economic developments increased the rate of urbanization and the damage to the environment was ignored at this development stage (Erdinç, 2016). At the stage of the 3rd Five-Year Development Plan, the acceptance of the 1972 Stockholm Conference, to which Türkiye was also a party, was a factor. Environmental issues are now on the agenda and the environment is seen as a sector for the first time. After this plan, environmental protection and development plans started to be taken as an example. Studies on minimizing the damage to the environment and sustainability principles in industrialization, modern agricultural practices and urbanization have started to be mentioned. With the 11th Development Plan, which is still valid today, the connection of all sectors with the environment, the importance of environmental awareness and environmentally friendly approaches are mentioned In addition, a new global development framework is drawn in Türkiye with the “Agenda 2030: UN Sustainable Development Goals (SDGs)” adopted in New York on September 27, 2015 and to which Türkiye is a party and which is the continuation of the Millennium Development Goals. Environmental issues such as sustainable cities, climate change, fight against drought, protection of biological diversity have been included in the agenda of sustainable development and studies on this subject are still continuing (Öztürk Kurtaslan, 2016; Karadağ & Demiroğlu, 2022).

4. University Campuses and Their Contribution to Urban Sustainability

Universities are important education and training institutions that are described as small cities, considering their physical structure and the opportunities they offer. Campuses, on the other hand, are units formed by the co-existence of these educational institutions in order to ensure and develop their interaction on economic, social and cultural issues (Açıkay, 2015). In addition to being a place where users meet their basic needs, university campuses should also be places that leave memories and new experiences, thus leaving a mark. (Broussard, 2009; Yalçın, 2012). Universities are campus areas that enable the implementation of appropriate planning and design approaches for both education and various social activities in ensuring and developing the interactions between ecosystem-environment-society and ensuring sustainability with this approach, and undertake a pioneering task in all these issues (Demiroğlu et al., 2016; Güvenç & Demiroğlu, 2016; Demiroğlu et al., 2017; Demiroğlu et al., 2018; Ak, 2022; Gemici & Öztürk Kurtaslan, 2023).

Along with the pollution and extinction in natural resources, awareness and change have begun to occur in the founding philosophies of universities, which are the pioneers of science, art and education. As a result of these changes, the concepts of *"ecological campus"*, *"green campus"*, *"sustainable campus"* have now been used frequently for universities and their campuses. The use of the concept of sustainability for universities dates back to the 1972 Stockholm conference. The Stockholm Conference was the first to make reference to the issue of sustainability on university campuses. In the declaration, it was emphasized that universities should work on environmental problems rather than lifestyles and system suggestions

(Köksal, 2022). Other important studies on ensuring sustainability in universities can be summarized as follows (Table 1).

Table 1. Studies on sustainability in universities (Güllü et al., 2012)

YEAR	DECLARATIONS	YEAR	DECLARATIONS
1972	Stockholm Conference	**2001**	Lüneburg Declaration
1977	Tbilisi Declaration	**2002**	Ubuntu Manifesto, Cape Town Manifesto
1990	Talloires Declaration	**2004**	Barcelona Declaration
1991	Halifax Declaration	**2005**	Graz Declaration
1992	UN's Environment and Development Report Chapter 36	**2006**	Statement of Responsibility in Higher Education
1993	Kyoto Declaration, Swansea Declaration	**2007**	ACPUCCC 2007 (America University Presidents' Climate Commitment), Lucerne Declaration
1994	CRE Copernicus Declaration	**2008**	Declaration of Partnership of French Universities, Sapporo Declaration
1997	Declaration of Thessaloniki International Conference on Environment and Society	**2009**	Tokyo Declaration, Bonn Declaration, AAU Green Energy Consensus Statement, Lübeck Declaration
1998	Higher Education World Declaration	**2010**	ISCN/GULF Declaration

All the agreements and conferences held have managed to attract the attention of the media and the public, but the monitoring and evaluation of the studies of universities on sustainability remained unclear. For this purpose, campus networks have been established and evaluation tools have been developed in order to activate, control and evaluate sustainability studies at universities. These organizations (ISCN, GUPES, EETU, etc.) acting with a common purpose are a general guide for sustainable universities, and universities are expected to work under the guidance of these organizations. In addition to these, the evaluation tools developed by institutions, organizations or associations in order to ensure sustainability in buildings at the beginning were reorganized in neighborhood and campus scales and assessment tools developed only for university campuses are also important for the control of sustainability studies on campuses (Oktay & Küçükyağcı, 2015; Demiroğlu et al., 2017).

5. Urban Sustainability Assessment Tools That Can Be Used on University Campuses

In addition to the studies carried out for the formation and development of environmental and sustainability awareness in cities, urban sustainability assessment tools prepared by local governments, universities, some institutions and organizations within the framework of certain criteria in order to encourage conservation and ensure stability in the realization of sustainability goals are also important studies with recognized competence. These studies, which have been frequently preferred in recent years, make very important contributions to the following issues; such as following a systematic and regular way in urbanization activities, approaching complex problems with controlled solutions, taking into account the wishes and needs of societies, ensuring long-term economic and ecological balance, creating resistance to climate change, adopting an impartial-objective-egalitarian management approach (Haapio, 2012; Medved, 2017; He et al., 2018; Demiroğlu et al., 2019; Orozco-Messana et al., 2021).

Urban sustainability assessment tools were first developed at the building scale, using terms such as *"green", "sustainable" and "environmentally friendly"* in order to reduce the consumption of natural resources, ensure their transfer to future generations, and minimize environmental pollution in order to ensure sustainability. (Martin et al., 2021). The main purpose of these tools is to maximize efficiency in buildings, to minimize the damage to the environment through construction, to encourage local and sustainable materials, to evaluate and monitor the performance of buildings (Sharifi & Murayama, 2014; Cengiz et al., 2014; Qu et al., 2020; Carvalhoa et al., 2021; Hegazy et al., 2021;). Although green certificate systems were initially handled at the building scale, certificate systems were later implemented at the scale of the site, neighborhood, and part of the city. (Ercoşkun & Mutdoğan, 2015). Some certification systems that can be adapted to university campuses, which have been implemented at different scales in the world and in Türkiye, and the general characteristics of these systems are summarized in Table 2. The general features of these systems are detailed in the following sections.

Table 2. Urban sustainability assessment tools that can also be used on university campuses

Evaluation Tool	Year	Developer Institution	Evaluation Categories
BREEAM Communities	2011	Building Research Agency (BRE)-England	*Management *Social and economic welfare *Natural resources and energy *Land use and ecology *Transportation and mobility
LEED Cities and Communities	2016	US Green Building Council (USGBC)-USA	*Integrated process *Natural systems and ecology *Transport and land use *Water efficiency *Energy and greenhouse gas emissions *Materials and resources *Life quality *Innovation *Regional priority
Green Mark for districts	2005	Singapore Building and Construction Corporation	* Energy efficiency *Water management *Material and waste management *Environmental planning *Green building and transportation *Society and innovation
CASBEE for cities	2006	Institute for Building Environment and Energy Conservation (IBEC)-Japan	**QUD** *Natural Environment, Microclimate and Ecosystems *Service Functions for the Designed Area *Contribution to Local Communities **LUD** ***Environmental Impacts

			on Microclimate, Facade and Landscape *Social Infrastructure *Management of the local environment
GSAS/QSAS Neighborhood	2009	Qatar Sustainability Assessment System (QSAS) and the non-profit Gulf Research and Development Organization (GORD).	*Urban connections *Area *Energy *This *Material *Outdoor *Cultural and economic value *Management and implementation
Pearl Community Rating System	2010	Abu Dhabi Urban Planning Council- United Arab Emirates	*Integrated development process *Natural systems * Livable communities *Precious water * Rich energy resources *Environmentally friendly material *Innovative application
DGNB NUD	2011	German Sustainable Building Council and the German Ministry of Transport, Construction and Urban Relations.	* Ecology, *Economy, *Socio-cultural and operational issues, *Technical issues *Evaluation of processes
Greenstar Communities	2012	Australian Green Building Council (GBCA)	*Management *Design *Livability *Economic welfare *Environment and innovation
YeS-TR	2022	Ministry of Environment, Urbanization and Climate Change,	*Region and neighborhood profile *Sustainable land use *Ecology and Disaster

YeS TR Yeşil Sertifika Bilgi Sistemi	Istanbul Technical University -Turkiye	management *Transportation and mobility *Urban design *Social and Economic sustainability *Innovation and Settlement

5.1. BREEAM (Building Research Establishment Environmental Assessment Method)

BREEAM is the first comprehensive certification system, developed by the UK Building Research Agency (BRE) in 1990, to evaluate sustainability at the building scale. The aim of BREEAM is to reduce the environmental impact of buildings throughout their life cycle, to provide environmental contributions and to increase the recognition of buildings, to provide reliable environmental labels to buildings, and to increase the demand for sustainable buildings (BREEAM, 2013). In the first years of its development, it aimed to minimize the environmental effects at the building scale, but later on, it renewed itself on large scales. BREEAM Communities (BC), developed in 2011 for this purpose; It enables the creation of planned and orderly communities with high social, economic and environmental welfare on an urban scale. (Sullivan, 2020). BC was created based on the BREEAM methodology, which is a third-party evaluation and certification standard, and based on independent European Union norms (Sharifi & Murayama, 2013; Venou, 2014; Yıldız et al., 2015). BC, which was developed again in 2012 and a new version was released, is intended to be more understandable and usable with the arrangements made. The BREEAM certification process for communities is only for medium to large renovation and new development areas and does not cover existing neighborhoods. It can also be applied to small settlements if it will have a significant impact on society. (Ercoşkun & Mutdoğan, 2015).

BC, which makes evaluations at the scale of residential areas, makes certifications after evaluating 40 criteria over 100 points in 6 main categories (Management, social and economic welfare, natural resources and energy, land use and ecology, transportation and mobility) in its latest version. (Table 2). The 1-30 point range is not taken into consideration because it is considered insufficient. A score of 30-45 is considered "pass", a score of 45-55 is considered "good", a score of 55-70 is considered "very good", a score of 70-85 is considered "excellent", and above 85 points "extraordinary". As a result of the scoring, stars are given to the structures depending on the grade level. A project with a passing grade receives a single star, while a project with an outstanding grade is awarded with five stars. (Basdil Gunes, 2017; Yoder, 2017).

There are many universities in Türkiye and around the world that have received BREEAM certificates on a structural scale. Sabancı University and Piri Reis University can be given as examples of universities holding BREEAM certificates at the building scale in Türkiye.

5.2. LEED (Leadership in Energy and Environmental Design)

LEED is a green building certification system developed by the US Green Building Council (USGBC) in 1998. Its aim is to minimize the environmental impact in the building sector, to reduce construction pollution in construction applications, to encourage and guide issues such as energy efficiency and sustainable material use (Ceasea et al., 2016; Ürük & Külünkoğlu İslamoğlu, 2019; Remizov et al., 2021). While LEED was a tool with a building-scale certification system, the neighborhood development program LEED ND was developed in 2009 with the cooperation of the USGBC and the US Natural Resources Conservation Council (NRDC) by expanding the scale of individual buildings (Sjöholm, 2013; Sharifi & Murayama, 2014; Smith, 2015; Ceasea et al., 2016; Brown, 2019). LEED-ND, which includes new developments in this system, for which LEED v.4 version was created in 2014, has been developed to provide more systematic results for purposes such as minimizing or reversing environmental impacts at the neighborhood scale, protecting natural resources, creating a green economy, and creating societies with healthy living conditions (Benson & Bereitschaft, 2020).

LEED Cities and Communities was developed by USGBC in 2016, which is the last and most comprehensive system developed by USGBC. The aim of this system, developed for cities and communities, is to encourage local governments to manage natural resources, energy, water, waste, transportation and improve the quality of life. It also helps local governments to create sustainable and special plans and contribute to their implementation. In short, this system was developed to improve the sustainability and quality of life in cities and community areas. (USGBC, 2021). Evaluating over 110 points in a total of 39 criteria within the framework of 9 main categories (Integrated process, natural systems and ecology, transport and land use, water efficiency, energy and greenhouse gas emissions, materials and resources, life quality, innovation and regional priority) (Table 2), the highest degree in the LEED Cities and Communities categories is platinum and is given for settlements with 80 points or more. 60-79 points gold, 50-59 points silver and 40-49 points range are determined as certified. Projects with a score below 40 points are not accepted and are expected to be developed. (Lee et al., 2015; Benson & Bereitschaft, 2020). The system has been developed over cities, but can be adapted to many scales, including countries, regions, districts, business development zones, economic development zones, neighborhoods, campuses, universities and military facilities (USGBC, 2021).

A total of 153 cities or communities around the world are LEED Cities and Communities certified to resist climate change and conserve natural resources. (URL-1). In Türkiye, it is the most preferred certification system in individual, institutional and commercial buildings and public buildings. There is not yet a city or community in Türkiye that has the Cities and Communities certificate, which is the latest version of LEED. However, there are many structures that have certificates of different versions of LEED in the public, institutional or residential category. (URL-2).

There are many universities in the world and in Türkiye that have LEED certification on a structural scale within university campuses.

Sabancı University, Boğaziçi University, Bezmi Alem Vakıf University, Özyeğin University and Acıbadem University can be given as examples of universities that have LEED certification on a structural scale within the university campus in Türkiye.

5.3. Green Mark for Districts

Green Mark for Districts was developed by the Singapore Building and Construction Corporation (BCA) in 2005. It has the distinction of being Singapore's first green certification system. It has been developed to easily apply to countries with tropical and subtropical climates, such as Singapore. The system has been developed in order to increase environmental awareness in the construction and real estate sectors, to create sustainable built environments using green building technology, and to present examples of environmentally friendly design and application. The system, which was developed at the building scale with the aim of "at least 80% of the buildings will be sustainable by 2030" in the vision plan, which Singapore defines as a national priority, started to be developed on an urban scale later on. The Green Mark assessment tool was redeveloped in 2009 to increase sustainable master plans and practices at larger scales. It provides the opportunity to evaluate in different categories such as new buildings, existing buildings, green areas, infrastructure and neighborhoods, areas defined beyond the building, and interior spaces. Although the upper limit is not determined for the size of the neighborhoods to be evaluated, the lower limit is defined as 20 ha (BCA, 2014). The most important feature that distinguishes the system from the others is that it deals with innovation criteria together with social criteria. Scoring in the category of society and innovation is evaluated with three classifications: residential areas, industrial areas, business centers and commercial areas. (BCA, 2013). Community areas are evaluated in 6 main categories (Energy efficiency, water management, material and waste management, environmental planning, green building and transportation, society and innovation) with a total of 38 criteria and 185 points (Table 2). In this system, certificates are given for 65-70 points in "pass", 75-90 points in "gold", 90-100 points in "gold plus", and 100 and above points in "platinum" categories.

5.4. CASBEE (The Comprehensive Assessment System for Built Environment Efficiency)

It is a system that evaluates and rates the environmental efficiency of buildings and all other structural areas. This method, which was created in cooperation with the government, industry and academia, evaluates the environmental impact and performance of buildings from the time they were built to the present. In addition to the features such as interior comfort, quality and aesthetics of the buildings, the energy savings they provide and whether environmentally suitable materials are used are extensively examined and evaluated. The objectives of CASBEE can be listed as motivating designers to design ideas that prioritize environmental contributions, presenting an evaluation system that is as simplified as possible, developing a system that can be applied to buildings with a wide variety of techniques, and developing a system that takes into account the problems specific to Japan and Asian countries. (Anbarcı et al.,2012; CASBEE UD, 2014; Oktay, 2015). CASBEE for Urban Development (CASBEE-UD) was developed in 2006, upon the idea that sustainability cannot be achieved by evaluating buildings alone in cities that change and develop over time, and a more holistic approach is required and Urban Renaissance Headquarters requested an "environmental rating of urban renewal projects". (IBEC, 2007). The CASBEE-UD tool is a standalone version of CASBEE for Cities developed for the evaluation of partial or entire groups of buildings on a smaller scale. (URL-3). CASBEE for cities has the same system as the evaluation stages. The difference of the system is that it is on a smaller scale and excludes the interior of the buildings.

The CASBEE assessment tool results are determined by the Building Environmental Efficiency (BEE) value. The BEE value of QUD (environmental quality) and LUD (Environmental load) ratio (Q/L) are taken and the environmental performance of the building is scored. (Figure 1). The assessment is handled in two categories:

“environmental quality in urban development” (QUD) and “external environmental burdens in urban development” (LUD). While QUD makes evaluations on “natural environment, service functions for the designated area and contribution to the local community”, LUD makes evaluations in three main categories: “microclimate, environmental impact on facade and landscape, social infrastructure, management of the local environment”. The QUD component is evaluated in 3 main categories, 15 subcategories and 38 criteria, and the LUD component is evaluated in 3 main categories, in a total of 16 subcategories and 43 criteria. The score obtained is multiplied by the weight, and as a result, the ratio of the QUD and LUD values gives the BEE value (Anbarcı et al., 2012; CASBEE UD, 2014; Oktay, 2015) (Table 2).

Depending on the result of measuring the quality criteria according to the environmental load of the cities, the evaluation process results in one of five points. Evaluation is done as follows; If the BEE value is more than 3.0 and the Q component is more than 50, as Superior (S); If the BEE value is between 1.5-3.0 and the Q component is less than 50, it is considered as Very Good (A); If the BEE value is between 1-1,5, it is considered as Good (B+); if the BEE is between 0.5-1 As Extremely Poor (B-), and if the BEE is less than 0.5 as poor (C).

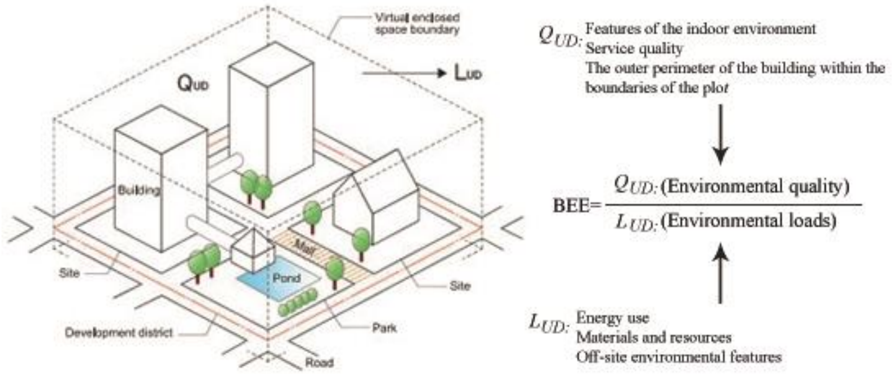

Figure 1.CASBEE UD evaluation system (CASBEE UD,2014)

Since the CASBEE certification system is a system developed exclusively for Japan, its use by different countries is limited. Although the system has been developed for residential areas, it has not yet been piloted. However, it is possible to see many examples certified with this system in Japan. Keio University, Nihon University and Kitakyushu University can be given as examples of universities that have CASBBE certification on a structural scale within the university campus. The CASBEE evaluation process is controlled by 3rd parties. Thus, the certification process is carried out in an open and transparent manner.

5.5. GSAS/QSAS Neighborhoods

The Global Sustainability Assessment System (GSAS) was developed in 2009 in collaboration with the Qatar Sustainability Assessment System (QSAS) and the non-profit Gulf Research and Development Organization (GORD). The aim of the system is to identify the local and environmental needs of the country and to provide a built environment that minimizes negative effects on ecology. In the system, evaluations can be made at different scales, including "master plan, building groups and individual buildings". In this system, which has more detailed tools than other methods, neighborhoods and parks can be evaluated on a master plan scale. (GSAS/QSAS Technical Committee & GORD, 2013). GSAS/QSAS Neighborhoods, which can also be adapted to university campuses, have been developed to measure the environmental contributions of neighborhoods, to test the environmental performance of systems and buildings in the neighborhood, and to ensure that neighborhoods adhere to sustainable urban planning.

The environmental impact of the region is evaluated by scoring 40 sub-criteria in 8 main categories (Table 2), with different values varying between -1 and 3. -1 point is unacceptable, 0 is accepted as the limit, 3 indicates the highest value. At the last stage, the values are multiplied by the criterion weights to obtain the criterion score, and the sum of the scores gives the total score. Degrees are expressed with asterisks. 1 star for those who are in the 0.5-1 point range; 2 stars for areas with 1-1.5 points range; 3 stars for areas with a 1.5-2 point range; 4 stars for fields with 2-2.5 points range; Scores with 2.5-3 points are given 5 stars, and those with 3 points or more are given 6 stars. (GSAS/QSAS Technical Committee & GORD, 2013).

5.6. Pearl Communities Rating System (PCRS)

PCRS was developed by Estidama in 2010 in Abu Dhabi for implementation in the United Arab Emirates. Estidama means sustainability in Arabic and is an initiative created to transform Abu Dhabi into a sustainable city model. The purpose of the PCRS is to promote the development of sustainable communities and improve the quality of life. PCRS aims to minimize water consumption, energy consumption and waste, encourage the use of local materials, and improve supply chains for sustainable and recycled materials and products. Estidama is the first initiative on sustainable urbanization and assessment tool in the Middle East and is therefore important. The most important work on this subject is PCRS. The difference of the PCRS assessment system from other systems is that it handles the population. The population of the neighborhood, site or campus that will apply for this certificate system must be at least 1000 people. If it is an area to be evaluated on a higher scale, the population should be 20-30 thousand people maximum. Upper scaled areas are evaluated by fragmentation. In the Estidama system, sustainability has been addressed in four dimensions as "*environmental, economic, social and cultural*".

The PCRS was developed on the measurement and monitoring of sustainability in these four dimensions throughout the life cycle of the subject area from design to operation. If the prerequisite criteria in 63 criteria in 7 main categories (Table 2) are met, 1 pearl is given to the region. After that, the scoring system is applied for the additional criteria provided by the project and the number of pearls increases. Therefore, it is certified by taking two pearls with 55 points in addition to the mandatory criteria, 75 points with 3 pearls in addition to the mandatory criteria, 4 pearls with 100 points in addition to the mandatory criteria, and 5 pearls with 125 points in addition to the mandatory criteria.

5.7. Greenstar Communities

It is a certification system developed by the Australian Green Building Council (GBCA) at building scale in 2003 and campus scale in 2012.

It is foreseen to be used in Australia as well as New Zealand and South Africa, which have similar climatic features. The system, which set out with the goal of sustainable society, was developed on a neighborhood scale in 2012 in order to guide local governments as well. (GBCA & AECOM, 2012). The system called Greenstar Communities is handled in two frameworks as “national framework” and “assessment tool” with the participation of users from different sectors. The reason why the system is handled in two frameworks is important in terms of providing a holistic approach. The aim of this approach is to create a national common language within the framework of a sustainable society, to encourage innovation, to support integrity, to increase communication between stakeholders, and to form a basis for the evaluation process. The difference of the Greenstar Communities system from other green certification systems is that the certified neighborhoods are expected to be certified again every 5 years to prove that the sustainability criteria are met. The method does not include building-scale evaluations. However, the existence of buildings certified with the sustainability assessment tool developed at the building scale is evaluated as a criterion. The highest total score is 100 points and projects over 75 points are certified with 6 stars. Projects with 4 stars and less than 45 points are not certified. (Table 2).

5.8. DGNB-NUD

DGNB is a system developed in 2008 in partnership with the German Sustainable Building Council and the German Ministry of Transport, Construction and Urban Relations. The DGNB green certification system was established to promote sustainable and economically efficient buildings and was created with a comprehensive approach with the active participation of the architecture, planning, construction industry, investors and the scientific community. This system, which is used in the planning and evaluation of buildings, covers all relevant sustainable structures. In 2011, DGNB New Urban Districts (NUD) was developed as both an evaluation and a design tool, as building-scale evaluation systems focusing on energy saving were insufficient for sustainable development and comprehensive systems became widespread. DGNB has three main goals in creating sustainable urban zones. These are to create regions that are compatible with the current climate, have little impact on climate change and are resistant to climate change. In addition, focusing on people, creating quality spaces where people will want to spend time, ensuring social equality in the region are important issues for DGNB. (Ercoşkun & Mutdoğan, 2015; DGNB, 2023). The DGNB program for urban areas provides support here as a planning tool. The DGNB NUD system has determined the settlement areas to be certified as at least 2 ha. In addition, it is expected that the area will be wide enough to accommodate more than one building, close to existing infrastructure systems and in an accessible location. In addition, the project supports the planning and construction of vibrant, attractive and at the same time resource-conserving districts. In the DGNB developed for urban areas, each building does not necessarily need to be documented, but they are included in the assessment by their consumption values and their impact on open spaces (eg, vertical and roof gardens). The DGNB system differs from other systems in terms of its method and application. Its distinguishing features from other systems are that it focuses more on the economic dimension of sustainability and leaves it to the customer which program and application to use while complying with local standards. The system is a green certificate system that can be used in urban areas as well as in commercial areas, industrial sites, holiday villages, business areas, activity areas, and vertical urban areas (Ercoşkun & Mutdoğan, 2015; Oktay, 2015; DGNB, 2023) (Table 2).

We can't see DGNB taking place at too many campus scales. In the world, only Singapore National University School of Design and Environment building can be given as an example as a university with DGNB certificate at the building scale.

5.9. YeS-TR Green Certificate Information System

The Green Certificate system is of Türkiye origin and the system is comprised of 32 academics from 11 different science working groups from Istanbul Technical University, Yıldız Technical University, Çankaya University, Middle East Technical University, Ömer Halisdemir University, Bahçeşehir University and Beykent University, and many experts from the Ministry of Environment and Urbanization (Özçevik et al., 2018). In the development process of the Green Certificate system, the methods of important certification systems that have been accepted in the world were used. Thus, it has been tried to develop a certification system with categories and criteria that can be applied primarily in Türkiye and then all over the world. It has been developed in order to minimize the environmental impacts and increase sustainability at every stage of the building's life cycle. (Aytaç, 2021; Ministry of Environment, Urbanism And Climate Change, 2021; YESU Lecture Note, 2022). The Green Certificate system has been developed to be used in existing buildings and new buildings that have received building occupancy permits and at least 2 years have passed since. In the “Green Certificate Settlement” system, existing and new development areas on a larger scale are evaluated with a systematic and holistic perspective. Green Certificate Settlement system; It is a system that aims to create settlements that are compatible with natural resources, climate data and local characteristics, consume energy and water as much as they need, use renewable energy resources, have waste management and whose carbon emissions can be monitored. The Green Certificate Settlement evaluation system consists of 6 themes, 21 categories and 77 criteria. (Table 2). Evaluation in the system is made over 100 points, but there is an innovation criterion worth 10 points in addition. This criterion does not directly affect the evaluation result, it only contributes to increasing the efficiency and prestige of the project. Rating levels were classified in 5 different ways as application, passing, good, very good, and national superiority. (Ministry of Environment, Urbanism and Climate Change, 2021; Koçak, 2022).

6. Evaluation Tools Used Specifically for University Campuses

In the USA and the EU, as of the 1990s, the concept of sustainable campus has begun to be given importance. In the People's Republic of China, one of the leading countries in this regard, studies on sustainable campus have been carried out since 1997 (Hajrasouliha, 2017; Washington-Ottombre et al., 2018). These evaluation tools, which were developed in order to ensure the continuity of these studies and to ensure that universities gain a fully sustainable qualification, prevents sustainability from being a process and a result in buildings, urban areas and campus areas and encourages the understanding of establishing a comparable, calculable, understandable and constantly improving system (Özdoğan & Civelekoğlu, 2019).

LEED Cities and Communities, BREEAM Communities, DGNB New Urban Districts and CASBEE Urban Development systems, which are among the important certification systems whose competence has been accepted in the international arena within the scope of the settlement, can also be used for university campuses. However, there are no university campuses in the world and in Türkiye that have these certificates on campus scale.

Versions of these systems that make assessments at the building scale are generally used for buildings in university campuses. There are many assessment tools that can be used specifically for campuses developed by different countries in order to ensure sustainability in campuses, to increase stability and competition among universities. The most preferred of these tools can be summarized as follows (Table 3):

Table 3. Sustainability assessment tools used in university campuses

Evaluation Tool	Developer	Year	Evaluation Criteria
UI Greenmetric	Indonesia University	2014	* Structure and Infrastructure * Energy and Climate Change * Wastes * Water * Transport * Education and Research
AASHE STARS	Higher Education Associations Sustainability Consortium (HEASC)-ABD	2006	* Organizational Features *Academic *Interaction *Operations *Planning and Management *Innovation and Leadership
University League	People and Planet-İngiltere	2007	*Environmental audit *Education *Waste and recycling *Policy and strategy, *Sustainable human resources, *Ethical investment and banking *Carbon management, *Labor rights, *Sustainable food, *Student and staff participation *Energy resources, *Carbon reduction, *Water reduction
THE	TES Global-İngiltere	2010	*Learning *Research *Transfer of information *International Outlook *Industry income

6.1. UI Greenmetric

UI Greenmetric, developed in Indonesia in 2010, is a ranking system among universities based on sustainability studies. This system, which sets out the necessary criteria to become a 'green campus' or 'sustainable campus' in a global sense, has been developed to set a standard for sustainability criteria in universities. UI Greenmetric acts as a guide on how universities with a sustainability goal should follow a path to achieve this goal. UI Greenmetric system can provide benefits in increasing international recognition, raising awareness on sustainability, social change and action by providing universities with free access. In addition, universities have the opportunity to compare their position on sustainability both with other universities in the region and with international universities **(**Suwartha & Sari, 2013; Marrone et al, 2018; Köksal, 2022; UI Greenmetric, 2022).

The UI Greenmetric system evaluates university campuses by scoring 51 sub-criteria in 6 main categories: structure and infrastructure, energy and climate change, waste, water consumption, transportation, education and research. Among the categories, the highest weight is given to energy and climate change with 21%. This is followed by waste management (18%), transportation (18%), education and research (18%), building and infrastructure (15%), and water management (10%). The university, which receives a total of 10,000 points from these evaluations, is at the top in terms of sustainability. (Köksal, 2022; UI Greenmetric, 2022) (Table 4). Rankings between universities are updated every year with the participation of new universities or the declaration of participating universities within the scope of sustainability studies. While the top five universities in the world for sustainability, evaluated within the scope of UI Greenmetric, are Wageningen University & Research (9300 p.), Nottingham Trent University (9175 p.), University of Nottingham (9175 p.), University of Groningen (9160 p.), University of California

(9150 p.); those in Türkiye are Istanbul Technical University (8585 p.), Cyprus International University (8350 p.), Erciyes University (8260 p.), Ozyegin University (8225 p.), Yıldız Technical University (8225 p.).

Table 4. Scores of categories in the UI greenmetric system

Main Categories	Max Score (point)
Energy and climate change	2100
Waste management	1800
Transportation	1800
Education and Research	1800
Building and Infrastructure	1500
Water Management	1000

6.2. STARS (The Sustainability Tracking, Assessment & Rating System)

STARS Rating System is a campus sustainability rating system prepared by AASHE (Association for the Advancement of Sustainability in Higher Education) in 2006. It is an evaluation system that transparently and systematically reports the work of universities on sustainability. STARS, developed by AASHE with the wide participation of representatives from higher education institutions, was established to monitor and promote the sustainability programs of all colleges and universities in North America and Canada. The system has an evaluation system that can be used both in existing universities and newly built universities (Köksal, 2022; STARS, 2019).

STARS provides a clear framework for the current and future planning and construction objectives of universities. The objectives of the STARS evaluation system are;

• To create a sustainability framework that can be used in all higher education institutions

• To be able to make meaningful comparisons between universities by creating a common measurement set that can be used in all international universities.

• Encouraging universities to ensure stability and continuous renewal in terms of sustainability

• To facilitate the exchange of information on sustainability studies of universities.

• To create a stronger and more diverse sustainable campus community (Köksal, 2022; STARS, 2019).

The STARS evaluation system evaluates universities within the framework of 18 subcategories and 68 criteria in 5 main categories: institutional characteristics, academic features, engagement, operations, planning and administration. If an institution has different initiatives to set an example, it can also earn Innovation and Leadership points. The points earned from this additional category are added on to the percentage obtained from other categories, allowing the certification grade to be increased. (Koksal, 2022). By weight, points are taken from the operations category the most. This is followed by the categories of academic characteristics, engagement, planning administration, innovation and leadership and institutional characteristics (Table 5). Making evaluations out of a total of 100 points, STARS; gives a "Reporter designation" certificate to the universities that apply for the certificate. Universities with at least 25 points from the categories and criteria can be awarded bronze, universities with 45 points can be awarded silver, universities with 65 points can be awarded gold, and universities with 85 points and above can receive platinum certificates. While the certification is valid for three years, institutions can upgrade the certification rating by resubmitting an updated report for a new rating once a year (STARS, 2019). Among the 347 universities registered in the STARS evaluation system in the world, the 5 universities that received the platinum certificate with the highest score are Arizona State University, Colorado State University, Cornell University, Stanford University, State University of New York College of Enviromental Science and Forestry. There is no university campus with STARS certificate in Türkiye yet.

Table 5. Scores of categories in the STARS assesment tools

Main Categories	Max Score (point)
Institutional Characteristics	-
Academics	58
Operations	72
Planning and Administrations	34
Engagement	41
Inovation and Leadership	A total of 4 bonus points can be earned, each rated at 0.5 points.

6.3. University League

It is a ranking system for universities established in England by People and Planet in 2007. In the system, universities are evaluated on the basis of categories such as policy and strategy, sustainable human resources, environmental auditing, ethical investment, carbon management, labor rights, sustainable food, student and staff participation, education, energy resources, waste and recycling, carbon reduction, water reduction. Each category contains sub-criteria. The accuracy of the categories is calculated by obtaining from publicly disclosed data inventories. The sub-criteria are obtained from the data repository of the university and included in the evaluation. Unreachable categories are given zero points by the system (Özdoğan, 2018). While evaluating the categories, the highest weight is given to the carbon reduction category with a rate of 15%. The carbon reduction category is followed by the following categories, respectively; environmental audit (10%), education (9%), waste and recycling (8%), water reduction (8%), carbon management (7%), ethical investment (7%), labor rights (7%), sustainable human resources (6%), student and staff involvement (5%), environmental policy and strategy (4%), sustainable food (4%), and ethical investment (3%). (Table 6). Universities that do not fall below these rates as a result of the evaluations are given a green badge in the virtual environment. However, the badges of universities that fall below 15% in the carbon emission reduction category turn red. This situation causes the university to fall behind in the ranking. Rates and rankings are updated according to the sustainability studies data published by universities in the virtual environment. The system can list a university within the framework of all categories, as well as for each category separately (People & Planet, 2023).

Table 6. University league evaluation criteria percentage distributions

Main Categories	Percentage	Main Categories	Percentage
Policy and strategy	%4	**Student and staff involvement**	%5
Sustainable Human Resources	%8	**Education**	%10
Environmental audit	%10	**Energy sources**	%8
Ethical investment	%7	**Waste and recycling**	%8
Carbon management	%7	**Carbon reduction**	%15
Labor rights	%5.5	**Water reduction**	%8
Sustainable food	%4.5		

6.4. THE (Times Higher Education)

The system, developed in 2010, allows the best universities in the world to be precisely identified and compared. Rankings are used to help universities determine their strategic goals. By compiling detailed performance information about all main fields of activity of universities, it allows them to be compared with other institutions or universities within the framework of regions, subjects and key criteria. While this system helps universities identify the missing issues, it is also open to national and international evaluations and allows easy access to the necessary data (THE, 2020). The participation of 1799 universities in 104 countries increases the accuracy and precision of

THE ranking system data. THE system evaluates a university with 13 indicators in five categories: learning, research, knowledge transfer, international Outlook and sectoral income. Among these categories, learning (30%), research (30%), knowledge transfer (30%) categories are equally important; international outlook (8%) and sectoral income (2%) follow them. (Table 7).

Universities are ranked with the data obtained in accordance with each category and criterion. Rankings are updated every year in accordance with the statements of universities in the virtual environment. It makes evaluations to ensure the economic, social and institutional sustainability of universities rather than environmental sustainability.

Table 7. THE ranking system category scores

Main Categories	Percentage
Learning	%30
Research	%30
Knowledge Transfer	%30
International Outlook	%8
Sectoral Income	%2

Essentially, the basis of all these sustainability tools, which are created at the urban, regional and/or campus scale, are the principles and criteria and strategies of ecological planning-design, in which the resistance to climate change is emphasized by evaluating the landscape characteristics of the area holistically in all the planning and design stages of the area. (Demiroğlu et al., 2014; Erdoğan Onur & Demiroğlu, 2016; Karadağ & Demiroğlu, 2016; Demiroğlu et al., 2016; Karadağ et al., 2016;

Demiroğlu et al., 2017; Demiroğlu et al., 2017; Demiroğlu et al., 2018; Karadağ & Cengiz, 2018; Demiroğlu et al., 2019; Karadağ, 2019; Karadağ & Şenik, 2019; Karadağ et al., 2019; Çoban et al., 2020; Karadağ et al., 2020; Öztürk Kurtaslan 2020; Demiroğlu, 2021; Demiroğlu & Karadağ, 2021; Demiroğlu et al., 2021; Karadağ, 2021a; Karadağ, 2021b; Maaşoğlu & Demiroğlu, 2022).

All these tools, shaped on the basis of ecological-based planning and design, provide the relevant fields with the guarantee of supporting social, economic and ecological sustainability, which are the 3 main pillars of sustainability.

In addition to these evaluation systems, various associations have also been established in order to support social-economic and ecological sustainability in the campuses and to develop global cooperation among universities on sustainability. The most important of these are the United Nations Global Compact (UN-GC) and the International Sustainable Campus Network (ISCN).

United Nations Global Compact (UN-GC): It is a voluntary initiative that takes action to ensure sustainability on a global scale and to achieve the UN Sustainable Development Goals. The United Nations Global Compact, established in the USA in 2005, is a community that has taken initiatives and been influential in the development of Sustainable Development Goals and their acceptance by stakeholders. Community, focused on ensuring corporate sustainability, has 10 principles in the themes of human rights, labor standards, environment and anti-corruption. Although there are 22,805 institutions and organizations in the world that are members of this compact; As of 2023, 424 corporate companies are members of the relevant association in Türkiye. Among these members, there are 10 member universities from Türkiye in the academy category in order to support the UN Sustainable Development Goals and to ensure corporate sustainability. These are Bahçeşehir University, Yıldız Technical University, Özyeğin University, Yaşar University, Istanbul University, Ankara University, Izmir University of Economics, Kadir Has University, Koç University and Sabancı University (URL-1; Köksal, 2022).

ISCN (International Sustainable Campus Network): Founded in 2007, ISCN is a non-profit organization made up of colleges and universities in more than 30 countries, dedicated to the development of campus sustainability studies. ISCN's mission is to provide an international forum to support higher education institutions in the exchange of knowledge, ideas and best practices to integrate sustainability into research and teaching (Fındıklı et al., 2021). It developed the Sustainable Campus Charter, which was signed in partnership with the Global Universities Leaders Forum (GULF), a group of the World Economic Forum, in 2009. The Sustainable Campus Charter was developed based on the sustainable development goals adopted as a result of the Paris Lecture. It is intended to provide a framework for mobilizing international and cross-sectoral action to develop the partnerships, strategies, policies and leaders needed for a more sustainable future. Universities are institutions that have the capacity to create and leverage new and important collaborations to develop solutions to urgent problems such as climate change, urban resilience, social justice, human health and well-being. Universities have the potential to provide vital stability and leadership in society while adhering to unbiased research, learning, testing new ideas and measuring change and impact. (Fındıklı et al., 2021; ISCN, 2023). Universities that have signed the ISCN-GULF Sustainable Campus Charter commit to accept and support the five calls to action. These can be summarized as follows.

-Corporate Leadership

• Include all strategies developed by the ISCN campus network in all units of the university (management, operations, learning, research, community)

• Environments should be planned in universities so that they are durable, strong and interesting that will contribute to the health of all academic and service personnel, all students and visitors.

• Healthy relationships should be established and developed with external partners, industry, government and civil society to disseminate knowledge, research and best practices to benefit the communities served.

-Network Collaboration

• Communication with other members of the ISCN network should be established and strengthened.

• In order to contribute to the Sustainable Development Goals, international dialogue and discussions should be included and contributed.

7. Conclusion

Ensuring urban sustainability has become the most important issue on the world agenda with the development of technology and industry, population growth in cities and changing climate. Especially after 1990, countries have not only made efforts to ensure their own sustainability; Multi-stakeholder conferences were held and papers were published on ensuring sustainability on a global scale. Based on these conferences, countries have developed strategies both in order to improve environmental health and welfare in their own countries and to ensure sustainability on a global scale. Especially developed and developing industrial countries have important responsibilities on urban sustainability.

In addition to all these agreements, conferences and papers, green certification systems that allow sustainability to be provided with systematic, understandable, provable and statistical data are also important tools. Green certification systems, which enable the evaluation of buildings, settlements and cities in terms of ensuring sustainability, are systems that have a category and criteria index suitable for the region in which they are used, and that make inspections and evaluations in accordance with this criteria index. These systems, which have been developed to make assessments on sustainability at many different scales from residences to countries, can be developed by companies in the construction industry, governments, universities or non-profit organizations with different purposes, formats or criteria.

Systems such as LEED, BREEAM, CASBEE, DGNB can be given as examples of green certification systems that are most used by countries today and have proven their competence in this sense. These systems set out primarily to create a sustainable built environment with criteria suitable for the climate and environmental structure of the country in which they were developed, and continue to expand their scale in line with increasing urbanization and climate change.

Universities are institutions similar to cities by their structure. Therefore, university campuses can be used as pilot areas for urban sustainability. Adapting the sustainability systems developed at urban scales to university campuses can provide permanent and definitive solutions. In this study, it was concluded that some important certification systems that approach sustainability holistically in urban areas can also be used for university campuses, as detailed in the above sections. (such as BREEAM Communities, LEED Cities and Communities, CASBEE UD, GSAS/QSAS Neighborhoods, Pearl Communities Rating System, Greenstar Communities and DGNB-

NUD). In all these systems, the inspection and evaluation stages are carried out by third parties; thus, a fair and transparent evaluation process is carried out.

Apart from all these, YeS-TR certification systems developed specifically for Türkiye has the potential to be used in university campuses. However, there are no examples of these certification systems in Türkiye yet.

Universities, which cooperate with local governments and non-governmental organizations in reducing environmental pollution, providing environmental services, and seeking solutions to environmental problems, provide economic and social contributions to the cities they are located in, in addition to their environmental contributions. In addition to the urban sustainability assessment tools used at the scales of buildings, neighborhoods and residential areas, there are systems that only make assessments specific to university campuses at national and international level in order to ensure sustainability in campuses and to increase stability and competition in this regard. UI Greenmetric is the most used of these systems. It encourages universities on sustainability by making national and international comparisons in sustainability studies. Today, it is one of the most used sustainability assessment tools specific to university campuses in Türkiye and in the world. However, in the UI Greenmetric evaluation system, ranking is made only based on the data published by universities on online platforms or websites. The fact that the evaluations are not controlled by third parties negatively affects the system's presentation of transparent and clear information.

Another evaluation system developed specifically for university campuses is STARS. It is a rating system that helps universities monitor and measure their sustainable development with a self-reporting framework. However, in this system, each main criterion has the same weight.

THE sustainability ranking system is a system that focuses on the institutional sustainability of universities. It makes evaluations on social, economic and institutional sustainability rather than environmental sustainability and ranks universities in the world in this sense. Sorting is done with the results obtained from the data entered in the virtual environment such as UI Greenmetric. Therefore, a transparent and controllable framework is not offered in this system.

Considering all these systems and evaluation categories, it is possible to observe that water and energy saving, waste management have an important place in all evaluation tools and have the largest share in the scoring. These tools may include a set of criteria in order to minimize the environmental impact of buildings, campus areas or the city, as well as to regulate the physical and psychological health and economic well-being of the user. Thus, it would be appropriate to say that the campuses that are planned and designed with a holistic understanding on the basis of sustainability will make significant contributions to the city/country they are located in, in economic, environmental and social terms.

However, by taking lessons from the green campus standards developed by other countries and/or organizations, diversifying national evaluation systems that are transparent and auditable and suitable for the realities of each country will increase the level of these contributions. And thus, the recognition of the relevant universities in the relevant international networks will also increase.

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Living Streets: Pedestrian Activities by Temporal and Climatic Determinants, İzmir Bornova Case

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1. Introduction

Throughout history, the city has functioned as a meeting place for its inhabitants. However, the gradual breakdown of the opportunities of urban space to function as a meeting place appeared due to the prevalence of modernist planning ideals to shape the urban space, which in turn made urban life continue out of urban space. In recent years, changes based on information and communication in human life have brought about new ways of meeting and encountering, which raises the question whether electronic environments have begun to replace urban space as a meeting place. It still seems difficult since a stream of images depicting the experiences of others in other places stimulates people to join in and play an active personal role to experience the qualities tied to urban space as meeting place (Gehl, 2010, p. 25-26).

Social life activities such as walking, resting, sitting in a cafe, walking the dog, meeting, looking in the window, sports, play, artistic activity and work create benefits socially and economically in cities. They are crucial for social and psychological health of citizens and they motivate economic development in certain parts of the cities. Streets and parks as public places are greatly important for sustaining social life activities in cities; however, some parts of cities offer better opportunities for the development of such activities.

Within the scope of this study, the central part of Bornova district in Izmir, Turkey is examined to scrutinize the intense social activities, and the places where they came to existence, such as the public spaces and the site that is renowned of its architectural heritage. One of the research interests of the field survey concentrated on the relationship between social life activities and temporal and climatic activities and this relationship has been determined statistically.

For this purpose, in accordance with the determination of the land use and morphological structure of the area, social life activities were counted in every street in the study area in the morning, noon and evening hours in four seasons, weekdays and weekends. Although street characteristics, land use and pedestrian density have been studied in the literature, there are few studies addressing activities and temporal characteristics. This paper aims to contribute to the examination of social life activities in public spaces and temporal characteristics.

This research is aimed to examine whether the highest values of the social life activities in question were determined on the basis of season, weekdays, weekends and hours of the day. In this study, in order to determine the relationship of the public space and the social activities;

-the social activities and temporal and climatic differences are compared

-Spatial distribution of the highest numbers of social life activities were represented.

1.1. Social Life Activities

"Social life activities" have been long on the agenda of urban planners. Discussion about their characteristics, and their relationship and urban morphology is being discussed. The main focus of these discussions is to contribute to the creation of healthier, sustainable and livable cities. In the creation of healthier, lively, safe and sustainable cities and public spaces, the interaction between social life and public space has been increasingly taken into account, accepted and started to be implemented (Gehl & Svarre, 2013, p. 69). Social life activities as; necessary in the hustle and bustle of daily life or leisure activities have been intersected with urban design strategies so far (Jacobs, 1961; Appleyard, 1981; Gehl, 1987). Walkability, which is one of the main activity t ype of the pedestrians on the street, have been studied with different contents and methods social life activities and public space interaction is a hot topic that requires work in every scope and scale. However, the relationship between temporal characteristics and social life activities has not been so much discussed.

In every period of history, urban open spaces have been places where individuals can express themselves and use freely, as well as places where they have the opportunity to interact, communicate and socialize. Socialization; it is only possible for people to see, hear, communicate and establish passive or active contact with others. Another important point is that while the abstract space, which gains meaning with the user activities, experiences and interactions, turns into a place as a public space, the formation of urban identity is also realized. Towards the end of the 20th century, various criticisms have been directed to the modernist urban planning approach from many aspects and as a result, many solutions have been developed along with it. In this context, public life studies of people such as Jane Jacobs, Clare C. Marcus, William H. Whyte and Jan Gehl come to the fore. These studies, which focus on human activities, focus on the changing and developing social life with design, rather than just giving importance to the design of the space (Gehl & Svarre, 2013, p. 69).

Mehta (2009) categorizes social life activities on the street as standing, sitting, lying/sleeping, walking pets, skateboarding or rollerblading, conversing, pushing a stroller, eating/drinking, reading or using a laptop computer, shopping, window-shopping, playing a game or performing, smoking and vending. Mehta (2014) asserts that social life activities have an important role in public space, and historically, public spaces in cities were used as spaces to serve basic survival, communication and entertainment needs and to perform several political, religious, commercial, civic and social functions.

In the 1980s and 1990s, as people began to demand healthier, vibrant, safe and sustainable cities and public spaces, the importance of this interaction between social life and public spaces was increasingly taken into account, accepted and applied (Gehl & Svarre, 2013, p. 69). In this context, before explaining the determinations of the social life activities taking place in the area within the scope of the research, it is necessary to look at the social life activities that take place in public spaces.

Temporal and climatic factors have been the subject of behavioral studies (Mehta, 2009), spatial configuration studies (Kubat & Özer, 2008; Ozbil et al., 2011; Kubat et al., 2013), the degree of constancy of physical features (Ewing & Handy, 2009). Public spaces are a "common ground" that people living around use in their daily lives or at certain times of activity, communicate and interact with the environment and each other (Carr et al., 1992). This study contributes to urban design literature with objective results by examining the different densities of each social life activities based on different climatic and temporal factors.

1.2. Temporal Differentiation

Two of the main factors affecting pedestrian behavior, movement and orientation in walkability studies are time factor, including hour and day, and weather conditions (Bradshaw, 1993; Kubat & Ozer, 2008; Kurkçuoğlu & Ocakçı, 2015). On the other hand, while the climate, which is one of the prerequisites for mental and physical comfort in the public space, depends on the sum of air temperature, humidity and air movements at the macro level, appropriate microclimates can be created with urban design practices. However, the climatic expectations of different user groups from the designed environment may also change (Acaralp, 2009). It is extremely important to investigate the user preferences of pedestrians in different time periods and in different seasons (climatic conditions). In the studies carried out on this subject, pedestrian densities at different time periods during the day were questioned by the pedestrian counting method, and the preferences of the pedestrians were questioned by the survey method.

In order to make urban design proposals, it is important to measure the dynamics of the area and the temporal differences, including weekdays and weekends. Kubat & Özer (2008) discussed the time factor in their study on walkability in Galata, Karaköy Square and its surroundings, which are located within the borders of Istanbul Beyoğlu District. In the study they carried out in five different time periods (morning, towards noon, noon, afternoon and evening), weekdays and weekends, it was determined that the pedestrian density on weekdays was higher than the pedestrian density on weekends. Likewise, Mehta (2008) determined pedestrian densities in two seasons, weekdays and weekends, in April and October, and determined that usability, belonging and satisfaction were the most important in people's walking needs, respectively. Kurkçuoğlu & Ocakcı (2015) studied perception and behavior in Kadıköy Çarşı Region. They found that the pedestrian densities on weekday mornings are less than on weekday evenings and every hour on the weekends.

In order to make urban design proposals, it is important to measure the dynamics of the area in different time periods during the day. In the research of Kubat et al. (2013) covering the pedestrianization projects of three squares in Istanbul, namely Beyazıt Square, Sultanahmet Square and Taksim Square, pedestrian counts were carried out in 3 different time periods in March at 10-minute intervals. According to the results of the study, pedestrian density is also high in areas where there is little change in direction and where there are more usable streets. According to the findings of Hamamcıoğlu & Akın (2015), it is seen that pedestrians have security problems in the evening and night hours in accessing the transportation hubs in Kadıköy center, shore and dock. Albayrak & Erkan (2016) conducted surveys in three different time zones in the morning (06.00 - 11.00), lunch (11.00 - 16.00) and evening (16.00 - 21.00) in their study to determine spatial behavior in transfer centers. In the survey results, it was determined that evening hours are more preferred than other hours in user preferences in transfer centers. In his study on livability on three radial streets, Capitanio (2016) counted pedestrians for 1 minute, repeated five times between 8:00 am and 19:30 pm at a fixed point on a not very hot weekday in October. According to the results of the study, it has been determined that the pedestrian density is higher on the streets that are longer than the others but with better quality. There was no effect of the time period during the day on the dependent variables.

In order to make urban design proposals, it is important to measure the dynamics of the area according to the seasons. Ünlü et al., (2009) investigated user interactions in interior, exterior and intermediate spaces in Istanbul's oldest faculties of architecture according to climatic differences, in two time zones a day (10:00-12:00 and 14:00-16:00) every 30 minutes. According to the climatic conditions (rainy weather-indoor use and outdoor-outdoor use), the rate of intermediate space usage is the lowest in both schools. On the other hand, Yıldız & Şener (2010), in their study of value-in-use analysis of outdoor spaces defined by buildings, investigated the effects of season and time factors on the total variety of outdoor activities, the total frequency of activities, and the total length of stay in the space. According to the results, it was determined that the seasonal variation was only effective on the duration of the individuals' stay in the space, and the variation in the time of the day had no effect on the variables. Semerci (2015), on the other hand, in his analysis proposal for the use of Sultanahmet Square, carried out pedestrian counts on Mondays and Wednesdays on weekdays, and between 09:00-10:00 in the morning, 12:00-13:00 in the afternoon and between 17:00-18:00 in the afternoon. As a result of the study, he stated that Sultanahmet Square is more intense in summer and spring, less busy in winter and partially autumn, and generally higher at weekends. Kaptan (2018) measured the user perception of the use of the squares in different climatic conditions (seasonal change) and found that they could not be used comfortably in all climates, except for 28% of the participants, due to the lack of sheltered areas arranged according to climatic conditions.

2. Material and Method

Izmir Bornova city center, which has an important role in Izmir's history, has been selected as the study area. It should be noted that the city center of Bornova has the characteristic of a laboratory space for architecture, art history, and planning specialties, as it represents different periods of history and identities. The spatial representations of their different identities offer a great wealth of spatial patterns for the central part of the city. Although the traditional Ottoman bazaar on the north and the Republic square are the representations of very different identities, a section where Levantine residences and mansions still exist, today, they exhibit an integrated structure in the city center. This rich texture integrates with the modern bazaar in the west of the city and the streets and squares where the cafes and restaurants are heavily used by young people on the south (Figure 1).

Figure 1. Cafes (left), traditional Ottoman bazaar (right) (TUBİTAK, 2020)

Pedestrian counts were conducted with 10 observers for 240 points (both ends of the street) (Figure 2) in four seasons; winter (February, 2019), autumn (September, 2018), summer (July, 2018) and spring (May, 2018). Two-day observations and pedestrian counts were carried out for each of four different seasons, one day on weekdays and one day on weekends. In these days, activity counts were collected in two hours during the morning (8:30 -10:30), noon (12:30- 14:30) and the evening (17:00-19:00). It should be taken into account that the seasonal weather conditions of İzmir can be variable, especially in the autumn season, winter weather conditions can be seen, and in the winter season, autumn weather conditions can be seen from time to time.

After the pilot observations at different times in the research area, the social life activities were defined as walking, resting, cafe sitting, meeting, dog walking, window shopping, doing sports, playing game, performing art, cycling and group gathering.

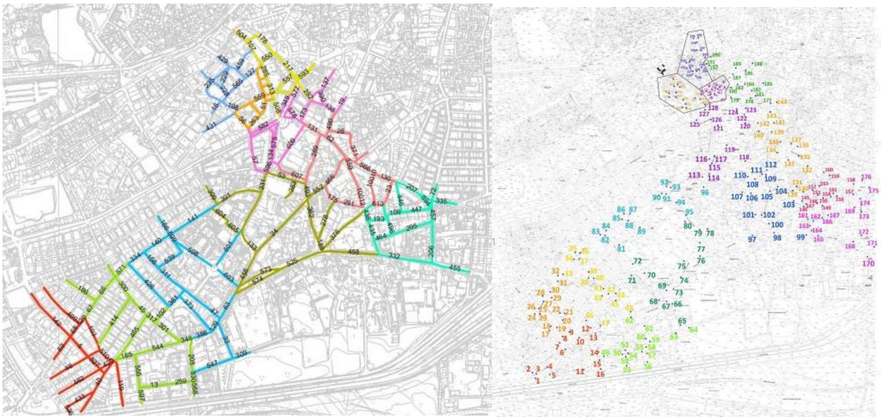

Figure 2. Study area and pedestrian count points (TUBİTAK, 2020)

In the first stage, the climatic and temporal (season-day-hour) densities were compared for each social life activity (Figure 3). In the second stage, the spatial densities of social life activities in the peak season and time are represented in street scale via ARCGIS program (Figure 4).

3. Findings and Discussion

Summers in Izmir are hot and humid, and winters are mild. February, which is in the winter season, can be warmer than the autumn season, especially in the second half.

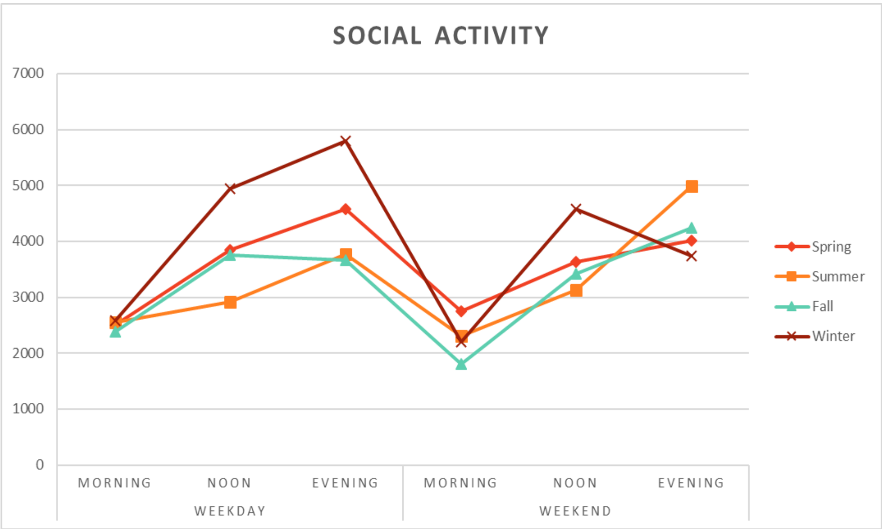

Figure 3. Study area and social activity count points (TUBİTAK, 2020)

The highest and lowest numbers of social life activities were observed according to seasons, days and hours (Figure 3). The activity of ***playing games*** on the street is highest in the evening hours of the summer season (47 people). It has been observed that games are played on the streets at least in the fall and spring seasons. In addition, the highest time for ***doing sports*** on the streets is during the weekdays of the winter season (56 people). It has been observed that no one does sports on the streets at noon and evening hours on weekdays in the spring season, at the evening and noon hours on the weekends in winter, and in the morning and evening hours on the weekends of the fall season. Moreover, the highest ***window shopping*** is during the summer weekdays (45 people) and weekends (48 people) evening hours. It was observed that window shopping was the lowest at noon in the spring season (5 people) (Figure 4).

The highest working activity on the streets is during the weekdays at noon (424 people) and evening (321 people) in the winter. The weekend morning (4 people) and weekday evening (6 people) of the fall season are the times when the working activity on the streets is the lowest. ***Walking*** is the most observed activity among the social life activities on the streets in the study area. It has been observed that walking activity is high in the evening hours on weekdays (6498 people) in spring and in the evening hours on weekdays in winter (6183 people). The lowest time for walking is the morning hours of the winter season (1903 people). Moreover, the peak hours of ***resting*** activity are in the evening (590 people) and at noon (509 people) on the summer weekends. The lowest resting time is at noon on weekdays in fall (Figure 4).

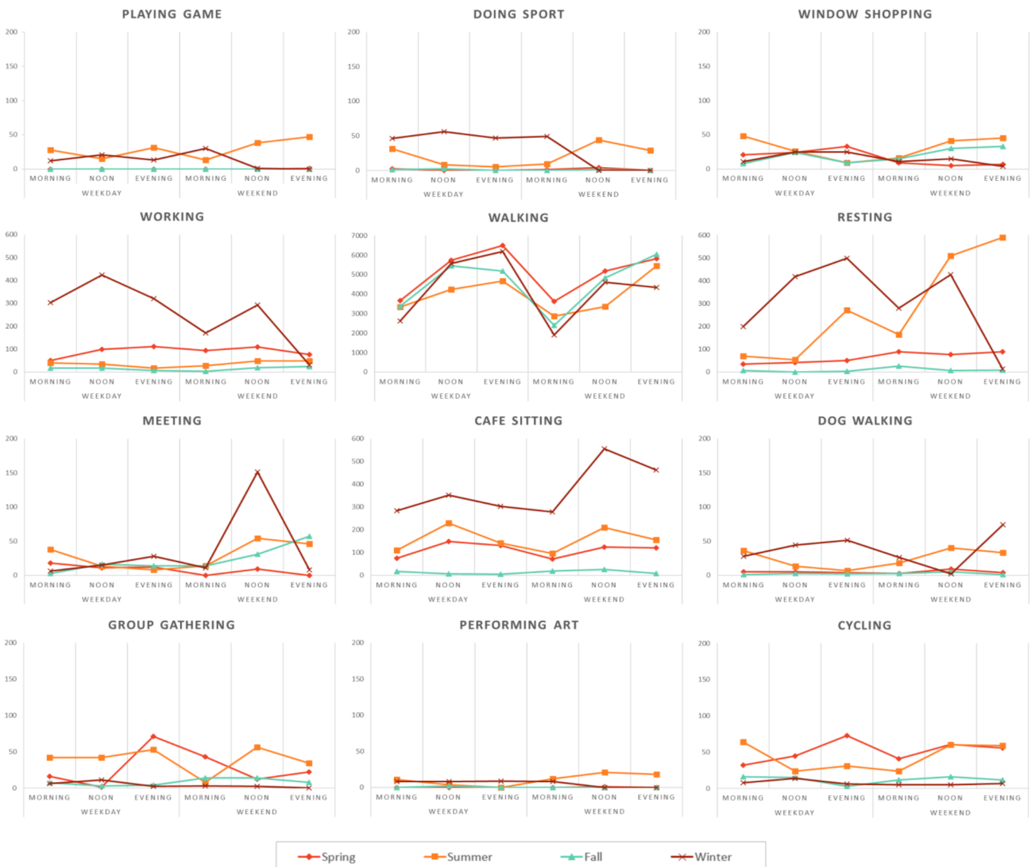

Figure 4. Climatic and temporal comparisons for each social life activity.

Meeting activity is at its highest during the winter weekend at noon (151 people). The lowest time of the meeting is in the morning hours of the spring weekend (0 people). The highest time for ***cafe seating*** is during the winter weekend lunch hours (556 people) and evening hours (463 people). The rate of café sitting is lower in fall compared to other seasons, and the lowest sitting activity in the cafe was observed in the evenings on weekdays in fall (5 people). ***Dog walking*** is at its highest during the winter weekend evenings (74 people) and weekdays at noon (44 people). Dog walking in fall is low compared to other seasons, and the lowest time is in the morning hours on weekdays in fall (1 person) (Figure 5).

The highest group gathering is during the weekday evenings of spring (71 people). It has been observed that group gatherings (56 people) are high at noon on weekends in summer. Group gathering is lowest in the evening hours of the winter season (0 group) and at noon on weekdays in the spring season (1 group). Moreover, the peak time for ***performing art*** activity is during the summer weekend at noon (21 people). The time period when performing art is the lowest in fall and spring seasons. As seen in the last chart, the peak time for ***cycling*** is in the evening hours on weekdays in spring (73 people) and in the morning hours on weekdays in summer (64 people). Cycling is the lowest in the evening on weekdays of the fall season (3 people) (Figure 5).

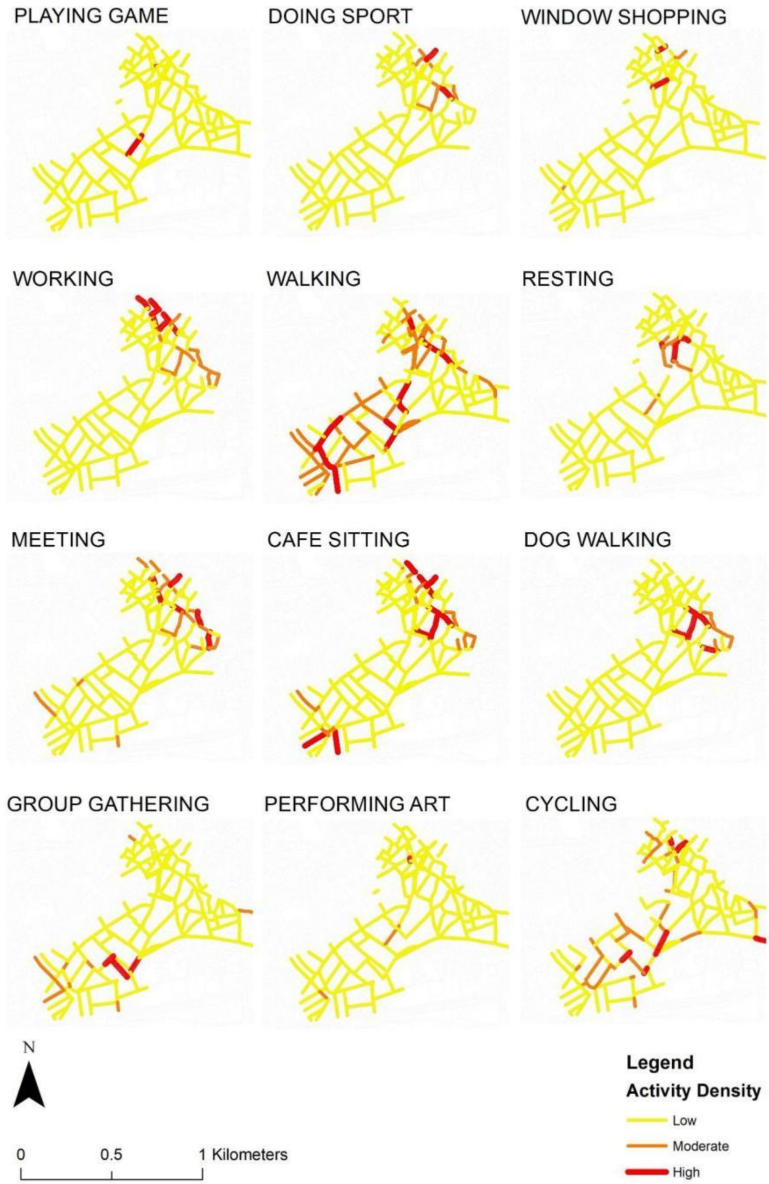

Figure 5. Spatial distribution of the highest numbers of social life activities.

According to Figure 5, the "***Big Park***" in the center of the study area is the area with the highest playing game activity, and it is an expected result that this area will be used for playing games, especially during the weekend evenings in the summer season. The fact that the window-shopping activity is highest in the north of the area during the weekdays of the summer season may be due to the fact that the boutiques in this area are clustered on the street. Because although it is seen that there are various "***boutiques***" in the south of the area, the presence of intervening cafes can be associated with the fact that this rate is not seen as high. In the "***traditional Ottoman bazaar"*** located in the north of the area, a high level of working activity on the street was observed at noon during the winter season.

4. Conclusion and Suggestions

The density of the activities varies according to the seasons, weekdays and weekends and different time periods during the day. Nevertheless, some seasonal and temporal associations were observed among social life activities. It is an expected result for Izmir that evening hours offer different values of social life activities with high density. The results of the study in the evenings on weekdays show similar findings to recent studies (Kurkçuoğlu & Ocakcı, 2015). On the other hand, Beyru (2011, p. 227) mentions the 19th century, in the evenings of the summer months, families would come together on the streets, in front of the houses, taking their cushions together. From the past to the present, it is seen that evenings are the time period when the streets are used. **Walking, *group gathering*** and ***cycling*** are the highest in the evening hours on weekdays in the spring season. Street lighting elements should be enhanced in areas where the movement (walking and cycling) is high in the evenings. There should also be urban elements that will allow working and internet access in areas where group gathering activity is high. Even if the spring is the highest, the evenings maintain the highest walking activities in all seasons. The evening period between 17:00-19:00 intersects with also the rush hour in weekdays that the results also verify the study area provides a walkable environment. In addition to spring evenings, summer evenings are also preferable times for those who ***play games*** and ***rest***. Playing games and resting are mostly observed on the weekend evenings in summer. Necessary road arrangements should be made, traffic calming measures should be taken and design arrangements should be made to further improve pedestrian awareness in this environment where play activities are common in the evenings. On the other hand, winter evenings seem to provide the most suitable time for dog walking activity.

Among the social life activities, different densities were observed according to the land use type offered by the study area. Due to the high concentration of cafes and parks in the study area, it is seen that ***cafe sitting***, ***resting*** and ***working*** activities are the most observed activities if the ***walking*** activity is excluded from the data. However, land use is not the only determinant in the density of social life activities. Only working and resting activities make sense in the areas where seating elements are located. For this reason, sitting areas should be located not only in the landscaped areas such as green areas, parks and squares, but also in every street of the city, and since these areas located in certain areas will attract more people, it will also affect the development of more social activities in these areas. While this study reveals that the same urban space provides opportunities for different social life activities due to climatic and temporal differentiation.

Although walking activity is the most common type of activity in the area, differences are striking when seasonal and temporal intensities are examined. In the study area, the intensity of walking during the week is higher than the intensity of the weekend and is similar to the results of the study conducted by Kubat & Özer (2009) in Galata and its surroundings. On the other hand, the spring season provides the best climatic conditions for the outdoor activities in Izmir, parallel to this, the results show that the activities of ***walking*** is more common in the spring season, and such design proposals as shading with trees or canopies would increase pedestrian comfort in all climates.

Carr et al. (1992) mentions that public spaces allow cultural interaction, integration and cultural interpretation in multicultural societies. Many activities are carried out in public places and these activities contribute to the development of social life in the city, and individuals may feel that they are part of a larger group. In the context of multiculturality, traditional Ottoman bazaar and the surroundings offer a potential for socialization. It is found that one of the social activity types where climatic differentiation is most effective is ***cafe sitting and meeting*** in the study area. It has been observed that these activities are quite intense at noon on the weekends of the winter season. While the spatial distribution of the meeting and cafe sitting activities mostly observed around the traditional Ottoman bazaar in winters, it was observed that the density in these areas decreased in other seasons. Thus, the interaction between people would be enhanced with the creation of seating units, lighting units, canopies, and various activity areas as urban design proposals, its usability will be increased in different climates and in different time periods during the day.

Climatic and temporal studies in cities not only analyze the densities but also show the necessity to design solutions according to spatial distribution of the activities. This study serves as a guide for decision makers by not only detecting the densities of each social life activity according to different climatic and temporal units, but also offers suggestions about which design solutions are necessary to increase street use.

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Evaluation of Cultural Representation of Persons with Disabilities in Iranian Cinema through Cinematic Space and the Social Model

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1. Introduction

Architecture focuses on the concept of space, so it interacts with many sciences and arts. This interaction is the subject of study by architects, scientists, and philosophers (Bachelard, 2013; Bruno, 2002; Merleau-Ponty, 2017; Pallasmaa, 2014; Penz, 1994; Tanyeli, 2017). While space is the cornerstone for architecture and cinema, it also keeps these two areas concurrently. For this reason, the person's experience of the place in social life and the actor's experience of the cinema space may show parallels and even reference each other. As a result of that relation, the theory of “the state of cinema as a sketch for architecture” (as quoted by Penz, 1997) arises. This understanding will be held on one hand to generate the conceptual background of this study, which gave place to a deep discussion on the relationship between architecture and cinema and cinematic spaces.

On the other hand, the constructive and feminist approaches to disability were used to shape the background of this study. Those approaches, both of which state that the meanings attributed to the different body types are products of societies, support the social model of disability, which claims that disability is also a social construct reinforced by cultural representations (Morris, 1991; Siebers, 2001). The scholars following those approaches claimed that the tendency to exaggerate and romanticize the disability experience (Shakespeare, 1994) intensifies the stigmas and prejudices in societies (Goffman, 1963/2009). To illustrate those stigmas, Burcu (2011) classified the cultural definitions of disability as "pitiful, excluded, useless-inadequate and combative.” The representation of people with disabilities in movies and television series also became a topic of discussion for disability scholars. For instance, Longmore (1985) focused on how having an impairment was shown as equal to being less human and thus used as a reason for having an evil soul in movies. Although similar studies focus on the personality of the characters with disabilities, there was a lack of studies combining the representation of disability in movies and the relationship between cinema and architecture. However, parallel to what was discussed above, the experience of the person with a disability in the social and built environments and the actor's experience of the cinema may show similarities and may be used to define the way disability is represented. Discussing the disablement occurs in social and built environments; it is beneficial to say that taking its background philosophy from the rights-based approach of the social model, the universal design paradigm was established by scholars to prevent the construction of disabilities by design products (Story, 1998; Story et al., 1998). So, the universal design understanding (Center of Universal Design, 1997) was used to analyze the spaces designed for characters with disabilities in movies.

Based on this three-branched (cinematic space, cultural representation of disability, and universal design) view (see also Figure 1), the study discusses venues and analyzes selected films in Iranian cinema. With this sophisticated conceptual background, the way disability is used in cinema, the experience of the person with a disability in the cinematic universe, and the barriers constructed for this experience and for attributing cultural meanings to disability in cinematic space were aimed to be analyzed.

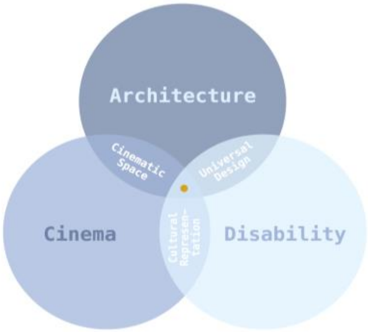

Figure 1. Venn diagram illustrating conceptual background of the study

The study aims to discuss the cultural representations of disability in Iranian films through selected films. This study, which is discussed, contributes to the literature on the representation of disability and the evaluation of universal design in cinematic spaces.

1.1. Architecture and Cinema

Although there are works in which architecture is combined with arts, such as photography and music, the interaction between architecture and cinema is more clearly defined. Gilles Deleuze (2014) states that the interaction is more precise because cinema contains the concepts of motion and time at the same time. In addition, it is seen that the theoretical or expressive power of architecture has become stronger through cinema (Benjamin, 2018). In addition, the cinema can turn into a working area for architecture (Hekimoğlu, 2021a). Cinema does not only relate to architecture through the space organization in set designs but also criticizes architectural space (Hekimoğlu, 2021b). Architecture reflects society and values, so architectural criticism in cinema can be evaluated as social or cultural criticism. This study deals with this criticism feature in the evaluation of cinema.

1.1.1. Cinematic space

This study uses the relationship between architecture and cinema to analyze cinematic spaces. Space is indispensable for cinema. In addition, cinema offers architects different perspectives on the perception of space (Vidler, 1993). Vidler (1993) claims that cinema builds its own architecture since it is constructed with elements like light, shadow, and movement. Also, he said that architects such as Hans Poelzig and Andrei Andreyev were inspired by cinema while emphasizing that architecture and cinema are areas that should be separated from each other (Vidler, 1993).

Eisenhard, as a filmmaker studying architecture, likens the production of space in films to that in architecture. Receiving an Academy Award for the movie Space: Architecture of Paul Rudolf (1983) also demonstrated his success (Lamster, 2000). The design of the building process in architecture according to the user's perspective and needs is similar to constructing the cinematic spaces after the characters and actors are determined. The most distinctive parallelism between the architectural space and the cinematic space is the production process of the space in question. Moreover, cinematic spaces can reflect the culture of the nations they belong to, similar to the feature of architectural spaces reflecting and representing culture.

1.2. Architecture and Disability

The concept of disability has evolved since the 1970s and resulted in the emergence of the social model that contends that an individual's disability is not a result of their bodily characteristics or the impairment but rather how society views those bodies (Oliver, 2004). This model suggests that people with disabilities are excluded from society and have their activities limited by the interaction of the individual body with a disability and the barriers in the social and built environment (Oliver, 1990). The model has gained worldwide recognition as a sociopolitical movement on disability (Erkılıç, 2011). In the past forty years, the social model has provided a crucial perspective for disability studies, rights, and policies in all disciplines, including architecture.

1.2.1. Universal design

With the understanding of the social model, Scholars have established an innovative approach, the discourse of Universal Design, to encourage creative design beyond accessibility requirements (Story, 1988). The term 'Universal Design' was coined by Ron Mace, an architect and wheelchair user, and is defined as 'designing all products, buildings, and exterior spaces to be usable by all people to the greatest extent possible' (Story, 1988; Sanfold et al., 1998).

In other words, the Universal Design philosophy supports the idea of considering everyone's needs, including those of those with disabilities, to assert creative solutions rather than defending the spatial rights of a particular group of people by adhering to regulations (Steinfeld & Tauke, 2002; Knecht, 2004). This paradigm aims to eliminate all forms of exclusion of marginalized identities, including differences in age, sex, size, weight, physical and sensory abilities, emotional and cognitive states, and intersections or overlaps of those, and achieve social justice (Hamraie, 2013). Therefore, we can say that built environments and cinematic spaces designed according to the universal design paradigm can eliminate barriers that are constructing disabilities and change the meanings attributed to the experience of the disability. Under the umbrella of the social model, universal design philosophy (see also Karayama, 2022) was kept in mind while making analyses in this study.

1.3. Cinema and Disability

The issue of the true representation of disability in cultural products as the social model promoted led to some implications in the cinema sector. For example, one of the most prestigious events in cinema, the Academy Awards, moved towards a more inclusive policy in recent years from award nominees to event spaces. To illustrate, in the 93rd Academy Awards, the movie "Sound of Metal", which focuses on the life of a drummer who happened to have a hearing impairment (Darius Marder, 2020), won the awards in the categories of film editing and sound; and also got nominations in four other categories including best actor in a leading role and best picture (2021 | Oscars.Org | Academy of Motion Picture Arts and Sciences, n.d.). In the same year, the documentary "Crip Camp: A Disability Revolution" (Nicole Newnham & Jim LeBrecht, 2020) was nominated in the best documentary category (2021 | Oscars.Org | Academy of Motion Picture Arts and Sciences, n.d.). This documentary focuses on a summer camp named Camp Jened, building a society freed from stigmas and discrimination for and by young people with disabilities. The audience was shown real-life stories of campers, including James LeBrecht, the director himself, and the disability rights movement starting in Berkeley, California. Moreover, the documentary premiered at the Sundance Film Festival (2020) and won the Audience Award (Crip Camp | A Disability Revolution, n.d.).

Furthermore, in the 94th Academy Awards, the movie "CODA" (Sian Heder, 2021) also held significant moments in the history of the disability rights movement. Screening the lives of a young girl without hearing impairment and her family who all have hearing impairments, the movie won the awards of Best Picture and Best Adapted Screenplay. In addition, Troy Kotsur, an actor with a hearing impairment since his birth, won the Best Actor in Supporting Role award and became the first man with a hearing impairment to win an Oscar (*2022 | Oscars.Org | Academy of Motion Picture Arts and Sciences*, n.d.). Beyond the film's success at the Oscars, the CODA movie also made the way for some firsts in the Oscars events. Troy Kotsur's giving his speech in sign language after receiving the award (Oscars 2022, 2022A), the presence of a sign language translator on the stage while the movie team was receiving the best film award, and the guests applauding the film using sign language were just a few of these inclusive moments (Oscars, 2022; 2022B). In addition, the fact that actress Liza Minelli, a 76-year-old actress, was on the stage in a wheelchair at the same event (Oscars, 2022; 2022B) opened a new page in the relationship between cinema and disability.

The physical properties in the Oscars' event spaces followed the new emerging inclusive policies of the Academy. In the event of 2021, due to the coronavirus pandemic, the Oscars event needed to be held according to social distancing measures. So, the event was hosted in a different place instead of its usual place, the Dolby Theatre. For that event, architect David Rockwell and the Rockwell Group designed a set within the Los Angeles Union Station (Englefield, 2021; 93rd Oscars -

Rockwell Group, n.d.). Besides all the other architectural qualities of that design, the ramp accompanying the stage's staircase took attention. By offering an egalitarian solution with this method, Rockwell provided a design following the universal design philosophy (Figure 2). The lack of applications offering equal participation in the stage design of the 81st and 82nd ceremonies, also designed by Rockwell, shows that the Academy have internalized this inclusive approach in recent years.

Figure 2. Photos showing the stage design in the 93rd Oscars, Photo Credit: Spencer Lowell/Rockwell Group (used with legal permission from credit owners)

Although it is vital that world-renowned and prestigious events take a step towards inclusion, ensuring that the disability experience depicted in films does not cause stigma and discrimination is essential for building a proper relationship between cinema and disability. The scholars studying this relationship discussed that beyond being a physical and mental condition, disability is constructed as a cultural product in movies (Hayes & Black, 2003). Since this representation in movies has the power to play a role in systematically excluding people with disabilities from society, it is required to critically analyze movies revolving around characters with disabilities (Botha & Harvey, 2022).

1.4. Space in Iranian Cinema

It can be interpreted that places are as important as stories in Iranian cinema (Çınar, 2019). Even though Iranian directors have had to use architectural spaces rather than spaces created by digital editing due to financial difficulties at first, this has become a choice rather than an obligation over time. Using actual spaces rather than virtual produced ones makes it possible to see Iran's social structure and culture through cinematic spaces. Therefore, Iranian cinema was chosen to examine in this study.

Moreover, using actual spaces as an essential part of the narrative makes movies establish a close connection with the truth and tell it in its entirety (Cevheri, 2021). In addition, it is seen that public spaces are more frequently used than private spaces in Iranian cinema (Çağlayan, 2011). This situation provides further data that has the potential to reflect the culture and social life.

It is beneficial here to note that Mecid Mecidi, whose movies are the focus of this study, is one of the significant directors of Iranian cinema; he prioritizes architectural spaces in his films and conveys emotion, narrative, and culture to the audience with the help of cinematic spaces.

2. Material and Method

As discussed above, space is the most vital common point of architecture and cinema. This study discusses cinematic spaces, which constitute the base of this common point, from the perspectives of the universal design paradigm and the spatial experience of people with disabilities. After the literature research carried out within the framework of these concepts, the representations of the relations of those subjects through Iranian cinema were examined. In order to be able to limit the scope of the study and have accurate results and discussion about disability, physical barriers, and universal design through Iranian culture, it was decided to examine those concepts from the perspective of a single director. For this reason, the films to be analyzed for this study were selected from the retrospective of the director Majid Majidi, whose movies revolve around the lives of people with disabilities.

This study is covered within architecture, cinema, and disability (Figure 1). Having explained these concepts in the previous part, the authors examined the selected films as case studies using the visual analysis method in the rest of this paper. In line with these data, it is revealed how the disabled individual, the subject of Iranian cinema, is represented in a cultural sense within his/her physical space.

3. Findings and Discussion

Iranian cinema has films that interact with each other, and it is possible to come across similar characters in these films. Majid Majidi is seen as one of the most important representatives of this cinema (Kırel, 2007). The study discusses the cultural representation of disability and its interaction with cinematic space in Majid Majidi's movies, The Color of Paradise and The Willow Tree. Both of those movies' main characters are people with visual impairments. Visual impairments and the effect of the presence/absence of universal design understanding in cinematic space on the representation of impairments were discussed in the rest of this paper.

3.1. The Color of Paradise (Rang-e Khoda, 1999)

The Color of Paradise movie tells the life of a child, Muhammad, who has had a visual impairment since birth and was portrayed by an actor with a visual impairment, Mohsen Ramezani. The film starts at the school for students with visual impairments and tells the life of Muhammed upon his return to his village. Succinctly, the film is mainly about his father's alienating Muhammad because of his disability and Muhammad's experiences with his grandmother and siblings in the rural. His father apprenticed Muhammad to a carpenter with a visual impairment to drive him away from the house. By the movie's end, the father's regret is shown when he goes to get Muhammed back. On the way back, the film ends with the scene of Muhammed falling into the river and his father saving him.

In the first sequences of the movie The Color of Paradise, the body orientations of the lead character, Muhammed, and other visually impaired children were shown as they experience the space (Figure 3). In these scenes, while the body-space relationship of the disabled person was seen, it was also depicted that it is possible to feel the void, like the texture of the space.

Figure 3. The special school, scenes of interior and exterior spaces (the Color of Paradise, 1999)

However, besides being a way of segregation and opposing the social model (Oliver & Barnes, 2010), this movie showed that this special school had not followed any *special* or universal design strategies for its students. With this method, school as the cinematic space represented disability by reinforcing the stigmas of vulnerability, unfitness, and otherness (Figure 4). But, in fact, Muhammed and his peers showed extraordinary abilities in sensing textures and sounds (Figure 5), which could have been stimulated in an inclusively designed environment.

Figure 4. Scenes from the special school (the Color of Paradise, 1999)

Figure 5. Scenes depicting the tactile ability (the Color of Paradise, 1999)

Moreover, a rural school for children without disabilities was shown in the movie, and it was seen that these two schools have nothing in difference regarding space design. However, since the students were segregated according to their abilities, there was expected to see specialized designs for visually impaired students. Alternatively, if there is no difference since the spaces were designed within the scope of universal design principles, both schools are expected to have features that let people with visual impairments use the space with equal ease and comfort. When the case is either of the two options, the special school exists to underline the bodily differences between two groups of students and represent the situation of "unfits" (Figure 6).

Figure 6. From left to right, the classroom in the special school and the rural school (The Color of Paradise, 1999)

Another comparison can be made between the experience of Muhammed in the city streets and rural areas. Despite his ability to sense the environment by focusing on the sounds, the character’s freedom was taken in the city since the city has not been designed for him and his abilities. However, in the rural areas where social organizations and roles could not control the design, Muhammed was seen as more unrestricted and more secure, as if his disability were not constructed there (Figure 7; see also Su & Burcu Sağlam, 2020).

Figure 7. From left to right, Muhammed in the city and the rural (the Color of Paradise, 1999)

The Color of Paradise is a movie telling the characters’ stories between personal spaces, such as the father's house, the carpenter's atelier, and public places, such as the schools, the rural lands. Neither in the public nor private spaces, the presence of a disability did not show reflections in the space design. Only in one scene, where Muhammed goes to the sea, his father's design of a special railing was seen (Figure 8). This can be an example of people with disabilities and their families being creative problem solvers for the problems they face (see also Miller et al., 2004; De Couvreur & Goossens, 2011).

Figure 8. Muhammed’s father made a design so that he could experience the sea (the Color of Paradise, 1999)

However, when we look at the film in general, there are no traces in the venue through the visual disability of the main character. The reason for this can be the fact that the disability was discussed within the scope of spirituality, and the physical experiences of the character were either ignored or left out on purpose to emphasize the stigma of vulnerability.

3.2. The Willow Tree (Beed-e Majnoon, 2005)

This movie by director Majid Majidi describes the dramatic shift in the personality of its lead character in the absence and presence of visual impairment. Yusuf, a literature professor with visual impairment, was given as a character with a successful career despite his disability. However, one day, Yusuf gets a cornea transplant, restoring his sight. Over time, his body does not accept the transplant, and he loses sight again. This medical process divides Yusuf's life into three parts: (1) losing sight at a young age and living with visual impairment until the age of 46, (2) having sight after treatment for a short time, and (3) losing sight because of the worsening of the treatment. The movie focuses on different parts of Yusuf's life and their effects on his personality.

It is seen in the movie that Yusuf established different relationships with his environment in different phases of his life. When the first phase of his life is viewed in the body-space connection, his disability can be seen through the orientation and movement of his body. First of all, his bodily movements in the space have changed between the first two periods, and he began to move confidently without needing to sense the space with his hands after his sight was recovered (Figure 9). In addition, it is seen that while the room's sounds were dominant in the film through the first part, they remained in the background after he gained the ability to see. This is for putting the audience in the character's place and making them feel his experience of the environment. In addition, one other experience that is transferred to the audience with the features of the cinematic spaces is the vulnerability Yusuf felt in the hospital. Since the hospital rooms and corridors were not designed by considering the abilities of people with visual impairment, it is given that Yusuf's situation was further medicalized in that environment. The scenes of the hospital rooms without tactile surfaces and guides visualize the feeling of detachment from space and alienation (Figure 10).

Figure 9. Images from hospital corridors (The Willow Tree, 2005)

Figure 10. Images from hospital rooms (The Willow Tree, 2005)

After Yusuf leaves the hospital, he wants to find his own home. He exits the car when he comes to the house's street. He consults traces in his memory, touches a door, and remembers (Figure 11). He remembers touching the garden door of his own house, hearing the sound of the pool, and when he opens the door, he encounters the garden pool. He remembers that he lived here before he saw it. He experiences space in two ways: the moment he is in and the moment he experiences the place in the past. These scenes explain how the person who cannot see but experiences the space with all his other senses uses his senses and memory. Spatial experiences reoccur with the ability to see. After he started to see the places, he was familiar with by touching, he began to combine the two experiences with and without sight and used the act of remembering.

Figure 11. The scenes of walking home with sight (The Willow Tree, 2005)

Furthermore, with those scenes of the pool (Figure 12) and house interior (Figure 13), the effect of stimulating tactile and auditory senses on the space experience of people with visual impairments was shown. Those scenes support universal design; without necessitating medicalized approaches or special design elements, inclusive environments can be achieved when all abilities are regarded.

Figure 12. The pool is crucial to the space experience (The Willow Tree, 2005)

Figure 13. The scenes of using tactile references to the house (The Willow Tree, 2005)

In the film, there are no traces of visually impaired individuals in public spaces, including the university where the professor's character teaches and the hospital where he receives treatment. In addition to the absence of physical traces or design in the public space, it is seen that there are few of those traces in the home of the main character. The private places were used by the character with a disability with comfort thanks to the devotion of him and his family. Those features of the cinematic space reinforce stigmas related to vulnerability and segregation and beliefs that people with disabilities should strive beyond disability to live a life of accepted normality.

4. Conclusion and Suggestions

In architecture, spaces reflect the culture of the place they are built, and the cinematic space can include this feature. In the study, the cultural representations of disability are discussed through cinematic spaces. This discussion takes place with inferences about Iranian culture through the films selected in Iranian cinema. Examinations are carried out on two films by Majid Majidi from Iranian cinema, where the main characters are visually impaired. The Color of Paradise and The Willow Tree films were selected for the study, and inferences are made based on their cultural representations by looking at the places that visually impaired individuals experience and their use of space in these films.

While the films The Color of Heaven and The Willow Tree are about visually impaired individuals, there are no traces of this in the physical spaces. Private and public spaces are included in both films, but it is seen that universal design solutions are not used even in public spaces like hospitals or special education schools. Moreover, while it is expected that a person with a disability will construct traces of his/her abilities in a private place, such reflection was not observed in the house of a person who had visual impairment for a long time in the movie Willow Tree.

In the films reviewed for the study, visually impaired individuals are shown as an element of pity or a part of the spiritual world, opposing the doctrine of the social model. This situation is supported and demonstrated by the cinematic space, meaning that a similar understanding of disability can also be observed in Iranian society. However, considering the complex relationship between architecture, culture, and cinema, giving a place to the social model in cinematic spaces would be beneficial to make a shift toward universal design in Iranian architecture and a more inclusive society in Iran. To conclude, this study suggests that a similar equation can be made for other cultures and invites all to view the representation of disability in cinema critically.

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City Intertwined: Grand Beşiktaş Bazaar at the Intersection of Agent-based Models and Space Syntax

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1. Introduction

"He's taught himself speech and wind-swift thought,
trained his feelings for communal civic life,
… If he treats his country's laws with due respect
and honours justice by swearing on the gods,
he wins high honours in his city."
Sophocles, Antigone

Cities are always important for societal, economic, and cultural reasons, they are opportunities to create larger and more abundant societies that played a pivotal role in the progress and knowledge of humankind much before 'urbanism' was developed as an expertise. For a long time, cities developed emergently with evolutionary principles.

The concept of planning cities with positivistic presumptions, and upbuilding an understanding of the conditions of the urban context is a modernist and fairly unprecedented approach, dating back to the seminal work of Engels, *Die Lage der arbeitenden Klasse* (1842-1844) (Ersoy, 2007). Therefore, –although it is a very ambitious agenda to trace all the turning points–, it is still crucial to have a brief understanding of the historical development of the theories of urbanism, to understand the underlying logic of this study.

In fact, before modern urbanism –approaching cities as a contrivable and predictable entity–, emerges in the 1880s; Ovidius (1976) was coequating Roman city's space with the world's space ('*romanae spatium est urbis et orbis idem*') approximately 150 years after Sophocles (1993) had been praising Greek cities in 441 BC for being transformative, educational and unifying. Likewise, Ottomans were proud by their cities by how prosperous and developed they are compared to Safavid cities (Necipoğlu, 2013). The examples of appreciation of cities in ancient cultures can be enriched easily; however, cities and their understanding have changed radically under the influence of modern *Zeitgeist*.

1.1. An Understanding of the City

The starting point for the orthodox modern city planning is considered Ebenezer Howard and the 'Garden City' program he proposed in 1898 (Jacobs, 1961). Howard was exposed to chaotic Victorian slum city conditions and was willing to propose more ordered and hygienic industrialized suburban conditions located in the rural area (Hall, 2014). The city is self-sufficient, locally managed, limited in itself, and self-governed "containing not merely farms, but also all kinds of urban institutions, like reformatories and convalescent homes, that could benefit from a rural location" (Hall, 2014, pp. 97).

Howard's ideas were praised in his time and influenced the rest of the urban theories as well as several criticisms, for example, it was found economically unsustainable from a capitalistic point of view (Beevers, 1987); and or being more focused on the social model than the spatial requirements (Mumford, 1946). However, the most severe criticism of his ideas was approximately 60 years later by Jane Jacobs. Jacobs (1961) charged Howard with being a utopian that has no bounds with reality and real conditions of people, and envisioning "not simply a physical environment and social life, but a paternalistic political and economic society (Jacobs, 1961, pp. 18)".

Garden Cities were basically a proposal for creating viable environments in the peripheries of the city. It is followed by the 'City Beautiful Movement' that is assertive about transforming the centers instead of suburbs by demolishing large parts and creating great interferences to the existing fabric. Although we can find the predecessors in the 19th century Haussmann's reconstruction of Paris or simultaneously Ringstrasse of Vienna; the City Beautiful Movement was mostly accelerated in the 20th century. Daniel Burnham and his 1909 plan of Chicago (along with many other cities that Burnham planned, Chicago can be considered his masterpiece) was the movement's benchmark in the US.

The concepts of preservation and restoration were not yet conceived as it is today, thus completely rebuilding the centers that are "the breeding places of disease, moral depravity, discontent, and socialism" (Boyer, 1978, pp. 269) was acceptable.

The City Beautiful Movement proved its downfall in 1909 at the 'National Conference on City Planning and Congestion'; however, the idea of creating vibrant city centers and decontaminated (both hygienically and socially) daily life had overlapped with the idea of grouping the different functions separately in the city (Jacobs, 1961); therefore led its place to 'Radiant City' (Hall, 2014).

Although Le Corbusier had predecessor trials of theorizing a completely rational and functional city as the ‘City Contemporary’ in 1922 and ‘Plan Voisin’ proposed for the center of Paris in 1925, the Radiant City was reflecting the most sophisticated version of the modern city vision. The principles settled in the Radiant City were later effected the Athens Charter in 1941 (Le Corbusier, 1973) and gradually transformed into its final form of ‘City Functional’ by the 4th CIAM (*Congrès internationaux d'architecture moderne*) in 1933 (Ceylanlı, 2008).

In the Athens Charter, the city’s functions (dwelling, recreation, work, and transportation) must be reformed into a new way of zoning strategy, that can function in ‘harmonious relationships’ that are connected by the rational network of major highways (Le Corbusier, 1973). That vision is an outcome of the modernist desire for a clockwork city with high-rise residential units that are levitated; so that the ground can be abandoned for recreational use and automobiles, mostly to automobiles, so that the residents can reach their workplaces (which are located in a completely segregated zone) and therefore the capital, with their private cars via a network of transportation.

Finally, the conceptions of Garden City, City Beautiful Movement, and Radiant City have “harmoniously merged, …into a sort of Radiant ‘Garden City Beautiful Movement’” (Jacobs, 1961, pp. 25) that became disruptive in 1940s New York, which Jane Jacobs strived against.

These approaches have found their way into the young nation-state of the Turkish Republic and its most developed cities so far; for example, Henri Proust was invited to replan İstanbul in 1936, and Hermann Jansen prepared a masterplan for Ankara in 1928, both of which were partially applied. Likewise, Le Corbusier was asked to prepare a masterplan for İzmir in 1939 (Ziegler, 2020).

Those examples are indicators of understanding the city under the influence of modernism that was seriously questioned by 'Team 10' for the first time, a group of young architects that were breached from CIAM.

1.2. Close-Knit Patterns of the City: Grand Beşiktaş Bazaar as an Example of Mat-Building

A group of young architects gathered at the 9th CIAM in 1953 –in the following congress they will be united under Team 10– later justify their existence by a "mutual realization of the inadequacies of the processes of architectural thought" which are inherited from the modern movement (Smithson, 1963, pp. 3). The main criticism of Team 10 against Le Corbusier's understanding of the city is that it creates a severe amount of neglect towards individual-social life; by dividing the city into its function-region bits (Frampton, 1994, pp. 271). This legitimate criticism inevitably revived concepts such as 'belonging' and 'identity' (Akın, 2005).

One of Team 10's most influential members, Alison Smithson, introduced the term 'mat-building' for the first time (Smithson, 1974) by analyzing several structures including Le Corbusier and Guillermo Jullian de la Fuente's Venice Hospital (1964-1965), works of other members of Team 10, and historical contexts including Sinan's Suleymaniye Mosque and its social complex.

The intention of the mat-building is to "epitomise the anonymous collective, where the functions come to enrich the fabric, and the individual gains new freedoms of action through a new and shuffled order, based on inter-connection close-knit patterns of association" (Smithson, 1974, pp. 573) (Figure 1) that were first collectively gathered in the *Team 10 Primer* (Smithson, 1963). Thus, in a mat-building, form does not follow function because human activities define the form; the city is not considered to be a functional entity but rather a relational being. As a result, the ground floors of the buildings are sensitive to the existing context of the city. Likely enough, all these principles are opposed to the modernist agenda (Calabuig, et. al., 2013). Although Smithsonian's are criticized for being indecisive about their ideological position since they were struggling between creating a sense of community and being highly under the influence of consumption culture (Frampton, 1994; Hays, 1995). Also, they seemed to neglect their initial criticism of Le Corbusier's zoning strategies by proposing zones for marketing and industry that are connected to residential areas (*pure sleeping zones* in their terminology) by a very well-developed network of highways (Akın, 2005).

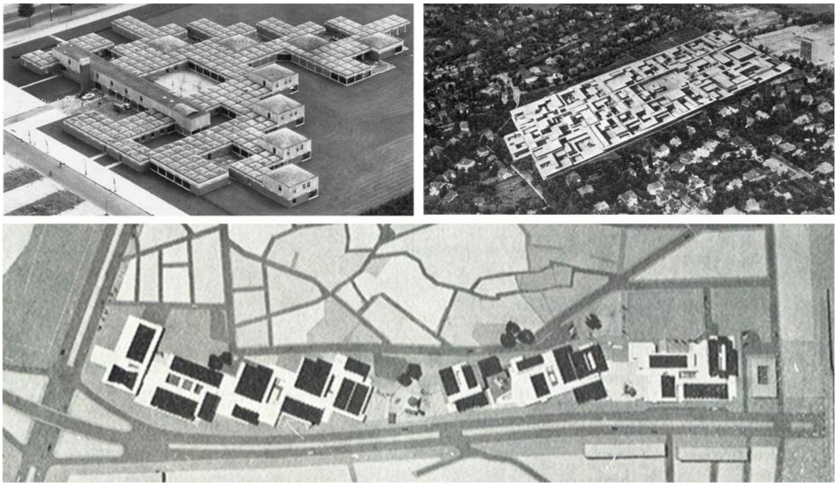


Figure 1. Top left: *Amsterdam Orphanage* (1955-1960) of Aldo Van Eyck (URL-01). Top right: The model of *The Free University of Berlin* (1963-1973) of Georg Candilis, Alexis Josic, Shadrach Woods, and Manfred Schiedhelm (URL-02). Bottom: Site plan of İstanbul Drapers Bazaar (1967-1968) of Doğan Tekeli, Sami Sisa, and Metin Hepgüler (URL-03)

Nevertheless, the concept of mat-building, –acknowledging buildings as an interconnected extension of the city's fabric– still preserves its importance in architectural discourses that derived from the lineage of urban design approaches. In other words, at this point in history it is almost impossible to neglect the effect of contextual input of the urban fabric on architectural production. The predominant approach gradually evolved from eulogizing the purified city centers to the recognition of the chaotic interaction between architectural and urban scales that is difficult to untangle. Therefore, this study is focused on a case that ingeniously overcame this complicated agenda: Grand Beşiktaş Bazaar. İstanbul Drapers Bazaar (IDP) is considered one of the most successful examples of mat-building in Turkey (Yürekli & Yürekli, 2003). Grand

Beşiktaş Bazaar (GBB), designed approximately 10 years later than IDP, which also has similar principles of mat-buildings configurationally.

GBB also known as Postane Market was designed by Sedat Gürel and Radi Birol at the end of the 1970s and built at the beginning of the 1980s located at the Beşiktaş District (Figure 2). Although the original blueprint was partially changed (the greatest intervention was the addition of the escalator in 2012-2013) during and after the construction; the main design ideas of the architects remained. The market was renowned for taking part in the '5th National Architecture Exhibition Awards' in 1996.

GBB consists of 184 market and office units in total. It was opened in 1985 and is considered one of the first shopping centers in Turkey dating back to the transition of traditional bazaar configurations into modern shopping centers. Unlike *Galeria* (another shopping center opened in 1988) –which was the first to have the enclosed characteristics of a typical shopping center–, GBB has a high level of pedestrian continuity and a permeable facade at the ground floor which as Atilla Yücel asserted, makes GBB "conceptually almost a pioneer" (Ötkünç, 2013).

Figure 2. Grand Beşiktaş Bazaar, perspective from Square 1. (The image is from the author's archive)

The importance of the market is in its relationship with the existing city fabric. It is very naturally connected to the nearby streets and other shopping centers around, thus functions as an "extension of the public space" (Ötkünç, 2013). It becomes an "integrative part of the city and the public flow" (Kara, 2019) (Figure 3).

The configuration of the market reveals the intricate nature of the structure. Both the ground and the semi-basement floors have commercial functions and gain public characteristics since they are integrated into the ground level with half the floors. Because the facade is semi-opened and the interior is porous due to the large interior atriums, the structure is permeable and environmentally sustainable. It is approved with the intention of preserving the grown, existing trees (Ötkünç, 2013). The open circulation system dissolves the boundaries between the interior and the exterior; as a result, the ground floor of the structure turns into an urban interface between the interior and exterior.

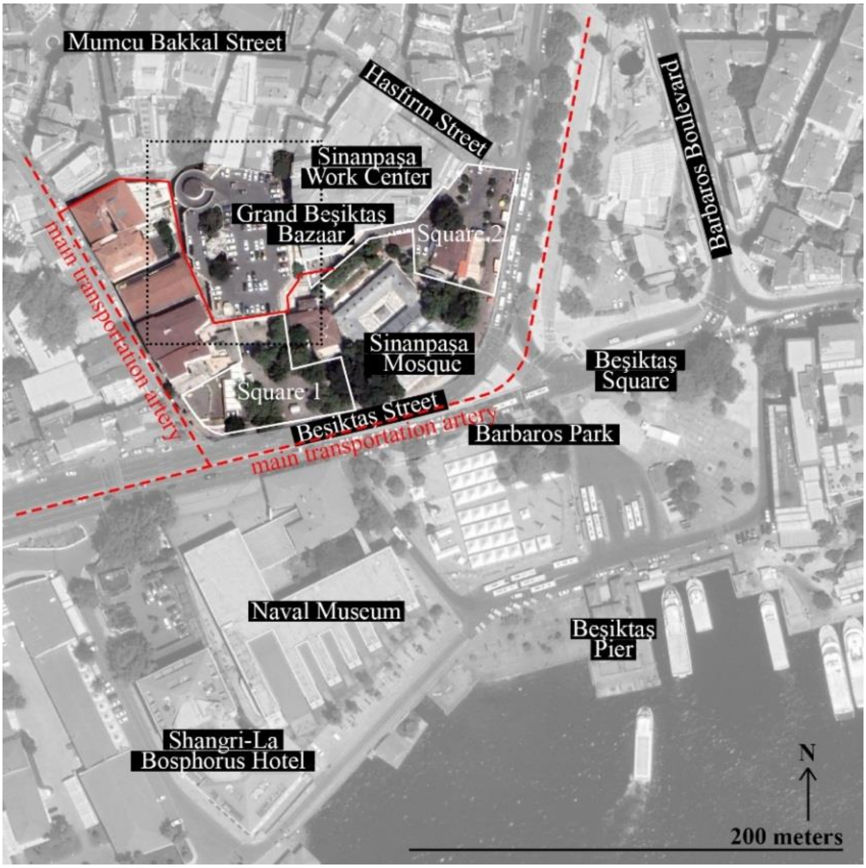


Figure 3. The urban context around GBB

On the other hand, since it is located in a very dense area (partially closed to the traffic), where many different users are in constant movement, it creates an opportunity for different representations of identities and functions to come together on the urban scale. Likewise, on the human scale, the market and its vicinity function as a gathering-sharing space (Kara, 2019); all of which are direct indicators that the market serves as an abundant public space for daily-communal life.

The permeable properties of GBB have been confirmed by several studies (Garip et. al., 2015; Wibowo et. al., 2023), both of which analyzed planimetric attributes of the ground floor plan by calculating syntactic measurands and compared the dataset with observational data of the pedestrian movement. The results of both studies consistently show that the commercial function and configuration of the GBB has less influence on pedestrian movement than its importance and centrality in the urban fabric. In other words, GBB functions more as a public threshold than a shopping mall or bazaar. Both of the studies are examining GBB from human experience and architectural scale.

In the scope of this study, –in addition to the previous approaches–, GBB recognized with its vicinity from the beginning, because the aim is to have an interconnected understanding of human–architectural–urban scales, and as aforementioned, GBB is particularyly relevant for such an inquiry, since it is an indispensable extension of the urban fabric.

2. Navigating through scales with a multiplicity of methods

The methodology is tripartite:

1. On-site observations of the market to reveal the users of the space. The users are analyzed by creating categories and subcategories to have a better insight into the user profile.

2. Modeling an agent-based simulation by reflecting the data derived from the observations of the real users of the space, to reveal how spatial configuration may affect the pedestrian movement.
3. Calculating the syntactic data of the entrances using visual graphs. Isovist area, mean depth, and integration were measured to analyze the effect of the geometric attributes of the space on accessibility.

The last step consists of an overall evaluation of all the information gathered from the aforementioned datasets.

2.1. The Observed Information of the Users

The thresholds, therefore the existing entrances of the ground floor of GBB are observed to understand how the urban fabric is associated with the interior and their effect on pedestrian flow (Figure 4). There are five pedestrian entrances and one ramp that lead users to the parking plot. The car park entrance is neglected because the context of this research is focused on pedestrian movement.

- **Entrance 1 (E1):** This entrance connects GBB with 'Square 1', and leads pedestrians to the center of the Beşiktaş District through Köyiçi direction.
- **E2:** It is the main entrance that connects GBB with 'Square 2'. It is also the closest entrance to the main transportation artery; however, pedestrian movement is not possible in that direction

because of the partition elements. Besides, there is a continuous connection between E1 and E2.

- **E3:** This entrance connects the market to Ortabahçe Street and the secondary transportation artery; moreover, it is directly connected to Square 1.
- **E4:** This entrance is located between the ramp of the car park and E3. It functions as an alternative entrance for the pedestrians who lead to/from the Ortabahçe direction.
- **E5:** This entrance leads pedestrians to the center of the Beşiktaş through a passage. However, because the connection is via a closed area this entrance is neglected.

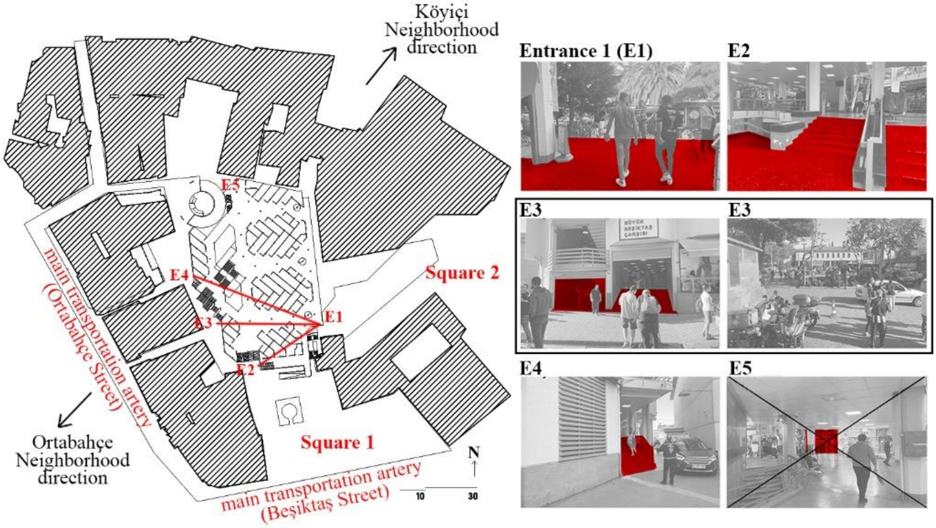


Figure 4. The ground floor entrances that are observed. (Site plan is generated from the floor plan that is retrieved from GGB administrative office.)

GBB, because of its organic relation with the city fabric, gains transitional characteristics for the users, except the permanent users such as owners of the stores, security guards, administrative officers. People passing by, use GBB as an interface for detours since it is connecting many routes. Therefore, some urban corridors are comprised when the location of the entrances and possible routes are considered (Figure 4):

- The urban corridor between **Entrances 1-2** connecting Squares 1-2,
- The urban corridor between **Entrances 1-3** connects Square 2, the main circulation artery, and Square 1,
- The urban corridor between **Entrances 1-4** connects Square 2 and the main circulation artery.

Other routes do not create a significant difference between moving through or outside the GBB, therefore they are not defined in the agent-based simulations which will be addressed in the following section. E1 is the focal point that directs the pedestrian movement; hence, the central position of E1 is affirmed by the observations.

The four entrances were observed simultaneously on May 21, 2022, Saturday, between 17:30-18:00. GBB was exceptionally crowded on that day since there was an important sports event in the district; thus the sufficient amount of pedestrian movement (*624 users*) could be recorded, extra days for observation were not needed.

The users are categorized according to *gender*, *age group*, *walking pace*, and *route direction*. The aim is to define as many parameters to the agent-based simulation. All these categories are grouped according to their subcategories (Table 1).

Table 1. The categories and subcategories of the pedestrians according to the observations

1. Gender	2. Age Group	3. Walking Pace	4.Route Direction
1.1 Female	2.1 Children	3.1 Slowly	4.1 Entering
1.2 Male	2.2 Adult	3.2 Moderately	4.2 Exiting
	2.3 Older adults	3.3 Quickly	

"Age groups" and intervals are vaguely defined by the United Nations and the World Health Organization. Thus the categorization of the National Institutes of Health (NIH) is approximately embraced for this study. NIH (2022) defines *children* 1-12 years old; *adolescents* 13-17 years old; *adults* 18-64 years old, and *older adults* 65 years and older. Since it is not possible to make a precise measurement by observation for age; those four categories are reduced to three categories: children (~1-15years old), adults (~16-40 years old), and older adults (~41 and older); depending essentially on how these groups might have different movement mechanisms in the city. 'Walking pace' is a relative category in-between the users. Finally, 'route direction' is observed only to determine if the users are entering or exiting the bazaar.

2.2. Agent-based Simulations

Swarm intelligence is for phenomena that cannot be understood with de facto organization theories or causality principles. It is used for emergent systems that are incoherent with conventional concepts of meronymy or hierarchy. Swarm intelligence is a research area working on social insects and hive formations, analyzing how the decision-making process of an individual affects the collective behavior (Bonabeau, et. al., 2003). Due to its emergent understanding, it caused groundbreaking findings in many fields, as well as in architecture, which is mostly used for analyzing self-organizational aspects at the intersection of the individual and environment.

Swarm intelligence is closely related to agent-based models, which also investigate emergent social behavior starting from the level of actions of the individual. By defining the relevant features of individuals in agent-based models, it is possible to capture collective behavior at the societal level.

For this study, the agent-based simulations were made with the limited use of AnyLogic software, which is a multinational software company operating in the United States and Europe, providing services to thousands of companies and academic institutions worldwide (The AnyLogic Company, 2022). First of all, the ground floor of the GBB, together with the partition elements that affect accessibility (such as walls, atriums, etc.), was transferred to the AnyLogic interface. Then, the users identified through observations were defined as agents in the most realistic way possible, according to the criteria specified in Table 1. The aim was to measure the effect of spatial geometry and its preceptor influence on the agents and their collective behavior.

The following distance between agents was determined by the concept of ‘safe distance’. For public settings, the safe range is considered to be between 50-65 centimeters (Hall 1966), therefore the following distance is set to 65 centimeters, the highest level possible to avoid congestion from the ‘Pedestrian Settings [PedSettings]’ command (Figure 5).

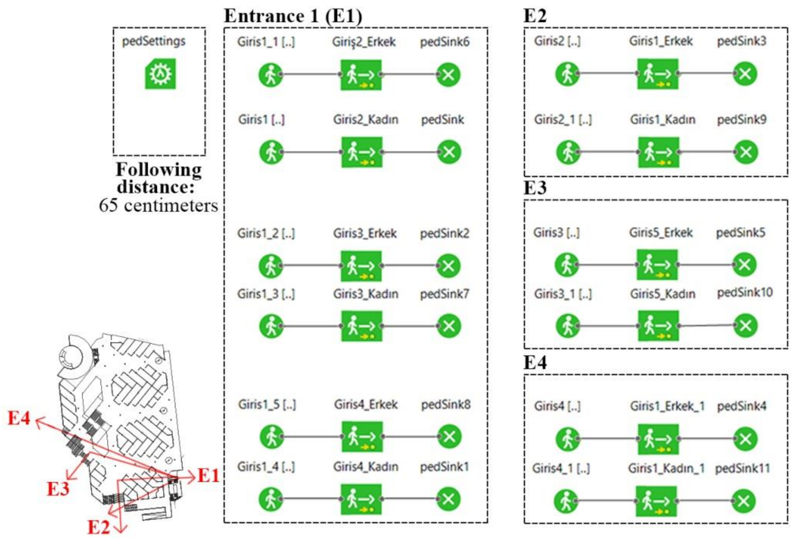


Figure 5. The parameters of the agents’ movements on the AnyLogic interface

From subcategories, gender, and route direction were incorporated into the simulation. Data for these two subcategories were distributed evenly based on the frequency of entrance usage. The urban corridors (E1-2, E1-3, and E1-4) were defined as routes via AnyLogic, and agent movements were defined as proportional to the frequency of use in both directions.

2.3. Syntactic Analysis

Although there were preliminary examples of understanding space as an interrelated network (Alexander, 1977); the theory and methodology of space syntax is introduced to the field of architecture by the seminal book, *The Social Logic of Space* (1984) by Hillier and Hanson. The fundamental premise of space syntax theories is that social structure is inherently interrelated to spatial configuration. In other words, through configuring space and by turning its continuous structure into a set of discrete units (Bafna, 2003), it is possible to control behavioral patterns of people, such as gathering or dispersing, and therefore organize the social relationships that take place in that space. However, it is a dynamic relationship; space and society reciprocally transform each other (Hillier & Hanson, 1984). Because these features of the space are underneath what is directly observable, what is inherent is not easily identifiable (Dovey, 2008).

Indeed, spatial configurations are often either shallow and integrated or deep and sequential. Shallow structures are more informal and prone to exploration, while deep structures tend to be more controlled and directive (Hanson, 1996). To examine these features, the concept of 'depth' will be a fundamental parameter.

A syntactic method, Visibility Graph Analysis (VGA), is used to calculate depth and integration. VGA is an isovist-based analysis. An isovist is the entire volume that is generated by a hypothetical point that has 360° visual capability. Isovists normally define a three-dimensional space but are often examined through its two-dimensional projections on a plan or section. In this study, the ground floor plan of GBB is examined.

To define a space, a large number of isovists are required (Figure 6) because all elements within the space that obstruct visual capability and accessibility (such as exterior walls, partition walls, atriums, etc.) alter the boundaries of the area defined by the isovist (Benedikt, 1979) which has a direct effect on the amount of control at the space.

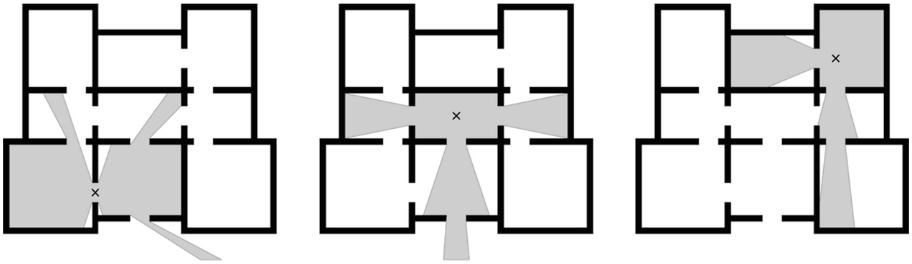


Figure 6. Different geometrical attributes of isovists are generated by different locations in space (Ostwald & Daves, 2018)

The calculations were made by Syntax 2D software developed by the University of Michigan. Firstly, the ground floor of GBB was transferred to the interface of Syntax 2D through a Computer Aided Design (CAD) software. Since GBB is not treated as a segregated structure but rather as an extension of the city; the vicinity of GBB is transferred as well to the two-dimensional drawings accordingly.

Eventually, Syntax 2D software defines a gridiron transposed to the plan drawings. For this study, a grid represents approximately 9 m² to optimize calculation time. The calculations were made for four entrances for the parameters of isovist area, mean depth, and integration, which are defined below:

- **Isovist Area:** The surface area generated by the isovist is located. It is relevant for this study because it provides direct information about the visual capability of the subject.
- **Mean Depth and Integration:** Mean depth provides values that are proportional to the distance that needs to be covered from one unit to another. As this value increases, accessing the space becomes more difficult, and therefore the space becomes more controlled. Integration value, on the other hand, measures the amount of relativeness between adjacent units. Mean depth and integration are in inverse proportion and they both carry information about the unit's depth in accordance with the global structure.

Both agent-based models and space syntax are useful tools to understand individual-environment interaction and are mostly used especially in way-finding studies. Although they can be applied separately, some researchers are using both of them at the same time (Cenani, 2017).

One of the important research using both agent-based models and syntactic analysis aims to define agents with visual capabilities through isovist analysis (Penn & Alisdair, 2001). A study conducted by the same team focused on morphological analysis based on the expansions and contractions of the geometrical attributes of the city (Penn & Alisdair, 2003). Another recent study by Soma Suzuki (2018) used Geographical Information System (GIS) data to compound agent-based and syntactic datasets, investigating urban morphology in the sense of accessibility. These studies mostly address the urban scale or at least choose between them. However, both agent-based models and space syntax analyses can be applied to both urban and architectural scales. Therefore, this study aims to investigate an intermediate scale between urban and architectural scales and GBB is analyzed accordingly to reveal its unique existence in the city.

3. Findings and Discussion

Findings of on-site observations, agent-based simulation, and space syntax analysis are going to be presented separately.

3.1. Frequency of Usage of the User Categories

On-site observational data showed that E1 was used by 228 individuals (36.5%), E2 by 169 individuals (27%), E3 by 72 individuals (11.5%), and E4 by 155 individuals (25%). Out of a total of 624 users, 274 were female (44%) and 350 were male (56%). Within 30 minutes, 45 children (7%), 390 adults (63%), and 189 older adults (30%) were identified, of which 67 (11%) walked slowly, 267 (43%) walked at a moderate pace, and 290 (46%) walked quickly. While 350 individuals (56%) were entering GBB, 274 individuals (44%) were exiting (Table 2).

Table 2: Fragments of the observation data according to categories and subcategories. The most frequent subcategories are indicated with [*]

ENTRANCE	1. Gender		2. Age Group			3. Walking Pace			4.Route Direction		TOTAL
	Female	Male*	Children	Adult*	Older adults	Slowly	Moderately	Quickly*	Entering*	Exiting	
E1	108	120	12	144	72	16	86	126	167	61	**228**
E2	71	98	13	123	33	26	48	95	72	97	**169**
E3	30	42	4	46	22	12	38	22	37	35	**72**
E4	65	90	16	77	62	13	95	47	74	81	**155**

As seen, the most frequently used entrance is E1, followed by E2, E4, and E3. While a greater portion of users was male, there was not a significant difference in the number of male and female users in terms of frequency, despite that observation day coinciding with a sports event that the most of its spectators are expected to be males. The majority of users were adults, and there were very few children. Most users walked quickly or at a moderate pace. Although not significantly different, the number of people entering GBB was measured to be higher than the number of people exiting.

To understand the distribution of the total of 624 users across subcategories, cross-tabulations were performed; first between age groups and walking pace, and then between walking pace and rote direction (Table 3). As observed, the majority of users are adults, who were entering to GBB, and walking quickly. In terms of frequency of use, they are followed by adults who were exiting, both walking fast and moderately. The representation of children is very low among all users, due to their rarity, which is confirmed by Table 2. In general, people tend to walk quickly instead of slowly along all categories.

Table 3: The outcome of cross-tabulation and representations of subcategories in percentages. The highest and lowest subcategories are indicated with [*]

Age group x Walking pace	Slowly		Moderately		Quickly	
	Nu.	(%)	Nu.	(%)	Nu.	(%)
Children (45 people)	9	0,001	20	0,002	20	0,002
Adult (390 people)	29	0,032	144	0,145	144	0,221
Older adults (188 people)	29	0,015	103	0,051	103	0,027

Walking pace x Route direction	Entering		Exiting	
	Nu.	(%)	Nu.	(%)
Slowly (67 people)	35	0,522	32	0,478
Moderately (267 people)	159	0,596	108	0,404
Quickly (290 people)	156	0,538	134	0,462

Age group x Walking pace (Route direction) (%)	Slowly		Moderately		Quickly	
	Entering	Exiting	Entering	Exiting	Entering	Exiting
Children	1*	1*	3	1*	1*	3
Adult	2	2	10	7	26*	17
Older adults	2	2	6	3	7	6

3.2. Agent-Based Model and A Simulation of Pedestrian Movement

The model is generated according to the frequency of usage of the entrances and urban corridors for a certain amount of duration. (Figure 7). The highest congestion is observed at E1, followed closely by E4. E1 stands out as the most frequently used entrance, making it naturally one of the potential points of congestion. However, despite ranking third in terms of usage frequency, E4 also emerges as a busy entrance. This can be attributed to its geometrical and spatial configuration.

Although E2 is the second most frequently used entrance based on the on-site observations, in the agent-based model it appears as a spacious and comfortable entrance. It can be explained by the emergence of alternative routes between E1 and E2. The most used area emerged at the geometric center of E1, E2, and E3 as expected.

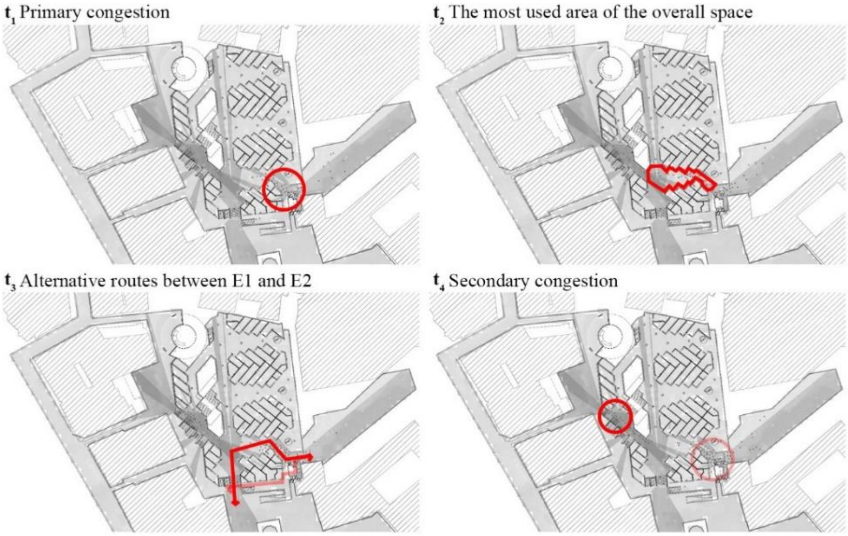


Figure 7. The agent models in four different phases. (Site plan is generated from the floor plan that is retrieved from GGB administrative office.)

3.3. Space Syntax Analysis for Understanding the Hierarchy

In VGA, the route between the E2 and E3 appeared to be more integrated. The intersection of all the isovists is located at a central point which transposes with the most frequently used area, derived from the agent-based model (Figure 8).

Calculations showed that the values for the isovist area for each entrance are ranked as E2>E1>E4>E3, the mean depth values are ranked as E1>E3>E4>E2, and the integration values are ranked as E2>E4>E1>E3. E2 stands out significantly in all three measurements. Its high values in terms of both the visible capability of the users and integration confirm that E2 is positioned at a more accessible point compared to the other entrances. To wit, these data align with the outputs of the agent-based analysis (Table 4).

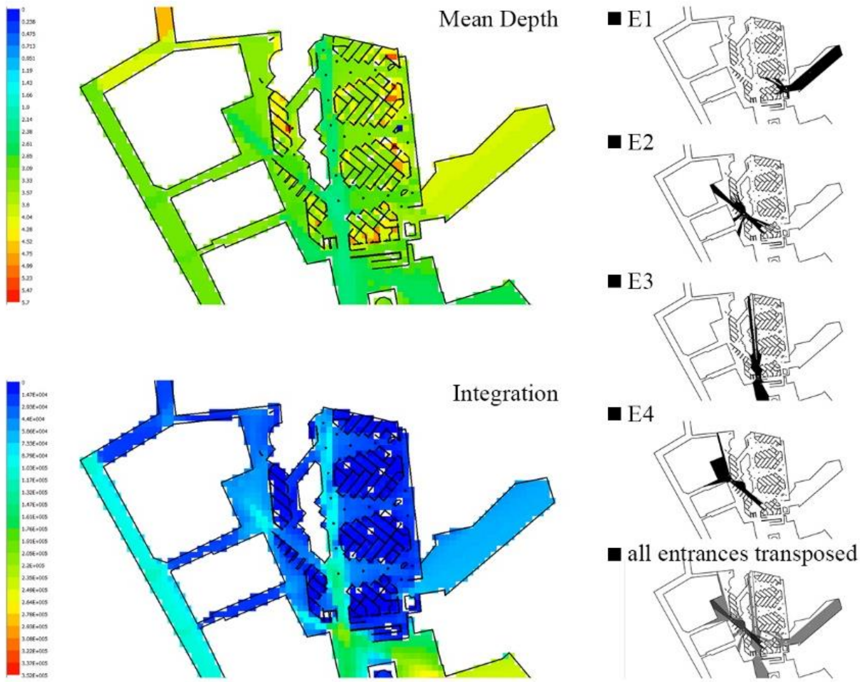
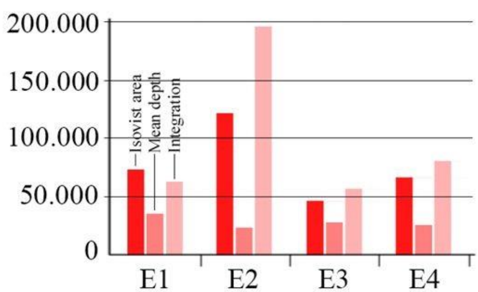


Figure 8. The VGA measurements for Mean Depth and Integration values and isovist areas for each entrance and transposed. (Site plan is generated from the floor plan that is retrieved from GGB administrative office.)

Table 4. Syntactic calculations for each entrance for isovist area, mean depth, integration, and their overall representation.

	Isovist Area	Mean Depth	Integration
E1	73.396	36.614	63.605
E2	124.127	23.965	196.929
E3	46.767	28.928	58.343
E4	68.542	26.624	81.281



4. Conclusion and Suggestions

The intention of this study is first to generate an overall understanding of how the understanding of the city has changed. Today, even for architectural practice, it is impossible to neglect the fabric of the city, and its effect on any attempt of creating a viable environment. GBB is considered to be a good example since its existence does not create boundaries, instead gives alternative semi-open routes for public use that create a plenitude of movement possibilities for individuals in the public space. In order to understand its unique existence in the city, on-site observations, agent-based models, and syntactic calculations were used.

The limitations of the study are manifold. Firstly, the observations were made on a slightly busy day in order to gather more data about pedestrian movements. However, further observations, especially on weekdays, can be acquired to enhance the dataset. Furthermore, pedestrian movements were translated into the agent-based model numerically, further studies might include routes instead of directions. For the classification of the users, the children could not be represented (because their frequency of usage was very low as aforementioned) in AnyLogic interface. Likewise, the spatial elements (defining facades of the shops and/or vertical circulation as attractors, etc.) can be included more abundantly in the AnyLogic interface for further studies. Although the rest of the entrances were defined commensurately, E5 could be included both in the observations and analysis. Lastly, numeric data could not be acquired from the limited edition of the AnyLogic interface. Thus, it was not possible to make a quantitative comparison between agent-based simulation and syntactic calculations.

The agent-based model and space syntax analysis show that, despite not being the most frequently used entrance E2 exhibits much higher performance in terms of spatial integration and flexibility compared to other entrances. It seems that in the current situation, the density of the district, and people approaching from its center (from Köyiçi District direction) are encountered by the E1, while morphologically the E2 functions as a more natural extension of the city fabric and GBB as well. Indeed, E2 is located on the facade where GBB establishes the most prestigious relationship with the city. Considering that Square 1 is also an important landmark for the city, E2 serves as a transition area between Square 1 and GBB. Thus, architects already envisioned E2 as the main entrance. Given that, E2 serves both as a main entrance and regulates the density of E1, it is, therefore essential to acknowledge its critical position.

Previous works already revealed that passing through is a more dominant behavior in GBB than commercial behaviours consistent with the building's function (Garip, et. al., 2015), that makes GBB to facilitate as a transitional building passageway for the pedestrians (Wibowo, et. al., 2023). This study reveals the underlying dynamics of why GBB gained such transitional roles in urban context.

If GBB had not been designed with such permeability –if the facades had functioned as boundaries– a problematic relationship between E2 (a natural main entrance in terms of orientation and its relationship with the main square, Square 1) and E1 (a busy entrance that accommodates the city's crowds approaching from the center) would have been inevitable. However, GBB's configuration has been able to find a semantic equilibrium between these two tendencies of movement. E3 and E4, as secondary entrances also contribute to this overall configuration.

Throughout urban planning theories and their gradual transformation, we can tell GBB can create an abundant public hub for the citizens and its principles can be implied in other architectural-urban phenomena.

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The Usage of Shape Memory Alloys and Shape Memory Polymers in Architecture

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1. Introduction

Smart materials have become a type of material that attracts attention in the field of architecture with the development of technology nowadays. These materials, which have many advantages, allow the construction of more functional, aesthetic and sustainable structures by using them in different areas of architectural design. Shape memory alloys (SMA) and shape memory polymers (SMP), which are frequently used in the architectural construction process in recent years, are also among the smart materials. Shape memory alloys are particularly obtained from metals such as nickel and titanium. These materials can return to their original shape when heated or subjected to stress. Thanks to this feature, it allows the structural elements easily adapt to environmental conditions such as temperature and mechanical effects. Shape memory polymers are a type of thermoplastic polymer. These materials can be deformed when heated or exposed to an environmental effect and return to their original shape when cooled. Due to its aforementioned features, it provides ease of application to architects with the possibility of usage in various areas such as building envelopes and roofs.

In this study prepared with a focus on the mentioned subjects, the usage areas of shape memory alloys and shape memory polymers, which are among the smart material types, in architectural applications were examined. In the study conducted using a literature-based analysis method, a conceptual framework regarding the topics of "smart materials", "shape memory alloys" and "shape memory polymers" was analyzed through readings conducted on literature. First, the emergence process, properties and classification of smart materials are explained. The nature of shape memory smart materials and the discovery phase are briefly mentioned. Then, shape memory alloys and shape memory polymers are discussed, respectively. The properties of these smart materials have been investigated and their usage in architecture has been examined through examples. In line with the findings obtained, the necessary syntheses were made, and the scientific outputs of the study were created. Finally, the study was completed by turning the research outputs into conclusions.

2. Smart Materials

The concept of smart material used in the field of architecture expresses an understanding of material that adapts to the environmental conditions by reacting to the stimuli in the environment instead of struggling with the conditions surrounding a building. In this approach, "smartness" encompass the appropriate design of building elements or components using smart materials (Addington & Schodek, 2005; Yağlı, 2019). Brownell (2006), on the other hand, defined smart materials as materials that can be physically transformed based on environmental stimuli. This concept includes a sequential relationship from materials to technologies and environments. In other words, there is a process that starts with the usage of smart materials, and this process progresses to technological developments and environmental factors (Albayrak, 2020).

2.1. The Emergence Process of Smart Materials

The progress of humanity has led to changes in the usage of building materials. While these changes took place slowly until the Industrial Revolution, they accelerated significantly after this period. In previous eras, simple conditions such as functionality and accessibility were the primary considerations in material selection, but with the Industrial Revolution, these criteria came to the forefront as structural and aesthetic changes in architecture. Nowadays, the advancement of technology has combined both the change in material diversity and properties and the desire for flexible and environmentally compatible building design to contribute to architectural design (Sevinç, 2023).

The history of smart materials goes back about 65 years. However, its applications in architecture, engineering and commercial fields can be considered a new trend. Interest in smart materials began in the late 19th century. Following the discovery of the fascinating properties of natural materials like quartz and Rochelle salt by the Curie siblings, it continued with Donald Stookey's invention of a product known as "Corning glass" in the early 1960s. The glass that Stookey discovered was light sensitive, darkening when exposed to light and reverting to its original state when the exposure ended. By the 1970s, National

Aeronautics and Space Administration (NASA) began researching materials that could predict potential faults, fatigue, or overvoltages that may occur in structural materials (Geiser & Commoner, 2001; Leo, 2007).

The concept of responsive architecture was first put forward by architect Negroponte in 1970. This concept was initially based on the idea of integrating sensors within the building, which would gather external stimuli and be evaluated by computers, allowing the building elements such as the shell and structure to respond through integrated movement mechanisms. However, with the usage of smart materials, it has become possible to produce structures in which smart materials are used as sensors and/or actuators without the need for computers (Negroponte, 1970). One of the first examples of responsive architecture is the Institut du Monde Arabe, designed by Jean Nouvel in Paris in 1987. In the facade of the building, a dynamic and adaptable cladding material has been used. This facade, through an automated system that adjusts based on the amount of light, contracts and expands to prevent excessive heating in the interior and contributes to controlling the impact of heat (Yağlı, 2019) (Figure 1).

Figure 1. Facade and mechanical diaphragm detail of Institut du Monde Arabe Building (Peutz, 2023; Winstanley, 2011)

2.2. Properties of Smart Materials

A class of materials known as "smart materials" stands out from conventional materials due to their unique dynamic properties. These materials have the ability to exchange energy, change their properties, change in different sizes and positions, and recycle, as well as respond to environmental factors by perceiving them. Even at the molecular level, one may witness these properties of smart materials. But, as can be seen in examples such as the expansion of metals with temperature or the reaction of wood to moisture, materials that are not included in the smart materials group may also contain some of these abilities. There are specific properties that are present in all smart materials that can be used to identify them as such (Ürkmez, 2019).

Smart materials are described as having directness, immediacy, selectivity, self-actuation and transiency by Addington and Schodek (2005). The material can be referred to as smart if it possesses all of these qualities; otherwise, this label cannot be used. Immediacy necessitates a real-time response from smart materials, which makes them temporal. They frequently switch between states or instantly transform energy. They are transient, which means they can alter in response to shifting environmental factors. The changes brought about by various environmental states must be reproducible and reversible to be considered direct. Selectivity is the ability to respond subtly to environmental changes and to be dependable in order to manage unpredictability. Self-actuation refers to a substance that activates itself based on its own molecular programming, composition, assembly, or chemical qualities (Addington & Schodek, 2005; Ürkmez, 2019).

According to Newnham and Ruschau (1998), the most important property of smart materials is the ability to remember. Shape memory materials are an exemplary type of this. When subjected to an external load, these materials can deform greatly, yet when the load is removed, they regain their previous shape. Shape memory materials have the ability to perceive and respond quickly and repeatedly (Newnham & Ruschau, 1998).

2.3. Classification of Smart Materials

Classification of smart materials has been done in studies prepared by Addington and Schodek (2005), Ritter (2007) ve Casini (2016). Addington and Schodek (2005) divided smart materials into two groups, Type 1 and Type 2 (Figure 2). Type 1 materials are those that are self-regulating and can modify their optical, chemical, magnetic, electrical, mechanical or thermal properties in response to a change in the environment. Materials with these properties are called “property-changing smart materials”. Materials belonging to the type 2 group are those that change energy from one form to another in order to arrive at the desired outcome. Materials exhibiting this behavior are called "energy-exchanger smart materials" (Addington & Schodek, 2005; Topal & Arpacıoğlu, 2020).

Ritter (2007), on the other hand, classified smart materials into three categories: those that change property-changing, those that energy-exchanger, and those that matter-exchanger (Figure 3). In this classification, materials that quality-changing are divided into sub-headings as materials that color and optics changing, adhesion modifying and shape shifting materials. In the subtitle of smart materials that energy- exchanger, there are materials that light emitting, electricity generating and phase changing materials (Ritter, 2007; Sevinç, 2023).

Casini (2016) also analyzed smart materials in three categories as those that property-changing, energy-exchanger and energy-exchanger bidirectionally (Figure 4). While making classification, he defined factors such as light, temperature, chemical, magnetic field, electric field, UV light, pressure, as trigger factors for smart materials (Albayrak, 2020; Casini, 2016).

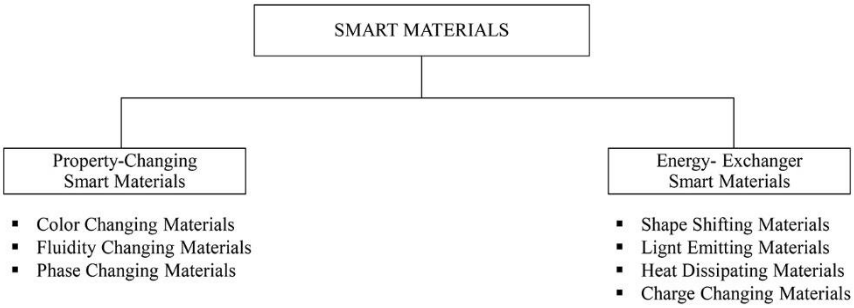

Figure 2. Classification of smart material (Edited using the Addington & Schodek, 2005; Casini, 2016; Ritter, 2007 sources.)

Within the scope of the study, shape shifting materials, which are in the energy-changing smart materials category, will be emphasized.

2.4. Shape Memory Smart Materials

Shape memory materials are a group of materials included in the group of shape-shifting materials. This family of materials known as "shape memory materials" are capable of returning to their original shapes after being momentarily deformed by an external stimulus. Any stimuli, including changes in the environment's temperature, electric current, magnetic field, pH, UV radiation, or certain compounds, might cause shape recovery. Gold-cadmium (Au-Cd) alloy materials were the first to exhibit the shape memory effect in 1932 and 1951, followed by brass (copper-zinc) alloy materials in 1938. At the US Naval War Research Laboratory, Buehler et al. discovered the nickel-titanium (NiTi) alloy in 1962, which contributed to the advancement of the shape memory effect (Addington & Schodek, 2005; Bedeloğlu, 2011) (Figure 3).

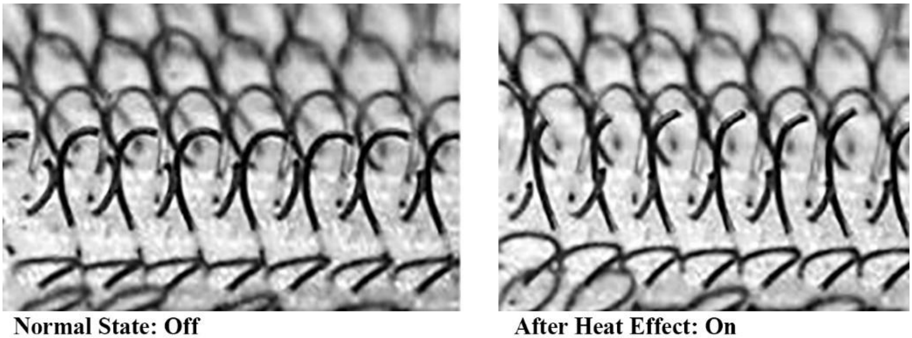

Figure 3. Changing shapes of Ni-Ti alloy hooks with excitation (Ritter, 2007)

Shape memory materials can be classified as organic or inorganic based on their components. Organic shape memory materials include polymers and gels. Inorganic shape memory materials include metal alloys, ceramics and glasses. Shape memory alloys and polymers are among the most widely usage materials. These materials can sometimes be used together because of their properties (Bedeloğlu, 2011; Sevinç, 2023).

3. Shape Memory Alloys (SMA)

Shape memory alloy (SMA) is defined as group of alloys that, when heated, can transform back into a certain shape or dimension. Shape memory alloys can be easily deformed to a new shape in the martensitic state. However, the alloy has the property of remembering its previous shape when heated above its austenite transformation temperature. Cu-based SHAs (CuAlNi, CuZnAl), Ni-Ti (also known as 'Nitinol') SHAs, iron-based SMA (FeMn) can be given as examples of SMA. Among all these shape memory alloys, Ni-Ti based alloys are widely used due to their excellent mechanical properties, flexibility, high deformation recovery ability, corrosion resistance and biological compatibility (Kurt & Orhan, 2003; Yi et al., 2020).

3.1. Properties of SMA

The main features of SMA are that they can have different crystal structures and shapes above and below certain temperature values. Although a material is deformed at low temperatures (martensitic), it can revert to its pre-deformation shape at higher temperatures (austenitic) because of the effect of temperature change on the material's internal structure (Albayrak, 2020; Ritter, 2007) (Figure 4).

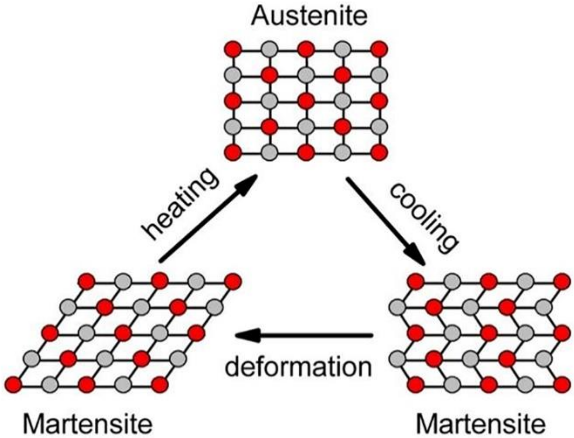

Figure 4. Transformation of SMA's Structure (Ürkmez, 2019)

Shape memory effect has two different types, unidirectional and bidirectional. Alloys with a one-way shape memory effect remember their shape only when heated. However, duplex alloys can remember their shape at high and low temperatures, meaning they can also regain their shape when cooled. However, bidirectional shape memory alloys are not commercially common because they require special training, and they tend to degrade, especially at high temperatures. For this reason, one-way SMA accepts more economical and considered safer (Auricchio, Marfia, & Sacco, 2003; Costanza, Tata, & Calisti, 2010; Stöckel, 1995; Ürkmez, 2019; W & Toh, 2000).

SMA have superelasticity. These features contribute positively to their ability to return to their original form after the applied load is removed (Ergin & Girgin, 2019).

The process of forming the memory alloy is called "programming" and is performed as long as heat is used to determine the shape. Materials usually have a programming temperature of 500°C, which is below the melting point, but can vary depending on the composition of the material. Heating treatments of SMA can be done by two common methods. The first is inductive heating. In this method, heating is carried out using the heat supply. The second method is resistive heating. In this technique, heating is carried out using electricity (Ürkmez, 2019).

The deformation of shape memory alloys varies depending on many factors. For example, the alloy composition and prior heat treatments affect the phase changeover temperature. The properties of the components and the proportions of the components can cause critical differences in behavior. In addition, the shape and thickness of the material are among the factors affecting the deformation. For example, a thick material may have a high activation force. However, as the thickness increases, the resistance decreases accordingly and the power consumption for activation increases (Ürkmez, 2019).

The useful life of shape memory alloys is about 30 years. The size and processing of these materials has a decisive influence on cost. It is quite costly compared to other building materials. Cost reduction is considered an important criterion for large-scale designs (Ayvaz, 2019). SMA are used in many fields including aerospace, robotics, automotive industries, medical instruments, bioengineering, optometry, dentistry, pharmaceuticals, construction industries and engines. In the construction industry, it can be applied to plastic, metal, ceramic, glass, gel, film surfaces as a surface, and to flooring, roof and wall as a building element (Ayvaz, 2019; Çakmak & Kaya, 2017).

3.2. SMA Applications in Architecture

The reason why SMA are preferred in architecture is their low activation energy and their ability to respond directly to changing conditions. Three of the samples used shape memory alloys in architectural structures have examined.

- *Iconic SKIN:* The SKIN project is structured on a network of implanted muscle fibers that change shape when an electric current pass through them. It consists of small-scale prototypes of an adaptable kinetic surface capable of spatial modulation and responsiveness to environmental stimuli (Ergin & Girgin, 2019) (Figure 5).

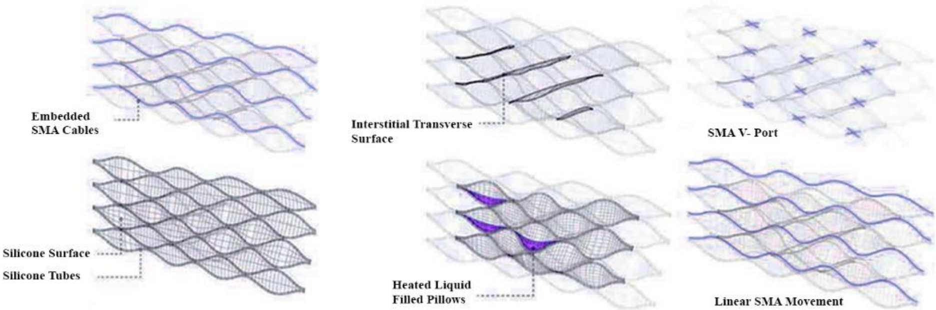

Figure 5. Detail representations of SMA used in the project (Ergin & Girgin, 2019)

Wire mesh provides surface transformations with smooth and muscle-like movements. Within the composite construction, the material system generated around the wire mesh modifies its thickness, stiffness, or permeability. Variability in the material system produces different behavior within the surface regions; it modifies the movement's speed and range, alters the transparency of the surface, and enables additional levels of performance, such as the ability to trap and release heat produced by the muscle fiber within the surface regions (Ergin & Girgin, 2019) (Figure 6).

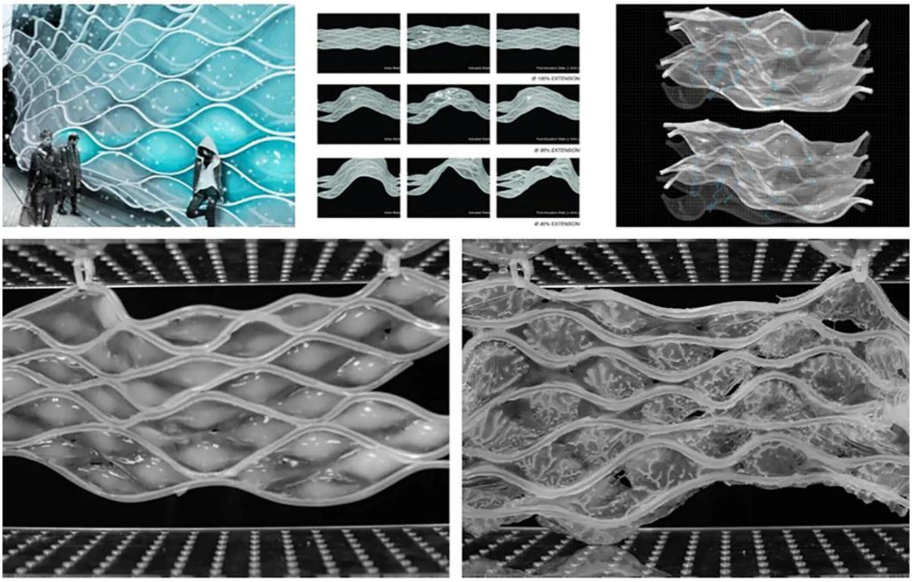

Figure 6. Changes in velocity, degree, and surface rigidity and transparency of movement (Ergin & Girgin, 2019)

- *Basilica of San Francesco:* The structure, which was built in Italy in 1253, was restored after it suffered great damage in the 1997 earthquake (Figure 7). While the building was being restored, shape memory alloys were used on the roof. SMA component was used to split and then reattach the sloping wall at the edge of the roof. Superelastic shape memory alloys are utilized in the connection between the roof and the wall to lessen the seismic forces transmitted to the vault. Distinct horizontal forces cause the shape memory alloy device to exhibit distinct structural characteristics. To prevent collapse under heavy horizontal stresses, the shape memory alloy's hardness rises (Ayvaz, 2019; Castellano, Indirli & Martelli, 2001) (Figure 7).

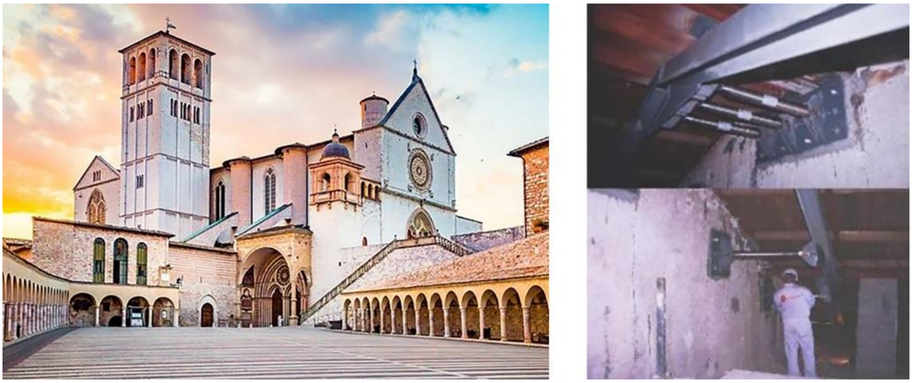

Figure 7. The Basilica of San Francesco and the usage of SMA on the roof (Castellano et al., 2001; Ytur, 2023)

- *The Air Flow(er):* The Air Flower project was designed by LIFT Architecture. The project was inspired by the thermonastic response of the Yellow Crocus plant in nature (Figure 8). The dynamic response of plant structure to temperature variations is known as thermonasty (Lift, 2023).

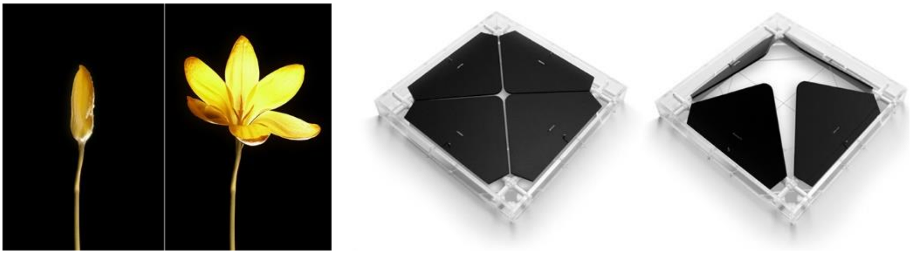

Figure 8. Behavior of yellow crocus against heat and its prototype (Lift, 2023)

In the project, it is aimed to keep the indoor quality in balance by providing indoor and outdoor air flow through shape memory alloy wires without the need for a power source. Accordingly, a thermally active ventilation system was established (Lift, 2023) (Figure 9).

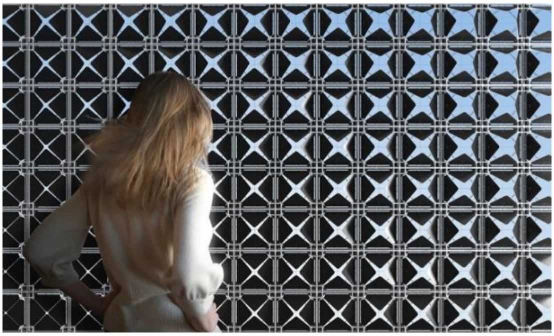

Figure 9. A double or single skin facade system of air flow(er) (Lift, 2023)

The temperature of the prototype is brought to approximately 65°C (150°F) using a heat gun. With this effect, the wires are shortened, and the panels widen, opening up like a yellow crocus plant. As the temperature decreases, the wires begin to expand, and each panel slowly returns to its closed position (Ergin & Girgin, 2019) (Figure 10).

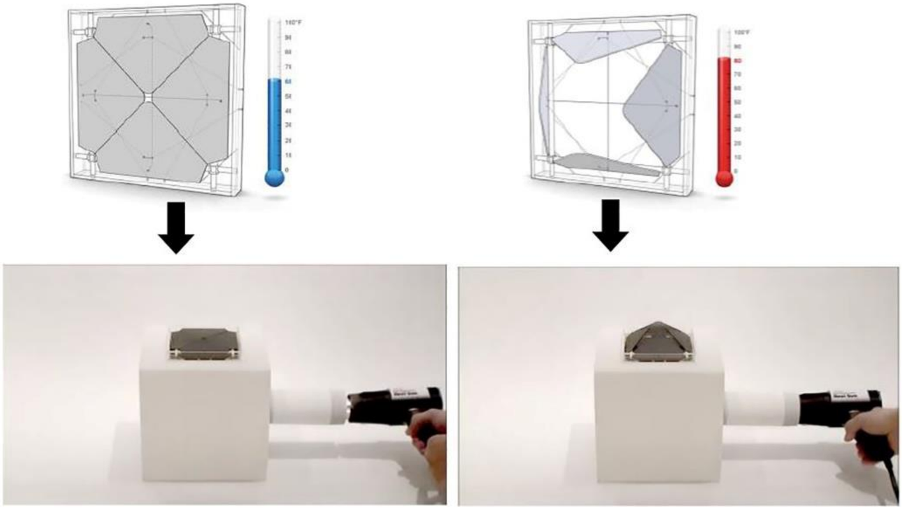

Figure 10. The experiment of opening the panel by shortening the SMA wires with increasing temperature (Edited using the Lift, 2023 source.)

4. Shape Memory Polymers (SMP)

Shape memory polymers (SMP) are a class of active polymers with the ability to have dual shape properties. They are smart polymeric materials that can revert from their deformed temporary shape to their original and permanent shape when triggered by an external stimulus such as chemicals, pH level, temperature, after being converted to SMP (Figure 11). There are two important factors for obtaining shape memory of a polymer. One of these factors is that it has a stable and stable structure. The other is that it changes shape when stimulated by environmental factors and returns to its original state when the stimulation is over. Although SMP has a memory feature like SMA, it has a completely different mechanism (Ege, Surmen, & Güneş, 2019; Tür, 2020).

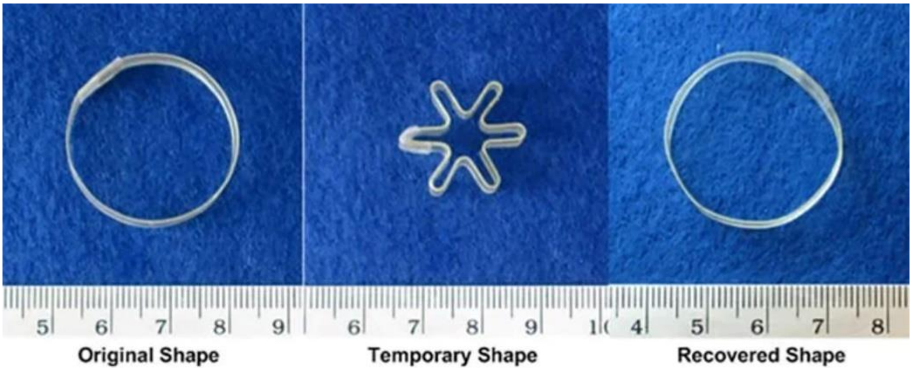

Figure 11. Shape memory polymers (Huang, 2012)

4.1. Properties of SMP

Shape memory polymers have been widely used in recent years with their wide range of shape recovery temperatures, easy processability and high recoverability. In addition to these, they also have properties such as high elastic deformation, low density, low cost, biodegradability and biocompatibility. However, despite such good extensibility and shape memory, voltage and load memory are low. In these cases, Shape Memory Polymer Composites are produced by increasing the stress and load strengths with the help of composites (Memiş & Kaplan, 2018; Mib, 2020).

Heat sensitive SMP has high elastic deformation ability and its elastic modulus differs above and below the Glass Transition Temperature (Tg). When the SMP is heated from a low temperature to a temperature above Tg without an external force, it exhibits the ability to recover its original shape by removing the stress (Hu, Meng, Li, & Ibekwe, 2012). According to the structure of the fixed points formed by intermolecular forces and/or covalent bonds, they are divided into two groups as chemically crosslinked SMP and physically crosslinked SMP. Chemically crosslinked SMP is also called "Thermoset SMP", while physically crosslinked SMP is also known "Thermoplastic SMP" (Leng, Lan, Liu, & Du, 2011).

SMP is a polymer class that has emerged with applications covering various areas of daily life. Among the applications of SMP are selfopening solar sails on spacecraft, self-destructing mobile phones, heat-shrinkable tubes for electronics or packaging, smart medical devices, or implants for minimal surgery. It is also possible to benefit from shape memory polymers in products such as foil, tube and cable. In addition, the usage of SMP is also found in various art applications (Behl & Lendlein, 2007; Mib, 2020).

4.2. SMP Applications in Architecture

The reason why SMP is preferred in architecture is that it can easily respond to environmental conditions. It is generally used in buildings built in the kinetic architectural style, which is a design concept that means "moving architecture" in the literature and can realize flexible design approaches (Zuk & Clark, 1970). Two of the samples used shape memory polymers in architectural structures have examined.

- *BalnaeNY:* It was designed by American designer Bryan Boyer in 2003 as a fun bathroom in New York's Soho neighborhood. SMP is used in BalnaeNY to enrich users' experience. It is aimed to make the activities carried out in a certain built area enjoyable through the deformable walls and floors in the project. Boyer proposed a sensor and actuator system that would provide a dynamic response to the various activities taking place during a day at BalnaeNY (Ritter, 2007; Yağlı, 2019) (Figure 12).

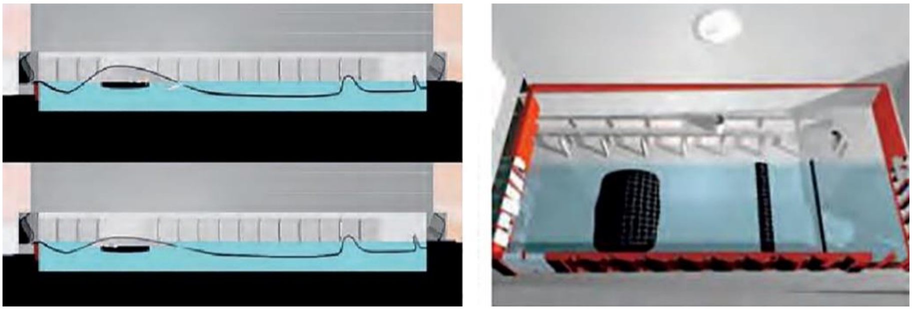

Figure 12. Section and perspective view of the pool (Ritter, 2007)

Electromagnetic radiation produced by humans is collected by electroactive polymers and converted into moving spatial changes. This material is integrated into the areas near the water level of the pool, the walls of the shower enclosures and the façade, the intermediate synthetic rubber floor. To give an example, depending on the time of day, the part where the SMP is located takes the form of waves, rising or falling on the surface of the water, thus creating an appearance as if it were a cave entrance. Shower walls can spiral into a shape to provide privacy or take another shape to function as splash guards. SMP has also been used on the walls forming the sides of the pool, and depending on the activities, they can turn into niches of various sizes. These niches can also be used as individual sauna areas. Niches can be projected onto the street from different angles, allowing them to be seen outside the building if desired (Ritter, 2007; Sevinç, 2023) (Figure 13).

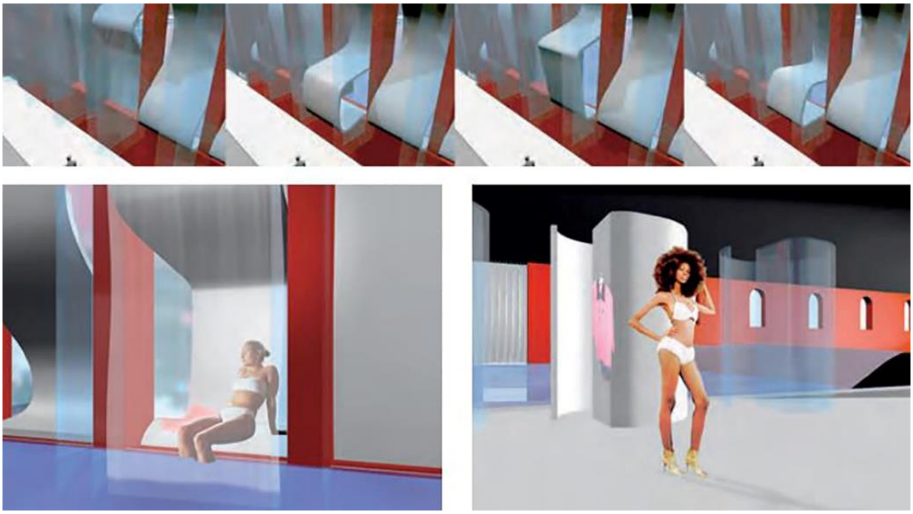

Figure 13. Kinetic wall surfaces made of SMP trips at BalnaeNY (Ritter, 2007)

- *Media-TIC:* Media-TIC was designed by Cloud 9 Architecture Office in Barcelona, Spain, under the leadership of Enric Ruiz Geli (Figure 14). Energy efficiency in the building and SMP are used in the exterior cladding. The facade consists of a building shell with kinetic character based on swelling and deflation (Arkitektuel, 2023).

Figure 14. Media-TIC (Ruiz-Geli, 2023)

The purpose of the SMP used on the facade of the building is to keep the heat and solar energy under control. While these smart materials absorb solar energy in hot weather, they release this energy in cool weather. In this way, the temperature in the interior is balanced. In addition, energy efficiency increases. SMP is also used in the movable partitions designed indoors. Responding to temperature or an environmental stimulus, polymers change shape, separating or joining segments (Arkitektuel, 2023) (Figure 15).

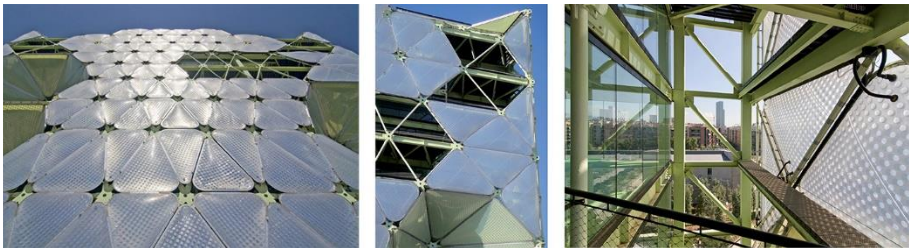

Figure 15. Facade of media-TIC (Ruiz-Geli, 2023)

5. Conclusion and Suggestions

With smart materials, building elements that are suitable for their function and capable of energy conversion can be created. In this way, it is possible to produce structures that have an increased lifespan, support environmental quality, improve energy performance, and occupancy comfort by control daylight and glare. In addition, it contributes positively to the safety and durability of the structure by providing static stress control. SMA and SMP, which are smart material types, have started to attract great attention in the field of architecture in recent years. The structural properties of these materials offer many new opportunities in architectural designs.

SMA has the potential to be applied in many points, from facade design in different forms to the control of air and light permeability from the facade. Having the ability to deform, SMA is used in the creation of movable and dynamic facade elements. Thanks to the panels used in the buildings and produced by making usage of SMA, energy efficiency can be increased by reacting to sunlight and external weather conditions.

SMP, on the other hand, can change shape or return to a predetermined shape by being activated by external factors such as heat and light. Thanks to this feature of polymers, it provides an innovative approach to designers in the field of architecture in various applications such as solar panels or adaptive roof systems. Thanks to the SMP used in the buildings, energy efficiency can be increased by storing solar energy.

The usage of these materials in architecture not only provides energy efficiency in buildings, but also makes a different and positive contribution in terms of aesthetics. It is among the other advantages that their use on the facade contributes to the sustainable building design, as well as having a positive effect on lighting and glare performance. With the effect of developing technology, as the building sector becomes familiar with systems based on smart materials in the coming years, the application area of SMA and SMP in architecture will also become widespread.

Acknowledgement and Information Note

The book section complies with national and international research and publication ethics.

Ethics committee approval was not required for the study.

Author Contribution and Conflict of Interest Declaration Information

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

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Experiencing Archaeological Landscapes

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1. Introduction

Due to their status as preserved cultural assets, archaeological landscapes require specific experiential engagement. Since today they are fast becoming integral to alternative paradigms, explaining nature of their experience in reference to the different types of encounters is necessary.

To that end, this study primarily aims to make the evolution of the notion of archaeological landscape experience visible in the international documents by conducting the method of content analysis. The phrase “archaeological landscape experience” does not exclusively pertain to Archaeology, landscape, or individual experience. Its intention is to understand and interpret the co-evolution of all three in the very context of the present and also to disclose why and how classic notion of "archaeological site" evolved into the "archaeological landscape" through experience. Within this framework, it re-reads mainly the documents of subsequent UNESCO, ICOMOS, OWHC and the Council of Europe charters, appeals and recommendations by both interpreting them separately and relationally.

2. A Co-Evolutionary Reading of our Understanding of Experiencing Archaeological Landscapes through its History. A Concise Review

From the Charter of Athens to the idea and definition of heritage as we know it today has an evolution of “many different complex and interdependent manifestations, reflecting the culture of a human community" (Luxen, 2004). Our understanding of experiencing archaeological landscapes as a phenomenon has inevitably shaped and evolved by such conditions, and such an evolution could be traced (perhaps investigated) through the contents distilled out of these conditions.

Throughout the international heritage preservation history, architectural/physical or more accurately monumental/restorative content of archaeological landscapes has been the primary interest (Carta Di Atene, 1931) (Charter of Athens, 1933). As it comes to its definition/description, in 1954 in Hague, its description has been extended to include "cultural property" and in 1956 in New Delhi issue of "conservation of archaeological heritage" was clearly noted (Vecco, 2010). In 1960, in the meeting of "Recommendation Concerning the Most Effective Means of Rendering Museums Accessible to Everyone," as the main parts of the heritage issue, the museums were described as "educational and cultural centers." Since they were described as the main instruments of "presenting works of art and scientific material to the public" and as the main sources of "enjoyment and instruction," they should be "accessible to everyone" on behalf of "cultural activities" and "mass communication." With such agreement, "leisure time" as part of the aim of "cultural advancement" was described. Such decisions on museums are important in terms of expressing the fundamentals of "museumization" and launching the parallel idea of experience on behalf of experiencing the archaeological landscapes. They are also important as their effort to define the core of touristic experience via the focus of modern discovery of the “leisure time” (UNESCO, 1960). Until the beginning of the 1960s, it is not possible to find any clear pattern related to the concept of landscape within the heritage literature. In 1962, its implicitly acknowledged within the critiques of “cultivation of virgin land” under the threatening effects of modern civilization that causes ill-regulated urban plans and careless industrial and commercial developments. Here, for the first time in the tradition of international agreements on preservation of heritages, the term “landscape” has been clearly investigated over its “aesthetic”, “natural,” “cultural” and “scientific” features. Landscapes as having both natural and cultural values described as highly “necessary to the life of man.” The approach mainly focuses on the questions, what are the values of landscapes, and how problematic approaches to experiencing the landscapes can be changed (UNESCO, 1962). In the Venice Charter, context of preservation was still dominantly defined within the limitations of conservation and restoration of the monuments (ICOMOS, 1964). Report of the Norms of Quito represents beginning of an era in which the physical preservation of monuments seems to have evolved into an approach where social functions were given greater emphasis. The evolution of the issue of preservation from the object to the environment, from the human-made to the natural and to that which relates to man and society in different layers helps us to understand complex evolution of the issue of experiencing the archaeological landscapes since then. The report also emphasizes role of “cultural tourism” within such a context (ICOMOS, 1967). In the middle of the 70’s, with the emphasize on “culture,” “cultural identity” and their “integration” into the “people’s lives” and into the “regional and town planning” in the European Charter of the Architectural Heritage at the year of 1975 (ICOMOS, 1975a), the idea of monuments in relation to a much wider and deeper context has been declared (Sandstrom, 1987). In The Declaration of Amsterdam in 1975, architectural heritage was defined as beyond the limits of a piecemeal notion and limited expression of “historic and artistic value”. Here heritages were described with their “surroundings” and they were contextualized as part of “all areas of towns or villages of historic and cultural interest”. This 'integrated' approach has introduced a broader perspective on the issue of context by anchoring future societal strategies and exploring physical cultural heritage more closely aligned with the scale and content of the landscape. Although the declaration was mainly shaped under the issues of planning of towns and education of youngsters, at the same time it made visible the notions of “human dimensions,” “contemporary life,” “town,” “countryside” and “villages” as the main atmosphere/context makers of the heritage. Since then, archaeological landscapes have been regarded as crucial elements of preservation, positioned at the core of the ideals that aim to foster 'a balanced and fulfilling life' for future generations. In relation to these, for the first time, together with the urban, “rural” was clearly expressed as an adjacent phenomenon. The declaration also highlights importance of human dimension by means of getting "public opinion," "participation" and "restoring the social balance" and emphasizes their existence as a challenging new constraint to the heritage protection and related town planning. (ICOMOS, 1975b). In connection with the 1967 report, international society reflected on the term "cultural tourism" to shed light on its presence in the field. The report underlines that the motivation of "cultural tourism" is to "discover monuments and sites" for the betterment of life, arriving at a "contemporary humanistic" quality. Within the document main elements of the model of cultural tourism (administrative bodies, tourist operators, organizations and users) was identified. Although the term mostly seemed to be approached from the side of the business, visitors' carefully structured experience within the boundaries of archaeological landscapes has mainly been anchored to this very model since then (ICOMOS, 1976). In 1982, The Florence Charter declared historic gardens as "living monuments," architectural compositions to be protected. The historic garden was characterized as the "place of enjoyment," "paradise" as in "idealized image of the world." Historic gardens were also described equal to the concept of "landscape." Although focus was rather on the outside environment or the background of the built environment, it is underlined that gardens "must be preserved in appropriate surroundings." The Florence Charter was said to be prepared as an addendum to The Venice Charter of 1965. Here, the act of "visiting" is clarified and refined by means of experiencing a place that is “designed to be seen and walked about it.” For the first time in such documents various types and moods (quite, festive, every day, special, occasional) in relation to visiting were described. By following the declaration of Amsterdam, here the concept of “atmosphere” once more used as explain the experiential complexity of context in preserving such places (ICOMOS, 1982a). Again in 1982, in Tlaxcala Declaration, principles of preserving rural settlements and small towns were decided (ICOMOS, 1982b). It could be observed that after the mid-70s a contextualist trend is discerned related with the notions of culture, history and the physical environment (especially by emphasizing rural and the urban). In addition to these, Appleton Charter through a contextualist gestaltic approach asserted that “any element of the built environment is inseparable from the history to which it bears witness, and from the setting in which it occurs.” Consequently, all interventions must deal with the whole as well as with the parts.” (ICOMOS, 1983). Following was the Granada Convention. It classified “architectural heritage” under three categories those are: monuments, groups of buildings and sites. Related to these widened and complexified fabric of heritage, it explains new conditions such as erection of new buildings, identifying and analyzing the effects of pollution, utilizing protected properties in light of the needs of the contemporary life (ICOMOS,1985). Experiencing the heritage as a complex “totality” and its being part of “everyday life” has been emphasized. (ICOMOS, 1987a). In these years, reports offer clearer approaches to thinking together heritages with the contemporary urban life (mega infrastructural plan decision principles, new functions and activities in plan decisions, improvement of housing, relations with residents, etc.) (ICOMOS 1987b). From the late 80s to the present, it is seen that studying of urban focused issues have been continuing by complexifying and broadening their context. In parallel to that, reports of the heritage society could have been traced as solid evidences of a complex understanding of experience (as a reflection of modern life perhaps) perceived in the archaeological landscapes. As part of such complexfying and broadening approach in the conception of the experience, it has been started to come across some novel issues such as "affordability," "sustainability," "environmental degradation," "protection of the natural sources," "cultural pluralism," "involvement of residents in planning" "biological diversity" etc. These concerns have been raised and are now starting to impact the experiential aspects of the phenomenon. Within them biological diversity's effect on the ways of contemplating upon and experiencing the archaeological landscapes is new. On behalf of identifying and monitoring components of biological diversity in need of conservation, the report of Biological Diversity describes living organism of all sorts (inter alia, terrestrial, marine and other aquatic ecosystems) with the ecological complexes of which they are part. This approach brought to the field various new terms such as "in-situ conservation", "ex-situ conservation" "genetic material," "genetic resources," "habitat," as well as problems such as: "degraded ecosystem," "alien species," "threaten ecosystems" etc. In the most parts, the report reflects a framework for developing a common understanding of approaching biological diversity, meantime it also draws a framework on how one should experience within such a vulnerable environment. The report was clearly prioritizing the scientific experience but it also leaves the doors open to connect local lifestyles in case they have the potential to support protecting the diversity (ICOMOS, 1993). In this category, other forms of experience (such as visitor experience) are seem to be possible only at the outside of natural habitats of biological life, under ex-situ conditions. Within the boundaries of biological diversity, it is seen that traditional means of experiencing landscape have become radically changed; especially archaeological-biological superposition in such category is expected to bring forth previously unknown experiential issues such as scale and density differences, phenomenological divergences and incompatibilities in the ways of protection. The other change that we see in the recent international heritage charters has occurred in the visiting, namely in the touristic experiencing of the heritage sites. In the Charter for Sustainable Tourism (1995), "ambivalent" type of engagement of tourism was clearly put forward. It is stated that while tourism makes a positive contribution to "socio-economic and cultural achievement," it also makes a negative contribution to the wellbeing of the environment and the local identities. For the first time visitors(tourists) take part in the reports in a highly negative way, they are defined as potential threads to the local people. Such analysis is important in the sense that it redefines issue of experiencing in the heritage sites (and so in the archaeological landscapes) by putting forward a third type of experience (neither scientists, nor visitors) that involves locals. In relation to these, fragility/vulnerability content of the heritage was discussed under two categories. First is the biological, environmental vulnerability of the visiting sites and second was the cultural vulnerability of locals and local identity settled in the sites. Also in 1996, for the first time, underwater heritage sites were discussed as part of "recreation and tourism" (ICOMOS, 1996a). Different from the Buenos Aires declaration, 1996 report aims to clarify accompanying peripheral issues. Also, as underlined at the introduction part of the document, statements about opening up the possibilities of conducted underwater visiting (in-situ) or visiting related materials through the agency of museums (ex-situ) clearly expands the boundaries of the field. In the next, San Antonio Declaration, heritage was mainly taken as a cultural phenomenon. Similar to the recent declarations, San Antonio declaration also has critical tones especially toward certain approaches of which begets "diluting and erasing local values," for the sake of an "advanced" universality. The declaration underlines that creating illusions as a form of experience threatens the idea of heritage the most as the act of homogenization requires breaking away from the real physical, cultural, historical values that built them at the outset

(ICOMOS,1996b). In the following Evora appeal, the previous criticisms have been met anew where various measures in order to prevent tourism from being a threat to heritage values were stated. In the appeal, it is endorsed that in reference to the Lanzarote Charter in 1995, tourism should become "sustainable," and in reference to San Antonio Declaration it should also be respectful to cultural identity of residents and finally it should not harm to the heritages themselves physically (OWHC, 1997). These three-point give us a profile about the main transformation pathways perceived in the experiential field along the way. In 1999, "dynamic interaction between tourism and cultural heritage" is stressed. The term "living experience" as one of the main elements of the concept of heritage comes to the fore and local identities are underlined as an integral part of the modern life. As a distinguishing point, in this document, with the expression "host communities" a completely tourism-oriented interpretation of the locals was introduced (ICOMOS, 1999). In 2000, again a convention is declared with a clear focus on landscape. Here, as in other recent documents, it is seen experience wise sensibilities toward, sustainability, local cultures, identity and quality of life as well as inclusion of the broadening of the content of landscape (natural, rural, urban and peri-urban areas; land, inland water and marine areas; outstanding as well as every day or degraded landscapes etc.). (Council of Europe, 2000). In the Convention of the Protection of Underwater Cultural Heritage, a positive change in approaching in in-situ underwater experience of the cultural heritages is seen, although strictly regulated (UN, 2001). In the following ICOMOS Charter on Cultural Routes, a new concept of “cultural routes” has been introduced into the literature for treating cultural heritage within a much wider geographical context “in order to describe and protect its significant relationships directly associated with its natural, cultural and historical setting.” The new concept could be described as an innovative reconsideration of an expanded form of experience within the heritage documents up to its date. While it categorizes itself as different from other types of cultural properties (monuments, cities, cultural landscapes, industrial heritage etc.), it has the potential of including them all. With such quality, the concept “cultural routes” offers a new context for re-consideration of the issue of experience in the archaeological landscapes (ICOMOS, 2008a). Finally, in the ICOMOS Charter on the Interpretation and Presentation of Cultural Heritage Sites, the issue of “communicative act” was brought forward. By highlighting the role of communication and addressing fundamental questions related to interpretation and presentation, the main tools that shape the issues surrounding the experience become visible and subject to debate. With this document for the first time there appears potential of seeing archeological landscapes as a valuable place for utilizing the new technology for the service of interpretation and preservation. (ICOMOS, 2008b).

3. Ways of Experiencing the Archaeological Landscapes

Above all the other factors contributing to the Archaeological experience of the heritage landscape are international agreements constructed through treaties, charters, appeals and recommendations between nations concerning primarily the ways of preserving the heritage for the humanity. Experience of archaeological landscapes in such context are thought to allow Archeology to confront the present from a position of full autonomy, from its outside. Such a past-dependent autonomy has to have loosened up and learn sharing with others on the way to its co-evolution (Figure 1).

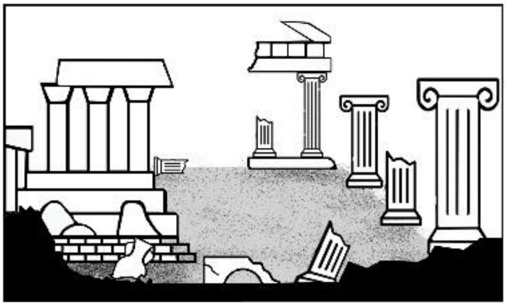


Figure 1. Archaeological landscapes (illustrated by Merve Ünal, 2023)

What one might observe when Archaeology does not prefer to include experience in an expanded semi-autonomous field is: research as experience. In this condition, the experience of the landscape is primarily approached within the boundaries of the autonomous discipline of 'preservation' and involves extensive research focused on excavating the past from the ploughed soil. The main objective is the discovery and protection of objects with archaeological significance.

This approach encompasses various aspects such as researching the landscape, authorities involved, soil and sub-soil analysis, archaeological composition of the site, ownerships, land permits, categorization of remains and found objects, removal of monuments, description of responsible excavation and protection bodies, adherence to uniform excavation principles, documentation, collection, exhibition, presentation of findings, establishment of related museums, public education, administration of archaeological work, scientific research description, required staff, development of techniques and archaeological knowledge, as well as emergency protocols. (UNESCO, 1956).

At the exact opposite of this framework, this study suggests loosening up disciplinary boundaries, for the sake of experience, for reaching out a living archaeological landscape and examines three basic scenarios drawn from the previous section: Scientific experience, visitors' experience and locals' experience.

3.1. Scientific Experience

First experience that we might call "Scientific" comes with a highly complex rule-based set of patterns reflecting the structural and functional contents of activities such as research, excavation, documentation, analysis, interpretation and preservation. Frameworks of experiences associated with this category generally focus on creating strategic bases for investigation of the landscape with the help of certain hypotheses. They are driven by a principle of conducting research in the field by contacting it "as little as possible." Scientific experience is then far from "everyday life" practices. In such experiences, the main goal is to examine, understand and explain the phenomenon that lies mostly hidden beneath the landscape, produce and disseminate knowledge, and of course above all to ensure a sustainable life for cultural heritage (Figure 2).

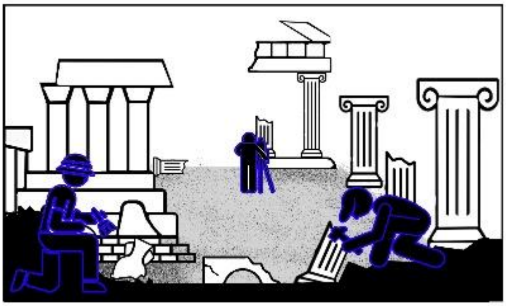


Figure 2. Scientific experience of archaeological landscapes (illustrated by Merve Ünal, 2023)

In this category, Architect is a part of the researcher group - mainly by doing documentation and presentation as part of the research in question. While at the same time his/her duty is to provide the scientific team to create a space necessary for researching.

3.2. Visitors' Experience

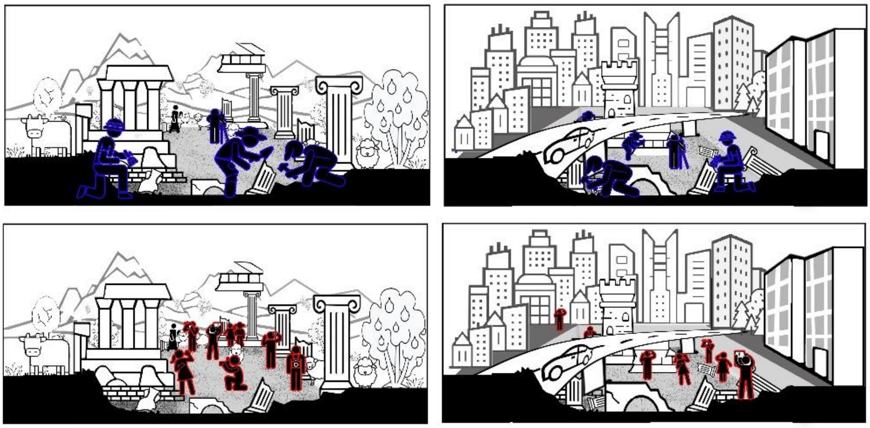
One can easily notice that the second category of experience that we might analyze under the title "Visitor" is mainly localized almost exactly on the opposite ends of the previous category. Experience through this position comes with a different agenda that often does not coincide with the primacies of the scientific research, and likely conflicts with it. The usual emphasis here is on the "recreation," “entertainment” and “fun”. All in all, it is important that the visitor spends a “good” and “enjoyable” time in well-defined space-time trajectories. On the other hand, since by its nature, archaeologic/scientific point of view demands a superior authority over all other experiences in the field, it demands that the visitors should experience the archaeological landscape primarily for educational purposes. From this point of view, it is seen that visitors of archaeological landscapes those that mainly defined by touristic experiential frameworks (motivated by fun/entertainment) may have conflicts with education-based experiential frameworks coming through the science side. The temporality of the visitors also creates a conflict, an inconsistency with the first type of experience. Tangible and intangible assets of the archaeological landscapes surely bring another difficulty in the relationship of the two. The visitor is expected to experience what is inherently "missing" (tangibly and intangibly) in the field by adding/completing the information obtained through research. The main goal is to bring the archaeological landscape (with all its missing parts, layers, complexities and rules) closer to the familiar preferably by the agency of an educational physical experience. That is the exact point where the expected dialogue between the two category takes place (Figure 3).

Figure 3. Visitors'' experience of archaeological landscapes (illustrated by Merve Ünal, 2023)

That is also the point where knowledge of Architecture is especially needed. In that sense, knowledge that matters for a required dialogue between these divergent paths belong to a highly specialized branch of architectural tradition that has evolved around issues such as representation, presentation, curation, museology and experience. And this is exactly where phenomenon of "visitor" engagement comes in. Gathering the particular experiences that seem to be incompatible with the causes and motivations of each other in a way to complements them for reaching out a creative holistic experience as part of the living archaeological landscape seems to be the most recent approach in experiencing such landscapes today. The higher motivation that engages such a novel issue is yet rather traditional that is: no matter how incompatible they might be, in the end, it is expected from both scientific and visiting experiences to create an ideal harmonious dialogue for creation of a culturally responsive society.

3.3. Locals' Experience

Finally, if the archaeological landscape coincides with a present-day settlement, it is necessary to mention a third category of experience, which might be discussed under the title of "locals." Considering that throughout their history, archaeological landscapes have been repeatedly resettled, it is not surprising that they might also be experienced as a part of urban and/or rural life. However, it should also be emphasized that such a consistent and steady relationship has long been neglected and has remained overshadowed by the previous two forms of experience (Figures 4-5-6-7).



Figures 4-5-6-7. Locals' (rural + urban) experience of archaeological landscapes (illustrated by Merve Ünal, 2023)

Culturally and historically locals are typically in multiple and nonlinear contacts with the visible and invisible assets of archaeological landscape. Gathered from the "cultural frame" they tightly or loosely have been in contact with a way of life which (linguistic & behavioral practices etc.) is often internalized and taken for granted. Even if there has been a transformation, the character of such transformation would be determined by the expression of "continuity within change" (Layton, 1998). This context-immanent position naturally opens up various possibilities to engage the landscape.

On the one hand, heritage assets of archaeological landscapes are widely recognized as integral to identity, fostering a sense of kinship and attachment. However, the introduction of a commodified form of experiencing heritage, with its 'surprise' effect, and the risk of cultural entropy leading to indifference and the erosion of meaning, may potentially contribute to feelings of alienation (Kockel, 2007).

It may largely due to the destructive effects of the World War 2 on the traditional urban pattern in Europe (Barley, 1977; Bilgin, 1996; Luxen, 2004; Alpan, 2005; Ripp, 2022) that when the literature is examined in the context of rural and urban, related data density is in favor of urban. When the post-war history of charters and conventions are examined, it is possible to say that effort of understanding and engaging the rural has been less visible than the urban. Within the literature, rural basically stands out as a "secondary" problem that have to be solved without an extra effort except to plan and organize land divisions, use and settlement.

A non-categorical category in experiencing archaeological landscapes:

As being the target of rivalries and tensions, archaeological landscapes have many times occupied and dominated by the crowds/alien forces through the ages in history. Experiencing the landscape as a battlefield is quite a different thing than experiencing it in a peace. (Lewin & Blower, 2009; Greenhalgh, 1998) It is important to note that his study focuses on experiencing archaeological landscapes in the "peacetime" by focusing on its participants as having intention of a certain degree of understanding via participating in various ways to complete the missing parts, not by transforming, destroying, non-participating or alienating it in a hostile manner.

4. Conclusion: From "Research as Experience" to Experiencing Archaeological Landscapes

"*Archaeology is not about digging up the past from the plough soil*" (2015, Yates)

"*Archaeology is not so much about reading the signs of the past but a process of writing these signs into the present*" (Tilley, 2015)

Experiencing archaeological landscape as a field of human engagement can only exist when the past and present are in a critical, dialectical relation (Hodder, 2013). Such a framework aims to understand and compare the landscape across various contents and stream of experiences within and without the conventional authority of Archaeology occurring in an archaeological landscape at the present and address the problem of "how" we come into contact with the phenomenon.

As seen through the ongoing heritage discourse, today apart from the traditional authority structures, fresh insights and inquiries have continuously been brought forward from the other interdisciplinary studies. In parallel to such a transformation, it seems it is important to abandon the unilateral, unidirectional past-dominant disciplinary forms of understanding at least to the degree of noticing and embracing divergent and even contradictory space/time frames.

Since the Charter of Venice, the problem of the experiencing archaeological heritage has tended to follow essential principles that are guided by the preservation rather than presentation. However, the last decades have been witnessing changes in the opposite direction. As indicators of this situation, one can point out ecological, natural sustainability, underwater and biodiversity issues. With this new frame of interpretations, it is seen that the problem of experiencing the archaeological landscape engages with novel issues. Since the new content is mainly focuses on the natural, archaeological landscape has to be examined to reconsider the problem of experience to digest such content also - dealing with all its sub-issues like: habitat, alien species, in-situ and ex-situ experiences, boundaries. When it comes to issues of rural and urban relations and global tourism, with this new frame of interpretations, the problem of experiencing archaeological landscape engages with issues that had not perceived before. Here since the new content is mainly Cultural in character, archaeological landscape has to be examined to reconsider the problem of experience to digest such content also - dealing with all its sub-issues like: peri-urban, human dimension, participation, identity, modern heritage, industrial heritage, cultural pluralism, cultural routes, complete life, globalism, planning and management. In all this new presentation/experience-oriented trend, interdisciplinary sub-study areas (research paths) fed by above defined map of themes could be noticed.

Within such paths, tourism is one of the most visible one for engaging the previously defined issues. From the beginning of the 20th century to present, it is clearly seen that the problem of experiencing the archaeological landscapes, those were shaped by the principles and ideals of conservation/preservation at the beginning, begins to appear as predominantly a problem of presentation attached mainly to the negative ends of global tourism. The probable reason for this highly criticized transformation might be the organic relationship of tourism with globalism. The effects of globalism on the archaeological landscapes are then included by way of tourism. As a result of this situation, it has been observed an evolution in the literature of tourism that is more harmless and supportive of the idea and ideals of the heritage with all its surroundings, sensitive to differences with the agenda of protecting the local life (Ashworth & Larkham, 1994). Also, one other discernible research path is gathered around the issues of identity, memory and tradition. As part of the modern life, identity, memory and tradition seem to provide humankind an ethic and aesthetic confrontation between its past and future. Problem of experiencing loss of meaning in monuments (Anay, 2019); or problem of identity and sustainability transitions in the life of a traditional city (Rharbi & Demirkol, 2023) might exemplify such framework well.

Within this context, it seems particularly important to notice another novel emergent transformative path originated from the cooperation of media and technology with the more traditional fields such as Architecture and Archaeology.

The cooperation has been ongoing for a considerable period, following an unconventional multi-contextual approach. This approach involves exploring dialectical relationships between physical and cultural aspects, preservation and presentation, past and present, factual and interpretive elements, as well as real and virtual dimensions. It addresses both existing and emerging challenges, aiming to overcome obstacles that have not been encountered before or have yet to be resolved. (Anay et al., 2019; Anay et al., 2021a; Anay et al., 2021b; Anay et al., 2022; Anay et al., 2023).

Contemplating on experience as attached to the issue of the world of heritage (and particularly to archeological landscapes) seemed to be evolving from an understanding of being mere “research” (at best “research as experience” which consist of the sum total of documentation/ preservation/restoration) to some rather diverse moods of experiences. In parallel with this condition, since it is a fragmented whole, experiencing archeological landscape by its nature should be understood as the second one that means it should be partially dependent to other contributing domains, mutually causative and involving multitude of fields, issues, variables, levels, scales, processes, participants, actors, activities and pathways.

And finally, no matter how regulated it is, experiencing archaeological landscapes is then in the end demands critical engagement, interpretative re-view/re-act in various contexts, in various scales, through various (preferably unconventional) media. Engaging and experiencing archaeological landscapes then needs to construct an interpretation in the form of a dialogue between past and present.

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The Role of Generative Artificial Intelligence in Architectural Design Education

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1. Introduction

There is great concern about the potential for generative Artificial Intelligence (AI), technology that can create new content, such as text, images, and video, to replace humans in many fields. However, one of the most significant opportunities generative AI presents is to increase human creativity and overcome the challenges of democratizing innovation.

Over the past two decades, many design environments have used crowdsourcing and contests of ideas to engage new designers in the innovation process. However, many businesses have needed help taking advantage of these contributions. For example, they needed an effective method for evaluating ideas or synthesizing different ideas.

Much research has been conducted on students' creative and innovative processes in architectural design education. Various approaches have been developed to incorporate human and environmental interaction in the design process. However, it has been challenging to produce practical methods in design education that could help students evaluate their ideas and synthesize different ones.

This article explains how generative AI can help overcome these challenges in architectural design education, especially in creative processes. It can foster the creativity of design students, help them generate and define new ideas, and improve the quality of raw ideas. Architecture and design schools, in particular, can use generative AI to encourage divergent thinking, challenge expertise biases, aid idea evaluation, support idea development, and facilitate collaboration between users. Generative AI can potentially increase human creativity and democratize innovation by aiding idea evaluation and supporting collaboration. This article explores how generative AI can benefit architectural design education. It focuses on using concepts used in the business world, such as crowdsourcing and democratization of innovation, in parallel with user-centered solutions in design education. This allows for a comprehensive audience to examine user-oriented strategies with designs and utilize artificial intelligence as a tool in these features.

2. Creativity, Crowdsourcing, and the Challenges of Democratizing Innovation

Generative AI has the potential to increase human creativity and democratize innovation despite concerns about replacing humans in many fields. In recent years, companies have increasingly involved users in innovation through crowdsourcing and contests to generate new ideas. Jeff Howe and Mark Robinson coined the term crowdsourcing in 2005. Cricelli et al. (2022) indicate that it remains popular because companies adapt to changing technology and user behavior. Social media companies that do not produce content can be an excellent example of crowdsourcing. Their content is thoroughly prepared and used by users. They serve only technically created infrastructure, systems, and necessary ideas for users. Today, millions of people routinely share and interact through these platforms.

Organizations such as transportation, food delivery, and hotel accommodation companies can often use it to mobilize the masses in problem-solving. Today, crowdsourcing creates a valuable bridge between companies and their users. The concept significantly impacts the speed at which consumers use technology. On the other hand, it highlights the issue of innovation and creativity more clearly. With crowdsourcing, innovative ideas from large audiences and different fields contribute to the growth of businesses in every field. Crowdsourcing also helps businesses reduce certain costs. It would be helpful to address the disadvantages and advantages of crowdsourcing. One of the handicaps of this system, which reaches a huge audience, is the lack of privacy. In other words, new ideas given by large masses bring the danger of being stolen. There is also the possibility of stealing and imitating ideas visible to other companies. For users, there may be a handicap, such as repeating ideas. It is also possible that the masses can submit ideas that are imitated or plagiarized to companies seeking new ideas. Evaluating these ideas can also cause a waste of time for companies. While Chat GPT, Midjourney, Stable Diffusion, and Dall-E can be listed as crowdsourcing, many Web 2.0 internet tools are also in dialog with the listed AI tools. Web 2.0 internet tools are also crowdsourcing, with many users sharing their designs, thoughts, and writings. Especially with the effect of COVID-19, the capabilities and numbers of distance learning systems spread a lot in design education. Web 2.0 tools were helpful in the beginning. At this point, we should admit the evolving user innovation phenomenon; users of products and services—both firms and individual consumers—can increasingly innovate for themselves.

Eric von Hippel of MIT coined the term "democratizing innovation" (2005). He has researched users' potential to develop their products and services since the mid-1970s instead of relying on companies. Despite many enterprises' valuable contributions, four challenges often prevent them from fully capitalizing on them (Eapen et al., 2023, pp. 14-16). First, efforts to democratize innovation can lead to idea overload. Crowdsourcing often generates many ideas that are ignored or thrown away. Companies require an effective method for evaluating and combining incomplete or minor ideas that could be powerful. Secondly, companies may fall prey to the curse of expertise. Domain experts who are best at generating and identifying feasible ideas often need help generating or accepting novel ideas. Thirdly, people without domain expertise can suggest new ideas but struggle to turn them into workable designs. Moreover, companies need assistance creating comprehensive solutions that appeal to their community despite synthesizing many customer requirements. On the other hand, Eapen et al. (2023) suggest that Generative AI tools can solve a significant challenge faced in idea contests: combining or merging many ideas to produce much stronger ones. All negative and positive aspects apply to AI applications for design.

2.1. Generative AI for Creativity in Architectural Design Education

The effective use of artificial intelligence applications, where the active participation of users in the design processes is aimed, can also be helpful in the democratization processes of creativity. Instead of viewing AI as a threat to the designer's influence, it can be leveraged as an opportunity for the designer to collaborate with users and produce more effective results. In design education, it is necessary to produce new alternatives that will allow the user-designer relationship to be developed in these ways. Thus, crowdsourcing and artificial intelligence applications should be adapted to architectural design education.

Design is a production process and involves various ways of thinking. In architectural design studios, with the help of AI Generative tools, experimental approaches can be a valuable experience for understanding design processes. Exercises questioning the relationship between the current environment, problematics, and future technologies offer essential opportunities. These exercises provide essential intellectual opportunities by encouraging designers to think without prejudice from the past. Using various design and research approaches to construct such academic exercises is beneficial.

2.2. Research and Design-Based Rational and Action-Oriented Thinking in Architectural Design for Creativity

To achieve a creative design in the traditional design process, there are two primary ways to produce a design, according to Dorst and Dijkhuis

(1995). These two methods have various names, but the first and most prevalent is referred to as the "rational model" (Brooks, 2010), "technical problem-solving" (Schön, 1983), or the "mind-centered perspective" (Ralph, 2010). The second method is known as "reflection in action" (Schön, 1983), "co-evolution" (Dorst & Cross, 2001), or the "action-centered perspective" (Ralph, 2010). The rational model is based on a rationalist philosophy and deals with design, research, and information in a predictable and controlled manner. Designers optimize design elements based on known constraints and goals; the design process is plan-driven. The designer coordinates the stages of the design activity (Pahl & Beitz, 1996; Simon, 1996). In contrast to the rational model, the action-centered model suggests that designers rely on their creativity and emotions to develop design ideas and products. This approach acknowledges that the analysis, design, and implementation phases are closely linked and that the design process often involves improvisation. (Ralph, 2010)

New developing technological tools can help advance rational and action-oriented design processes in architectural design. Architectural design studios should prioritize the functional and emotional needs of users. Therefore, they should focus on producing rational and action-centered design thinking. Today, it is crucial for the studio to include questioning to develop different and multidimensional thinking skills through different and various problems brought by technology to design. When multidimensional thinking and questioning skills are carried out through research, it can be defined as a process that includes thinking, writing, discussing, validating, disseminating, and applying. When we consider the architectural design studio as the area where the research takes place, according to Murray (2013), the architectural design studio is approached in two different ways for research: design-oriented research and research-based design. In the rational model, architectural design is achieved through research. This involves identifying the design problem, monitoring the lifecycles of potential users, making observations, and finding ways to work with them. The data obtained is then used to identify user needs, analyze, evaluate, synthesize, and transform it into a design. Architectural design research often employs action-oriented thinking approaches, which involve conducting research through design representations and representational practices. To achieve this, various methods are used; drawings, maps, and archives are examined in line with this goal; diagrams, sections, sketches, and 2D and 3D drawings/models are created; the manifesto and the script are written; with the use of programming and digital tools, various expression methods are tried, and design research is carried out (Verberke, 2013). In addition, the analysis of architectural examples through literature review also provides essential input (Coyne, 2013). New technology possibilities can catalyze and enhance the circular design process. However, research should feed design, and design should feed research; it is essential for research and design to complement each other.

Figure 1. Eapen et al. (2023) prompted Midjourney to produce an image combining an elephant and a butterfly; they dubbed this creation "phantafly" (left). Then the authors prompted Stable Diffusion to generate designs for chairs and artisanal chocolates inspired by "phantafly" (right).

Expressing the knowledge gained through research-based design, the design element and other modes of research activity and research methodology must work together in an interactive and symbiotic way, each feeding the other throughout the process from start to finish. In the method Halu (2020) calls the Inquiry Method or Define/Design-Design/Define (2D-2D), defining and designing the design problem is repeated as a cycle. In Figure 1, a circular design process with prompts to different AI programs and their interaction can explain the variety of inspirational designs.

3. Findings and Discussion

Generative AI programs have been used in various design research for a long time. However, at the point reached today, traditional design processes have become questionable because the capacity to design many AI programs such as Midjourney, Gpt-4, and Dall-e2, which has come to the fore in recent periods, is much more than expected, and they can be realized in a short time. Today, the continuous development of artificial intelligence programs inevitably affects the rational and action-based development process of architectural design. The architectural design process, rapidly affected by technological developments, is a matter of debate on including the latest AI programs in its field.

Generative AI programs, such as Midjourney, Stable Diffusion, and Dall-e2, produce images according to the text input and allow changes to the produced images. On the other hand, Alpha3D, Luma, Spline, and many more can transform 2D drawings into 3D models with various features. The randomness of the visual outputs changes according to the text's writing style or the image's detail level. Recently, there has been an increasing interest in the literature for Generative AI programs to be considered in the architectural design process. In addition to the views that the program "expands students' perspectives" towards creating a design concept (Yıldırım, 2022), there are studies claiming that the program has difficulties in solving even the relationships between simple objects (such as over, inside, and under) (Conwell & Ullman, 2022). Leach (2022), who deals with artificial intelligence programs through the myth of creativity, advocated using artificial intelligence programs to solve comprehensive and complex architectural situations.

While Hegazy and Saleh (2023) argue in their research that AI programs can be helpful in inspiration in the architectural design process, they point out that the issue of design ethics can pose a significant problem. Although artificial intelligence programs tend to reduce the margin of error in each release, it is seen that researchers have discussed many positive and negative aspects.

4. Conclusion and Suggestions

In the architectural design process, students and designers start producing thoughts, which constitute an input to the design, through emotional and subjective evaluations or rational observations. They express these thoughts in a written text, a sketch, or a three-dimensional model. Written texts can accompany design research sketches, models, and technical drawings. At a stage, they transform models into drawings or written expressions. While the design stages are sometimes consciously advanced, sometimes they go through instant, spontaneous stages. Designers can also accompany Generative AI programs in the design process as one of these stages. So that they can help find their designs' users. With crowdsourcing, they can discuss their strategies with some real users.

Moreover, with the help of crowdsourcing, they can start research-based design. Alternatively, they can research by design with the help of all the generative AI programs mentioned. One of the opposing sides of AI programs is that when researching by design when local parameters are not accompanied, the design can lack coherence. So, the coherent idea that comes from research becomes more valuable.

AI helps experience different shape grammars quickly, but on the other hand, it makes the designer feel pressured to choose a suitable design alternative. So, design research becomes more valuable.

Designers can evaluate the mutual relationship between the visual results obtained from AI and the real-produced models, drawings, and texts from different perspectives. It has been interpreted that this interrelation can work as a catalyst regulating the forward and backward movements and feedback in the symbiotic relationship between define-design and design-definition in the design process. The designers can undertake a task that can establish a dialogue in the rational and action-oriented thinking process during and after the design process of the programs.

Another prominent evaluation is to reveal how important the power of the text is in design. Emotions and objective realities that can be described with written and verbal expressions will be essential in using new design tools that develop in the future. In addition to using the mother tongue effectively and correctly, mastery of materials, details, and architectural terminology will gain more and more importance. Designers can test written and verbally definable realities quickly in digital environments. Even though Generative AI applications will not be able to overcome the unknown capacities of the unique human brain, design education will evolve in a different direction using all these tools. Human and user-oriented designs will increase with the effective use of these tools in design education and design processes. It has the potential to democratize access to designs that put people first, democratize innovation by enabling user and designer interventions, prioritize sustainability, and reduce the effects of natural disasters.

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Dystopian Spaces at the Intersection of Literature, Cinema, and Architecture: Fahrenheit 451

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1. Introduction

Swiss architect Bernard Tschumi defines architecture not only in relation to space and volume but also as a field concerned with events, actions, and what occurs within a space (Tulum Okur & Gezer Çatalbaş, 2022). Therefore, the discipline of architecture is not only about creating spaces that fulfill users' physical needs. Considering its definition and its role in human experience, architecture is the art of creating living spaces that go beyond meeting users' physical requirements, enabling the realization of social, cultural, and psychological needs and actions. By incorporating social and psychological needs alongside physical conditions, architecture can be seen as a powerful tool in shaping human experience. In this aspect, architecture demonstrates itself as both a social production field and an interdisciplinary phenomenon (Serin Güner & Gökmen, 2020).

It is known that architecture, as an interdisciplinary phenomenon, nourishes and is nourished by numerous fields. Over time, the discipline of architecture has been associated with various fields such as design, urban planning, history, art, philosophy, archaeology, technology, and politics, and the areas that can be evaluated at the intersection of architecture have expanded with the developments that have taken place (Ayyıldız & Müştak, 2016). Starting from the 1960s, these areas have diversified, and the interaction between architecture and other disciplines has been strengthened under the influence of major formations such as phenomenology, aesthetics, linguistic theory (semiotics, structuralism, post-structuralism, deconstruction) (Nesbitt, 1996 cited in Çağlar & Ultav, 2004).

In addition to its existing relationships with other art forms, architecture has the potential for new productions that can contribute to the phenomenon of architectural space by employing language as a tool (Tümer, 1982 as cited in Gerçek Atalay & Kuloğlu, 2019). French philosopher Jacques Derrida (1930-2004) defines architecture as a form of writing and, thus a way of life (Leach, 2005). Derrida, who argues that architecture can be associated with linguistic and semiotic signs, emphasizes the importance of language for architecture to express itself and be interpreted. In parallel with Jacques Derrida's discourse, American anthropologist Edward T. Hall sees literature as a key to understanding how humans perceive space (Tümer, 1982 as cited in Somer, 2006).

Every language has its architecture, and each architecture has its own language. Both architecture and literature are based on a fictional structure. It can be said that one of the common characteristics between literature and architecture is that they have concrete or abstract symbolic languages, possess content, and can refer to a situation or a problem. Furthermore, these two fields parallel each other in shedding light on the past and making assumptions about the future by embodying the characteristics of their respective periods

(Somer, 2006). Although the novel is considered a temporal art, the view that it establishes a significant relationship with spatial arts such as architecture, painting, and sculpture is gaining strength (Kestner, 1990, as cited in Çağlar & Ultav, 2004). Based on this perspective, it can be said that another concept shared between architecture and literature is “space.” Architecture is the art of creating livable spaces, while literature provides a narrative for the events in these constructed spaces. The writer describes the spaces without giving too much detail, leaving room for the reader's imagination depending on the level of detail required by the genre of the writing.

Just like literature, cinema is an art form that both nourishes architecture and is nourished by it. With the invention of cinema in the 19th century, a new art form emerged that interacted with architecture (Ayyıldız & Müştak, 2016). Cinema, which occurred in the 1890s, is a phenomenon born out of the dialectics of art and technology (Nowell-Smith, 1997). Cinema, which serves as a tool to experience everyday life and fictional worlds, cannot be considered independent of the concepts of time and space due to its nature of conveying a narrative and snippets of human experience (Ünver, 2020). Similarly, Soviet director Tarkovsky states that the unique aspect of cinema is its ability to fix time (Fettahoğlu & Erbay, 2021).

Cinema is closely related to architecture not only due to its temporal and spatial structure but also because both art forms depict lived spaces. Just as buildings and cities represent cultural images and their respective periods, these two art forms create a comprehensive lifestyle image. Both cinema and architecture define the dimensions and essence of existential space; they both create experiential scenes of life situations. In parallel, prominent contemporary architects such as Bernard Tschumi, Rem Koolhaas, and Jean Nouvel emphasize the mutually nourishing relationship between architectural approaches and cinema (Pallasmaa, 2008).

Architectural influences are evident in creating film sets at a fundamental level. Within the context of films, spaces hold significant importance alongside the story and actors. In addition to technical aspects such as lighting and camera work, the presence of physical objects that contribute to the atmosphere of the narrative is essential. Things used in film sets and scenes often become symbolic through their formal qualities in addition to their practical functions in everyday life. Therefore, arranging these objects by the desired atmosphere of the narrative is crucial. In this context, natural objects can be used, but depending on the narrative, alternative universes, cities, buildings, spaces, and even genres can be designed and utilized (Bezci & Dündar Türkkan, 2017).

In this context, dystopias, which are an intersection of architecture, literature, and cinema, have been chosen as the subject of study. Dystopia is generally defined as creative works that envision a dark future where societal problems are addressed, and a powerful faction somehow controls individuals. Dystopias in literature and cinema offer a critical approach that shapes people's lives, imposes rules, and sets restrictions. In dystopian stories, architecture can be seen as a means of control, designed with buildings and structures that limit individual freedom and enforce conformity.

1.1. Purpose of the Study

This study aims to uncover the intersection of architecture, an interdisciplinary phenomenon influenced by various fields, such as art, philosophy, and technology, in literature and cinema through the lens of dystopian spaces. The objective is to analyze how architectural elements in the depicted areas of literary works and films are shaped by the rules existing within dystopian narratives. It seeks to examine the architectural counterparts of dystopian spaces described in novels and cinema and analyze the parameters that define their relationships through various parameters.

1.2. Scope of the Study

Within the scope of this study, the answers to the following questions are sought: “What roles can architecture play in dystopia?” and “Which architectural elements contribute to the creation of a dystopian atmosphere?” Sample examples for examining spatial narratives in dystopian fiction and exploring societal rules that shape and dictate spatial needs and human behavior are selected from Ray

Bradbury's Fahrenheit 451. It is one of the most well-known dystopian novels published in 1953, and its film adaptations. Another consideration considered during the selection process is the existence of two different film versions released in 1966 and 2018, respectively. By comparing the depictions of spaces and technologies in the novel and the adaptations in different periods, the study aims to analyze the spatial changes brought about by the passage of time and developments in various fields, as well as the differences in the adapted spaces from different perspectives.

Based on the stated purpose, objectives, and research questions, this study hypothesizes that architecture and architectural elements in dystopian stories serve as indicators of dystopia's dark atmosphere, reflecting society's characteristics and representing lifelessness, hopelessness, and coldness. Another hypothesis of the study is that architecture and its various elements can create a dystopian atmosphere in spaces.

2. Material and Method

Within the scope of the research, the novel Fahrenheit 451, an example of dystopia in literature, has been read, and the films Fahrenheit 451 (1966) and Fahrenheit 451 (2018) have been watched. The aim is to make inferences about dystopian spaces based on the novel and films. Within this framework, an analysis is conducted on the architectural spaces, focusing on elements such as light, color, and furniture to understand how they contribute to creating a dystopian atmosphere. The research explores which architectural elements can effectively establish the ambiance of a dystopian setting. Based on the analyzed materials, it can be inferred that spaces can be interpreted in terms of lighting, color, and furniture to gain insights into their dystopian characteristics.

2.1. The Novel “Fahrenheit 451”

"Fahrenheit 451" is a dystopian novel written by Ray Bradbury first published in 1953. The novel's title is derived from the temperature at which paper ignites, which is 451 degrees Fahrenheit. The story depicts a future American society where books are banned, and firefighters are tasked with burning them. The narrative revolves around Guy Montag, one of the firefighters responsible for burning books, and it explores the question of whether it is possible to live without books. The novel depicts the world where the exteriors of houses are covered with fireproof plastic, minimizing the risk of fire, but firefighters burn books instead of extinguishing fires. The novel serves as a critique of a society where censorship, authoritarianism, and conformity take precedence over individuality and intellectual freedom.

2.2. Fahrenheit 451 Movies (1966 and 2018 Adaptions)

The fictional work was first adapted for the big screen in 1966 under the title "Fahrenheit 451" in many countries. This UK-France co-production is a dystopian science fiction movie and marks French director François Truffaut's first color and English-language film (“Fahrenheit 451 (1966 Film)”, 2023). In 2018, it was adapted for the second time under the title "Fahrenheit 451" (“Fahrenheit 451 (2018 Film)”, 2023).

3. Analysis and Findings

In the scope of the study, the spaces mentioned in the novel and films were compiled into a table, and subsequently, they are being analyzed based on parameters such as lighting, color, and furniture (Table 1).

Table 1. Spaces featured in Fahrenheit 451 novel and films

SPACES FEATURED IN FAHRENHEIT 451 NOVEL AND FILMS									
	Montag’ s House	**Fire Station**	**Clarisse's Residence**	**Downtown / Public Spaces**	**Faber's House**	**Clarisse’ s School**	**Old Lady’ s House**	**House in the Countryside**	**Their Neighbourhood**
Fahrenheit 451- Novel	✓	✓	✓	✓	✓		✓		✓
Fahrenheit 451 1966 - Film	✓	✓	✓	✓		✓	✓	✓	✓
Fahrenheit 451 2018 - Film	✓	✓	✓	✓			✓	✓	

From among these spaces compiled in table, four spaces have been selected as they are commonly mentioned in both the novel and films, and considered to provide the most significant data. These four spaces are Montag's house, the Fire Station, Clarisse's residence, and the City Center and public spaces.

3.1. Montag’s House

In this section, the house of Guy Montag, the protagonist of the dystopian narrative, is described based on its portrayal in the novel, as well as in the films “Fahrenheit 451” (1966) and “Fahrenheit 451” (2018). In the novel, Montag's house is depicted as follows:

“…It was like coming into the cold marbled room of a mausoleum after the moon had set. Complete darkness, not a hint of the silver world outside, the windows tightly shut, the chamber a tomb-world where no sound from the great city could penetrate…”

“…They sat in the hall because the parlour was so empty and greylooking without its walls lit with orange and yellow confetti and skyrockets and women in gold-mesh dresses and men in black velvet pulling one-hundred-pound rabbits from silver hats. The parlour was dead, and Mildred kept peering in at it with a blank expression as Montag paced the floor, came back, squatted down, and read a page as many as ten times, aloud…”

“…He stared at the parlour that was dead and grey as the waters of an ocean that might teem with life if they switched on the electronic sun…”

“…He took hold of a straight-backed chair and moved it slowly and steadily into the hall near the front door and climbed up on it and stood for a moment like a statue on a pedestal, his wife standing under him, waiting…”

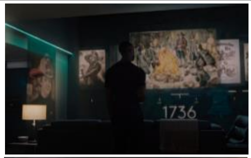
“…Not many gardens anymore to sit around in. Moreover, look at the furniture. No rocking chairs anymore. They are too comfortable… (Bradbury, 2018)”

In the novel, it can be observed that the bedroom and the living room are predominantly described. As evident from the excerpts, the home space is portrayed as cold and different from the concept of “home” today. It lacks identity and has been uniformized to keep people under control.

Although no specific lighting device is mentioned, it can be inferred that a low-level lighting environment is described. There is no information regarding the color of the lighting. The walls of the house are described as gray, indicating the presence of a cold atmosphere. Additionally, it can be said that color symbolizes situations in dystopian spaces where people are driven to despair, imposed lifelessness, and kept under control. In the interior spaces, particularly in the living rooms, the walls are composed of television screens, indicating that the only element adding color to the environment is the television.

The furniture, on the other hand, is designed with uncomfortable materials and forms that hinder people from communicating with each other, sitting down to think, and reading books. It can be observed that the furniture is not ergonomically suitable for humans. In parallel with the characteristics observed in other parameters, the furniture also plays a role in controlling people and shaping their lives in line with the atmosphere of dystopian spaces.

Table 2. Montag's house in the Fahrenheit 451 (1966) and Fahrenheit 451 (2018)

	Fahrenheit 451 (1966)	**Fahrenheit 451 (2018)**
External Facade		
Living Room	 	 
Bathroom		
Kitchen		
Bedroom		

The table above (Table 2) lists the rooms in Montag's house. Furniture, on the other hand, is designed with uncomfortable materials and forms that prevent people from communicating with each other, sitting down and thinking, and reading books. It is evident that the furniture is intentionally created to hinder these activities. The designs do not conform to human ergonomics and are meant to disrupt comfort. In line with the other parameters, furniture plays a role in shaping the atmosphere of dystopian spaces and controlling people's lives. In the 1966 film adaptation, Montag's house is depicted, including the living room, bedroom, study, kitchen, and bathroom. The walls of the residence are made up of television screens in the novel, while in the film, only one television screen is shown. The spaces in the visuals are evaluated based on parameters such as lighting, color, materials, and furniture.

Generally, regional illuminations are observed to be used in terms of lighting. It can be said that a dim environment prevails in terms of lighting level. Neutral colors are seen to be used in lighting color. Additionally, television is also used as a lighting tool.

In terms of color, it is observed that various shades of a single color dominate the walls of the house, while wood is used for furniture and flooring. In the living room, details such as coffee tables and lighting fixtures feature the use of gold color on their legs. Generally, it can be said that light colors are used in Montag's house. Partially warmer colors are used in the door windows, bathroom, and bedroom furniture. Overall, it can be inferred that light colors are used in the house, creating neutral environments.

In Montag's house, wood is encountered as a material used on the floor, kitchen cabinets, and most of the furnishings. However, the warm feeling given by wood is eliminated through the use of lighting, colors, and forms.

The use of wood stands out in the furniture, and it can be observed that the furniture, except for the bedroom and living room, is made in sizes and forms that can be considered ergonomically uncomfortable. The furniture in the living room follows the “mid-century modern” style, featuring comfortably shaped leather-covered modern furniture of that era, as described in the book. However, it is seen that the seating and backrests of the chairs are designed in a way that does not conform to the human form. Additionally, it can be interpreted that the chairs used in the living room resemble the high-backed chair designs of Charles Rennie Mackintosh. Furthermore, in the living room, a chair named “Kontur,” designed by Swedish furniture designer Alf Svensson in the 1960s, is also used. In the living room, wooden furniture is used across from the television, while in the bedroom, along with a chair similar to the Renaissance period design of the “Savonarola Chair,” a chair representing modern design examples of that era, is used as a seating unit.

There are significant differences between the 2018 film and the 1966 film in terms of the technological advancements that have emerged in the intervening time, which have impacted both architecture and cinema.

It can be said that the environment is illuminated at a deficient level, resulting in a dark atmosphere prevailing in the space. Additionally, cool colors have been preferred for light sources, and artificial lighting has been extensively used to create artificially lit spaces. LED light sources contribute to the overall cold impression of the environment. Furthermore, in the living room, the walls consist solely of television screens, serving as the primary illumination source. It can be noted that the use of natural lighting through windows, is minimal.

In the 2018 film, light colors are used on the walls and floor, while dark colors are used for the furniture. It can be said that the colors used create a cold atmosphere in the environment. Once again, the television walls serve as the source of color in the environment. Despite the use of light tones, the types of lighting and colors used contribute to the perception of a cold environment.

Contrary to what is described in the novel, the chosen furniture appears typical of everyday life. It is observed that the chairs in the living room are leather-covered, which also contributes to the cold appearance of the space.

3.2. Fire Station

The depiction of the fire station where Guy Montag and his firefighter friends work, both in the book and in the films, is analyzed in this section.

The fire station where Guy Montag and other firefighters work is generally described in the book as a place where firefighters use a beast-like machine called the "Hound," possessing certain animalistic qualities, to capture criminals and destroy books. It is mentioned that there is a kennel for the Hound and an entrance to the building. The book describes this location in the following ways:

"…The Mechanical Hound slept but did not sleep, lived but did not live in its gently humming, gently vibrating, softly illuminated kennel back in a dark corner of the firehouse…"

"…At night when things got dull, which was every night, the men slid down the brass poles, and set the ticking combinations of the olfactory system of the Hound and let loose rats in the firehouse area-way, and sometimes chickens, and sometimes cats that would have to be drowned anyway, and there would be betting to see which the Hound would seize first…"

"…Montag grabbed the brass pole with one hand. The pole, reacting, slid upward, and quietly took him through the ceiling. He stepped off in the half-lit deck of the upper level…"

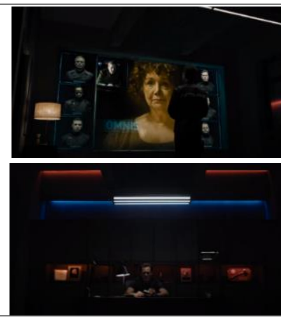
"…Montag stood, letting the fears pass, by the drop-hole. Behind him, four men at a card table under a green-lidded light in the corner glanced briefly but said nothing… (Bradbury, 2018)"

When looking at the quotes from the book, it is noteworthy that instead of ordinary architectural elements such as stairs or ramps at the building entrance, the author chose to use technologically updated versions of emergency poles used by firefighters, which can be interpreted as futuristic based on the time the book was written, in order to convey the pessimism of dystopian narratives to the reader. The brass poles, which they use as vertical circulation elements and are referred to as “chutes” in the book, have been equipped with sensor-like elements, allowing them to be used not only for exiting the building but also for entering it.

The kennel where the machine named Hound, used by firefighters as a weapon against humans, is depicted as an area illuminated with low, flickering light.

Table 3. Fire station in the Fahrenheit 451 (1966) and Fahrenheit 451 (2018)

	Fahrenheit 451 (1966)	Fahrenheit 451 (2018)
External Facade		
Circulation Elements and Common Areas	 	 

Classroom		
The Office of the Fire Chief		

As observed in the data presented in Table 3, in the 1966 film adaptation, the fire station is depicted with a red color on its exterior façade, reminiscent of fire. When transitioning to the interior, in parallel with the description in the book, a vertical circulation element in the form of a pole is used. Additionally, in the film, stairs are also included in the space, in addition to the depiction in the book.

In the film "Fahrenheit 451 (1966)," the dystopian narrative is supported by a bleak and technological atmosphere, which is reinforced through furniture, color, and lighting. It can be observed that the lighting elements used in the space are mainly focused on regional lighting. Considering that the film was shot in a studio, it can be said that there is no general lighting in the space due to the absence of a ceiling element. However, it can also be interpreted that this approach is adopted to convey the sense of dystopian gloom to the audience. In the fire chief's office, attention is drawn to the use of directionally adjustable regional lighting fixtures, commonly used in present times. Overall, with the influence of dark colors used in the architectural elements, the space has a low illumination level. However, with the arrival of an alarm, the lighting color changes to a vibrant red, conveying a sense of urgency.

In the mentioned space, it can be said that the dystopian atmosphere is created not only through lighting and color but also through the selection of furniture. The futuristic vision and the dominance of technology, characteristic of dystopias, are emphasized through the use of modern furniture. The use of wood and leather materials stands out in the furniture of the space. In the bench-style seating units placed in the corridor, it can be interpreted that Florence Knoll's bench design, which showcases the influences of Mies Van Der Rohe's Barcelona Chair, is used. In the storage and display area in the corridor, the use of glass material, commonly employed in spaces that represent futuristic visions, can be observed. In the common area of the fire station, which serves as a seating, waiting, and dining area for firefighters, chairs and wooden tables designed by Eric Buch in the 1960s are utilized.

It is observed that the storage unit used in the office is the same color as the dark gray wall.

In contrast to the film “Fahrenheit 451 (1966),” the 2018 adaptation of it utilizes more technological advancements. This can be attributed to the progress made in the fields of cinema, architecture, and technology over the intervening years. Based on Table 3, the figures in the 2018 movie show that all the technological devices used within the interior spaces are controlled through artificial intelligence. This artificial intelligence establishes authority over humans and monitors and regulates their lives.

In this film adaptation, based on the novel of the same name, it can be observed that lighting and color usage are more dominant in shaping the spaces compared to the 1966 film. This approach is used to characterize the narrative's pessimism, authority, and negativity. The spaces are generally illuminated at a low level, creating a dark atmosphere. LED light sources are predominantly used, and regional lighting is preferred. The colors, tones, and combinations of the light sources used in the interior spaces create extremely cold environments. Additionally, the circular light sources used in the corridor establish a play of light and shadow between the illuminated areas and those left in darkness. This light-shadow relationship, created due to differences in brightness levels, strengthens the spatial narrative and contributes to the atmosphere, supporting the characteristics of dystopian narratives. As described in the book, the film also features walls in some rooms consisting of televisions. These televisions serve as both light and color sources for the spaces. Furthermore, it can be observed that a single color is used on horizontal and vertical surfaces in general.

In the film “Fahrenheit 451 (2018),” it can be observed that dark colors are preferred in the selection of furniture. The use of furniture in the spaces is minimal, drawing attention to their absence. Remarkably, the storage units are discreetly placed within the room, blending with the surfaces in terms of color. Additionally, it can be noticed that the cabinets in the corridors, where the firefighters store their weapons and personal belongings, are made of black metal in a cage-like structure. This further contributes to the cold and bleak atmosphere of the dystopian setting.

3.3. Clarisse’s Residence

Clarisse is the character who changes Guy Montag's thoughts in the book “Fahrenheit 451” in the novel and the film “Fahrenheit 451 (1966),” Clarisse lives in the same neighborhood as Montag, residing in a house. However, in the film adaptation of “Fahrenheit 451 (2018),” she is depicted as staying in a dilapidated hotel-like place.

In the novel, Clarisse lives in the same neighborhood as Guy Montag, along with her mother, father, and uncle. The book only briefly mentions the exterior space and the level of illumination associated with their house.

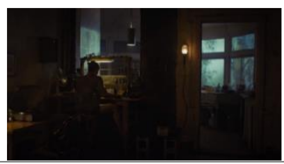
"...They walked the rest of the way in silence, hers thoughtful, his a kind of clenching and uncomfortable silence in which he shot her accusing glances. When they reached her house, all its lights were blazing...Montag had rarely seen that many house lights..."

"...Laughter blew across the moon-coloured lawn from the house of Clarisse, her father and mother, and the uncle who smiled so quietly and earnestly. Above all, their laughter was relaxed and hearty and not forced in any way, coming from the house so brightly lit this late at night while all the other houses were kept to themselves in darkness. Montag heard the voices talking, talking, talking, giving, talking, weaving, reweaving their hypnotic web..."

"...Montag's face was entirely numb and featureless; he felt his head turn like a stone carving to the dark place next door, set in its bright borders of Flowers..."

Contrary to the dark atmosphere portrayed in the dystopian setting, it can be said that Clarisse's house represents happiness, knowledge, and communication. Although there is no specific description of the interior space, it can be inferred that the light and color present in the house are not solely derived from television sources, indicating a bright atmosphere.

Table 4. Clarisse's residence in the Fahrenheit 451 (1966) and Fahrenheit 451 (2018)

	Fahrenheit 451 (1966)	Fahrenheit 451 (2018)
External Facade		
The Hidden Room (Attic) Where Clarisse Stays	 	 
Room		

Similar to the novel as seen in Table 4, Clarisse's house represents knowledge and happiness in the film. Clarisse's room is only shown in one scene, providing limited data for analysis. In the hidden room, Clarisse keeps her secret belongings. The room is depicted with gray tones and utilizes regional lighting. The use of regional lighting creates shadows that enhance the storytelling of the scene.

A rocking chair is another element seen on the stage, in addition to lighting and color. In the book, during Clarisse and Montag's conversation, there is a reference to the chairs that were eliminated to prevent people from reading books, talking, and thinking. Clarisse hides a rocking chair in the attic, reminiscent of the Bentwood Rocking Chair designed by Michael Thonet in the 1800s, displaying Art Nouveau features.

Unlike the novel Fahrenheit 451 and the film adaptation from 1966, in the 2018 film, Clarisse does not stay with her family in a house but rather in an old hotel. Therefore, it cannot be said that the place where Clarisse stays represents knowledge, happiness, and conversation in this film, as in the other works.

In the film, Clarisse stays in an old hotel located in a remote corner of the city. The entrance corridor of the hotel is dimly lit, creating a contrast between the illuminated and dark areas, thereby enhancing the storytelling through the interplay of light and shadow. Additionally, the deliberately designed low-level lighting and dominant yellow hues in the dark and staged scenes support the perception of a dystopian setting. A similar dark atmosphere is maintained upon entering the room, mirroring the corridor. Generally, localized lighting fixtures and windows are employed to allow the city lights and natural light to penetrate the interior space. In terms of color, no specific data was found in the setting that would allow for a general inference about dystopias. However, considering Clarisse's role within the dystopian narrative as a rebel against the system, someone who rejects being part of the established order, it can be inferred that she resides in spaces removed from technology, distant from city centers and society, and characterized as "old" or "outdated." The furniture in the room can be argued to serve as a symbolic representation of the various factions of people, the limitations imposed by authority, and lives shaped by circumstances in the dystopian narrative. Consequently, the belongings in Clarisse's room are notably antiquated.

3.4. Downtown and Public Spaces

In dystopian narratives, the oppression of a totalitarian society is often manifested through the architecture of the city and the organization of public spaces. In the context of Fahrenheit 451, the depiction of the city and public spaces can be described as follows:

"... No. Houses. have always been fireproof; take my word for it."

"... "I rarely watch the 'parlour walls' or go to races or Fun Parks…Have you seen the two-hundred-foot-long billboards in the country beyond town? Did you know that once billboards were only twenty feet long? But cars started rushing by so quickly they had to stretch the advertising out so it would last."

"...Across the street and down the way, the other houses stood with their flat fronts. What was it Clarisse had said one afternoon? "No front porches. My uncle says there used to be front porches. And people sat there sometimes at night, talking when they wanted to talk, rocking, and not talking when they did not want to talk. Sometimes, they just sat there and thought about things, turned things over. My uncle says the architects removed the front porches because they did not look well. But my uncle says that was merely rationalizing it; the real reason, hidden underneath, might be they did not want people sitting like that, doing nothing,

rocking, talking; that was the wrong kind of social life. People talked too much. Moreover, they had time to think. So they ran off with the porches. And the gardens, too. Not many gardens anymore to sit around in. And look at the furniture. No rocking chairs anymore. They are too comfortable. Get people up and running around…"

"…He ran steadily for six blocks in the alley, and then the alley opened out onto a wide empty thoroughfare ten lanes wide. It seemed like a boatless river frozen there in the raw light of the high white arc lamps; he felt you could drown trying to cross it; it was too wide and open. It was a vast stage without scenery, inviting him to run across, easily seen in the blazing illumination, easily caught, easily shot down."

"…And here was the gas station, its attendants busy now with customers. Approaching from the rear, Montag entered the men's washroom. Through the aluminium wall, he heard a radio voice saying, "War has been declared." (Bradbury, 2018)"

From the descriptions in the book, it is evident that the exteriors of the houses are covered with fire-resistant plastics, and gardens and various furniture are banned to prevent people from interacting, sitting down to read books, and thinking. In addition to these circumstances, it can be inferred that despite the city's wide roads, tall buildings, and high lighting levels, a prevailing sense of darkness pervades the entire city.

From the descriptions of the parks in the city, no specific data could be found that would allow for inferences about elements of dystopian narratives. However, it can be stated that in shared spaces, there is a utilization of lighting, technology, furniture, and materials that contribute to a sense of pessimism. The downtown and public spaces in the two films are in the table below (Table 5).

Table 5. Downtown and public spaces in the Fahrenheit 451 (1966) and Fahrenheit 451 (2018)

	Fahrenheit 451 (1966)	**Fahrenheit 451 (2018)**
City Center	 	 
Restaurant-Entertainment Area		

In the 1966 film adaptation, it is evident that the city center features low-rise buildings. These buildings have been uniformly painted in the same color, reflecting the monotony and uniformity of the dystopian narrative. Additionally, urban furniture has been placed in the city center as a part of the fictional setting, serving the purpose of reporting individuals who are reading books.

In shared spaces such as restaurants, it can be observed that wooden materials are predominantly used for interior design. Similarly to the overall aesthetic of the film, localized lighting is employed in these spaces as well. In terms of technology, no significant use of advanced technological elements is depicted in the film, considering the technologies available during that time.

In the 2018 film adaptation of Fahrenheit 451, it is depicted that the facades of buildings in the city center are covered with screens, much like the interior spaces of homes. Live broadcasts are continuously aired, showcasing people's reactions. Holographic technologies are used to create statues in the city center, while advertising billboards consist of screens. This aspect highlights the influence of the powerful entity in shaping people's lives and becomes a contributing element to the vivid darkness of the dystopian narrative.

Correspondingly, in the space serving as both a dining and entertainment venue, cold colors are used, creating a technological atmosphere with the use of LED lighting. Despite the multitude of lighting devices and methods employed, the overall lighting level is low, contributing to creating a cold environment, further enhanced by the chosen lighting color. Additionally, neon lights are incorporated as part of the design, emphasizing slogans that underscore the control of the management over the people.

The furniture in the environment includes a bar counter, bar stools, and seating units. Furthermore, virtual reality goggles are placed in the space to prevent interpersonal communication. The design also transforms the bar counter and seating units into light sources, and linear localized lighting fixtures are installed for each seating unit, emitting cold-colored light.

4. Discussion and Conclusion

Works presented in the dystopian genre are speculative narratives that reflect how the future might be shaped in an unknown time, utilizing existing or anticipated possibilities parallel to the advancement of technology. Dystopian works, classified within the science fiction genre, incorporate elements such as architecture, interior design, furniture, color, and more, all contributing to the atmospheric portrayal of the fictional world. In this context, the settings and requirements of the narrative, such as urban designs, architectural structures, interior spaces, furniture, and various elements, constitute essential components of these narratives (Yararel Doğan et al., 2022).

When described as the process of shaping and designing a society's physical environment, architecture in a dystopian world can be seen as a reflection of the society's values, ideologies, and conditions. Furthermore, within the concept of dystopia, architecture provides significant clues about how society and the world are shaped, serving as a manifestation of the atmosphere and social structure of the dystopian world. The primary framework utilized by dystopian narratives, which critically analyze current events while envisioning scenarios for the future, is the spaces in which human lives unfold (Günal, 2015). In dystopian narratives, architectural spaces play a crucial role in conveying the pessimism, darkness, and negativity inherent in dystopias to the readers or viewers. To put it differently, dystopias can be seen as a spatial representation of the criticism directed towards systems (Günal, 2015).

This study aimed to explore the role of architecture in dystopia through an analysis of color, furniture, and lighting, focusing on the novel Fahrenheit 451 and its film adaptations. In Fahrenheit 451, the spatial elements are crafted with futuristic predictions considered advanced for the time it was written. In the depicted spaces of the novel, the use of lighting, color, and furniture stands out to reflect the dark and negative atmosphere. Due to the novel's premise, where reading books is forbidden and people cannot communicate with each other, the use of furniture is designed to hinder comfortable sitting in all spaces except for the ones where television is watched or in the firehouse. The presence of cold colors is emphasized within the interior spaces, and it is noted that the only source of color in the environment is the television screens covering the walls. This portrayal can be interpreted metaphorically as the architectural reflection of the dystopian narrative, where the only color and element in people's lives is the television. Additionally, the urban furniture is also shaped in parallel with the dystopian narrative, adapted to the new habits of the people. Within this framework, Tong's (2004) viewpoint asserting that urban architecture in dystopian settings functions as a means to imagine future lifestyles and translate contemporary societal, ethical, ideological, and scientific principles into the realm of human existence can be considered supportive evidence (Tong, 2004).

In the 1966 film adaptation of Fahrenheit 451, it is noteworthy that famous and iconic furniture designs from the time of the film's production, as well as furniture from the Renaissance period and the 1800s, are used. Montag's house, the firehouse, the city center, and public spaces adopt a futuristic approach that emphasizes the totalitarianism, discipline, and societal norms of the dystopia. Considering the conditions of the era in which the film was made, more technologically advanced devices, modern-classic furniture, low-level localized lighting, and metallic-cold colors and glass materials frequently used in future predictions are employed. In contrast, reflecting the representation of light, knowledge, and tranquility, Clarisse and her family's house, as depicted in the novel, is portrayed in the 1966 film adaptation with ancient furniture in Clarisse's secret room. This use of architecture can serve as an example of addressing social discrimination or class distinctions in dystopian narratives. In summary, within the context of dystopian narratives, the spaces where people spend most of their lives transform into artificial and disconcerting environments (Yararel Doğan et al., 2022).

In dystopian narratives, color and lighting play a vital role in establishing the desired atmosphere. The selection of colors within a setting is essential in shaping its overall ambiance. Different hues can evoke a range of emotions, such as warmth, coldness, intimacy, or comfort. Monochromatic colors can convey a sense of uniformity, abstraction, and spatial cohesion when applied consistently across ceilings, walls, and floors. (Manav, 2011). In the 2018 film adaptation of "Fahrenheit 451," the dystopian atmosphere is predominantly conveyed through color, lighting, and technological devices. The environments are characterized by low-level lighting, cold colors, and color combinations, creating a dark atmosphere. Additionally, incorporating artificial intelligence in the narrative enhances the dystopian nature and amplifies the sense of soullessness in the spaces. The use of low lighting levels and localized lighting creates contrasts within the areas and strengthens the narrative through light-shadow relationships. Dark colors are used in the furniture and surfaces of the interiors, with storage elements predominantly embedded into the space. In contrast, the color of the space is provided by the televisions and lighting that constitute the walls of the space. Taking advantage of technological advancements in line with the film's context, more technologically advanced devices are utilized compared to the book and the 1966 film adaptation.

In conclusion, it can be inferred that in Fahrenheit 451, both in the novel and the films, existing furniture is selected. At the same time, lighting and color elements are used to contribute to the dystopian atmosphere. In the context of Fahrenheit 451, architectural elements are employed to shape societal habits, control and oppress individuals and represent class distinctions. Cities, public spaces, and places where people spend time individually or collectively are carefully organized by authorities. Parks and open areas are limited in size, and tightly regulated with strict rules and surveillance systems. These spaces lack nature and are dominated by artificial elements. Their priority is functionality and conformity rather than providing spaces for leisure, relaxation, or personal activities. Overall, the depiction of the city and public spaces in Fahrenheit 451 reflects the dehumanizing effects of a totalitarian regime. The architecture and organization of these spaces reinforce the purpose of controlling and suppressing individuality, creativity, and free thought within the dystopia.

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The Effects of Major Earthquakes on Cities in Türkiye, A Comparative Evaluation from Urban Planning Perspective

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1. Introduction

Earthquakes occur as a result of the rupture of fault lines on the Earth's surface. Throughout history, numerous destructive earthquakes have occurred in Türkiye and its region due to the rupture of fault lines. These earthquakes have led to the loss of thousands of lives. When disasters in Türkiye's history are examined, it is observed that the most impactful and deadliest type of disaster affecting cities is earthquakes. This situation stems from Türkiye's location within one of the most active seismic belts, the Alp-Himalayan seismic belt (Şenol, 2020; Bahadır & Uçku, 2018).

In Türkiye, there are primarily two significant fault zones. The first one is the North Anatolian Fault (NAF), which starts from the Saros Gulf and stretches through the Marmara Sea, İzmit, Düzce, Bolu, Merzifon, Suluova, Erbaa, Niksar, and Kelkit Valley, reaching as far as Varto (Muş). The second is the East Anatolian Fault (EAF), which originates from the country's southern region, passes through the Red Sea and Lake Lut, enters the country at Antakya, goes through Kahramanmaraş, Pazarcık, Lake Hazar, and Bingöl, and eventually merges with the North Anatolian Fault in Varto. Additionally, in the Aegean region, there are east-west trending grabens, and in Eastern Anatolia, there are numerous faults around Lake Van, Erzurum, Malazgirt, Pasinler, and Horasan (Şenol, 2020). These fault zones, which are among the most active seismic belts in the world, account for 93% of Türkiye's territory being within earthquake-prone areas. As a result, many industrial facilities, dams, residential areas, large-scale power plants, and other structures have been established in high-risk earthquake zones throughout Türkiye (Altun, 2018; Genç, 2007).

Over time, cities have had to be rebuilt or relocated due to both natural and human-made reasons they encounter. Throughout Türkiye's history, some settlements have been destroyed and others have been displaced due to devastating earthquakes. As a result, settlements that were destroyed by earthquakes have been abandoned, and new ones have been established in different locations. This transformation has led to spatial and demographic changes in the cities, causing them to evolve in various ways (Şenol, 2020).

As a result of cities being exposed to destructive earthquakes, various damages occur in terms of spatial, economic, and socio-cultural aspects both during and after the earthquake. Despite continuous reevaluation through modern technologies and academic and institutional efforts focused on earthquakes, these endeavors have not reached a sufficient level. In Türkiye, most recently, the earthquake on February 6th affected 11 provinces and stands out as one of the most significant earthquakes in the country's history. Despite the ongoing academic and institutional efforts, the impact of earthquakes remains a challenging issue to address comprehensively (Şenol, 2020).

Within the scope of this study, a comprehensive assessment will be conducted based on the most recent 7 destructive earthquakes in Turkish history. The identification of the destructive damages that occurred after each earthquake, the changes in legal processes related to these damages, and the state of urban planning processes will be evaluated. The significance of addressing the holistic structure of urban planning from a macro-scale to a micro-scale perspective, particularly in the context of earthquakes, will be discussed. The literature examined within this scope emphasizes the necessity of taking precautionary measures in areas with high earthquake risk before an earthquake occurs. The impact of evaluations and efforts conducted after each earthquake on the subsequent earthquake will be comparatively assessed.

2. Method

In Türkiye, numerous institutional and private studies and publications have been conducted on the subject of earthquakes up to the present day. However, these studies have primarily focused on the distribution of faults, earthquake-prone areas, geological structures, earthquake magnitude, depth, intensity, and technical aspects such as building damage assessment. On the other hand, the holistic nature of urban settlements has often been overlooked.

In this study, earthquakes that have occurred in Türkiye from 1927 to the present day have been examined. Destructive earthquakes have been addressed in terms of their impact on urban and demographic structures, as well as the reorganization of resettlement areas after earthquakes. The analysis has specifically focused on the most recent 7 earthquakes. A comprehensive review of the literature has been conducted, compiling studies conducted on each earthquake, and a comparative analysis has been performed based on the information obtained. The challenges of the study included gaining direct access to recorded information on the years of occurrence of earthquakes and the diversity of academic studies in various fields. The analysis results in a discussion of the effects of earthquakes in Türkiye from an urban planning perspective.

3. Major Earthquakes and Their Destructive Effects on Cities

In the 20th century, there were 152 major earthquakes in Türkiye that resulted in destructive outcomes. These earthquakes led to approximately 92,000 casualties and 550,000 severely damaged structures. Throughout the course of time up to the present day, significant earthquakes causing substantial losses have occurred. As examples of these earthquakes, recent ones include the 1992 Erzincan earthquake, the 1999 Gölcük earthquake, the 1999 Düzce earthquake, the 2011 Van earthquake, the 2020 Elazığ earthquake, the 2020 Izmir earthquake, and the 2023 earthquakes in Kahramanmaraş and its surrounding areas (Table 1) (Genç, 2007; Güner, 2020; AFAD, 2023).

Table 1. Destructive earthquakes covered in the study

Date	Time	Location	Losses	Magnitude
February 6, 2023	13:24	Elbistan, Kahramanmaraş Pazarcık, Kahramanmaraş	59.259 (all) 50.783 (Türkiye) 8.476 (Syria)	7.5/ 7.6 7.8/7.7
October 30, 2020	14:51	Aegean Sea, İzmir	119 (all) 117 (Türkiye) 2 (Greece)	6.9/ 7.0
January 24, 2020	20.55	Sivrice, Elazığ	41	6.8
October 23, 2011	13:41	Edremit, Van	644	7.2
November 12, 1999	18:57	Düzce	894	7.5
August 17, 1999	03.02	Gölcük, Kocaeli	17.118	7.8
March 13, 1992	19.08	Erzincan	653	6.8

Cities are residential areas that started with the settled life of humanity (Tuğluer & Çakır, 2019; 2021). Natural disasters that affect our environment and cities lead to adverse consequences. As previously mentioned, the most destructive disasters in Türkiye are earthquakes. Cities should prepare for earthquakes or potential disasters they might face. In order for cities to be resilient to disasters, planning processes need to be established that encompass decisions within the city's physical environment and spatial design before a disaster strikes. During the planning phase, identifying earthquake risks and addressing necessary measures comprehensively enhances the city's and society's capacity to adapt, allowing them to sustain crucial functions (Uzuner & Akıncıtürk; 2020).

In this context, the main factors contributing to the increase in earthquake damages in cities can be summarized as follows: the physical magnitude of the earthquake, the distance of the earthquake from settlement areas, the geological structure of the ground, the quality of buildings, the national income level (poverty and underdevelopment), rapid population growth, rapid and unregulated urbanization and industrialization in high-risk areas, lack of knowledge and education, and the preventive measures taken by the community before an earthquake (Taş, 2003). Earthquakes and the damages they cause in settlements located on fault lines not only affect those specific areas but also extend to their surrounding regions and, in different circumstances over time, can impact the entire country (Taş, 2003).

Other factors that contribute to the increased destructive impact of earthquakes in Türkiye include rapid urbanization since the 1950s, the emergence of unplanned residential areas, informal housing problems, inadequate and unplanned infrastructure, and poor location choices for major investments, among other shortcomings in urban development. Additionally, major cities in Türkiye are located in the first and second-degree earthquake zones. As a result, societal insensitivity to the destructive effects of earthquakes and inadequate measures in laws and regulations play a significant role in this process. For instance, the earthquakes that occurred in and around the Marmara region on August 17 and November 12 emerged as the first major earthquakes experienced in Türkiye's densely populated urban areas. These earthquakes signaled the potential for more significant disasters on this issue. Moreover, besides urban problems, various deficiencies have been revealed from a legal and administrative perspective. The lack of effective disaster management specifically for earthquakes has become evident (Taş, Payan & Elmacı, 2000).

3.1. March 13, 1992 Erzincan Earthquake

Erzincan, being situated on the Erzincan Fault, a segment of the North Anatolian Fault, and located in a valley, has historically experienced numerous earthquakes (Figure 1). In 1992, an earthquake centered in Erzincan resulted in a total of 653 fatalities. The earthquake caused 5,093 buildings to collapse or sustain severe damage, while 6,480 buildings were moderately damaged (Şenol, 2020; Şengün, 2019).

Figure 1. Urban Environment View of the March 13, 1992 Erzincan Earthquake, (URL-1)

Erzincan, situated in an alluvial plain, became one of the significant cities of Eastern Anatolia after resettling in its current location following the 1939 earthquake. The city is laid out on main streets intersecting at right angles. Historically, it doesn't possess a rich accumulation. Geologically, the area where the city is situated rests upon a deep alluvial layer forming the plain. (March 13, 1992 Erzincan Earthquake Engineering Report, 1992) Through scientific studies conducted in this region, it has been determined that there are several active fault systems to the south of the plain as well. (March 13, 1992 Erzincan Earthquake Engineering Report, 1992; Şengün, 2019). Erzincan has rapidly developed since 1939. However, numerous issues emerged in the city after the 1992 earthquake. Migration, unemployment, and production loss problems arose, and existing legal regulations couldn't provide effective solutions. The fact that the earthquake affected Erzincan's urban area and the reconstruction of collapsed buildings following the implementation of earthquake regulations holds a distinct significance. This not only tested the application but also revealed a separate engineering research field concerning urban structures. (Şengün, 2019)

In the aftermath of the 1992 Erzincan Earthquake, the legal, spatial, and structural solutions that were introduced were rapidly implemented. Despite the risks posed by tall buildings during earthquakes, the implementation of floor limitations contributed to making the city safer than before the earthquake (Genç, 2007). Additionally, within a short period of one year, the Ministry of Public Works and Settlement reconstructed 5,000 housing units, repaired and strengthened around 5,000 moderately damaged residential units, as well as damaged public buildings. The reinforcement and repair of moderately damaged buildings following the Erzincan Earthquake stand as a significant innovation and a turning point in Türkiye's post-disaster reconstruction efforts, warranting its recognition (Şengün, 2019).

After the Erzincan earthquake, for the first time in Türkiye (Genç, 2007; Şengün, 2019):

• Detailed geotechnical studies were conducted to enhance earthquake safety when selecting new settlement locations and preparing settlement plans.

• A special law was enacted to promote the social and economic development of the earthquake-affected region. (Law No. 3838 on the Execution of Services Regarding the Earthquake Disaster Occurred in Erzincan, Gümüşhane, and Tunceli Provinces and the Damage and Destruction Occurred in Şırnak and Çukurca).

• Building safety in the earthquake zone was significantly increased and controlled.

• State-of-the-art earthquake-resistant construction and inspection technologies were introduced to the region for the first time.

• An intensive repair and strengthening program were implemented for moderately damaged buildings, involving authorities from Istanbul Technical University, Middle East Technical University, and Boğaziçi University.

3.2. August 17, 1999 Marmara Earthquake

One of the largest and still-felt disasters in Türkiye is the 1999 Gölcük and Düzce earthquakes. The Marmara earthquake, which occurred on August 17, 1999, with a magnitude of 7.4 (Gölcük-Kocaeli), affected the provinces of Bolu, Bursa, Düzce, Eskişehir, Istanbul, Kocaeli, Sakarya, Yalova, and Zonguldak, where a total of 14.5 million people resided (Figure 2). The epicenter of the earthquake was approximately 120 km away from Istanbul. In this event, 981 lives were lost in Istanbul, and around 4,000 buildings suffered severe damage across the province (Güner, 2020).

Figure 2. Urban Environment View of the August 17, 1999 Marmara Earthquake, (URL-2)

In this highly impactful disaster, official records indicate that 17,480 people lost their lives, and 73,342 buildings became unusable. Additionally, due to the inability to reach many individuals during the earthquake, there are varying opinions regarding the exact number of casualties. The earthquake, which was also felt in neighboring provinces, resulted in a significant loss of life. At the provincial level, the highest casualties occurred in Kocaeli with 9,477, followed by Sakarya with 3,891 and Yalova with 2,504 casualties. As the distance from the epicenter increased, the impact of the earthquake diminished, leading to a decrease in the number of fatalities. Apart from these figures, 981 lives were lost in Istanbul, 270 in Bolu, 268 in Bursa, 86 in Eskişehir, and 3 in Zonguldak (Şenol, 2020; Çetin, Kara, Ceren & Correia, 2020). Furthermore, prior to the earthquake, a census revealed that the population, which was 65,000 in the year 1990, had risen to 76,855 by 1997. However, after the earthquake (in the year 2000), the central population decreased to 55,790. The rapid decline of over 20,000 people in a short period is attributed to the impact of the earthquake.

In the aftermath of the earthquake, the assessment of damages in the most affected areas, including Kocaeli, Adapazarı, Düzce, and Yalova, led to investigations into the underlying causes of the damage, considering factors such as the ground conditions and settlement characteristics, resulting in the identification of risk situations. Efforts were then directed towards mitigating these risks. It is observed that in Kocaeli, Adapazarı, and Düzce, the urban centers remained in the same locations after the earthquake, while safe and stable areas were identified in the vicinity based on geological studies, and urban development was oriented towards these safer directions (Genç, 2007; Güner, 2020). In municipalities that adopted the strategy of directing the city towards safer areas, the existing urban centers were renewed in their original locations. Furthermore, when selecting locations for permanent housing areas after the earthquake, these identified development areas were taken into consideration. As part of this strategy, permanent housing complexes were established alongside relocating or constructing certain public service buildings, such as governor's offices, military offices, and hospitals, in these safer zones. This approach aimed to redirect urban development by establishing new infrastructure facilities in these areas (Genç, 2007).

The earthquake served as a turning point in the housing development of Gölcük. The rapid industrialization along the coastal areas of the district, coupled with population growth, led to the rapid expansion of the urban fabric and the opening up of areas with high earthquake risk for development. Prior to the earthquake, the presence of industrial and military facilities on the coast of Gölcük and the scenic factor were prioritized in residents' housing choices. However, the fear generated by the destruction and loss of life following the earthquake shifted the focus of the local population towards the southern city perimeters, which have more stable ground and are rich in green spaces and natural resources (Uzuner & Akıncıtürk, 2020). Furthermore, in Gölcük, where the physical structure was severely disrupted by the earthquake, the immediate housing needs that arose during the emergency relief phase led to the establishment of emergency shelters (tents) in vacant designated areas. As tents only provided short-term shelter, they were gradually replaced by temporary housing units such as prefabricated or container-type dwellings to address the ongoing housing demand (Uzuner & Akıncıtürk, 2020).

3.3. 12 November 1999 Düzce Earthquake

The earthquake occurred on November 12, 1999, with its epicenter located in Düzce. The earthquake had a magnitude of 7.5 and resulted in fewer casualties and less property damage compared to the Gölcük earthquake. In total, 763 people lost their lives, and 35,519 buildings were damaged in the earthquake (Figure 3). According to population data before (1990) and after (2000) the earthquake, the population of the city center of Düzce, which was 62,606 in 1990, decreased to 56,649. The impact of the earthquake led to a significant outmigration from the city, surpassing the number of casualties (Şenol, 2020).

Figure 3. Urban Environment View of the Düzce Earthquake on November 12 (URL-3)

The most significant structural damages during the earthquake occurred in the town center of Düzce and the village of Kaynaşlı. Despite the surface rupture passing through the middle of the Darıyeri-Hasanbey village, very significant structural damages were not observed there (Erdoğan et al., 2004). The main factor contributing to structural damages in Düzce and Kaynaşlı, in particular, has been identified as the construction of multi-story and poor-quality buildings. In specific cases, the number of floors had been increased to more than six stories through additional construction, which resulted in economic losses on a national scale (Erdoğan et al., 2004). Liquefaction, which was particularly observed in Adapazarı during the August 17, 1999 earthquake, was not observed in Kaynaşlı during this earthquake, and in Düzce, it could only be inferred from a few points where buildings sank into the ground. One of the major urban areas affected by the earthquake was Bolu city center, especially in the southern neighborhoods (imo.org, 1999). Risk assessment maps were prepared for determining new settlement areas in Düzce. Alternative green spaces were attempted to be identified. Furthermore, the Ministry of Public Works and Settlement categorized the city's geological and geotechnical conditions into three groups: unsuitable areas for settlement, areas of significant development potential, and suitable settlement areas in a study that highlighted the city's ground conditions (Genç, 2007).

3.4. 23 October 2011 Van Earthquake

On October 23, 2011, a 7.2 magnitude earthquake centered in Van resulted in a total of 644 casualties and the destruction of 2301 structures. The main causes of damage were attributed to ground effects, poor-quality materials, and design errors (Figure 4). One of Van's central districts, İpekyolu, suffered significant damages during the earthquake (Güner, 2020). Despite the earthquake's epicenter being close to Van, the most severe damage occurred in the district of Erçiş to the north of Lake Van. This earthquake led to more than 30% of the building stock in Erçiş, which consists of over 43,000 buildings, being severely damaged and rendered uninhabitable. The number of habitable buildings did not exceed 25% of the total building stock (Görüm, 2016).

Apart from the direct damages it caused, the earthquake also triggered various types of landslides in its vicinity (Görüm, 2016).

Figure 4. Urban Environment View of the Van Earthquake on October 23, 2011 (Bedirhanoğlu & Önal, 2011)

Following the earthquake, various factors contributing to the damage in buildings have been identified, including issues with material quality, inappropriate aggregate and concrete mixtures, short columns, strong beam-weak column configurations, reinforcement corrosion, insufficient stirrup spacing and connection, connection problems, labor errors, and deficiencies in the 1975 Turkish earthquake code and earlier regulations (Bikçe, 2017). Through assessments conducted on collapsed and heavily damaged buildings, it has been revealed that errors in the design of the load-bearing systems were among the primary factors leading to the damage (Bedirhanoğlu & Önal, 2011). In the aftermath of the Van earthquake, efforts to mitigate the impact of landslides in the vicinity of the earthquake center resulted in an extended period of disaster response. During this period, significant population movements were observed in the affected areas.

3.5. January 2020 Elazığ Earthquake

On January 24, 2020, a magnitude 6.8 earthquake with its epicenter in the Sivrice district of Elazığ resulted in a total of 41 casualties in the provinces of Elazığ and Malatya (Şekil 5.). The earthquake left thousands of people homeless in its aftermath (Şıkoğlu & İnce Güvenay, 2020). In Elazığ, a total of 8,519 rural and urban structures were either destroyed or suffered severe damage, while in Malatya, this number was 3,795, totaling 12,314 structures (Güner, 2020). The structural causes of building damage in urban areas during the earthquake include weak floor formation, inadequate use of reinforcement, construction and material errors, lack of supervision, poor-quality concrete usage, and architectural design and load-bearing system configurations not being suitable for earthquake effects (Güner, 2020).

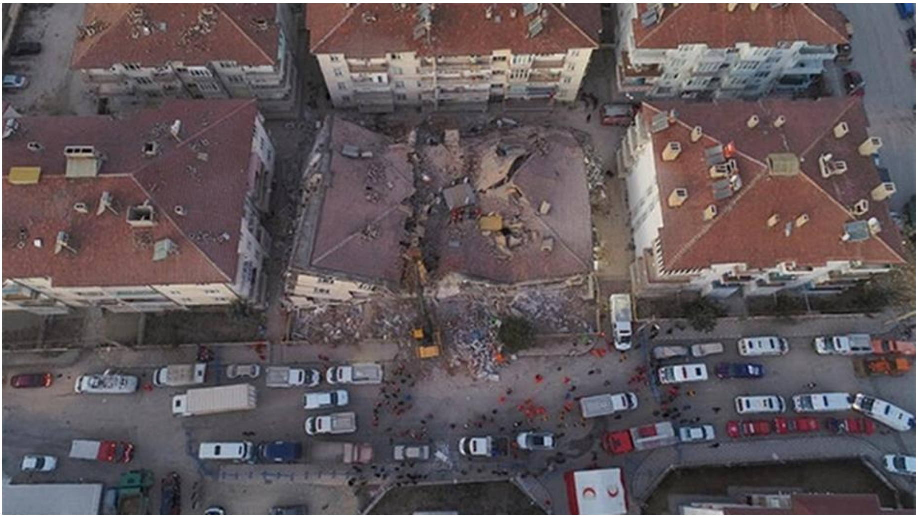

Figure 5. Urban Environment View of the Elazığ Earthquake on January 23, 2020 (URL-4)

The earthquake, especially in Elazığ, has caused significant urban destruction. The most damage occurred in the Mustafapaşa, Abdullahpaşa, and Sürsürü neighborhoods. In these three neighborhoods, which were previously characterized by predominantly one or two-story adobe houses, concrete construction began in the late 1980s (Güner, 2020). Buildings constructed before the update of the earthquake regulations suffered severe damage, whereas those built afterwards experienced less damage. Additionally, it was observed that the collapsed structures were situated on alluvial soil. About 13% of the buildings in Elazığ city center were found to be either collapsed, in urgent need of demolition, severely damaged, or moderately damaged. The number of individuals directly affected by the earthquake is approximately 47,800, which means that around 13% of the total population has been adversely impacted by the earthquake (Şıkoğlu & İnce Güvenay, 2020). People who couldn't stay in collapsed or severely damaged homes started spending the winter in tents or containers. Due to this temporary situation, housing demand gradually increased over time. In Elazığ, the housing stock was insufficient to meet such demand, resulting in a rapid increase in rental and sale prices of houses. Besides the adverse effects of the destruction in housing areas, the damage to structures registered as commercial establishments has also harmed the local economy, exacerbating the impact of the earthquake (Ökde & Ekinci, 2022).

3.6. 30 October 2020 İzmir Earthquake

On October 12, 2020, a magnitude 7.0 earthquake with its epicenter in the Aegean Sea near İzmir resulted in the loss of 115 lives and injuries to 1034 individuals (Figure 6). Due to the earthquake, 16 buildings were completely demolished. The Ministry of Environment and Urbanization conducted damage assessment studies, covering a total of 109,900 buildings. According to these assessments, the number of severely damaged buildings that need to be demolished immediately is 506, while the number of slightly damaged buildings is 5119, and the number of moderately damaged buildings is 511.

Figure 6. Urban Environment View of the İzmir Earthquake on October 30, 2020 (URL-5)

During the earthquake, the most significant structural damage occurred in the Bornova and Bayraklı districts, located at distances of approximately 65-70 kilometers from the epicenter of the earthquake. The primary geological cause of the observed structural damage is the ground amplification effect (Kürçer, Elmaci & Kayadibi, 2021; Bilgili & Aktaş, 2022). Furthermore, the greatest damage to settlements during the earthquake occurred in alluvial soils characterized by weak engineering features (Yılmaz & Şengöçmen Geçkin, 2021). Many of the buildings that collapsed or suffered severe damage in the Bayraklı and Bornova districts were situated on floodplains and delta sediments of rivers draining into the İzmir Bay. Other contributing factors to the structural damage include inadequate construction quality and post-construction usage errors. Moreover, following the earthquake, tsunamis occurred to the north at Sığacık Bay (Seferihisar) and to the south at Sisam Island. In Sığacık Bay, the horizontal distance of the tsunami waves' inland advancement was estimated to be approximately 200-250 meters (Kürçer, Elmaci & Kayadibi, 2021).

The four primary factors causing structural damage in earthquakes are: active faults generating earthquakes and local ground conditions, characteristics of the structural system, quality of materials and workmanship, and the building inspection process. Regional geology and topographic conditions of the ground influence ground conditions, and these variations can significantly alter the characteristics of earthquake waves, leading to varying levels of damage in similar structures exposed to the same seismic motion in nearby regions. This phenomenon was observed in the Bayraklı and Karşıyaka settlements. The collapse and damage of buildings during the earthquake were primarily attributed to deviations from the seismic design principles of the structural system as stipulated by earthquake regulations, as well as the quality of materials and workmanship. Furthermore, one of the major contributing factors to the widespread damage was the inadequacy of building designs to accommodate the specific ground conditions (Yılmaz & Şengöçmen Geçkin, 2021).

3.7. February 6, 2023 Kahramanmaraş and Surroundings Earthquakes

According to the data from Kandilli Observatory and Earthquake Research Institute, on February 6, 2023, a seismic event of magnitude 7.7 occurred in Sofalaca-Şehitkamil-Gaziantep at 04:17 local time. Additionally, on the same day at 13:24, another earthquake with a magnitude of 7.6 was experienced, centered in Ekinözü-Kahramanmaraş (Figure 7) (TMMOB Chamber of Architects, 2023). The series of earthquakes in Kahramanmaraş and its vicinity, characterized by an exceptional intensity and magnitude, has caused unprecedented destruction in the region, making them the largest earthquakes in Türkiye's history. These devastating earthquakes were strongly felt in the provinces of Kahramanmaraş, Hatay, Adıyaman, Malatya, Kilis, Gaziantep, Adana, Osmaniye, Şanlıurfa, Diyarbakır, and Elazığ (Ünlügenç, Akıncı & Öçgün, 2023). The earthquake sequence resulted in significant loss of life and property. The destructive effects of the earthquakes have impacted 11 different provinces, covering approximately 16% of the country's total area, with varying degrees of severity (Işık, Avcil & Büyüksaraç, 2023). During the day of the earthquakes and the subsequent few days, more than 9,000 aftershocks occurred. Within this period, five fault segments along the Eastern Anatolian Fault were ruptured (Ünlügenç, Akıncı & Öçgün, 2023).

Figure 7. Urban Environment View of the February 6, 2023 Kahramanmaraş and Surroundings Earthquakes (URL-6)

Two major earthquakes occurred in close succession with their epicenters in Kahramanmaraş (Pazarcık and Elbistan). The province most significantly affected by this earthquake pair is Hatay. Structures with diverse structural systems in Hatay suffered damage at varying levels. The short time interval between these dual earthquakes has adversely influenced the extent of damage. Moreover, numerous buildings have either partially or entirely collapsed (Işık, Avcil & Büyüksaraç, 2023). The first three provinces to experience substantial losses due to this earthquake pair were Kahramanmaraş, Hatay, and Adıyaman. In addition to these provinces, significant human and property losses were recorded in Malatya, Diyarbakır, Şanlıurfa, Elazığ, Gaziantep, Kilis, Osmaniye, and Adana. Particularly in Malatya and Elazığ, the two provinces most affected by the 2020 Sivrice-Elazığ earthquake and still grappling with its aftermath, various types of structural systems exhibited different levels of damage, including collapse, severe damage, moderate damage, and minor damage (Işık, Avcil & Büyüksaraç, 2023).

According to the report by the Union of Chambers of Turkish Engineers and Architects (TMMOB) in 2023, observations and evaluations regarding damaged and collapsed buildings in urban centers indicate that the following practices and decisions have had an impact on the causes of structural damage and collapses:

• Urban planning and zoning revisions carried out without consideration of disaster data,

• Encouragement of illegal construction through zoning amnesties, non-compliant project and implementation practices, and unauthorized structures,

• Conversion of agricultural lands and low-bearing capacity soils into construction areas,

• Exclusion of qualified architectural, engineering, and planning services from the building production and inspection process,

• Inadequacy of technical personnel and lack of oversight in professional expertise areas,

• Failure to establish the structure-soil relationship and construction on soils unsuitable for the load of the building,

• Compromising the soil-structure relationship by increasing the building load with high-rise structures,

• Soil liquefaction,

• Damage resulting from improper foundation selection,

• Implementation of architectural and structural designs that do not consider seismic loads,

• Faulty material selection, workmanship, and practices,

• Low concrete quality,

• Use of flat reinforcement and insufficient number of reinforcements,

• Use of asbestosis and beamless slabs without taking necessary precautions,

• Damage resulting from interventions during the usage phase of the building,

• Alterations made to the ground and first floors of buildings for commercial functions (such as markets, galleries, offices, etc.), leading to the formation of soft-story and short-column effects due to wide openings, mezzanine floors, and varying floor heights,

• Hammering effect due to the lack of necessary adjustments in adjacent building arrangements.

In Adana, 11 buildings collapsed, resulting in 408 fatalities. In Osmaniye, 326 structures were demolished, and more than 877 individuals lost their lives. In Gaziantep, 28 buildings were destroyed, with casualties exceeding 400 people. Malatya witnessed the collapse of 1154 buildings and a loss of 1300 lives. In Diyarbakır, 7 buildings crumbled, leading to 409 fatalities. In other provinces as well, the earthquake's destructive impact and loss of life were significantly high. Both urban and rural settlements suffered extensive devastating damage (TMMOB Chamber of Architects, 2023).

The region is located in the first-degree earthquake zone according to Türkiye's seismic hazard map. From a geological and geotechnical perspective, including historical value-rich cities, they have developed in risk-prone areas with unstable ground (Korkmaz, 2006). The process of determining structural damage has not yet been officially provided in a clear manner, given the extent of the earthquake's coverage. Academic studies on the earthquake are still ongoing.

4. Comparative Evaluation

As previously mentioned, Türkiye is a country with the most intense seismic activity within the first and second earthquake zones due to its soil characteristics. In these conditions, earthquakes have a destructive impact. This general destructive impact, according to literature research, can be attributed to inadequate legal regulations, deficiencies/shortcomings in urban planning, negligence in construction, and insufficient oversight. Research conducted in relation to Türkiye's last seven destructive earthquakes indicates that similar problems are encountered after each earthquake, leading to the formulation of certain regulations and solution processes, albeit at an insufficient level. Especially in the years around 2020 and between the years 2020 and 2023, it can be observed that no assessment, precaution, or measures were taken in the short term, despite the occurrence of significant earthquakes. This situation highlights the inadequacy of Türkiye's efforts in terms of earthquake analysis, studies, scientific research, and similar

In terms of the scope of the study, the environmental, economic, and spatial impacts of the 7 earthquakes analyzed have hindered both the regional and local development in the aftermath of the earthquakes, based on their respective locations and affected areas. When compared in terms of their general characteristics, the destructive effects of the earthquakes have led to significant loss of life, destruction of urban settlements, and substantial spatial damage, impeding both the region and local development (Table 2). Additionally, after each major earthquake, new regulations have been introduced, but they have not proven sufficient for the subsequent earthquake.

Table 2. Comparison of the Earthquakes Covered in the Study

Earthquakes	Date and Location of the Earthquake	Magnitude and Intensity	Casualties and Damages	Number of Damaged Buildings	Outcome and Effects	Relevant Regulations
February 6, 2023 Kahramanmaraş and Surroundings Earthquakes	According to the data from Kandilli Observatory and Earthquake Research Institute, on February 6, 2023, a magnitude 7.7 earthquake occurred at 04:17 local time in Sofalaca-Şehitkamil-Gaziantep. On the same date at 13:24, another earthquake with a magnitude of 7.6 centered in Ekinözü-Kahramanmaraş took place.	The magnitudes of the earthquakes were measured as 7.7 and 7.6, respectively. The intensity of the earthquake was strongly felt in the provinces of Kahramanmaraş, Hatay, Adıyaman, Malatya, Kilis, Gaziantep, Adana, Osmaniye, Şanlıurfa, Diyarbakır, and Elazığ. Numerous aftershocks occurred, causing severe damage.	As a result of the earthquakes, official figures indicate that at least 50,783 people lost their lives in Türkiye, and at least 8,476 in Syria. Moreover, more than 122,000 people were injured.	Buildings to be demolished: 17,491; Severely damaged: 179,786.	Due to the regional scale of the earthquakes, cities experienced significant destruction, leading to substantial economic, spatial, and socio-cultural losses at a national level. Shortcomings have been identified in terms of earthquake preparedness, post-earthquake response, and overall management of the process.	2018 Earthquake Regulation
October 30, 2020 Izmir Earthquake	The Izmir Earthquake occurred on October 30, 2020, at 14:51 local time, in the western part of Türkiye, in the Aegean Sea. The epicenter of the earthquake was located off the coast of Seferihisar district of Izmir province.	The magnitude of the earthquake was measured as 7.0. The intensity of the earthquake was strongly felt in Izmir and the surrounding provinces. Additionally, due to the earthquake occurring beneath the seabed, concerns about a tsunami also arose.	As a result of the earthquake, 115 people lost their lives, and hundreds of people were injured. Especially the city center of Izmir and its surrounding areas suffered damages.	Buildings collapsed and severely damaged: 506, Moderately damaged: 511.	The Izmir Earthquake caused a major disaster in the region. It highlighted the need for a stronger focus on disaster management and infrastructure reinforcement.	2018 Earthquake Regulation.
January 24, 2020 Elazig Earthquake	The Elazig Earthquake occurred on January 24, 2020, at 20:55 local time, in the eastern part of Türkiye, near the Sivrice district of Elazig province.	The magnitude of the earthquake was measured as 6.8 on the Richter scale. The intensity of the earthquake was felt in Elazig and the surrounding provinces.	As a result of this earthquake, 41 people lost their lives, and thousands were injured.	Damaged buildings (Malatya + Elazig): 12,314.	The Elazig Earthquake caused a major disaster in the region. The loss and damages caused by the earthquake prompted Türkiye to focus more on disaster management and infrastructure reinforcement.	2018 Earthquake Regulation (The 2007 regulation has been updated. Additionally, the "Türkiye Earthquake Zones Map" that came into effect in 1996 was updated to the "Türkiye Earthquake

						Hazard Map" in 2018.)
October 23, 2011 Van Earthquake	The Van Earthquake occurred on October 23, 2011, at 13:41 local time, in the eastern part of Türkiye, near the Ercis district of Van province.	The magnitude of the earthquake was measured as 7.2 on the Richter scale. The intensity of the earthquake was strongly felt in Van and the surrounding provinces. Additionally, the regional impact of the earthquake manifested as a landslide disaster.	As a result of this earthquake, 644 people lost their lives, and tens of thousands were injured.	Collapsed buildings: 2,031	The Van Earthquake was a major catastrophe for the region and once again demonstrated Türkiye's earthquake risk.	2007 Earthquake Regulation
12 November 1999 Düzce Earthquake	The Düzce Earthquake, which occurred on 12 November 1999 at 18:57 local time, took place on the North Anatolian Fault Line in Türkiye. The epicenter of the earthquake was located to the southeast of the Düzce city center.	The magnitude of the earthquake was measured as 7.2 on the Richter scale. The intensity of the earthquake was felt not only in Düzce province but also in surrounding provinces like Istanbul, Kocaeli, and Sakarya.	As a result of this earthquake, 894 people lost their lives, thousands were injured, and numerous buildings were damaged. Particularly, Düzce city center, Gölcük, and Kaynaşlı districts suffered extensive damage.	Damaged buildings: 35,519	The Düzce Earthquake once again highlighted Türkiye's earthquake risk and underscored the urgent need for the country's disaster management.	1998 Earthquake Regulations
17 August 1999 Marmara Earthquake	The Marmara Earthquake of 17 August 1999 occurred at 03:02 local time. The epicenter of the earthquake was located to the west of Gölcük district in Kocaeli. However, surrounding provinces such as Istanbul, Kocaeli, Sakarya, and Yalova were also affected.	The magnitude of the earthquake was measured as 7.4 on the Richter scale. Intense tremors caused buildings to collapse, infrastructure to be damaged, and significant destruction to occur in many settlements.	As a result of the earthquake, 17,118 people lost their lives, and hundreds of thousands were injured..	Ağır Severely Collapsed: 27,634 Moderate Damage: 27,428	The 1999 Marmara Earthquake led to increased awareness in Türkiye about earthquake risk and preparedness.	1998 Earthquake Regulations

3 March 1992 Erzincan Earthquake	The Erzincan Earthquake of 13 March 1992 occurred at 17:18 local time. The epicenter of the earthquake was located in Erzincan province in the eastern part of Türkiye.	The magnitude of the earthquake was measured as 6.8 on the Richter scale. Intense tremors affected Erzincan and the surrounding settlements.	As a result of the earthquake, 653 people lost their lives, and tens of thousands were injured..	Collapsed-Heavily Damaged: 5,093 Moderate Damage: 6,480	The Erzincan Earthquake once again drew attention to Türkiye's earthquake risk.	1975 Earthquake Regulations

As a result of the Marmara earthquake's consequences, it has transcended regional implications and led to a national impact. Thus, the formation of public earthquake awareness in Türkiye largely occurred at a relatively late date, around the end of the 20th century. Approaches towards earthquakes have completely changed, paving the way for a new era. As a result of these developments, a period has commenced in which the long-standing notions of unregulated urbanization, housing policies, unchecked construction, and earthquake regulations have been intensely debated (Güner, 2020).

Countries often determine how urban settlements are planned through urban planning laws. According to Tekeli (2023), viewing post-earthquake urban planning efforts in a city merely as a plan renewal exercise is an oversimplification. Just as in planning, it is necessary to tailor planning according to the distinct characteristics of each region and area (Tekeli, 2023). If there is a high earthquake risk, it must not be overlooked.

In Türkiye, the spatial planning system is organized hierarchically, starting from the national level of higher-scale planning/strategy system, followed by environmental arrangement plans, regional plans, master plans, and implementation plans (Tekeli, 2023). In planning efforts for settlements that have suffered damage from earthquakes, it is essential to update and evaluate plans at all levels of planning. Once the necessary information for upper-level tiers is gathered during the research phase, conducting planning for the three lower tiers would be sufficient (Tekeli, 2023). On the other hand, the post-earthquake redevelopment of the disrupted physical environment should be carried out based on factors such as the level of damage in cities and the soil characteristics of housing locations. This planning can involve distributing the affected settlement's population to surrounding areas, completing repairs in the existing settlement and facilitating new construction in the same area, or establishing new construction zones near the affected area (Uzuner & Akıncıtürk, 2020).

In this context, it is observed that the planning processes of the earthquakes evaluated in the scope of this study do not manage a distinct process specifically tailored for earthquakes. Similar destructive characteristics have emerged from each settlement. These include insufficient and uncontrolled urban growth, erroneous and distorted urbanization, deficiencies or shortcomings at the building scale, structures not conforming to the project, incorrect site selections, and similar issues. The prevalence of these problems underscores a lack of oversight. This situation is a result of inadequate stages such as planning, implementation, supervision, and reorganization.

5. Conclusion

Due to its geological characteristics, Türkiye is composed of first and second-degree earthquake zones. Earthquakes are statistically the most common natural disasters and the most destructive ones. As a country prone to earthquakes, Türkiye falls short in terms of preparedness against them. Within the scope of this study, the reasons for this situation concerning the earthquakes under consideration include unplanned settlements, unauthorized constructions, inadequacy of scientific evaluations such as geological studies, insufficient public awareness, deficiencies in building construction and non-project-related interventions on buildings. Experiencing devastating earthquakes at certain intervals, yet each time encountering even greater losses, is a significant misfortune. Unfortunately, the lives lost and substantial material damages caused by previous earthquakes in Türkiye tend to be forgotten within a short period of time. Although rapid research, development, and precautionary measures are initiated after earthquakes, problems arise in sustaining this process.

When evaluated in the context of urban planning and urban development, a crucial issue arises from the fact that existing plans do not account for earthquake preparedness. Furthermore, the inadequate implementation of existing plans and disregard for earthquake regulations play a significant role in this process. Superficial and profit-driven decision-making processes in selecting locations for urban development areas constitute another challenge. Additionally, there are secondary effects of natural disasters, such as tsunamis, landslides, fires, etc., that occur after earthquakes. It is evident that the destructiveness of some natural events cannot be prevented. However, preparing action plans to minimize damages and swiftly address them remains important. Particularly, the advanced level and technological support of global natural disaster management serve as a crucial reference. Action plans to be executed before, during, and after disasters will mitigate the impact of such events. Addressing Türkiye's planning processes, laws and regulations, public awareness and participation, and the comprehensive handling of disaster action plans can collectively reduce the destructive effects of earthquakes

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Sustainable Approaches in Kitchen Spaces Transformed by Technology

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1. Introduction

Rapidly changing and developing technological developments bring innovations to all areas of life. The 21st century is called the electronic age, information age, or cybernetic age (Özturan, 2007). Technological developments play a decisive role in life and effectively shape the environment and spaces. The negative conditions created by technology in the environment necessitate spatial transformations. rooms are functionally and formally renewed with the effect of technological developments while also contributing to environmental protection awareness (Çelebi et al., 2008; Bekar & Kutlu, 2022). Environmental protection awareness can be achieved by integrating technology with nature instead of focusing on consuming resources. Thus, environmental problems caused by industry and technology are prevented (Guy & Farmer, 2007). Therefore, a livable and developed world in the long term will only be possible by entering into harmony with nature. This situation has increased the importance of sustainability in space design day by day.

Sustainability meets space needs with activities sensitive to the environment, emphasizing the efficient use of energy, water, and materials and including all periods of existence. Sustainable buildings benefit the user from natural light comfort to the fresh air quality of the interior spaces. At the same time, they can provide resources to other facilities after they are demolished with a measured, environmentally respectful approach to the consumption of natural resources (Sev, 2008; Kutlu, Bekar & Şimşek, 2022).

The concept of sustainability is in close contact with all variables related to the environment. However, the idea of sustainability will become a reality with the increase in the ecological awareness of societies (Yetkin, 2019). This study is planned through the reflection of environmental consciousness awareness on kitchen spaces through the eyes of future designers. The study was created by evaluating the outputs of the studio studies carried out within the scope of the Kitchen Design course in the 8th semester of the 2022-2023 Education and Training Period of the 4th-grade students of the Department of Interior Architecture and Environmental Design of Avrasya University. At the end of the study, it aims to reveal sustainable approaches to kitchen spaces that transform with technology.

1.1. Sustainability

The foundations of the concept of sustainability, which aims to eliminate the negative situations caused by the unconscious consumption of natural resources, were laid in the 1970s with the idea of environmentalism (Vatan & Poyraz, 2016). The internationalization of sustainable ideas took place in Stockholm in 1972 with the "United Nations Conference on the Human Environment." In this conference, it was underlined that human behavior and attitudes are shaped according to their environment (Ünal & Dımışkı, 1999). In 1987, sustainability was defined as meeting today's needs without jeopardizing future generations' needs with the Bruntland report of the World Commission on Environmental Development named "Our Common Future" (Brundtland Commission, 1987; Erdede & Bektaş, 2014). In this respect, sustainability will improve life while maintaining continuity in access to natural resources (Ruano, 2000). Sustainability, which aims to protect resources and transfer them to future generations, has always been the main subject of the period in which it has been experienced and has constantly changed and developed (Brundtland Commission, 1987; Çiğan & Yamaçlı, 2020; Konakoğlu, Bekar & Çakır, 2023).

In addition, sustainability not only comments on the present but also offers suggestions for the future. With the impact of technological and scientific developments, sustainability represents a developing process (Çiğan & Yamaçlı, 2020). In this process, societies use their cultural, social, natural, and scientific resources in a balanced way and respect everyone with a participatory approach (Gladwin et al., 1995).

The concept of sustainability is used in almost all disciplines. Especially with the deterioration of the natural environment, its interaction with architecture has increased (Williamson et al., 2003). The concept of sustainability in architecture requires restructuring ecological, economic, social, and cultural systems to create habitable environments. In this context, environmental sustainability is the protection of resources and the ecosystem; economic sustainability is the long-term availability of resources and low usage costs; social and cultural sustainability are the principles that construct strategies for human health, comfort, and the protection of social and cultural values (Dikmen & Toruk, 2017).

As part of architectural production, concepts such as energy saving, waste accumulation, and recycling, which symbolize environmental sensitivity, come to the fore (Yedekçi, 2015; Bekar, 2023). In sustainable architectural designs, which are important for the ecosystem, three basic principles are mentioned in the conceptual framework: resource conservation, life cycle design, and design for people (Kim & Rigdon, 1998; Sev, 2009). The principle of resource conservation aims to conserve energy, water, and materials. In contrast, the principle of life cycle design evaluates the lifespan of the building and its effects on the environment. The focus of design for people includes protecting natural and cultural values, urban design, and comfortable building design criteria by examining the human-environment relationship (Özyol, 2006).

1.2. Sustainability in Interior Architecture

The basis of interior architecture is human. The essence of providing design services to people is human needs (Kaptan, 2013). Interior architecture solves the actions related to human needs in a functional, aesthetic, and practical way. However, interior architecture is a profession that responds to human beings' spiritual and physical characteristics (Kaçar, 1998).

Interiors are expected to adapt to the changing and developing lives of users. Interiors, which play an active role in the lives of their users, should be designed to adapt to various conditions. In this sense, interiors are expected to respond to sustainable variables (Yılmaz & Keleş, 2004; Bekar & Nayeb, 2022). The four principles of sustainable interior architecture, which are a healthy interior environment, ecologically appropriate materials, environmental form, and good design (suitable for function), aim to create a building in harmony with the environment (Bulhaz, 2020).

Interior design elements such as kitchens, living spaces, furniture, and fittings are important for a livable environment. The processes from materials used in furniture and fittings and interior design elements to waste, production to transportation, and material extraction to material processing are considered pollutant factors (Bulhaz, 2020). These problems can be prevented with the right decisions made during the design and implementation phase.

When the right material selection, efficient energy, and wastewater use in interior design and applications are handled with environmental awareness, resource use will be reduced, and resource outputs can be recycled or reused (Özbek, 2015).

When the energy in the materials is low, it reduces the emission of harmful substances during production and protects the air quality indoors during its use. It is important that materials can be recycled at the end of their life. In this direction, using natural or less processed materials in spaces will meet aesthetic and functional requirements and prevent negative environmental impacts (Jones, 2008; Wilson, 2000; Kwok & Grondzik, 2007).

Increasing the use of gray water while designing spaces, using water in interior landscaping, or using sanitary systems that minimize water use are among the measures developed for effective water use (Edwards, 1999; Jones, 2008).

The location of the space within the building and its relationship with other areas are among the variables that affect energy saving. In space organization, the orientation of the building should be analyzed and designed to benefit from natural ventilation and lighting. In this way, the energy efficiency of buildings will increase by creating quality interior space (Edwards, 1999; Jones, 2008).

In short, sustainable interior design minimizes the adverse effects on the user and the environment in economic, environmental, and social-cultural terms with its implementation and usage process (Kang & Guerin, 2009; Adıgüzel, 2011). In 1999, the International Council for Development and Research in the Building Industry CIB Task Group 39 published a report titled "Sustainable Construction," which categorized sustainable spaces into 3 groups under the headings of resource utilization, improvement of the environment and natural environment, and consideration of socio-economic and cultural realities (Altuncu, 2010).

Researchers such as Ehrlich and Holdren (1971) and Sylvan and Bennet (1994) state that the need for space from the interior to the urban scale is a consumption phenomenon that increases with population and should be supported by technology. The combination of population, consumption, and technology creates environmental impacts.

According to Karyağdı (2019), the proper spatial arrangements in housing design, efficient use of energy resources, interior space organizations that provide the necessary comfort conditions, occupancy-void, spaces that can be transformed with flexible use, ecological material choices, nature-friendly and human-oriented approaches contribute to sustainability.

Bulhaz (2020) evaluated interior architecture elements regarding solid waste management and discussed sustainable design principles under efficiency, material selection, multifunctionality and usability, simplicity, flexibility, and lifetime.

Aktaş (2013) evaluates energy and emission in interiors with thermal comfort, insulation, ventilation, lighting, and material effects on surfaces by addressing green design approaches that play an important role in the building sector.

Güney Yüksel & Seçer Kariptaş (2019) argue that natural light and ventilation, efficient energy and water use, and the right spatial organization of residential interiors in line with sustainable approaches are the basic requirements that contribute positively to the design process.

Celadyn (2019) sets out the criteria for the design of interior components, including the development of interior components by integrative architectural design goals, comprehensive design criteria with an emphasis on temporal context, and the inclusion of environmental sustainability-oriented assessment of interior components in the design procedure.

2. Material and Method

The study was created by evaluating the outputs of the studio studies carried out within the scope of the Kitchen Design course in the 8th semester of the 2022-2023 Education and Training Period of the 4th-grade students of the Department of Interior Architecture and Environmental Design of Avrasya University. In the spring semester of the 2022-2023 academic year, the course was conducted online, and then the course was continued as a hybrid; some students continued face-to-face, and some continued online. Since the course started online, it was left to the student's preference to carry out the study in groups of 2 students each or to do individual work. The study was conducted on 7 projects submitted by 12 students at the end of the semester. At the end of the study, it aims to reveal sustainable approaches to kitchen spaces that are transformed with technology.

The study gives theoretical information, design process, and evaluation of project outputs (Figure 1).

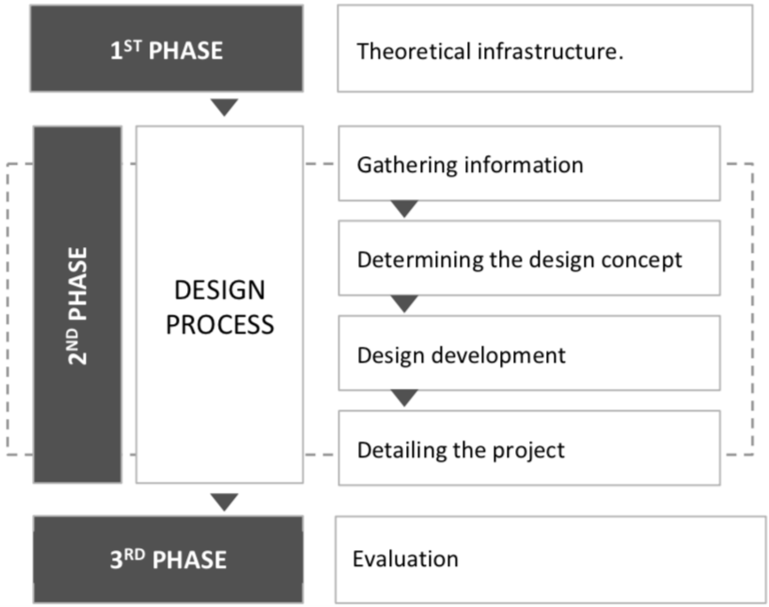


Figure 1. Stages of the study

In the study planned within the scope of the Kitchen Design course, which aims to evaluate the general design principles of residential kitchens, which are shaped depending on user needs and functional features, and to make a sample design application, theoretical knowledge was first given to create a theoretical infrastructure. Students were given detailed information about the history of residential kitchens, the importance of kitchen space design, the relationship of kitchens with other spaces in houses, the actions and sequence of actions in the kitchen space, working zones and working triangle, critical anthropometric dimensions in kitchens, kitchen types and design principles. Afterward, the students were given the plan of a 40 m^2 space on the ground floor of a 3-story villa where they would design their kitchens, and they were informed that no changes could be made to the walls on the facade and that changes could be made to the interior non-bearing walls depending on the designer. At the same time, the students were also informed that the relationship of the kitchen space with the entrance, living, or dining space should be established correctly and that it can be included in the design if necessary. The subject of the study was determined as "designing a sustainable residential kitchen shaped by the impact of technology" (Figure 2).

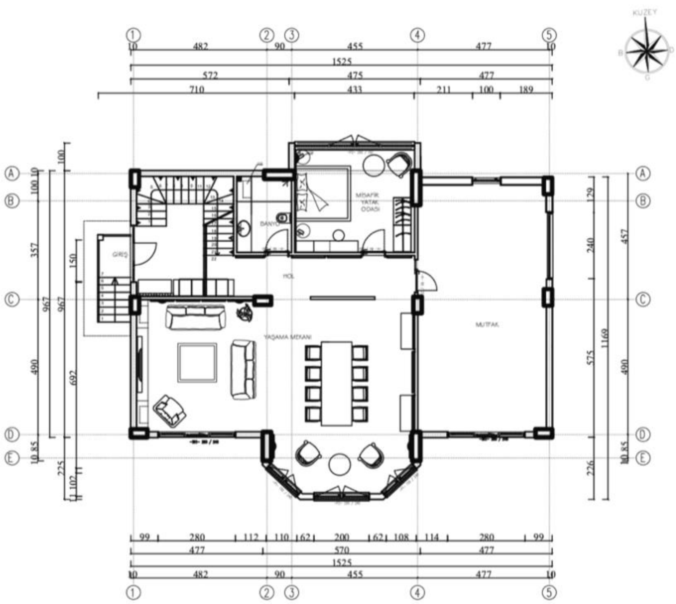


Figure 2. Ground floor plan S:1/200

The second stage of the study is the design process. The design process consists of gathering information, determining the concept that forms the starting point of the design, developing the design, and detailing solutions for implementation.

Gathering information: In the information gathering phase, which constitutes the first stage of the design process, the students first researched new approaches in kitchen design and then presented their research in detail to their peers and course instructors. Afterward, the students studied sustainability and learned about the reflection of this concept on space design. All students who took the course made their presentations individually and online at this stage.

Determining the design concept: At this stage, students were first asked to create a usage scenario based on the design problem. The user group was determined to be the same for each student; they were asked to design for a family consisting of a parent and a child. Students determined factors such as occupation, interest, age, etc., and created usage scenarios. Students were then asked to identify a concept based on their completed design. The appropriateness of the chosen concept in terms of technology and sustainability was discussed during the course with the participation of the course instructors and all students.

Design development: At this stage, students were asked to make their first design sketches based on the concept they had identified. While making the design sketches, functional suitability, as well as concept-technology-sustainability suitability, were taken into consideration. They finalized their designs, which they presented to the course instructors weekly.

Detail solutions for the application: At this stage, where the finalized designs were detailed, drawings were made for implementation. While the application project drawings were prepared at a scale of 1/20, the furniture and surface expression details used in the design were drawn with the flexibility to vary from 1/1 scale to 1/20 scale. The interior surface (floor, wall) covering materials, furniture textiles, countertop covering, and kitchen cabinet materials that are foreseen to be used in the application are expected to be given in the form of legends. In addition, they prepared a project tag including the use scenario and design decisions related to the project and submitted it with their projects at the end of the semester.

The third phase of the study was the evaluation phase based on the final products. First of all, sustainability criteria were created based on the literature. Considering environmental, social, cultural, and economic phenomena in the design of sustainable interiors ensures that the environmental damage of the spaces is minimized (Kang & Guerin, 2009; Adıgüzel, 2011; Demiraslan & Demiraslan, 2017). Accordingly, kitchen designs were evaluated under environmental, social, cultural, and economic categories (Table 1).

Table 1. Sustainability criteria

Sustainability Criteria			
Ecological	**Social Cultural**		**Economical**
Resource conservation Energy conservation Material conservation Water conservation	Human health and comfort	Protection of cultural values	Long-term use of resources

An analysis table was created by the researchers by making use of the sub-criteria in the studies on sustainability in the field of architecture and interior architecture (Bulhaz & Aktaş, 2013; Güney Yüksel & Seçer Kariptaş, 2019; Celadyn, 2019; Karyağdı, 2019) (Table 2).

Table 2. Sustainability sub-criteria

Sustainability Criteria														
Environmental								**Social Cultural**					**Economical**
Energy Conservation			Material Conservation			Water Conservation		Human Health and Comfort					
Renewable energy	Natural Air Conditioning	Low Energy Use	Natural materials	Recycling	Less materials	Reduced water consumption	Water recycling	Functionality	Flexibility	Simplicity	Aesthetics	Cultural Value	Lifetime

Identity cards with presentation sheets and plan and section drawings were created for each project. The designs were analyzed based on the use scenarios and the narratives given by the students in the project tag. The sustainability criteria found in each project and shaped by the influence of technology were marked in the analysis table created, and the most effectively used criteria were determined. Thus, how the sustainability approach in kitchen spaces is reflected in the design and the effect of technology on the sustainability approach in kitchen spaces were revealed.

3. Findings and Discussion

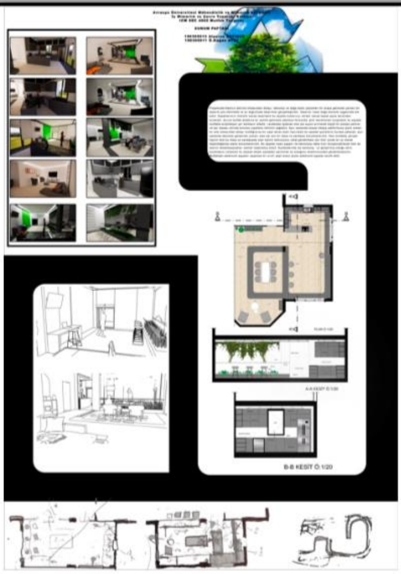
In the study, which aims to design a sustainable residential kitchen shaped by the impact of technology, the project outputs of the students were analyzed through the use scenarios and the narratives given by the students in the project tag and evaluated based on sustainable design criteria. For each of the 7 projects submitted at the end of the semester, the concept, general space organization, technological approach, and sustainable approach were explained. They were then analyzed in tables prepared according to the sustainable design criteria in the literature. The parameters used effectively from the sustainable design criteria are evaluated through their reflection on the design and the effect of technology on the sustainability approach in kitchen spaces.

Kitchen -1

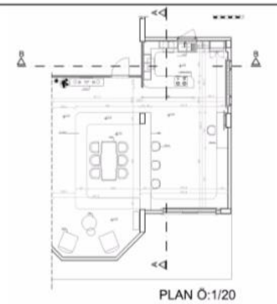
The presentation sheet and the identity card with plan-section drawings of kitchen number 1, designed for a family consisting of an environmental activist woman, a technology development specialist man, and their 13-year-old child, are shown in Table 3. This family also produces video content for social media (Table 3).

Table 3. Kitchen design 1 identity card

KITCHEN- 1



Plan



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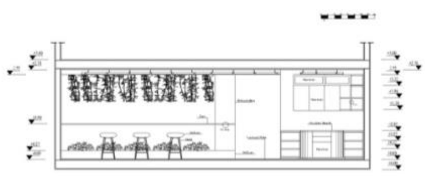


Students: Kağan AYAZ-Alperen ÇETİNER

In the project, technology and environmentally friendly solutions are brought together because the female user is an activist. In this direction, an environmentalist approach was adopted as a starting point for the design. The design is based on the axis of humans, nature, and economy and is developed in line with the users' occupations.

The kitchen space consists of two parts: food preparation and working area. In the kitchen, which is designed in the G kitchen layout according to how the countertops are arranged, a bar is solved with a mini garden outside the counter. The bar also acts as a dividing border between the kitchen and the living space. This open divider allows interaction between the kitchen and the dining area of the living space. The TV placed in the kitchen can also be watched from the living space, making it able to serve both spaces. A part of the kitchen space has also been turned into workspaces suitable for the users' occupations, offering flexible use (Figure 3).

Figure 3. General views of the kitchen space

A green screen was placed in the kitchen for the family, producing content for the social media platform. In addition, a table was designed about the shooting screen for assembly and editing. This table can also be used as a workspace for the man who works from home. The TV in the kitchen is positioned where the working area and the people using the kitchen can easily see it, allowing both the person working in the kitchen and the person using the working site to see it comfortably. In this way, flexible spaces that can bring human life and technology together faster and where users will not interrupt their work are designed (Figure 4).

Figure 4. Views from the workspace

Kitchen doors are designed hydraulically to provide ease of use. In addition, hidden stairs in the form of drawers were created, and a solution was proposed for inaccessible places in the kitchen (Figure 5).

Figure 5. Views from the food preparation area

In the selection of equipment in the kitchen, attention was paid to the fact that it has smart technologies and is from the A + class green energy group. Water-saving faucets were also selected for the kitchen armature. Thus, both a technological and environmentally friendly approach was adopted. In order to be intertwined with nature in the design, a mini garden was designed under the bar table. The wastewater from the sink is purified and transmitted to the flowers under the bar table with the help of a small pump. The mini garden is designed to be related to both the kitchen and the living space (Figure 6).

Figure 6. Views from the mini garden area

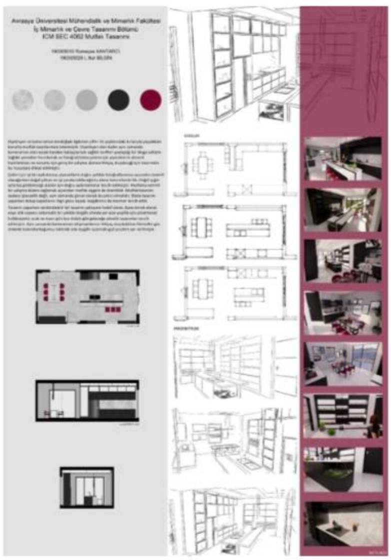
Sustainability criteria were taken into consideration in material selection. Hygienic and antibacterial porcelain material was used as ceramic. Membrane material was used for the kitchen cabinet, and a parquet was preferred for the floor.

Kitchen-2

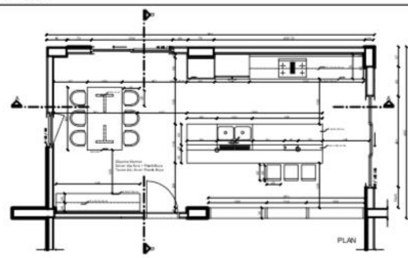
The presentation sheet and the identity card with plan-section drawings of kitchen 2, designed for a family including a woman who is a dietitian, a man who is a cameraman, and their 16-year-old child, are as shown in Table 4. The dietitian woman has a blog where she shares healthy food recipes. She shoots the presentations she prepares for her blog with her cameraman husband (Table 4).

Table 4. Kitchen design 2 identity card

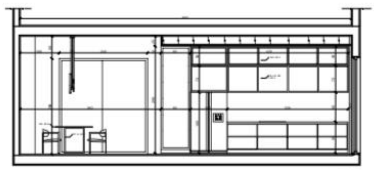
KITCHEN-2



Plan



Section



Students: Rümeysa KANTARCI – L.Nur BİLGİN

The kitchen consists of food preparation and dining areas. The sink is located on the island counter in the project with an island kitchen type. The island counter, which is designed quite large, can be used as a working area and food preparation. The design of the island counter was influenced by the need for a large workspace for the couple who regularly prepares healthy meals and shoots videos or photographs. At the same time, the island bench has hidden sockets for the camera equipment used in video shootings, which they can quickly charge when needed. Thus, the island counter was suitable for preparing, serving, and eating (Figure 7).

Figure 7. General views of the kitchen space

The organization of the action areas in the kitchen space, which consists of food preparation and eating, was created by considering natural light. Good lighting, especially for shooting, is important for photographing food accurately. In this context, the food preparation area is located on the south façade of the kitchen, where natural light is utilized the most. Natural light should be considered holistically together with artificial light. While providing visual comfort in the interior, it is also important to contribute to energy saving. In order to determine the extent of the need for artificial light, it is necessary to know the condition of daylight both during the day and depending on seasonal changes (Abdelatia et al., 2010). The dining area is located in the room facing the north facade of the kitchen, where the window sizes are slightly smaller than on the wall facing the south front. In the dining area, where natural light is relatively insufficient, artificial lighting is supported with pendant fixtures above the dining table and general lighting.

A surface design consisting of open shelves was made between the kitchen and living spaces. Plants that can be grown without soil are placed on some of the open shelves. The design, which is the focal surface in the kitchen, adds aesthetic value to the space and delimits the living and kitchen spaces. In creating the character, sustainable approaches come to the fore due to the intensive use of water in the kitchen.

One of the most basic methods of protecting water resources is reusing wastewater. In buildings such as homes, offices, dormitories, schools, hotels, and sports centers, the water produced from sinks in kitchen spaces, such as hand sinks, washing machines, or showers, except for toilet inputs, is defined as gray water (Javadinejad et al., 2020; Thomaidi et al., 2022). It is essential to recycle and use greywater as an alternative urban water source (Revitt et al., 2011). Recycling and reusing it for purposes other than drinking is essential in reducing water consumption (Al-Ghazawi et al., 2018). In this sense, the project aims to use the gray water from the sink for growing plants. Thus, the designed surface solves the problems caused by the highwater consumption in kitchens. With a similar approach, a green area was created on the shelf of the island countertop. The gray water from the sink systematically reaches the plants on the counter shelf and open shelves (Figure 8).

Figure 8. Views of surface design and under-counter shelf

Technological developments were influential in the selection of equipment for the project. By using an induction cooker and blue light refrigerator, it is aimed to save energy through the equipment. Sustainability criteria were also taken into consideration in material selection. High gloss material was used on the kitchen cabinet doors, natural granite was used on the countertop, and hygienic and antibacterial ceramic was preferred for the floor.

Kitchen-3

The presentation sheet and the identity card, including the plan and section drawings of kitchen number 3, designed for a family consisting of a couple giving recipes on social media and their 5-year-old daughter, are shown in Table 5. The family, who likes to be together, spends a long time in the kitchen due to their professions.

Table 5. Kitchen design 3 identity card

<table>
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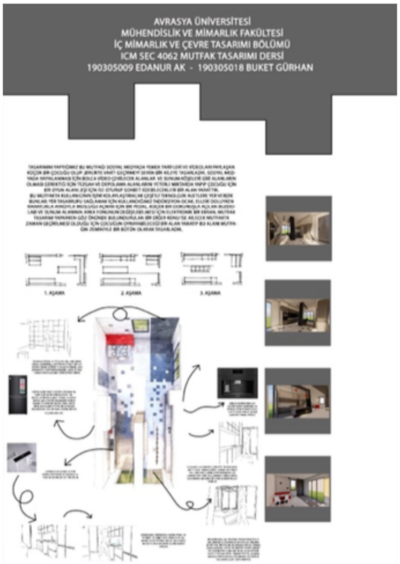
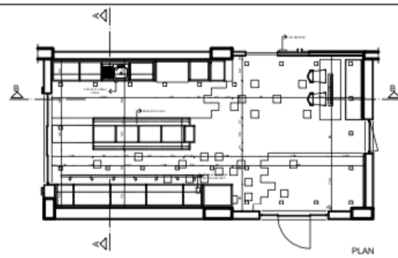
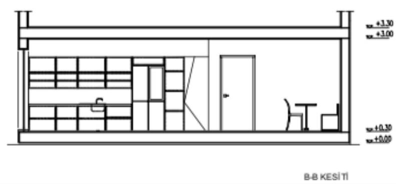
<tr><td rowspan="4">
</td><td>Plan</td></tr>
<tr><td>
</td></tr>
<tr><td>Section</td></tr>
<tr><td>
</td></tr>
<tr><td colspan="2">Students: Edanur AK – Buket GÜRHAN</td></tr>
</table>

The kitchen has a food preparation area, a dining area, and a children's play area. The place where food preparation and the presentation of the content prepared for social media are made is positioned on the south side of the house, where there is a lot of natural light. The island counter has an induction cooktop system in the project where island type kitchen is used. Thus, the counter is flexible enough to meet various functions such as the cooking surface, work table, and dining table (Figure 9).

Figure 9. General views of the kitchen space

Shelves are designed on the main counter, adding aesthetic value to the space. The digital screen right next to the shelves is used to control the child who spends time in the room during the long video shootings of the parents. A children's playground is designed right next to the dining area. This way, parents can be together with their children while working (Figure 10).

Gaining sustainable awareness in early childhood will have positive and lasting effects on the sustainable understanding of future generations (Leal Filho, 2009; Samuelsson, 2011). Initiatives that positively support individuals' sustainable awareness are seen as a fundamental step. (Gadotti, 2010). In this direction, the playground designed in the project aims to teach children waste sorting for glass, plastic, and paper waste. Each correct trash thrown into the box created for each waste earns the child points, and the points earned are reflected on the screen. Thus, it is aimed to both have fun and contribute to the child's sustainability awareness.

Figure 10. Views from children's playground and digital screen

The equipment used is one approach that stands out with sustainable consciousness in the project. The refrigerator has a glass door. Users can see what is inside without opening the door. At the same time, the fridge prepares a shopping list of the consumed food. Thus, the refrigerator allows users to save time as well as energy. A water-saving dishwasher and an energy-saving oven are other preferred equipment. A counter-mounted scale is used for users who measure their recipes. The scale is powered by solar energy.

The sustainable approach is also reflected in the material preferences used in the kitchen. In the kitchen, where very few materials are used, the materials are arranged in a way that does not harm human health. Upcycled carbon emission ceramic tiles were preferred on the walls and floor. Marble was used on the kitchen countertop, and wood was used for the cabinets under and above the countertop.

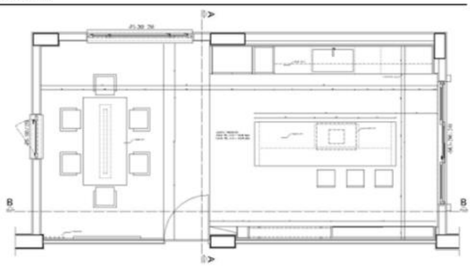
Kitchen-4

Kitchen 4 is designed for a nuclear family consisting of a male cook, cookbook author, and blogger, a female software engineer, and a child. Project information is included in the identity card (Table 6).

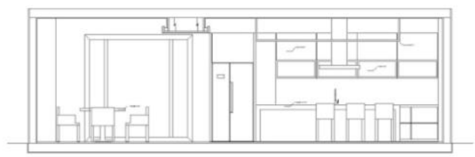
Table 6. Kitchen design 4 identity card

KITCHEN- 4

Plan



Section



Student: Furkan GÜNDÜZ

The project's starting point was the users' occupations and interests. Accordingly, a kitchen was designed for the father, who is also interested in organic agriculture, where he can produce new recipes, do organic farming in his kitchen, and shoot and share them on his blog.

The space is planned as a food preparation and eating area. According to its shape, it is designed as an island-type kitchen, and the wall opposite the counter is designed as an organic farming area. The island counter is also a bar where 3 people can eat (Figure 11).

Figure 11. General views of the kitchen space

The under-counter hidden stove system in the island worktop provided a large surface when the stove was not in use. A smart screen, which also allows shooting, was positioned, and the organic farming area was integrated into this system (Figure 12).

Figure 12. Island countertop and smart screen

The design of the kitchen space aims to use water and energy effectively. In this direction, it aims to collect rainwater from the roof, filter it and use it to irrigate the plants in the area created for organic agriculture. In addition, the energy produced by the solar panels used in the house is also used to illuminate the organic farming area in the kitchen (Figure 13).

Figure 13. Organic farming area

The location of the space is suitable for natural light and natural ventilation. Water management was emphasized in the kitchen design, and suggestions were made for more efficient use of water and energy efficiency.

In the kitchen, where few materials are preferred with a minimalist approach, natural wood is used in the under-counter and over-counter cabinets, and natural granite is used on the countertop.

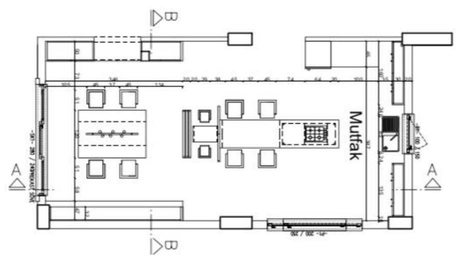
Kitchen-5

The project information, presentation sheet, and plan section drawings of Kitchen 5, which was designed for a family promoting traditional dishes from different regions of our country through a digital platform, are included in the project identity card (Table 7).

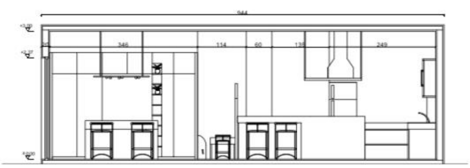
Table 7. Kitchen design 5 identity cards

KITCHEN-5

Plan



Section



Students: Berna ÇEBİ – İrem GÜRSU

In the kitchen designed based on the occupation of the users, traditional Turkish cuisine was determined as the starting point of the design. The targeted design perception is to reflect the traces of the past to the present by utilizing today's technology. In addition, the space has been customized for the third family member so that the child can spend time with their family.

The kitchen is designed as a preparation and dining area and an island-type kitchen according to the countertop configuration. The island countertop allows family members who prepare and present traditional dishes to practice the dough rolling technique applied on the floor tables. Placing a hidden induction cooker on the island counter aims to obtain a large surface when not in use. The shelf system used for storage has been replaced by glass cabinet designs (Figure 14).

Figure 14. General views of the kitchen space

A playground is designed in the space where the child can also spend time. In this way, the space has the flexibility to allow for play (Figure 15).

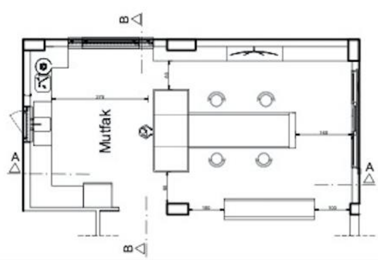
Figure 15. Views from the children's playground

FSC-certified plywood is used in the furniture and colored with water-based varnishes. Plywood, which has low gas emissions, is also a durable material. The playground furniture, which the child will also interact with, does not adversely affect material and child health. Water-saving faucets were preferred as kitchen faucets. As technological equipment, a smart refrigerator that lists consumed products was used. The fact that the starting point of the project is traditional Turkish cuisine has brought along a cultural approach. In the design, which aims to blend the traces of the past with today's technology, the choice of sustainable materials has also come to the fore.

Kitchen-6

The presentation sheet and the identity card, including the plan and section drawings of kitchen number 6, designed for the family consisting of a woman who works as a CEO in a private company and a male assistant specialist and their 10-year-old children, are as shown in Table 8. The family aims to leave their children a livable world and raise them with this awareness.

Table 8. Kitchen design 6 identity card

KITCHEN-6	
	**Plan**
	
	Section
	
Students: Serhat DAYAN – Ferhat SERDAN	

The kitchen, which consists of food preparation and eating spaces, is designed as an open space connected to the living room. The dining area is close to the living room, and the service buffet between the living room and the dining area acts as a boundary between the two rooms. The buffet is also used for storage purposes. L kitchen layout is preferred in the food preparation area according to how the countertops are arranged (Figure 16).

Figure 16. General views of the kitchen space

The project's design emphasizes technological approaches that will save time for users with busy work lives. Lids that open with sound, batteries with sensors and flow at the desired liter, and wireless phone charging places on the dining table are used.

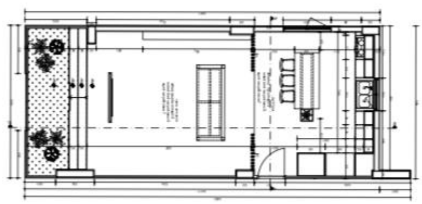
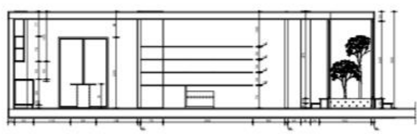
Automated and self-sufficient systems can be transformed with technology. The benefits of sustainable design technology are many (Yazıcı, 2009). Technology and products significantly contribute to sustainable design by utilizing renewable resources and creating waste that does not harm the environment (Ateş Can & Kurtoğlu, 2017). In this context, a self-sufficient system that enables all electrical appliances to work with solar energy without using almost any electricity was developed in the project. The family, which meets the house's energy needs with solar panels used on the roof of the house, also aims to contribute to the development of their children with this awareness. The water requirement of the kitchen space is met by filtering rain or snow water with a tank placed at the back of the house. In addition, in the kitchen space, where waste production is high, a garbage sorting system is used for household waste and paper, plastic, metal, or glass in various categorizations.

The tall cabinets behind the dining table and glass doors on the shelves above the counter in the food preparation area are made of self-cleaning glass material that removes dirt from the sun. While this material is important in terms of sustainability, it also facilitates the lives of busy working family members. Edible wood material was preferred for the dining table with under-counter and over-counter cabinets, and acrylic-based countertop material suitable for long-term use was preferred for the countertop.

Kitchen-7

The presentation sheet of Kitchen-7, designed as the kitchen of a phytologist couple, and its identity card, including plan and section drawings, are as shown in Table 9.

Table 9. Kitchen design 7 identity card

<table>
<tr><th colspan="2">KITCHEN- 7</th></tr>
<tr><td rowspan="4">
</td><td>Plan</td></tr>
<tr><td></td></tr>
<tr><td>Section</td></tr>
<tr><td></td></tr>
<tr><td colspan="2">Student: Yusuf AKYOL</td></tr>
</table>

The space is designed as a kitchen, living space, and botanical garden to the users' interests, and the kitchen is designed in an L-shape according to the countertop's shape (Figure 17).

Figure 17. General views of the kitchen space

An island was built in the kitchen, and this area was shaped to be used as a dining and plant study area at the same time. The botanical garden was separated by a glass divider on the facade of the space that receives natural light, and the space continued to receive natural light. It aims to utilize the wastewater from the sink to irrigate the botanical garden designed in the space. In this context, the wastewater from the sink was purified and transferred to the botanical garden. In addition to packaging wastes, organic wastes were also considered, as well as recycling bins to separate waste in the kitchen. In the kitchen, where a lot of organic waste is produced, a home composter was used to compost this waste and use it in the botanical garden. In addition to creating zero waste, it aims to make sustainability awareness for the family's children.

Wood and marble were preferred as sustainable materials in the space. Birch plywood was preferred as wood. Marble, a natural material, was used on the countertop and island, while plywood was used on the wall surfaces and the kitchen modules (Figure 18).

Figure 18. The use of wood materials in the kitchen

The effectively used sustainability criteria determined from the analysis based on the narratives in the project tags and presentation sheets of the kitchen designs are given in Table 10.

Table 10. Analysis of kitchen spaces according to sustainability criteria

	Sustainability Criteria													
	Environmental								**Social Cultural**					
	Energy Conservation			Material Conservation			Water Conservation		Human Health and Comfort					
	Renewable energy	Natural Air Conditioning	Low Energy Use	Natural materials	Recycling	Less materials	Reduced water consumption	Water recycling	Functionality	Flexibility	Simplicity	Aesthetics	**Cultural Value**	**Economical**
K1		o	o		o			o	o	o		o	o	o
K2		o	o	o	o	o		o	o		o	o		o
K3		o	o		o	o	o		o	o	o	o	o	o
K4	o	o			o	o		o	o		o	o		o
K5		o	o	o	o		o		o	o		o	o	o
K6	o	o		o	o			o	o			o		o
K7				o	o	o		o	o		o	o	o	o

As a result of the analysis, it was seen that natural air conditioning, use of recycled materials, functionality, and economy were most effectively included in the projects. The study analyzed environmental sustainability through energy, water, and material conservation. Energy conservation is primarily addressed in terms of using renewable energy sources. It was observed that solar energy, a renewable and clean energy source, was utilized in kitchen spaces using solar panels. Using sunlight's lighting and heating properties saves energy (Sarıgül, 2014).

In most projects, natural lighting, heating, and ventilation features were utilized by designing the house's orientation. Low energy consumption was ensured by using smart technologies in the equipment included in the projects.

Using materials that utilize renewable resources and are recyclable, harmless to human health, and do not create harmful wastes to the environment is becoming increasingly important in sustainable designs. (Ateş Can & Kurtoğlu, 2017). Material conservation was evaluated under natural materials, recycled materials, and low material use criteria. Recyclable materials were used in all kitchen spaces. Wood, granite, and marble were preferred as natural materials. Minimally designed spaces without material diversity were evaluated as less material, and it was seen that less material was used in more than half of the spaces.

The main goal of the water conservation principle is to reduce the amount of water used in the building (Yetkin, 2019). The study discusses water conservation under the titles of reducing the amount of water consumed and recycling water. The recycling of water was evaluated in terms of the treatment and reuse of both rainwater and gray water. In this direction, two projects included equipment for water saving, while in other projects, water was recycled, especially for use in plant irrigation.

Creating spaces suitable for the comfort conditions of the user forms the basis of creating sustainable interiors (Güney Yüksel & Seçer Kariptaş, 2019). Under the social and cultural sustainability title, evaluations were made based on human health and comfort criteria and the inclusion of cultural elements. In order to use the space efficiently in the kitchen and to perform the actions at the optimum level in the shortest time, the relationship between the cooler (refrigerator), sink and preparation, washing and cooking (cooker) should be established in a triangular way (Örs, 2020). This triangle called the working triangle, should not be interrupted by other uses. For the principle of functionality, the arrangement of equipment elements in kitchen spaces is considered in the context of the working triangle. In all of the designs, the spatial organization is designed by the kitchen triangle to ensure efficient use. Flexibility, which is the capacity to meet the needs that arise with changes depending on the user, time, technology, and function, is an important criterion in designing a sustainable space (İslamoğlu & Usta, 2018). Design flexibility is mainly achieved by integrating different functions into the same space. For sustainable interior design, less material should be used ergonomically (Bulhaz, 2020). This situation, evaluated under the simplicity title, was observed in half of the designs by considering the lack of material diversity, minimalist design, and minimization of details. While aesthetics, which has an important place in user requirements, is accepted as the primary criterion in evaluating the architectural product (Kuban, 2005), it is included in the sustainability principles to ensure human comfort. It is possible to say that all designs meet the aesthetic criterion when variables such as color, texture, form, proportion, ratio, and balance are considered.

While the cultural sustainability approach ensures culture transfer between generations, it also makes it possible to transform living spaces from a consumer society to an environmentally sensitive and important element that fulfills people's responsibilities without changing their quality (Güvenç, 2010). In one of the kitchen designs, cultural sustainability was achieved by carrying the traces of the past to the present; in two designs, sustainability awareness was created by trying to develop sustainability awareness for children.

Economic sustainability was addressed by associating it with a long lifespan. Since it is foreseen that the durability of the materials used in the spaces, the flexible design of the spaces, allowing multifunctionality and different forms of use, will allow longer use, the evaluations were made accordingly. It is possible to say that all of the designs provide economic sustainability.

4. Conclusion and Suggestions

While technological developments affect spatial transformation functionally and formally, they also contribute to preventing environmental problems. With the impact of technology, spaces are developing self-sufficient systems. In this study, residential kitchens transformed by technology are discussed from the perspective of future designers with a sustainable approach. The study's results were analyzed holistically based on the identity cards created and the analysis table. Sustainability criteria affecting the shaping of the design are presented in detail.

Energy conservation: In kitchen spaces, energy consumption is intense and used all day. In kitchens, energy needs arise due to the actions of the users in the kitchen, the equipment used in the kitchen, and the need for lighting. Technological developments enable people to produce the energy they use. In some kitchen projects, systems have been developed to meet the energy consumed in the kitchen through solar panels used on the roof of the house. Smart designs that can save energy were preferred in the selection of equipment.

In the projects, the action areas are positioned to benefit from daylight. The maximum daylight utilization by users during long periods spent in the kitchen contributes to energy conservation.

Material conservation: In today's world, where there is a wide variety of materials, one of the most important factors to be considered in selecting materials is minimizing environmental damage. Whether the materials are natural or less processed affects many factors, from indoor air quality to human health. At the same time, using renewable materials minimizes resource consumption and provides economic gain to the user in the long term. In the projects prepared in light of this data, it has been noted that most of the materials used in the tasks can be recycled. At the same time, it is aimed to ensure material conservation by using less material.

Water conservation: Water, which is of vital importance for all living things, is consumed quite a lot in housing, especially in kitchen spaces. Protecting water resources is possible by preventing unconscious water consumption and transforming water, a renewable resource. In the projects prepared in this direction, systems that can transform water with the help of technology are included. In addition, water-saving faucets were selected to prevent excessive use of water.

Human Health and Comfort: Ideal kitchens are expected to optimize time and space and save energy. In the projects designed in this direction, the actions performed in the kitchen are designed by considering the sequence of steps. The arrangement of the working triangles aims to minimize the users' movement and to meet the needs of preparing and serving food comfortably. Thus, the energy consumption of the users is minimized.

In line with changing living conditions, kitchen spaces are designed to be flexible enough to meet different needs besides food preparation and eating. It aims to achieve sustainable comfort conditions for users with simple designs that minimize materials and details. At the same time, attention was paid to ensuring that the designs met aesthetic criteria.

Another prominent approach in the designs is the phenomenon of cultural sustainability. Emphasis has been placed on the continuity of cultural values between generations and the formation of sustainable awareness at young ages.

All designed projects provide economic sustainability for both the user and the environment.

In the design of kitchen spaces, minimizing energy and water consumption, proper selection and minimal use of materials, designing the spatial organization to meet the needs of the user, making designs that can attract the user's attention visually, containing cultural and ecological values and being economical are among the requirements of sustainable design. Utilizing technological opportunities to meet these criteria is also necessary in today's conditions.

Addressing kitchen design with a sustainability approach contributes to ecology and creates comfortable, healthy, and aesthetic spaces for users. In addition, it is possible to say that it contributes to raising awareness among the future designers involved in the project about integrating technology with nature instead of consuming resources.

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Author Contribution and Conflict of Interest Declaration Information

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

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He was born in Samsun in 1990. He continued his primary, secondary and high school education in Ankara, Rize and Ordu and completed it in Antalya. He started studying at Atatürk University Department of Landscape Architecture in 2009 and participated in the ERASMUS program at the Estonian University of Life Sciences (Tartu/Estonia) between 2011 and 2012. After graduating from undergraduate education as a High Honor Student in 2013, he started his master's degree at Akdeniz University Institute of Science, Department of Landscape Architecture, in 2013 and graduated in 2016. In the same year, he was appointed as a research assistant at Süleyman Demirel University Faculty of Architecture, Department of Landscape Architecture. He started his PhD at Süleyman Demirel University Institute of Science and Technology, Department of Landscape Architecture in 2016 and graduated in 2020. In 2022, he was appointed as an assistant professor at Süleyman Demirel University, Faculty of Architecture, Department of Landscape Architecture. He served as research assistant council representative and department vice president. He currently works as the Head of the Department of Landscape Architecture at Süleyman Demirel University. He has authored many national and international articles, symposium papers, and book chapters. He is the section editor and publication editor of the Journal of Architectural Sciences and Applications.

Halime GÖZLÜKAYA

Halime Gözlükaya completed her undergraduate education at Süleyman Demirel University, Faculty of Engineering and Architecture, Department of City and Regional Planning. She was second in her class when she earned an honors degree from the department in 2009. She carried on with her graduate studies at Süleyman Demirel University's Institute of Science's Department of City and Regional Planning. She started working as a research assistant in the Department of City and Regional Planning at Amasya University's Faculty of Architecture in 2013 while completing her master's degree. Later in 2014, she changed institutions and worked as a research assistant at the Department of City and Regional Planning at Süleyman Demirel University's Faculty of Architecture. Since 2018, she has been working toward her doctoral degree at the Department of Urban and Regional Planning, Graduate School, of Istanbul Technical University. She was hired by the Department of City and Regional Planning at Istanbul Technical University's Faculty of Architecture for the academic year 2022–2023 while pursuing her doctorate, and she spent roughly one and a half years there as a research assistant. She has consistently participated in numerous initiatives and committees within the faculty and department throughout her career. Additionally, she has participated in the planning of numerous symposiums, congresses, and seminars. She has been working for the Journal of Architecture Sciences and Applications since 2017 as an associate editor and editor. She continues her academic career at Süleyman Demirel University as a research assistant in the Department of City and Regional Planning.

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