ICONARP

International Journal of Architecture & Planning

INDEXED IN
EMERGING SOURCES CITATION
(Web of Science)
CLARIVATE ANALYTICS

E-ISSN: 2147-9380
Volume 12
Issue 1
JUNE 2024

International Journal of Architecture & Planning
Volume 12, Issue 1, June 2024
DOI: 10.15320 / E-ISSN: 2147-9380
Online: http://iconarp.ktun.edu.tr

ICONARP

Contact: *ICONARP Konya Teknik Üniversitesi Mimarlık ve Tasarım Fakültesi Akademi Mah. Yeni İstanbul Cad. No: 235/1 Selçuklu/KONYA* ***Tel:*** *+90332 2051000* ***E-mail:*** *iconarp.editor@ktun.edu.tr*

International Journal of Architecture & Planning
Online: http://iconarp.ktun.edu.tr

ICONARP

Volume 12, Issue 1, June 2024
DOI: 10.15320 /E-ISSN: 2147-9380

ICONARP INTERNATIONAL JOURNAL OF ARCHITECTURE & PLANNING

ICONARP as a free academic e-journal considers original research articles and viewpoints in peer-reviewed.

Architecture, Planning and Design are strongly affected by other disciplines such as fine arts, philosophy, engineering, geography, economics, politics, sociology, history, psychology, geology, information technology, ecology, law, security and management. However, there are not enough academic journals which specifically focus on the connections of architecture, planning and design with other fields of science. ICONARP aims to fill that gap. Our scope is to provide a suitable space for theoretical, methodological and empirical papers, which use global and local perspectives together, in architectural and urban studies.

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

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

Volume 12, Issue 1, June 2024
DOI: 10.15320 /E-ISSN: 2147-9380

ABSTRACTING AND INDEXING

ICONARP is an Open Access Journal which presents its content freely for online researches with the aim of contributing to the global exchange of knowledge. ICONARP believes that providing free online access ensures a wider spectrum of research base and reading rate to develop the related literature.

*"The abstracting, database and indexing services that ICONARP is included are:
Emerging Sources Citation Index (ESCI) (Web of Science ESCI), DOAJ, Tubitak Ulakbim TR Dizin, Iconda Bibliographic (The International Construction Database), Avery Index to Architectural Periodicals, Erihplus, EbscoHost, Ulrichsweb, NSD Norwegian Register for Scientific Journals, OpenAIRE, OCLC WorldCat, BASE (Bielefeld Academic Search Engine), Scilit, ROAD (Directory of Open Access)"*

Cover Photo: Sony Center, Berlin, Germany (2014), Cover Owner: Selçuk Sayın, Cover Design: Ceyhan Tazefidan.

ACKNOWLEDGEMENT

We would like to thank the former editors who contributed to the publication of this issue; Mehmet Topçu, Murat Oral and Hale Öncel.

CONTENTS

International Journal of Architecture & Planning
Online: http://iconarp.ktun.edu.tr

ICONARP

Volume 12, Issue 1, June 2024
DOI: 10.15320 /E-ISSN: 2147-9380

ICONARP
International Journal of Architecture and Planning
Received: 24.11.2022 Accepted: 04.01.2024
Volume 12, Issue 1/ Published: 30 .06.2024
DOI: 10.15320/ICONARP.2024.273 E- ISSN:2147-9380
Research Article
ICONARP

Improving Indoor Air Quality with Natural Ventilation Methods: A Simulation Study

Caner Yetiş[*]
Merve Tuna Kayılı [**]

Abstract
In modern life, strategies developed in line with the increasing energy demand cause many environmental problems on a global scale. One of the most important of these problems is inadequate indoor air quality. The most critical parameters affecting indoor air quality during the design phase are selecting wrong and unhealthy building products, insufficient window sizes, and unplanned natural ventilation. This study investigates whether indoor air quality can be improved only by effective natural ventilation methods, without compromising thermal comfort, through small changes that can be applied to buildings. For this purpose, simulation studies were carried out to reveal whether indoor air quality could be improved without compromising thermal comfort in a library building. As a result, when evaluating the improvement recommendations, the thermal comfort range for the cross-ventilation and chimney effect ventilation recommendations is 'comfortable' in winter and 'comfortable-partially comfortable' in summer. For the ventilation recommendations with roof wings, skylights and wind towers, the thermal comfort range for summer and winter remained in the "comfortable" range due to the high natural ventilation performance.

Keywords:
Buildings with atriums, Improvement proposals, Indoor air quality, Natural ventilation, Thermal comfort, Simulation software, IDA ICE

[*]Vocational School of Technical Sciences, Bitlis Eren University, Bitlis, Turkey. (*Corresponding author*)

E-mail: cyetis@beu.edu.tr

[**]Başak Cengiz Faculty of Architecture, Karabük University, Karabük, Turkey.

E-mail: mervetunakayili@karabuk.edu.tr

To cite this article: Yetiş, C., & Tuna Kayılı, M. (2024). Improving Indoor Air Quality with Natural Ventilation Methods: A Simulation Study. *ICONARP International Journal of Architecture and Planning,* 12 (1), 1-23. DOI: 10.15320/ICONARP.2024.273

INTRODUCTION

Since the beginning of the 20th century, the time spent indoors has increased due to changing living standards, and this situation has led individuals to need a more comfortable indoor space. Therefore, in the literature, in addition to air pollution, the effects of indoor air pollution on human health have also been investigated (Klepeis et al., 2001; De Giuli et al., 2012; Odeh & Hussein, 2016; Rivera-Rios et al., 2021; Li & Ma, 2021; Wang & Norbäck, 2022). It has been observed that due to the worldwide energy crisis emerging, especially in the 1970s, and the high insulation level in buildings, the air permeability between the indoor and outdoor environment of buildings has been prevented. As a result of this, short- and long-term health problems as well as other disorders related to the living environment, such as Sick Building Syndrome and Tight Building Syndrome, have emerged in individuals (Vural, 2004; Persily & Emmerich, 2011; Güler, 2012). Wrong design decisions and the production of buildings with high impermeability and artificial building materials cause a decrease in indoor air quality due to the ineffective use of natural ventilation. The most important reasons of the decrease in indoor air quality are the infiltration of industrial gases originating from the outside environment, CO_2 and particulate matter arising from human activities, and volatile organic compounds (VOCs) included in bitumen-based building products, cleaning materials, and furniture (Abt et al., 2000; Chao & Cheng, 2002; Cattaneo et al., 2011; Salma et al., 2013; Luengas et al., 2015; Lei et al., 2019; Shrubsole et al., 2019; Sun et al., 2019; Kozielska et al., 2020; Abdel-Salam, 2021; Gonzalez-Martin et al., 2021). It is known that this pollution in the indoor air causes psychological and physiological effects on people using buildings. These effects have led to the need to determine indoor air pollution levels and to develop effective methods for solving problems (Mendell et al., 2013; Mendes &Teixeira, 2014; Fernández-Agüera et al., 2019; Kapola et al., 2020; Ao et al., 2021).

Adequate ventilation is one of the most effective ways to remove building-based pollutants, which reduce indoor air quality, from a building (Gonzalez-Martin et al., 2021; Etheridge, 2011; Jin et al., 2014; Kumar et al., 2021). In the context of sustainable building design criteria, it is vital to make decisions for adequate and effective natural ventilation during the design process of the building in order to create healthy interior spaces by using low energy (Heiselberg, 2004; Omrani et al., 2017; Wang & Malkawi, 2019; Utkucu & Sözer, 2020). Artificial building materials, the disproportion between the number of users and the size of the space, and the lack of adequate natural ventilation openings are some of the reasons that reduce indoor air quality. In such cases, indoor air quality can be improved by mechanical ventilation, which requires additional equipment and energy (Emmerich, 2006; Wright et al., 2009; Kovesi et al., 2009; Park et al., 2014; Francisco et al., 2017; Huang et al., 2020; Zhang et al., 2021). On the other hand, buildings are responsible for a large part of global energy consumption. The energy needed for heating,

DOI: 10.15320/ICONARP.2024.273

cooling, air conditioning, and clean air causes resource consumption. The energy needed for building ventilation constitutes half or more than half of the total building energy consumption (Cui et al., 2020). Therefore, reducing the energy needed in buildings is as important as the indoor air quality. Thus, indoor air quality and energy performance must be achieved together (Zhang et al., 2021).

The purpose of this study was to investigate whether the indoor air quality of a building can be improved without compromising on the thermal comfort of the building and increasing energy consumption by applying only the principles of controlled natural ventilation. The study also aimed to develop recommendations for natural ventilation based on on-site measurements and simulation results. Within the scope of the research, on-site measurements were carried out in the building for five days. The results obtained through on-site measurements were verified by the simulation program, and natural ventilation recommendations were developed based on simulation results. It is expected that this study, which underlines that indoor air quality can be improved with the effective design of natural ventilation methods, will guide works aiming to build constructions with low energy consumption. The study will also contribute to the literature in the fields of economics and sustainability.

MATERIALS AND METHODS

Case Study

The adequate provision of indoor comfort conditions and natural ventilation strategies is directly related to the natural and artificial environment in the nearby area, as well as the physical characteristics of the building. At this stage, it is essential to identify the areas causing pollution near the building and determine the direction of possible air currents in the environment.

In the context of the study, to be able to improve indoor air quality by only natural ventilation designs without compromising thermal comfort, a university library building with an atrium and many users was chosen. The building is located in Karabük, which is a city in Turkey's Western Black Sea region. The campus where the library is located is on the southern slope of the valley shaped by Araç Stream and in the center of the sloping topography. There are iron and steel rolling mills on the northwest line of the building and agricultural and forest areas along the east and south facades (Figure 1). As seen in Figure 2 (a and b), air currents formed around the building are in two primary forms: the air currents formed in the prevailing wind direction and the air currents formed due to the slope developing depending on the topography. While there are no structures in the area facing the northern facade of the building, there is the laboratory building of the university in the area facing the southern facade of the building. The southwest facade of the building leads to the low-rise sports complex, and the northwest facade leads to the R&D building (Figure 3a). The library with two floors has a rectangular plan of 25 m-37.5 m and is located in the northwest-southeast direction. A double-winged automatic door provides entrances to the building from the southeast and northwest facades. The atrium area, which defines the entrance axis in the planning scheme, is 10.5 m-8.4 m in size and is located in the center of the building circulation axis. The circulation axis formed by the atrium covered with a steel carrier glass cover system is a glass curtain wall, while the other facades of the building are composite curtain walls. The eastern and western parts of the atrium consist of symmetrical study areas and bookshelves. There are a total of six group study rooms, three of which are on the ground floor and three on the 1st floor (Figure 3b, c). These rooms are located next to the stairs and elevator block on the northeast facade of both floors.

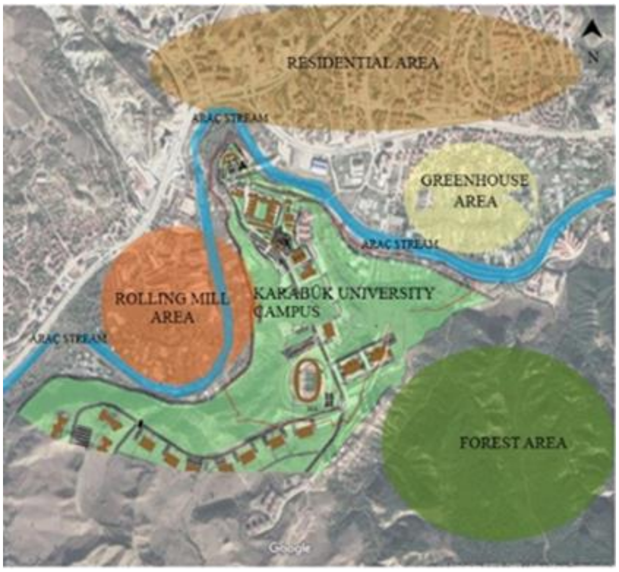


Figure 1. Analysis of the close environment of the library

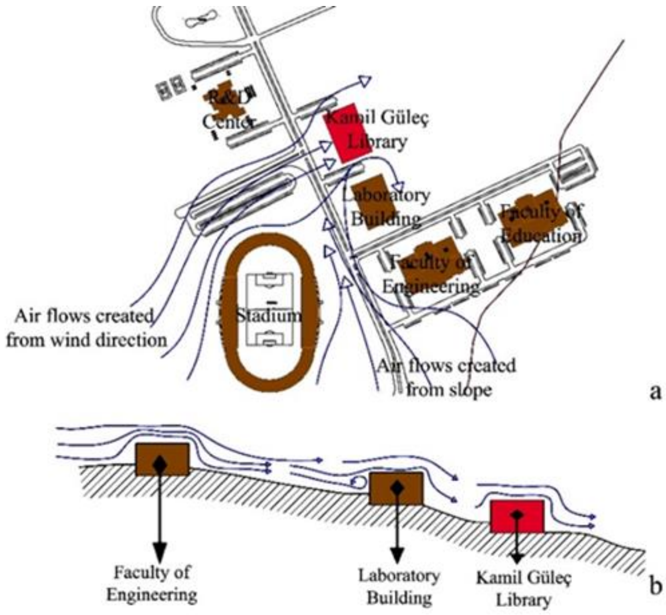


Figure 2. a) Air currents formed in the vicinity of the building **b)** Air currents formed from the slope

DOI: 10.15320/ICONARP.2024.273

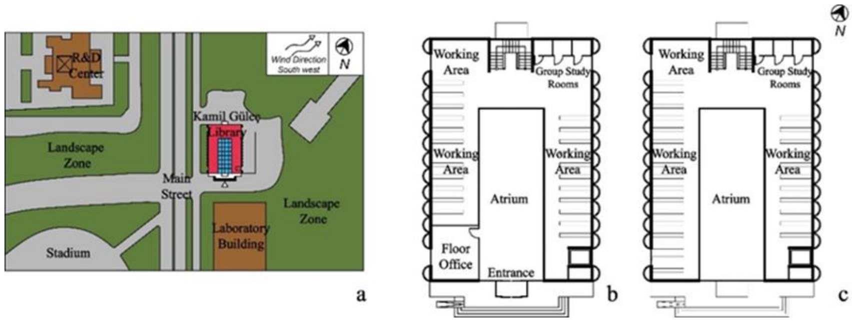


Figure 3. a) Site plan of the library **b)** Ground floor plan of the library **c)** 1st floor plan of the library

Simulation Software

In the study, the IDA ICE (IDA Indoor Climate and Energy) software was used to determine the thermal comfort of the building and to analyze the improvement proposals. IDA ICE is a simulation software that provides outputs related to indoor comfort by simulating indoor energy consumption, thermal comfort conditions, lighting, heating and cooling loads, CO_2 amount, humidity amount, and PMV-PPD (predictive mean vote-predicted percentage of dissatisfied) calculations. The IDA ICE software has been used in many studies related to indoor comfort, and it is stated that this software is suitable for determining indoor climatic comfort (Mateo & Aranaz, 2011; Soleimani-Mohseni et al., 2016; Hilliaho et al., 2015; Karlsen et al., 2015). The software offers an infrastructure where meteorological data and all data related to the building and its environment can be evaluated together. In addition to the IDA ICE's modeling capability, IFC models created by Archicad, Revit, Autocad, and Magicad-based programs can also be loaded. Data related to regional heat and energy balances, air and surface temperatures, amount of daylight and illumination level, results related to building occupancy rate, heat and mass transfer, and results for indoor air quality, PPD, PMV comfort indices, and energy demand are the outputs reported by the software.

Determination of the Thermal Comfort and Indoor Air Quality

In order to determine the current indoor air quality of the library and to validate the simulation software to be used in the presentation of improvement proposals, indoor thermal comfort and air quality should be determined. In this context, temperature, humidity CO_2, and TVOCs (total volatile organic compounds) measurements were performed using the devices detailed in Table 1.

Table 1. Devices used in measurement process and their features.

Measuring Device	Function	Technical Features
Extech CO250	CO_2, humidity, and temperature	Measuring range: 0-9.999 ppm (Sensitivity: 1 ppm)
Extech VFM200	TVOCs	Measuring range: 0.00-9.99 ppm (Sensitivity: 1 ppm)

For measurements, three different points on each floor, which were far from each other and where there was no airflow, were determined

(Figure 4a, b). While deciding the measurement times, considering that the library would be used more during the exam periods, the interval of 12.30.2019-01.03.2020 was determined for the winter period. During the winter, the measurements were performed by repeating each of them three times at 30-minute intervals for five days between 10:00-19:00 when the library was the busiest. The mean values were determined by calculating the arithmetic mean of the three measurements. The data obtained for each indoor pollutant were analyzed based on the threshold values determined by international institutions and organizations (US-EPA, WHO, WSHD, ASHRAE, HONG-KONG) (Table 2).

Figure 4. a) Ground floor measurement points **b)** 1st floor measurement points

Table 2. Threshold limit values determined for indoor thermal comfort and indoor air quality (CO_2 and TVOCs) according to international institutions

Parameters	EPA	WHO	WSHD	ASHRAE	HONG-KONG
CO_2 (ppm)	1000	1000	1000	1000	800
TVOCs (ppm)	3	1-3	1-3	2	-
Temp. (°C)	22.5-25.5	22.5-25.5	22.5-25.5	22.5-25.5	22.5-25.5
Hum. (%)	<70	<70	40-70	30-60	40-70

Determination of the improvement proposals and decision-making process

Natural and mechanical ventilation methods can ensure the removal of pollutants detected indoors. However, taking into account the hypothesis that “it is possible to achieve a sustainable and healthy building by following the right design strategies without increasing the energy needs of the building", it was aimed to improve the building only with natural ventilation. When examining the design of the building at this stage, the presence of an atrium space was a guide in natural ventilation scenarios.

In order to create natural ventilation scenarios, indoor air circulation was discussed first. As seen in Figure 5, the currents coming from the prevailing wind direction and the slope reach the interior space through the existing windows in the northwest and southeast on the ground floor and the first floor and the main entrance door on the ground floor. Air currents formed in the prevailing wind direction are directed depending on the landscape elements lined up along the road, and air vortices are formed here and there. It can be said that the effect of the air currents

DOI: 10.15320/ICONARP.2024.273

reaching the building is limited due to the short stature of the trees positioned along the facade and their arrangement along the sloping land.

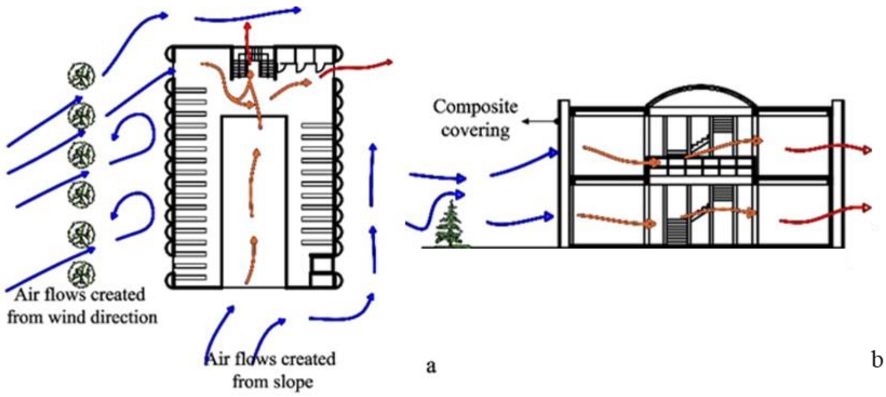


Figure 5. a) Plan diagram of air currents in the building **b)** Section diagram of air currents in the building

In the first stage, a simulation was carried out by taking into account the indoor and outdoor air movements and using the existing openings of the structure. For the simulation, it was assumed that the existing windows in the building remained open for ten minutes every two hours. As a result of the simulation, by providing fresh air to the building from the southwest, which is the prevailing wind direction, the CO_2 level was in line with the threshold values. However, the temperature and humidity values were 3-4 ℃ and 20% higher than the threshold values, respectively. It was determined that thermal comfort could not be provided due to the small size of the windows (Figure 6). The large size of the existing windows and their negative effects on thermal comfort, especially in winter, necessitate insulated culverts with smaller dimensions. Therefore, within the scope of the study, insulated culverts with a size of 30*30 and a relatively low thermal permeability coefficient were preferred (Table 3). In addition, since the humidity value was much lower than it should be, a steam humidifier with a special control feature was included in the system to improve humidity values.

Table 3. Technical specifications of the insulated grille.

Parameters	**Value**
Width (cm)	30
Height (cm)	30
Material	Aluminum
Solar heat gain coefficient	0.78
Heat conduction coefficient W/(m^2.K)	3.688
Thermal resistance (m^2.K)/W	0.271

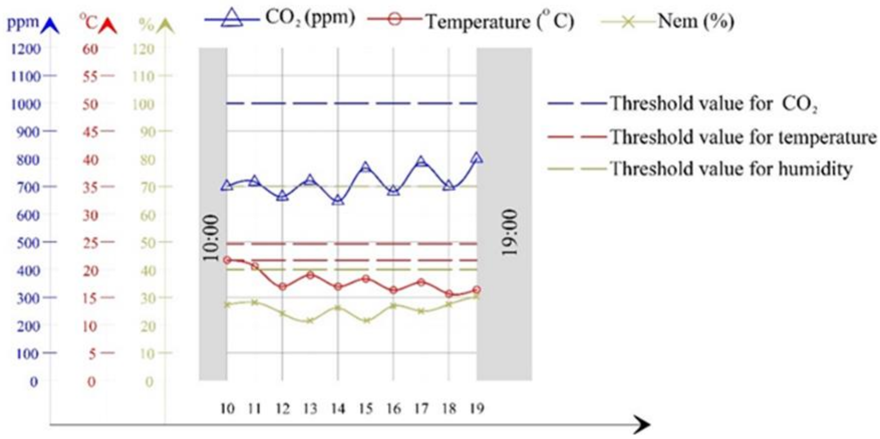


Figure 6. The effect of natural ventilation planned using existing structural openings on indoor thermal comfort and air quality

Based on the literature review (Kuesters & Woods, 2012; Jomezadeh et al., 2020; Haw et al., 2012; Acret & Hunt, 2014; Escombe et al., 2019; Carbonari et al., 2006) conducted considering the atrium space, it was decided that it would be the correct way to develop improvement scenarios in the context of the principles of cross-ventilation, chimney effect ventilation, roof wing ventilation, skylight ventilation, and wind tower ventilation. In each scenario created by considering each ventilation method, the prevailing wind direction (the southwest) was taken into account, and the air currents were planned to enter through the vents to be opened in these areas. In order to evacuate the polluted air, culverts in the southeast direction were considered. Height differences were created between the inlet and outlet vents to provide adequate natural ventilation in each scenario. The primary and visual characteristics of these proposed systems are presented in detail in Table 4 and Figure 7.

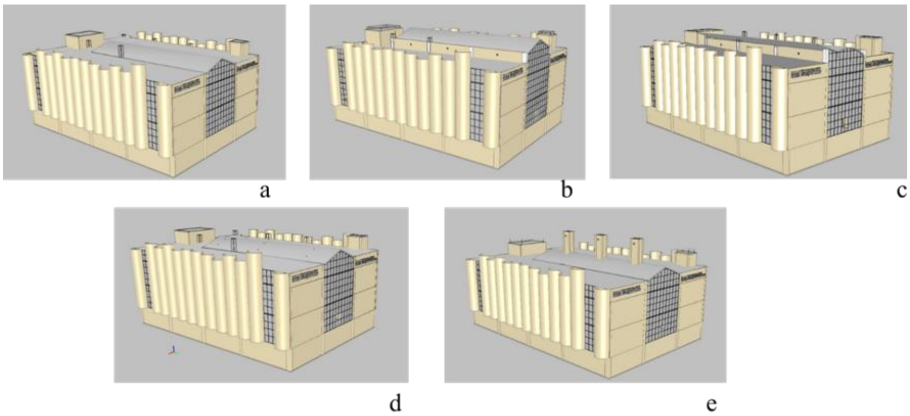
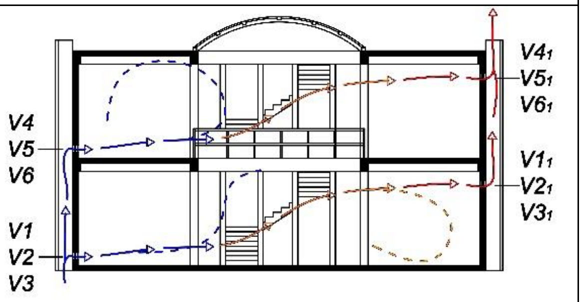
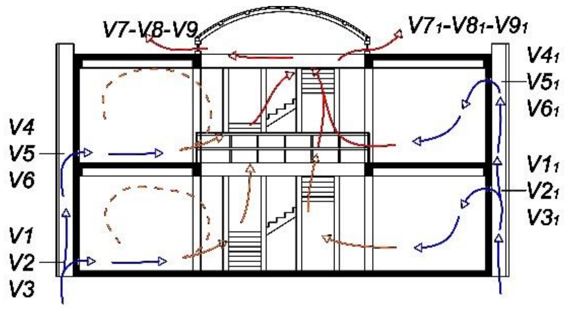
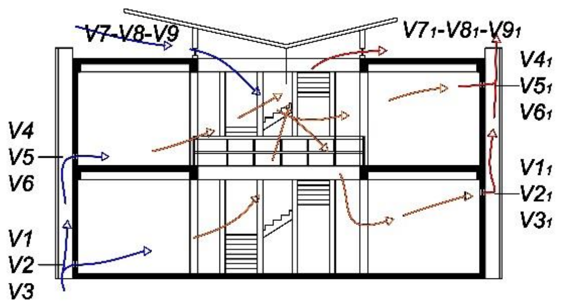
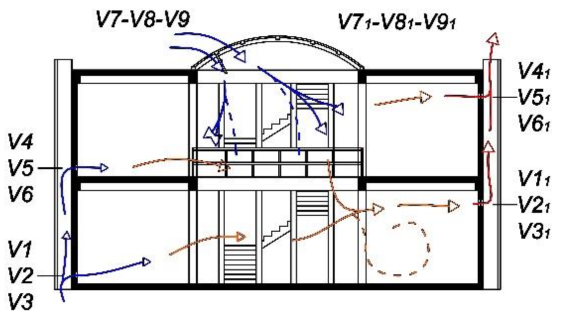


Figure 7. a) Simulation model for cross ventilation proposal, **b)** Simulation model for stack ventilation proposal, **c)** Simulation model for roof wing ventilation proposal, **d)** Simulation model for skylight ventilation proposal, **e)** Simulation model for wind tower ventilation proposal

DOI: 10.15320/ICONARP.2024.273

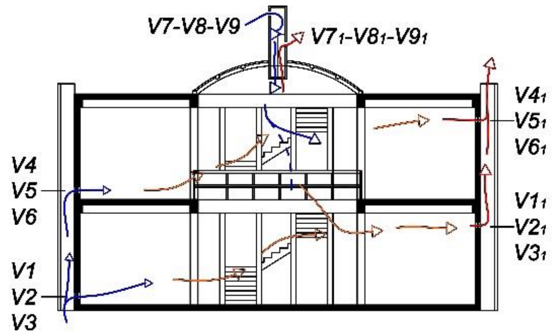
Table 4. Decisions on improvement proposals and their features.

Cross Ventilation (12 vents)	
Location of vent	**Section schemas**
Ground floor; southwest façade +1.10 altitude; V1, V2 and V3, southeast façade +3.50 altitude; $V1_1$, $V2_1$ and $V3_1$ 1st floor; southwest façade +4.60 altitude; V4, V5 and V6, southeast façade +8.00 altitude; $V4_1$, $V5_1$ and $V6_1$	
Stack Ventilation (18 vents)	
Location of vent	**Section schemas**
Ground floor; southwest façade +1.10 altitude; V1, V2 and V3, southeast façade +3.50 altitude; $V1_1$, $V2_1$ and $V3_1$ 1st floor; southwest façade +4.60 altitude; V4, V5 and V6, southeast façade +8.00 altitude; $V4_1$, $V5_1$ and $V6_1$ Atrium ceiling height; southwest façade +10.20 altitude; V7, V8 and V9, southeast façade +10.20 altitude; $V7_1$, $V8_1$ and $V9_1$	
Roof Wing Ventilation (18 vents)	
Location of vent	**Section schemas**
Ground floor; southwest façade +1.10 altitude; V1, V2 and V3, southeast façade +3.50 altitude; $V1_1$, $V2_1$ and $V3_1$ 1st floor; southwest façade +4.60 altitude; V4, V5 and V6, southeast façade +8.00 altitude; $V4_1$, $V5_1$ and $V6_1$ Atrium ceiling height; southwest façade +10.20 altitude; V7, V8 and V9, southeast façade +10.20 altitude; $V7_1$, $V8_1$ and $V9_1$	
Skylight Ventilation (18 vents)	
Location of vent	**Section schemas**
Ground floor; southwest façade +1.10 altitude; V1, V2 and V3, southeast façade +3.50 altitude; $V1_1$, $V2_1$ and $V3_1$ 1st floor; southwest façade +4.60 altitude; V4, V5 and V6, southeast façade +8.00 altitude; $V4_1$, $V5_1$ and $V6_1$ Atrium ceiling height; southwest façade +10.20 altitude; V7, V8 and V9, southeast façade +10.20 altitude; $V7_1$, $V8_1$ and $V9_1$	

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

<table>
<tr><th colspan="2">Wind Tower Ventilation (18 vents)</th></tr>
<tr><th>Location of vent</th><th>Section schemas</th></tr>
<tr><td><u>Ground floor;</u> southwest façade +1.10 altitude; V1, V2 and V3, southeast façade +3.50 altitude; V1$_1$, V2$_1$ and V3$_1$

<u>1st floor;</u> southwest façade +4.60 altitude; V4, V5 and V6, southeast façade +8.00 altitude; V4$_1$, V5$_1$ and V6$_1$

<u>Atrium ceiling height;</u> southwest façade +10.20 altitude; V7, V8 and V9, southeast façade +13.20 altitude; V7$_1$, V8$_1$ and V9$_1$</td><td>
</td></tr>
</table>

RESULTS

Thermal comfort and indoor air quality

It is observed that the library ground floor temperature values tend to increase in the process from morning hours to noon and show a slight decrease in the evening hours and proceed in a stable course. It is possible to say that this increase between morning and noon is related to the increase in the number of people and the outdoor temperature. The fact that the temperature on the 1st floor is higher than the temperature on the ground floor can be explained by the constant inflow of cold air into the interior due to the main entrance door on the ground floor, the high number of users on the 1st floor, and the fact that the heated air reaches the upper levels by rising. As seen in Figure 8, the temperature values varying between 22℃ and 24.3℃ throughout the day are in line with the threshold values (22.5℃ to 25.5℃) determined by the US-EPA, WHO, WSHD, ASHRAE, and HONG-KONG institutions.

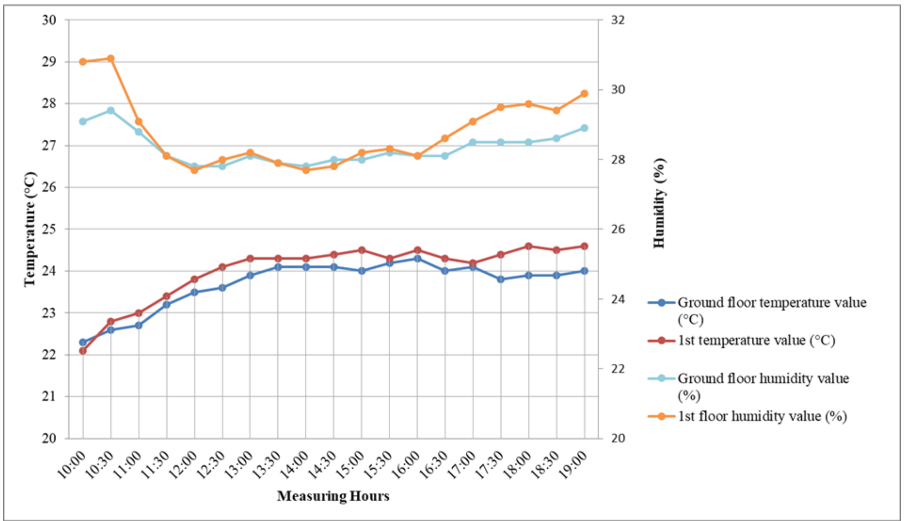


Figure 8. 5-day average temperature-relative humidity graph for the ground floor and 1st floor

DOI: 10.15320/ICONARP.2024.273

It is observed that the ground and first-floor relative humidity values tend to decrease sharply towards the noon hours and tend to increase sharply towards the evening hours. The fact that the humidity is lower between 12:00 and 16:30 compared to morning and evening hours can be explained by the decrease in the relative humidity due to the increase in indoor temperature. It is believed that the reason why the humidity value of the first floor is lower and fluctuates between 12:00 and 16:30 compared to the ground floor is that the temperature level on the 1st floor is higher than the ground floor. The humidity measured on both floors follows the limit values determined by the US-EPA (<70%) and WHO (<70%) institutions; WSHD (40%-70%), ASHRAE (30%-60%), and HONG-KONG (40%-70%) were determined not to comply with the lower limit values determined by the institutions (Figure 8). In the context of the average indoor temperature (23.8℃-24.2℃), relative humidity (27.4%-29.2%), air movement velocity (0.02 m/s), activity level (1 met), clothing condition (1 clo) data, and ASHRAE 55-2017, the obtained PMV value was found to be 0.02 and 0.14 (i.e., "Neutral") for the ground floor and 1st floor, respectively. The PPD value, which expresses the percentage of people dissatisfied with the interior thermal comfort, was determined as 5% for each floor. Based on the thermal comfort ranges determined by ASHRAE 55-2004, the thermal comfort range of the interior was determined as "partially comfortable" (Figure 9).

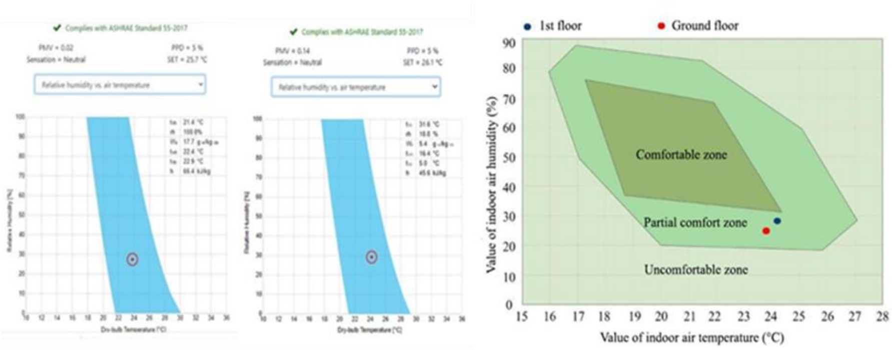


Figure 9. Thermal comfort graph (ASHRAE 55-2017) and comfort zones of Ground and 1st Floor

As seen in Figure 10, while CO_2 values on the ground floor were determined between 800 ppm and 1200 ppm, these values were between 800 ppm and 1250 ppm on the 1st floor. These values were 2-3 times the amount of CO_2 (423 ppm) measured outdoors. It was determined that since the morning hours, the CO_2 values for both floors were above the threshold values determined by the HONG-KONG (800 ppm) institution. At noon, in parallel with the increase in the number of people, the CO_2 concentration in the environment increased sharply and exceeded the threshold value determined by the US-EPA, WHO, WSHD, and ASHRAE (1000 ppm) institutions (Figure 10).

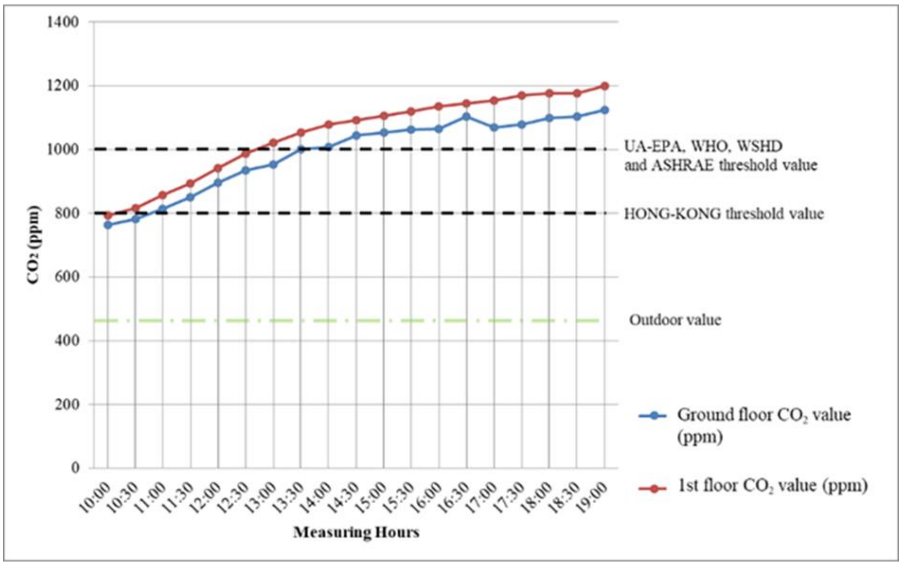


Figure 10. Average CO_2 value graph for ground floor and 1st floor for 5 days

The amount of TVOCs measured within the scope of the study represents the total amount of all VOC types in the environment. It was observed that the total TVOCs concentration measured in the ground and first floor was around 1.5 ppm throughout the day (Figure 11). This value was below the threshold values determined by US-EPA (3 ppm) and ASHRAE (2 ppm) and above the threshold values determined by WHO and WSHD (1 ppm). It was also observed that with the start of the cleaning process in the space as of 16:00, there was an increase in the amount of TVOCs in the space due to the chemical used in this process (Figure 11).

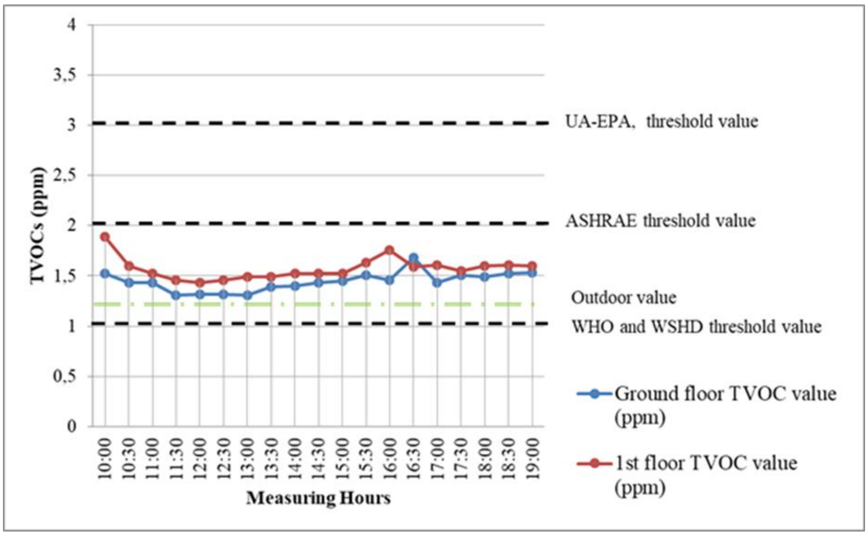


Figure 11. Graph of 5-day average TVOCs for ground and 1st floor

Calibration of the Simulation Data

After the indoor air quality level was determined by on-site measurements performed in the library, the current situation was simulated with the IDA ICE simulation program, and the margin of error was determined by comparing the obtained results with each other. At this stage, physical data such as the current state of the building, the

DOI: 10.15320/ICONARP.2024.273

density and number of users on the measurement days, and weather conditions were entered into the simulation program, and attention was paid to ensure that all conditions were the same. The graph of 5-day CO_2, humidity, and temperature values obtained from simulation results and on-site measurements is given in Figure 12.

Root mean square deviation (RMSE/Root-Mean-Square-Deviation) and mean crossover error (MBE/Mean Bias Error) were determined for the deviation of CO_2, humidity, and temperature values obtained as a result of simulation studies and on-site measurements, and these are presented in Table 5. In order to verify simulation results based on the ASHRAE 14-2002 standard, RMSE and MBE values are expected to be within 30% and 10%, respectively. As seen in Table 5, RMSE and MBE values were found to be much lower than the accepted upper limit values, and it was determined that the simulation program was appropriate for use in determining improvement proposals.

Table 5. The deviation values determined between the simulation program and on-site measurement values

		Day 1		Day 2		Day 3		Day 4		Day 5	
		CV (RMSE)	**NMBE**	**CV (RMSE)**	**NMBE**	**CV (RMSE)**	**NMBE**	**CV (RMSE)**	**NMBE**	**CV (RMSE)**	**NMBE**
G	Temp	0.01	0.32	0.01	0.24	0.01	0.04	0.01	1.03	0.01	0.82
	Hum	0.09	6.5	0.06	3	0.11	12	0.05	3.4	0.12	6.4
	CO_2	0.01	0.23	0.03	0.32	0.03	1.30	0.02	0.73	0.02	0.83
1	Temp	0.01	0.2	0.01	0.51	0.01	0.97	0.01	0.08	0.01	0.24
	Hum	0.06	0.8	0.03	0.87	0.09	7.3	0.02	0.13	0.06	1.88
	CO_2	0.75	7.8	0.33	2.6	0.06	0.7	0.12	1.4	0.03	0.06

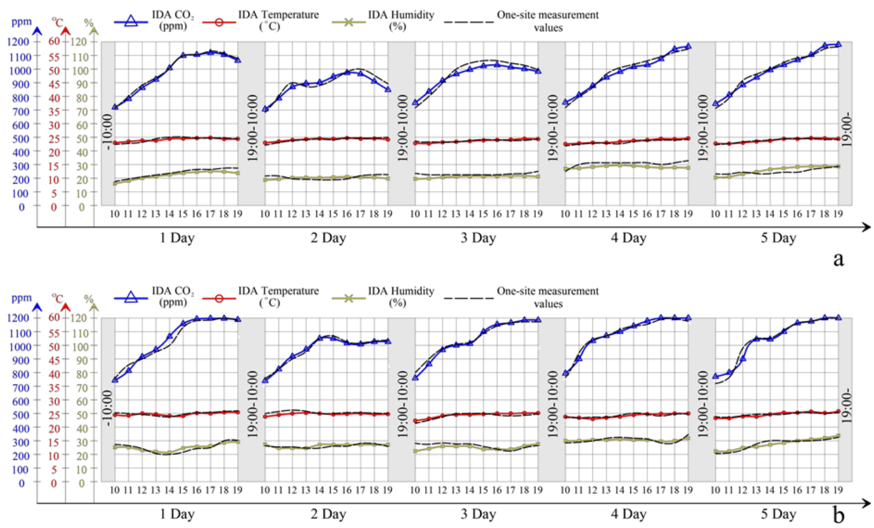


Figure 12. Daily CO_2, temperature, and humidity verification graphs of **a**) the ground floor and **b**) the 1st floor

Results of the Improvement Proposals

For the cross-ventilation proposal, it was planned to install 12 vents. Results revealed that the air quality of the space could be improved without compromising thermal comfort. The average CO_2 level was 838.5 ppm, while the average temperature and humidity were 22.1 ℃ and

50.9%, respectively. Based on this proposal, it can be recommend that the vents should be kept open for 10 minutes at intervals of 30 minutes during the summer season and for 10 minutes at intervals of 120 minutes during the winter season when the library is in use (Table 6).

For the proposal on chimney effect ventilation, 18 vents were planned. Results related to this proposal showed that the air quality of the space could be improved without compromising thermal comfort. The average CO_2 level was 812.5 ppm, and the average temperature and humidity were 22.3°C and 52%, respectively. Based on this ventilation proposal, it can be recommended that the vents should be kept open for 10 minutes with an interval of 45 minutes during the summer season and for 10 minutes with an interval of 180 minutes during the winter season when the library is in use (see Figure 13). Chimney effect ventilation is more effective than cross-ventilation in terms of natural ventilation performance because it incorporates both the principles of cross-ventilation and the additional ventilation provided by the additional vents located at the roof level (Table 6).

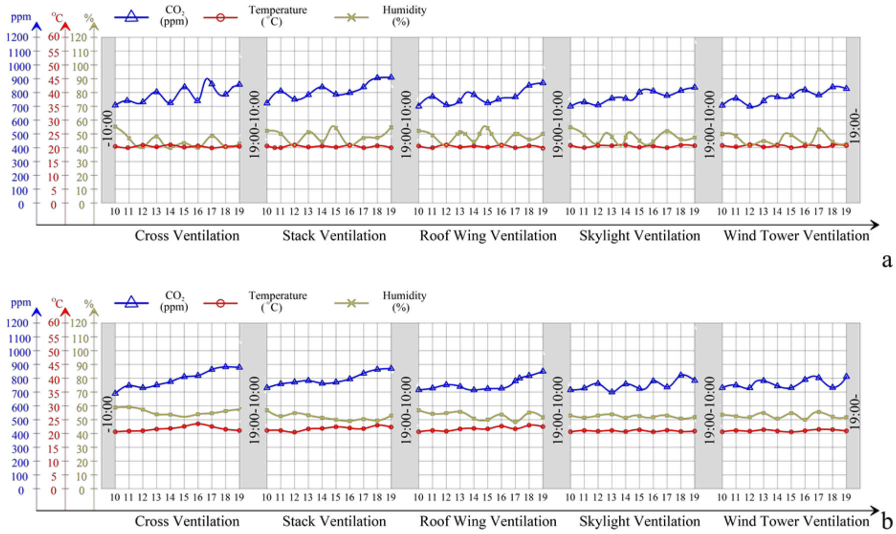


Figure 13. a) Winter period simulation results for improvement proposals, **b)** Summer period simulation results for improvement proposals

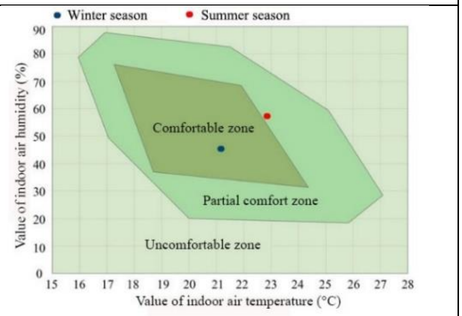
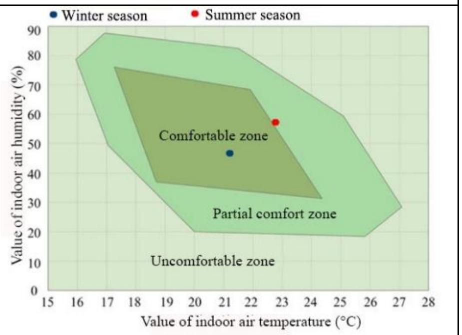
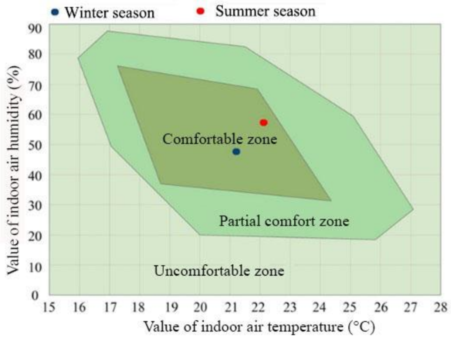
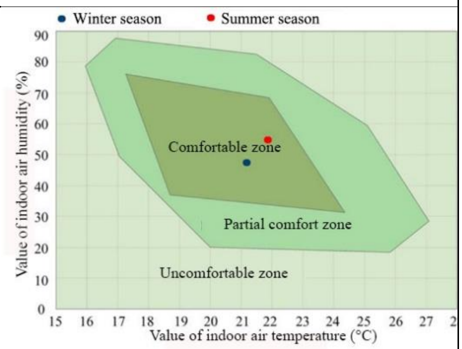
In the proposal of roof wing ventilation, the grilles were open for 10 minutes with 60-minute intervals in summer and 10 minutes with 180-minute intervals in winter. In addition, the CO_2 content was kept at an average value of 783 ppm. In the skylight ventilation proposal, the grilles were open for 10 minutes with 45-minute intervals in summer and 10 minutes with 150-minute intervals in winter. The results revealed that the roof wing provided better ventilation performance than the skylight due to its ability to direct wind towards the prevailing wind direction (Table 6 and Figure 13).

For the wind tower ventilation proposal, it was planned to install 18 vents. Results showed that the air quality of the space could be improved without compromising thermal comfort. The average CO_2 level was measured at 785 ppm, while the average temperature and humidity were 21.9 °C and 50.5%, respectively. Based on this ventilation proposal, it can

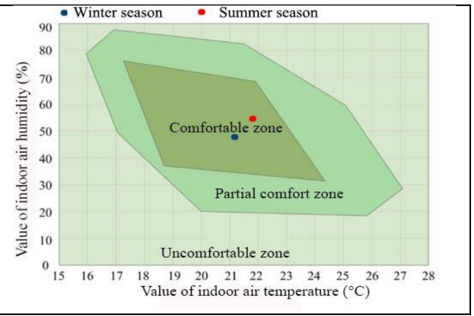
DOI: 10.15320/ICONARP.2024.273

be recommended that the vents should be kept open for 10 minutes at 30-minute intervals during the summer season and for 10 minutes at 150-minute intervals during the winter season when the library is in use. As seen in Table 6 and Figure 13, the natural ventilation performance of this proposal is lower than that of the chimney effect, roof wing, and skylight proposals during the summer season, while it is lower than the chimney effect and roof wing ventilation proposals during the winter season, and equivalent to the skylight proposal.

Table 6. Thermal comfort and indoor air quality results for improvement proposals

	Window opening periods	**Average values**	**Comfort charts**
Cross V.	Summer season; 10 min every 30 min Winter season; 10 min every 120 min	Temp.; 22.1 Hum.; 50.9 CO_2; 838.5	
Stack V.	Summer season; 10 min every 45 min Winter season; 10 min every 180 min	Temp.; 22.3 Hum.; 52 CO_2; 812.5	
Roof Wing V.	Summer season; 10 min every 60 min Winter season; 10 min every 180 min	Temp.; 22.1 Hum.; 52.6 CO_2; 783	
Skylight V.	Summer season; 10 min every 45 min Winter season; 10 min every 150 min	Temp.; 22.1 Hum.; 51.5 CO_2; 780	

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Wind Tower V.	Summer season; 10 min every 30 min Winter season; 10 min every 150 min	Temp.; 21.9 Hum.; 50.5 CO_2; 785	

DISCUSSION

Results of the study revealed that in terms of indoor air quality, skylights (780 ppm), roof wings (783 ppm), and wind towers (785 ppm) had the lowest average CO_2 values, while cross-ventilation (838.5 ppm) and chimney-effect ventilation (812.5 ppm) had the highest CO_2 values. Based on the analyses related to the effects of the proposed improvements on thermal comfort, it can be said that the winter season's thermal comfort range remains within the "comfortable" range. For the summer season, the cross and chimney effect ventilation proposals that offer the minimum open periods necessary to ensure thermal comfort and air quality result in a "comfortable-partially comfortable" range. The ventilation proposals, which include a roof wing, skylight, and wind tower, maintain a comfortable thermal range during both summer and winter seasons due to their high natural ventilation performance. These findings provide an answer to the research question by demonstrating the consistency of natural ventilation systems in improving indoor air quality without compromising thermal comfort.

The research findings showed that all five proposed systems offered comfortable space during the winter season. However, only cross-ventilation and chimney effect ventilation provided partially comfortable space during summer. Literature studies have shown that systems developed using atrium spaces provided suitable conditions for the summer season but not for the winter season (Sokkar & Alibaba, 2020). The reason for this is the decrease in outdoor temperature during winter and the restriction of natural ventilation conditions as a result. It is important to note that this evaluation is objective and based on empirical evidence. Furthermore, the position of the building, climatic conditions, type and size of the atrium, and the material used for the atrium's top covering can contribute to varying outcomes in both summer and winter. It should be noted that in such studies, the combination of multiple variables can result in diverse findings. In the study, solutions for both summer and winter seasons were examined taking into account all relevant factors for the winter season due to the building's location in a cold climate zone. In addition to atrium ventilation, composite facades of the building act as a chimney carrying outdoor air to the interior in a warmer manner. Based on the evaluation of these proposed solutions and the various factors, it is believed that the results of this study are consistent with the existing literature and offer a unique perspective.

DOI: 10.15320/ICONARP.2024.273

Many studies on natural ventilation proposals for buildings with atriums take into account window elevation differences, compliance with the prevailing wind direction, and the amount of airflow (Li et al., 2013; Ghafar & Moosavi, 2015; Hijleh & Vethanayagan, 2019; Mahmoud et al., 2019; Sokkar & Alibaba, 2020). In this study, these factors were also considered because they are supported by the literature.

Cost is a major issue in proposals for natural ventilation. The economic burden of interventions to existing structures is a key factor that needs to be addressed. In the study, five proposals were also analyzed in terms of their economic impact. Cross-ventilation, chimney-effect ventilation, and skylight ventilation were designed to open only vents without intervening in the structure. Therefore, the economic problems in these systems are limited. However, interventions to the top cover of the building may cause economic problems in the proposals of roof-wing ventilation and wind-tower ventilation. The study shows that all five proposed systems improve thermal comfort and indoor air quality with no significant differences between them. Therefore, considering economic issues, it can be recommended to use the systems that require the least structural intervention first. When using systems that require building intervention, practical solutions can be achieved by using inexpensive and removable panels.

In the literature on natural ventilation in buildings with atriums, extensive research has been conducted to determine the most efficient atrium size, height, and form (Li et al., 2010; Aldawoud, 2012; Hussain & Oosthuizen, 2012; Acred & Hunt, 2014). This current study aimed to emphasize the significance of design decisions by highlighting interventions made to the atrium space in an existing layout. It is expected that the systems proposed in the context of this study will enhance the literature and reinforce the study's originality. Furthermore, evaluating an atrium space in a heavily used environment where mental activities occur and its role in natural ventilation are viewed as factors that bolster the study's impact on user health and sustainability.

CONCLUSION

In this study, five natural ventilation proposals designed to improve the indoor air quality of a library by only natural ventilation without compromising on thermal comfort were created taking into account the natural ventilation principles that can come to the fore in buildings with atriums. In the proposals, it was assumed that insulated grilles were integrated into the structure as required by cross-ventilation, chimney-effect ventilation, roof-wing ventilation, skylight ventilation, and wind-tower ventilation. In the context of each proposal, the minimum open periods that can be applied to the culverts in terms of providing thermal comfort and air quality for the summer and winter seasons were determined by numerous simulations. It was revealed that the indoor air quality could be improved without compromising thermal comfort in the building by determining the appropriate culvert open times for each of

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

the five proposals. However, not all improvement methods played a role in the ventilation of the building with the same degree of effectiveness as expected. The chimney ventilation was more effective than the cross-ventilation regarding natural ventilation performance. It can be said that the reason for this is the cross-ventilation principles and the additional ventilation provided by additional vents on the roof level. In addition, the ventilation efficiency obtained with the roof wing was higher than that provided by the skylight due to the large wind volume obtained by directing the roof wing to the prevailing wind direction. However, it can be said that the wind-tower ventilation efficiency is lower than the efficiencies of chimney-effect, roof wing, and skylight ventilation methods for the summer season, it is lower than the efficiencies of chimney-effect and roof-wing ventilation methods for the winter season, and it has the same performance with the roof-window ventilation (Figure 14).

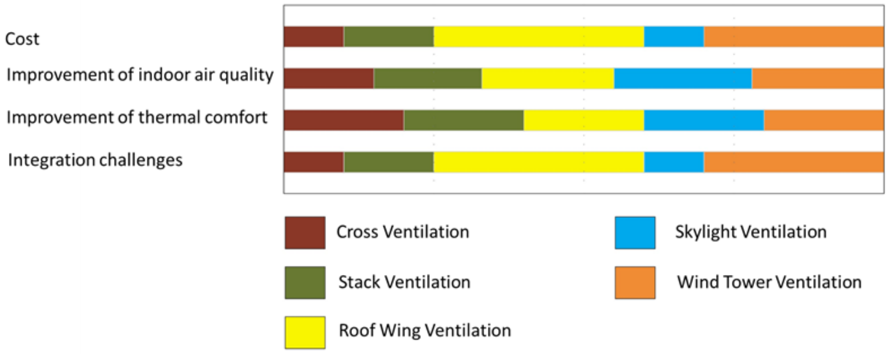


Figure 14. Performance analyses of natural ventilation proposals

On the other hand, in terms of cost-effectiveness, it can be said that there are costs of only 12 grilles and application costs in the cross ventilation proposal. In comparison, there are costs of 18 grilles and application costs in the chimney-effect ventilation proposal. Even though the roof wing proposal has higher ventilation performance than the ventilation proposals with the roof wing, skylight, and wind tower, which have the cost of 18 culverts, it is costlier than other proposals because it requires the integration of the proposed roof wing to the structure by completely replacing the covering system in the atrium.

In conclusion, solutions to improve indoor air quality should include pollutant source control and natural and mechanical ventilation. In addition, to provide the indoor air control of a building effectively and sustainably and provide adequate natural ventilation, the land characteristics, prevailing wind direction, and the analysis of climatic data are the criteria that should be taken into account during the design process of the building. If these criteria are not considered sufficiently during the design process, the systems proposed to be integrated into the building may cause both time and economic losses (Figure 14). In this context, it is believed that this study, in which the hypothesis of "indoor air quality of a building can be ensured by natural ventilation methods without compromising the thermal comfort" was confirmed, will shed

DOI: 10.15320/ICONARP.2024.273

light on new improvement proposals to be developed for atrium structures and natural ventilation methods to be considered in the design phase of these structures.

This study highlights the significance of decision-making during the design phase and proper management of atrium spaces within a building. Due to the dependence of natural ventilation on various parameters, design decisions are limited to the structural scale. Improving this situation was the primary objective of this study. Furthermore, future studies should aim to develop a comprehensive model encompassing all buildings by incorporating the spatial elements and criteria discussed in the current study.

ACKNOWLEDGEMENTS/NOTES

The authors thank the Scientific Research Unit of Karabuk University for the financial support provided for the study. We also thank the staff of Karabuk University Library who participated in the study.

REFERENCES

Abdel-Salam, M. M. (2021). Outdoor and indoor factors influencing particulate matter and carbon dioxide levels in naturally ventilated urban homes. Journal of the Air & Waste Management Association, 71(1), 60-69. https://doi.org/10.1080/10962247.2020.1834009

Abt, E., Suh, H.H., Allen, G., Koutrakis, P. (2000). Characterization of indoor particle sources: A study conducted in the metropolitan Boston area. Environmental Health Perspectives, 108(1), 35-44. https://doi.org/10.1289/ehp.0010835

Acred, A., Hunt, G. R. (2014). A simplified mathematical approach for modelling stack ventilation in multi-compartment buildings. Building and Environment, 71, 121-130. https://doi.org/10.1016/j.buildenv.2013.09.004

Acred, A., & Hunt, G. R. (2014). Stack ventilation in multi-story atrium buildings: A dimensionless design approach. Building and Environment, 72, 44-52. https://doi.org/10.1016/j.buildenv.2013.10.007

Aldawoud, A. (2013). The influence of the atrium geometry on the building energy performance. Energy and Buildings, 57, 1-5. https://doi.org/10.1016/j.enbuild.2012.10.038

Ao, C. K., Dong, Y., Kuo, P. F. (2021). Industrialization, indoor and ambient air quality, and elderly mental health. China Economic Review, 69, 101676. https://doi.org/10.1016/j.chieco.2021.101676

Carbonari, A., Peron, F., Cereser, N. (2006). Daylighting and ventilation using a dynamic skylight. 61st ATI National Congress –International Session "Solar Heating and Cooling". Perguia, Italy.

Cattaneo, A., Peruzzo, C., Garramone, G. Urso, P. Ruggeri, R. Carrer, P. Cavallo, D.M. (2011). Airborne particulate matter and gaseous air pollutants in residential structures in Lodi province, Italy. Indoor Air, 21(6), 489-500. https://doi.org/10.1111/j.1600-0668.2011.00731.x

Chao, C.Y., Cheng, E.C. (2002). Source apportionment of indoor PM2.5 and PM10 in homes. Indoor and Built Environment, 11(1), 27-37. https://doi.org/10.1159/000063490

Cui, C., Zhang, X., Cai, W. (2020). An energy-saving oriented air balancing method for demand controlled ventilation systems with branch and black-box model.

Applied Energy, 264, 114734. https://doi.org/10.1016/j.apenergy.2020.114734
De Giuli, V., Da Pos, O., De Carli, M. (2012). Indoor environmental quality and pupil perception in Italian primary schools. Building and Environment, 56, 335-345. https://doi.org/10.1016/j.buildenv.2012.03.024
Emmerich, S.J. (2006). Simulated performance of natural and hybrid ventilation systems in an office building. HVAC&R Research, 12(4), 975-1004. 10.1080/10789669.2006.10391447
Escombe, A. R., Ticona, E., Chávez-Pérez, V., Espinoza, M., Moore, D. A. (2019). Improving natural ventilation in hospital waiting and consulting rooms to reduce nosocomial tuberculosis transmission risk in a low resource setting. BMC Infectious Diseases, 19(1), 1-7. https://doi.org/10.1186/s12879-019-3717-9
Etheridge, D. (2011). Natural ventilation of buildings: Theory, measurement and design. United Kingdom: John Wiley & Sons
Fernández-Agüera, J., Domínguez-Amarillo, S., Alonso, C., Martín-Consuegra, F. (2019). Thermal comfort and indoor air quality in low-income housing in Spain: The influence of airtightness and occupant behavior. Energy and Buildings, 199, 102-114. https://doi.org/10.1016/j.enbuild.2019.06.052
Francisco, P. W., Jacobs, D. E., Targos, L., Dixon, S. L., Breysse, J., Rose, W., Cali, S. (2017). Ventilation, indoor air quality, and health in homes undergoing weatherization. Indoor Air, 27(2), 463-477. https://doi.org/10.1111/ina.12325
Gonzalez-Martin, J., Kraakman, N. J. R., Perez, C., Lebrero, R., Munoz, R. (2021). A state of the art review on indoor air pollution and strategies for indoor air pollution control. Chemosphere, 262, 128376. https://doi.org/10.1016/j.chemosphere.2020.128376

Güler, Ç. (2012). Çevre sağlığı ders kitabı. Ankara: Yazıt Yayınevi.
Haw, L. C., Saadatian, O., Sulaiman, M. Y., Mat, S., Sopian, K. (2012). Empirical study of a wind-induced natural ventilation tower under hot and humid climatic conditions. Energy and Buildings, 52, 28-38. https://doi.org/10.1016/j.enbuild.2012.05.016
Heiselberg, P. (2004). Natural ventilation design. International Journal of Ventilation, 2(4), 295-312. https://doi.org/10.1080/14733315.2004.11683674
Hilliaho, K., Lahdensivu, J., Vinha, J. (2015). Glazed space thermal simulation with IDA-ICE 4.61 software—Suitability analysis with case study. Energy and Buildings, 89, 132-141. https://doi.org/10.1016/j.enbuild.2014.12.041
Huang, K., Sun, W., Feng, G., Wang, J., Song, J. (2020). Indoor air quality analysis of 8 mechanically ventilated residential buildings in northeast China based on long-term monitoring. Sustainable Cities and Society, 54, 101947. https://doi.org/10.1016/j.scs.2019.101947
Hussain, S., Oosthuizen, P. H. (2012). Validation of numerical modeling of conditions in an atrium space with a hybrid ventilation system. Building and Environment, 52, 152-161. https://doi.org/10.1016/j.buildenv.2011.12.016
Jin, Z. Y., Wu, M., Han, R. Q., Zhang, X. F., Wang, X. S., Liu, A. M., Zhou, J.Y., Lu, Q.Y., Kim, C.H., Mu, L., Zhang, Z.F., Zhao, J. K. (2014). Household ventilation may reduce effects of indoor air pollutants for prevention of lung cancer: A case-control study in a Chinese population. PloS One, 9(7), e102685. 10.1371/journal.pone.0102685

DOI: 10.15320/ICONARP.2024.273

Jomehzadeh, F., Hussen, H. M., Calautit, J. K., Nejat, P., Ferwati, M. S. (2020). Natural ventilation by windcatcher (Badgir): A review on the impacts of geometry, microclimate and macroclimate. Energy and Buildings, 226, 110396. https://doi.org/10.1016/j.enbuild.2020.110396

Kapalo, P., Vilčeková, S., Mečiarová, Ľ., Domnita, F., & Adamski, M. (2020). Influence of ındoor climate on employees in office buildings—A case study. Sustainability, 12(14), 5569. https://doi.org/10.3390/su12145569

Karlsen, L., Grozman, G., Heiselberg, P., Bryn, I. (2015). Integrated design of daylight, thermal comfort, and energy demand with use of IDA ICE. 7. Passivhus Norden Conference: Sustainable Cities and Buildings. Copenhage, Denmark.

Klepeis, N.E., Nelson, W.C., Ott, W.R., Robinson, J.P. Tsang, A.M., Switzer, P., Behar, J.V., Hern, S.C., Engelmann, W.H. (2001). The national human activity pattern survey (NHAPS): A resource for assessing exposure to environmental pollutants. Journal of Exposure Science & Environmental Epidemiology, 11(3), 231-252. https://doi.org/10.1038/sj.jea.7500165

Kovesi, T., Zaloum, C., Stocco, C., Fugler, D., Dales, R. E., Ni, A., Barrowman, N., Gilbert, N. L., Miller, J. D. (2009). Heat recovery ventilators prevent respiratory disorders in Inuit children. Indoor Air, 19(6), 489-499. https://doi.org/10.1111/j.1600-0668.2009.00615.x

Kozielska, B., Mainka, A., Żak, M., Kaleta, D., Mucha, W. (2020). Indoor air quality in residential buildings in Upper Silesia, Poland. Building and Environment, 177, 106914. https://doi.org/10.1016/j.buildenv.2020.106914

Kuesters, A. S., & Woods, A. W. (2012). On the competition between lateral convection and upward displacement in a multi-zone naturally ventilated space. Journal of Fluid Mechanics, 707, 393-404. https://doi.org/10.1017/jfm.2012.287

Kumar, R., Farhan, H. A., Nayak, S., Paswan, M. (2021). Building design on wind driven natural ventilation with different simulation air model. Materials Today: Proceedings, 46(15), 6770-6774. https://doi.org/10.1016/j.matpr.2021.04.336

Lei, L., Chen, W., Xue, Y., Liu, W. (2019). A comprehensive evaluation method for indoor air quality of buildings based on rough sets and a wavelet neural network. Building and Environment, 162, 106296. https://doi.org/10.1016/j.buildenv.2019.106296

Li, N., Zhang, M., Hou, S., He, D., Li, J. (2010). Effect of atrium configuration characteristic on buoyancy-driven ventilation of high-rise residential buildings. Journal of Guangzhou University (Natural Science Edition), 3, 015.

Li, Y. W., & Ma, W. L. (2021). Photocatalytic oxidation technology for indoor air pollutants elimination: A review. Chemosphere, 280, 130667. https://doi.org/10.1016/j.chemosphere.2021.130667

Li, Z. R., Ai, Z. T., Wang, W. J., Xu, Z. R., Gao, X. Z., & Wang, H. S. (2014). Evaluation of airflow pattern in wind-driven naturally ventilated atrium buildings: measurement and simulation. Building Services Engineering Research and Technology, 35(2), 139-154. https://doi.org/10.1177/0143624412474941

Luengas, A., Barona, A., Hort, C., Gallastegui, G., Platel, V., Elias, A. (2015). A review of indoor air treatment technologies, Reviews in Environmental Science and Bio/Technology, 14(3), 499-522. https://doi.org/10.1007/s11157-015-9363-9

Mahmoud, E. S., Mousa, M. G. S. (2020). The Role of Atriums and Courtyards in Improving Natural Light and Ventilation in Hospitals. MEJ-Mansoura

Engineering Journal, 44(4), 1-15. https://doi.org/10.21608/bfemu.2020.95011
Mateo, A., Aranaz, T. (2011). IDA simulation of indoor climate variations in a church, validation of IDA model. Master Dissertation. University of Gävle, Gävle, Sweden.
Mendell, M. J., Eliseeva, E. A., Davies, M. M., Spears, M., Lobscheid, A., Fisk, W. J., Apte, M. G. (2013). Association of classroom ventilation with reduced illness absence: a prospective study in California elementary schools. Indoor Air, 23(6), 515-528. https://doi.org/10.1111/ina.12042
Mendes, A., Teixeira, J.P. (2014). Sick building syndrome. P. Wexler (Eds.), Encyclopedia of toxicology (3rd ed., pp. 256-260). Elsevier Science & Technology. https://doi.org/10.1080/15287394.2014.911134
Moosavi, L., Mahyuddin, N., Ghafar, N. (2015). Atrium cooling performance in a low energy office building in the Tropics, A field study. Building and Environment, 94, 384-394. https://doi.org/10.1016/j.buildenv.2015.06.020
Odeh, I., & Hussein, T. (2016). Activity pattern of urban adult students in an Eastern Mediterranean Society. International Journal of Environmental Research and Public Health, 13(10), 960. https://doi.org/10.3390/ijerph13100960
Omrani, S., Garcia-Hansen, V., Capra, B., Drogemuller, R. (2017). Natural ventilation in multi-story buildings: Design process and review of evaluation tools. Building and Environment, 116, 182-194. https://doi.org/10.1016/j.buildenv.2017.02.012
Park, J. S., Jee, N. Y., Jeong, J. W. (2014). Effects of types of ventilation system on indoor particle concentrations in residential buildings. Indoor Air, 24(6), 629-638. https://doi.org/10.1111/ina.12117

Persily, A.K., Emmerich, S.J. (2011). Indoor air quality in energy efficient buildings. ASHRAE Journal, 52, 76-83. 10.1080/10789669.2011.592106
Rivera-Rios, J.C., Joo, T., Takeuchi, M., Orlando, T.M., Bevington, T., Mathis, J.W., Pert, C.D., Tyson, B.A., Anderson Lennert, T.M., Smith, J.A., Ng, N.L. (2021). In-flight particulate matter concentrations in commercial flights are likely lower than other indoor environments. Indoor Air, 31(5), 1484-1494. https://doi.org/10.1111/ina.12812
Salma, I., Dosztály, K., Borsós, T., Söveges, B., Weidinger, T., Kristóf, G., Péter, N., Kertész, Z. (2013). Physical properties, chemical composition, sources, spatial distribution and sinks of indoor aerosol particles in a university lecture hall. Atmospheric Environment, 64, 219-228. https://doi.org/10.1016/j.atmosenv.2012.09.070
Shrubsole, C., Dimitroulopoulou, S., Foxall, K., Gadeberg, B., Doutsi, A. (2019). IAQ guidelines for selected volatile organic compounds (VOCs) in the U.K. Building and Environment, 165, 106382. https://doi.org/10.1016/j.buildenv.2019.106382
Sokkar, R., Alibaba, H. Z. (2020). Thermal comfort improvement for atrium building with double-skin skylight in the mediterranean climate. Sustainability, 12(6), 2253. https://doi.org/10.3390/su12062253
Soleimani-Mohseni, M., Nair, G., Hasselrot, R. (2016). Energy simulation for a high-rise building using IDA ICE: Investigations in different climates. Building Simulation, 9(6), 629-640. https://doi.org/10.1007/s12273-016-0300-9
Sun, Y., Hou, J., Cheng, R., Sheng, Y., Zhang, X., Sundell, J. (2019). Indoor air quality, ventilation and their associations with sick building syndrome in Chinese

DOI: 10.15320/ICONARP.2024.273

homes. Energy and Buildings, 197, 112-119. https://doi.org/10.1016/j.enbuild.2019.05.046

Utkucu, D., & Sözer, H. (2020). An evaluation process for natural ventilation using a scenario-based multi-criteria and multi-interaction analysis. Energy Reports, 6, 644-661. https://doi.org/10.1016/j.egyr.2020.02.001

Vethanayagam, V., Abu-Hijleh, B. (2019). Increasing efficiency of atriums in hot, arid zones. Frontiers of Architectural Research, 8(3), 284-302. https://doi.org/10.1016/j.foar.2019.05.001

Vural, M.S. (2004). Yapı içi hava niteliği risk süreci modeli belirlenmesi. PhD Dissertation. Yıldız Technical University, İstanbul, Turkey.

Wang, B., & Malkawi, A. (2019). Design-based natural ventilation evaluation in early stage for high performance buildings. Sustainable Cities and Society, 45, 25-37. https://doi.org/10.1016/j.scs.2018.11.024

Wang, J., & Norbäck, D. (2022). Subjective indoor air quality and thermal comfort among adults in relation to inspected and measured indoor environment factors in single-family houses in Sweden-the BETSI study. Science of the Total Environment, 802, 149804. https://doi.org/10.1016/j.scitotenv.2021.149804

Wright, G. R., Howieson, S., McSharry, C., McMahon, A. D., Chaudhuri, R., Thompson, J., Donnelly, I., Brooks, R.G., Lawson, A., Jolly, L., McAlpine, L., King, E. M., Chapman, M.D., Wood, S., Thomson, N. C. (2009). Effect of improved home ventilation on asthma control and house dust mite allergen levels. Allergy, 64(11), 1671-1680. https://doi.org/10.1111/j.1398-9995.2009.02098.x

Zhang, S., Ai, Z., Lin, Z. (2021). Novel demand-controlled optimization of constant-air-volume mechanical ventilation for indoor air quality, durability and energy saving. Applied Energy, 293, 116954. https://doi.org/10.1016/j.apenergy.2021.116954

Resume

Caner YETİŞ graduated from Karabük University Department of Architecture in 2018. He started his master's degree at Karabük University in 2019 and completed his master's degree in 2021 with a dissertation titled Determination of indoor air quality and suggestions for improvement in atrium buildings: Example of Kamil Güleç library' and completed his master's degree in 2021. In the same year, he started his doctoral education and his doctoral education continues. He continues his studies in the fields of energy, indoor air quality, building materials and sustainability.

Merve TUNA KAYILI graduated from Karabük University Department of Architecture in 2008. She started her master's degree at Gazi University in 2008 and completed her master's degree in 2010. Between 2011-2016, she worked as a researcher at Delft Technical University while doing her doctorate. In 2023, she received the title of Associate Professor and continues her studies in the fields of energy efficient building design, building materials and sustainability.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

ICONARP
International Journal of Architecture and Planning
Received: 07.06.2023 Accepted: 07.05.2024
Volume 12, Issue 1/ Published: 30.06.2024
Research Article
DOI: 10.15320/ICONARP.2024.274 E- ISSN:2147-9380
ICONARP

Utilization of Intelligent Facade Technologies in High-rise Office Buildings: A Comparative Study

Fazilet Tuğrul Okbaz *
Simay Aydinç**
Ferhat Pakdamar***

Abstract

In the late 19th century, spurred by the Industrial Revolution and the concomitant rise in population and technological advancements, high-rise buildings began to emerge in urban centers. Initially, concerns regarding the environmental impacts of these structures were not at the forefront. However, the advent of sustainability debates in the 1970s elevated this discourse, particularly regarding high-rise buildings. This progression notably influenced the materials and facade systems of high-rise structures. Alterations in building facades subsequently catalyzed the development of adaptive building coatings that consider environmental factors, climate variations, and user preferences. Termed as intelligent facade systems, these innovative facades aim to enhance indoor comfort and diminish energy consumption. Integration of control and sensing technologies into facades has rendered them multifunctional components. The amalgamation of diverse technologies has rendered the concept of intelligent facades intricate, thereby complicating a definitive definition. This study scrutinizes the employment of intelligent facade systems in high-rise buildings, offering a fresh perspective by proposing a classification in line with existing definitions and classifications in the literature. It categorized the changes introduced by integrated devices and mechanisms into five groups: passive, mechanical, electro-mechanical, integrated technology, and information technology. Additionally, changes resulting from materials are classified under energy and property-transforming materials. Based on the new proposed classification, a comprehensive comparative analysis of 20 high-rise office buildings, encompassing 10 from Turkiye and 10 from across the globe, was conducted. The investigation revealed passive technologies as the prevailing systems employed in high-rise building facades, both domestically in Turkiye and worldwide. Integrated technology is the second most utilized system after passive technology. Based on all the investigations conducted, it can be concluded that energy-changing materials are employed in a greater number of buildings worldwide compared to Turkiye. However, there is still concurrent progress in facade technology.

Keywords:
Facade technologies, High-rise buildings, Intelligent façade, Office buildings

* Department of Architecture, Faculty of Architecture, Gebze Technical University, Kocaeli, Turkiye.
(*Corresponding author*)
E-mail: ftugrul@gtu.edu.tr

** Graduate School of Natural and Applied Sciences, Gebze Technical University, Kocaeli, Turkiye.
E-mail: simayaydinc@gmail.com

*** Department of Architecture, Faculty of Architecture, İstanbul Technical University, İstanbul, Turkiye.
E-mail: pakdamar@itu.edu.tr

To cite this article: Tugrul Okbaz, F., Aydinç, S. & Pakdamar, F. (2024). Utilization of Intelligent Façade Technologies in High-rise Office Buildings: A Comparative Study, *ICONARP International Journal of Architecture and Planning,* 12 (1), 24-45. DOI: 10.15320/ICONARP.2024.274

INTRODUCTION

High-rise buildings, emerging because of technological and economic advancements, represent a typology of structures that cater to the increasing needs of the population. Starting with the construction of the Home Insurance Building in Chicago in 1853 and progressing to the world's first high-rise, the Burj Khalifa, this typology has witnessed rapid advancement worldwide. Parallel to the Industrial Revolution, the economic progress of the 19th century triggered a transformation in high-rise buildings, evolving office structures into buildings that better meet the demands and comfort conditions of users. During this period, global energy crises led to prioritizing energy consumption and efficiency issues in building design.

Energy consumption in the construction sector in the United States and the European Union is significantly higher compared to other sectors (Oró et al., 2012). Dominant factors contributing to energy consumption in buildings include heating, ventilation, and lighting, which constitute approximately 46% of total energy consumption in constructed environments (Department of Energy, 2015). According to the Energy Information Agency, buildings account for approximately 41% of US Energy Consumption. Consumption in commercial buildings is mainly attributed to lighting (20%), space heating (16%), and space cooling (14%) (Sawyer, 2014) (Monthly Energy Review, 2013). According to the 'Energy Performance of Buildings Directive' published by the European Union, buildings play a significant role in energy consumption, accounting for approximately 40% of the total energy consumed in the EU (Bertoldi et al., 2019). This statistic highlights the substantial impact that buildings have on energy usage and emphasizes the need to address their energy efficiency to achieve sustainable development goals. This statistic emphasizes the significant impact of building energy usage and underscores the necessity of addressing energy efficiency to achieve sustainable development goals. Recognized as major energy consumers, buildings have a significant impact on overall energy demand and carbon emissions. Various energy-intensive activities such as heating, cooling, lighting, and operation of electrical devices contribute to the substantial energy footprint of buildings. Therefore, improving building energy performance is not only about reducing energy consumption but also vital for mitigating climate change, enhancing resource efficiency, and promoting environmental sustainability.

In evaluating energy consumption concerning building components, it becomes evident that building envelopes take precedence. The facade, constituting the outer shell of a building and segregating the interior from the external environment, serves not only as a protective element but also as a pivotal structural component with substantial influences on energy efficiency and indoor comfort. Facades of buildings play a crucial role in energy loss, accounting for approximately 20-60% of the building's total energy consumption (Balali & Valipour, 2020; Cheng et

DOI: 10.15320/ICONARP.2024.274

al., 2014). The energy loss attributed to facades stems from several factors. Firstly, when facades are constructed from materials with high thermal conductivity, they can increase heat transfer. This can lead to higher energy consumption for heating and cooling systems, consequently resulting in increased energy costs. Secondly, inadequate insulation can cause fluctuations in indoor temperature depending on external conditions, negatively impacting indoor comfort. Finally, a lack of control over sunlight and heat gain can further escalate energy losses from facades.

The facades of high-rise buildings constitute a critical component that separates indoor spaces from the external environment while endeavoring to minimize energy loss. Due to their expansive glass surfaces and heights, the facades of high-rise buildings account for a significant portion of energy consumption, necessitating a prioritization of energy-saving measures in these areas. Moreover, because high-rise building facades are more exposed to sunlight and weather conditions, there is a greater need to focus on advanced technologies and the use of smart facades to enhance energy savings and indoor comfort. This circumstance forms the primary rationale for focusing on high-rise building facades in the study.

While traditional facade systems provide limited energy and lighting performance under various environmental conditions (Selkowitz et al., 2003), research has demonstrated that active facades generated by advanced technologies can enhance performance by 40% to 65% compared to static facades (Khaled Dewidar et al., 2010). Liu et al., 2015, in their study, have found that the energy consumption of a building can be reduced by approximately 60% when an intelligent glazed facade is used instead of a static facade in the climate of Denmark Recent investigations have demonstrated that Intelligent Facade (IF) services can contribute significantly to the prevention of approximately 70-80% of energy consumption (Habibi et al., 2022). Therefore, the use of intelligent facades is an important strategy to enhance energy efficiency and minimize energy losses. Intelligent facades are designed to automatically control the entry of sunlight and heat, using energy-efficient materials and systems. These systems monitor external conditions and internal requirements through sensors, actuators, and control systems, allowing the facades to adapt their properties accordingly.

These applied technologies enable facade systems to continuously modify their functions, features, or behaviour over time in response to environmental stimuli, occupants' preferences, and needs, thereby improving thermal and visual performance of the facade (Heidari Matin & Eydgahi, 2019) Building facade systems, play an essential role in controlling the amount of heating and cooling loads since they separate the indoor and outdoor environments (Halawa et al., 2018; Thalfeldt et al., 2013). Furthermore, studies conducted on responsive facades indicate that implementing such technologies can reduce cooling load by up to 25% and heat gain by up to 80%, leading to a 15% to 20% decrease in cooling costs (Kolarevic & Parlac, 2015) For this reason, researchers have become increasingly interested in developing facade systems that reduce cooling and heating energy consumption of buildings, have the ability to adapt to environmental and climatic conditions, control ventilation and thermal heating, and balance natural lighting. These findings highlight the importance of adopting intelligent facade systems (IFS) that can respond and adapt to changing environmental factors, leading to improved energy efficiency and occupant comfort.

Although the construction of high-rise buildings in Turkiye started approximately seventy years later than worldwide, it can be said that the country has largely closed the gap in terms of following and implementing globally used technologies. Currently, many of the contemporary structural and material technologies employed worldwide are also utilized in Turkiye. At this point, the state of implementation of IFS forms the research question.

The main aim of this study is to categorize the IFSs implemented in high-rise office buildings, evaluating this new categorization by focusing on both local and international examples. The study aims to assess the status and advancements of high-rise office buildings with intelligent facade designs, for which the most information has been accessed worldwide and in Turkiye in the past 10 years, through a comparative approach. Additionally, it aims to identify the current situation in Turkiye and provide recommendations for enhancing intelligent facade applications.

INTELLIGENT FACADES AND CLASSIFICATION

The era known as the Third Industrial Revolution, or the age of information technology, has ushered in a period of rapid technological advancements s, giving rise to novel forms of human existence. Consequently, these emerging lifestyles have engendered a discernible shift in the needs and demands of individuals. On the other hand, the rapid population growth, and the depletion of natural resources, leading to an energy crisis and increased energy costs, prompted the emergence of intelligent building designs in the 1970s.

IFS, which have been developed in parallel with the emergence of user comfort and environmental awareness concepts in architecture, are a type of facade that exhibits various characteristics and can be referred to by different names in the literature. The concept of intelligent facades, refers to facade types that can adapt, transform, learn, and respond to various factors such as users, environment, and climate. These facades, known by multiple names in the literature, generally operate on similar principles. Active and passive systems drive the functionality of intelligent facades by responding to environmental stimuli and enabling changes in the facade. Since the 1970s, these facades have experienced rapid development and have

DOI: 10.15320/ICONARP.2024.274

become an indispensable system that ensures minimum energy consumption and maximum efficiency for high-rise buildings in the present day.

The term intelligent building was initially coined and implemented by the former Intelligent Buildings Institute (IBI), located in Washington, D.C., in the early 1980s. The IBI defined an intelligent building as a ''one which provides a productive and cost-effective environment through optimization of four basic elements: structure, systems, services and management, and the interrelationship between them." Despite numerous efforts by various organizations to establish a universally accepted definition, there exists a wide range of definitions for building intelligence (Omar, 2018). In Europe, the European Intelligent Buildings Group (EIBG) introduced a novel definition that characterizes an intelligent building as ''creates an environment which maximizes the effectiveness of the building's occupants while at the same time enabling efficient management of resources with minimum life-time costs of hardware and facilities.'' In Asia, the definitions focused on the role of technology for the automation and control of building functions (Wigginton & Harris, 2013) (Wong et al., 2005) illustrate in their examination of Intelligent Building research that most initial definitions focused on reducing human involvement within the building.

The terms "smart" and "intelligent" have often been used interchangeably without a clear differentiation between the two. The term 'smart' refers mostly to surfaces and materials, while the term 'intelligent' describes a complex system. There is a difference between perception, reasoning, and action ability. Smart Buildings aim to provide occupants with control while simultaneously minimizing energy consumption per occupant hour (Buckman et al., 2014). In contrast, Intelligent facades have a perception system created according to inputs, while smart facades have action-based material integration. Nevertheless, Intelligent Buildings have primarily emphasized the incorporation of intelligent systems within their infrastructure, rather than focusing on the construction itself.

Previous Classification Studies

Since the first appearance of IFS in the 1970s, many studies have been carried out to classify these systems, but since there is no common terminology for the classification of technologies applied on building facades, a clear classification has not emerged. One of the earliest attempts to classify intelligent facades was made by Fox and Yeh in 2000. They categorized the responsive/kinetic design in architecture into three areas within the context of mechanical and technological principles. These areas include structural innovation and material development, general kinetic typologies in architecture, and control mechanisms (Fox & Yeh, 2000). Structural innovation emphasizes both the implementation methods and tools for achieving a structural solution. The implementation methods include folding, sliding, expanding, and transforming. The tools can be pneumatic, chemical, magnetic, natural, or mechanical. Material development offers integrative solutions in the construction industry by integrating with kinetic systems, utilizing ceramics, polymers, gels, fabrics, metallic components, and composites that can adapt to evolving technology.

In 2010, Schnädelbach examined intelligent facades under three main categories. These are motivation factors, adaptive buildings and components, and design strategies in adaptive architecture. *Motivation factors* are numerous and diverse motivations and driving forces for adaptive design. These motivations can be cultural, social, organizational, and related to communication and social interaction. *Adaptive Buildings and Components* are user and environment. *Design strategies;* mobility, reusability, automation-human intervention, time scales, user focus and stimulus level (Schnädelbach & March, 2010).

In 2011, Ramzy and Fayed proposed two different classification systems. The first of these is to classify kinetic systems in architecture according to system configuration, control techniques and tools. The other is classification based on kinetic systems, control techniques, system configuration, control limit and cost (Ramzy & Fayed, 2011). The movement limit created by the system, known as *kinetism,* varies depending on whether it is partial, inclusive, or a small mobile subunit dependent movement. *Control techniques* deal with how the movement starts, while *system configuration* includes embedded, deployable, and dynamic kinetic structures as determined in Fox and Yeh's (1999) research. *The limit of control* pertains to the degree of environmental changes that the system offers, emphasizing the impact on human comfort and interaction with the building context. Additionally, *cost* is a crucial factor for kinetic fronts, referring to the system's cost relative to its environmental performance (Ramzy & Fayed, 2011).

In 2013, Loonen et al. argued that building envelopes are at the boundary between interior and exterior and are subject to a range of variable conditions, so they must have the ability to react to these changes. The Climate Adaptive Building Shells (CABS) they recommend could repeatedly and reversibly change some of their functions, properties or behaviors over time in response to changing performance requirements and changing boundary conditions, and they do this with the aim of improving overall building performance. Building facades defined as CABS offer the potential to reduce energy demand for lighting and space conditioning by combining the complementary aspects of passive design with active technology. It also positively affects indoor air quality and thermal and visual comfort levels (Loonen et al., 2013). Climate Adaptive Building Shells (CABS) are examined under five main headings according to their characteristics. These include *sources of inspiration*, where nature is a significant influence, with concepts such as tropism, phototropism, and heliotropism inspired by natural adaptability. *Physical interaction* involves building envelopes acting as

DOI: 10.15320/ICONARP.2024.274

interfaces for various physical interactions, affecting behaviours like blocking, filtering, and storing energy. *Time scales* refer to temporal solutions generated by environmental influences over the building's life. *Scales of adaptation* indicate characteristic changes on macro or micro levels. *Types of control* highlight the importance of effective control for CABS, with two types of control available.

In 2015, Loonen et al. proposed a new classification, this time examining smart facades under eight headings. These are purpose, responsive function, business, technologies, reaction time, spatial scale, visibility and adaptation scale (Loonen et al., 2015).

In 2015, Kolarevic and Parlac described four activation methods in the building shells. These are engine-based, hydraulic, pneumatic and material-based (Kolarevic & Parlac, 2015). *Engine based systems* consist of motor systems mounted on double skin facades (For example, blinds, sunshades, etc.). These systems can significantly reduce glare and solar heat gain. *Hydraulic* actuators contain a piston placed in a hollow cylinder (Harry, 2016). When force is applied to the piston, a force is applied that moves the objects. The motion thus produced can be linear, rotary, or oscillating. *Pneumatic* facade systems are systems that aim to create movement by pumping air or gas under pressure. It is designed with an understanding that combines the features of biological design and smart technology to create a mobile facade on facades (Harry, 2016). *Material-based* activation systems emerge because of innovations in developing production and control mechanisms. Such materials have multiple applications (Harry, 2016).

In 2018, European COST Action TU1403 'Adaptive Facades Network' proposed a new classification. According to this classification, façade system change is classified based on activation system and triggering event (Bedon et al., 2018). System change occurs as geometrical and rigidity change. Geometric change includes rigid body deformation (rotation and rotation) and non-rigid deformation (bending and expansion) movements under 2 headings.

1. Activation System: It can be realized by self-changing materials, mechanical movements and swelling.

2. Triggering Event: It includes exposure to normal loads, namely its own load, wind-induced vibration, temperature, humidity and daylight events. Other exceptional cases occur because of storm, flood, fire, earthquake and explosion.

The fundamental basis of the classification addressed in this study is the article published by (Heidari Matin & Eydgahi, 2022). In their article, IFS were examined under six headings: passive and active systems. Active technologies are divided into three categories: Mechanical technology, electro-mechanical technology, and information technology. Passive technologies are divided into material-based and passive. The technology that includes these two groups, active and passive technology, is examined under a separate heading known as integrated technology.

Table 1. The chronological order of classification studies on intelligent facade systems

Year	Study	Classification
2000	Fox and Yeh	* Structural innovation *(folding, sliding, expanding, and transforming)* * Material Development *(ceramics, polymers, gels, fabrics, metallic components, and composites)*
2010	Schnädelbach & March	* Motivation Factors *(cultural, social, organizational, and related to communication and social interaction)* * Adaptive buildings and Components *(users, environment)* * Design strategies *(mobility, reusability, automation-human intervention, time scales, user focus and stimulus level)*
2011	Ramzy & Fayed	* Kinetism * Control techniques * System configuration * Limit of control * Cost
2013	Loonen et al	* Sources of Inspiration * Physical Interaction * Time scales * Scales of adaptation * Types of control
2015	Loonen et al	* Purpose * Responsive function * Business technologies * Reaction time * Spatial scale * Visibility * Adaptation scale
2015	Kolarevic & Parlac	* Engine Based * Hydraulics * Pneumatic * Material-Based
2018	European COST Action TU1403	* System Change * Activation System * Triggering Event
2020	Heidari Matin & Eydgahi	* Active technologies *(mechanical technology, electro-mechanical technology, and information technology)* * Passive technologies (*material-based and passive)*

New Classification Proposal

When examining classification studies from the past to the present, it is observed that each study has both different and similar criteria, which is why they have not reached a common point. Therefore, considering the evolving and changing technology, it has been determined that there are numerous systems that activate facade systems. In recent years, material technologies have significantly advanced, and numerous materials capable of creating various effects have been developed. Evaluated within a new framework of classifying intelligent facades based on materials, as proposed by (Addington & Schodek, 2005) in their book. Therefore, within the scope of the study, the materials used in intelligent facades were separated from the technologies and examined under a separate heading. As a result, facades have been

DOI: 10.15320/ICONARP.2024.274

classified based on the technologies and materials used. The technologies section is divided into five categories: mechanical technologies, electro-mechanical technologies, information technologies, passive technologies, and integrated technologies (Fig 1).

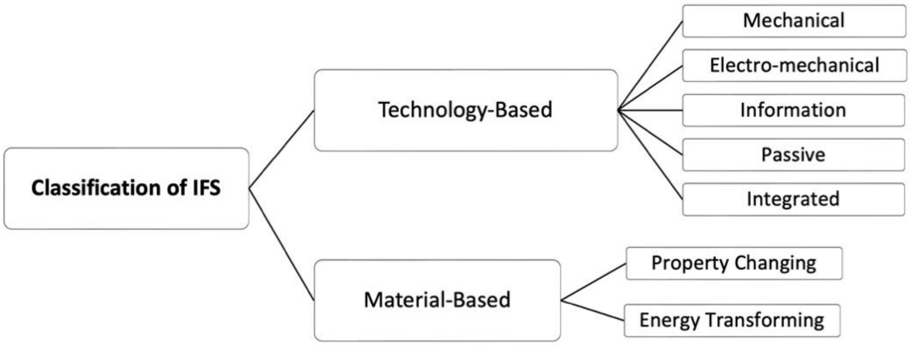


Figure 1. Classification of Intelligent Facade Systems

Mechanical technologies: The first generation of responsive facade systems utilized mechanical technology to improve both the efficiency and comfort of the building (Addington & Schodek, 2005). Although mechanical systems have a relatively long life, non-mechanical parts tend to wear faster (Decker & Zarzycki, 2013). In addition, the maintenance of mechanical components is very difficult and expensive compared to other types of technology applied (Meagher, 2014). Hand-operated façades, which are manually controlled by the occupants, have limited adaptability. Due to the dependence on manpower, mechanical technologies are limited, especially for users with disabilities.

Electro-mechanical technologies: Electro-mechanical technology is recognized as a reliable technology with significant advantages such as standardization of parts, modular design components, cheap initial cost, and centralized monitoring and control (Decker & Zarzycki, 2013). Electro-mechanical sensing, actuation and switching control technologies in buildings were first used in remote-controlled structures located on the facades (Velikov & Thün, 2013).

Information Technologies: Information technology is used in sensitive facades to control interconnected panels via microcontrollers with a distributed control system (Yekutiel & Grobman, 2014). Networks of sensors embedded in responsive façade systems can be connected to software to enable the system not only to collect climate data, but also to exchange data between other building systems, called intermediaries.

Passive Technologies: The first alternative technology is the passive approach to responsive façade design. Based on this design approach, the dependence of a façade system on electrical and manual power has been eliminated and natural resources such as wind, water and sunlight have been used as power sources. The advantages of passive sensitive facades are that they are independent of mechatronic forces, the activation ability provided by environmental variables, and they offer a minimalist approach. On the other hand, these low-cost, low-maintenance and low-tech passive facades do not react in unpredictable conditions due to the uncontrollability of the system.

Integrated Technologies: The mechanical and electro-mechanical components of the façade systems provided an active and sustainable approach to design. However, this primary active approach has been replaced by a passive approach due to the disadvantages of mechanical or electro-mechanical systems. Due to the lack of controllability in passive systems, the integration of passive and active systems with the advantages of both suggests a new system. This integrated technology uses electro-mechanical, information and material-based technology together. In such systems, sensors, actuators, and control systems are all built into the body of advanced materials.

The materials section, on the other hand, is examined under two categories: Property-changing materials and Energy-transforming materials (Fig 1).

Property-changing Materials: Materials that change one of their properties (chemical, mechanical, optical, electrical, magnetic or thermal) in response to a change in ambient conditions and do not need further control.

Energy-transforming Materials: Materials that convert energy from one form to another to achieve the desired end state (Addington & Schodek, 2005).

METHODOLOGY AND METHODS

In this study, a sample of twenty high-rise buildings was selected, comprising ten from Turkiye (Nida Tower Goztepe, Allianz Tower, Istanbul Tower 205, Maslak No:1 Tower, Soyak Crystal Tower, Skyland Office Tower, Zorlu Levent 199, Vakif Bank Headquarters Tower, Palladium Tower, AND Kozyatagı) and ten from various locations worldwide (Torre Reforma, Al Bahar Towers, 1 Bligh Street Tower, Pearl River Tower, NBF Osaki Building, The Leadenhall Building, Salesforce Tower, Doha Tower, PIF Tower, One World Trade Center). In this study, the first constraint is the function of the selected buildings as the focus. To delineate the differences arising from the varied usage characteristics of residential and office buildings, the study has concentrated on office buildings. Office buildings have been preferred due to their significant energy consumption and diverse requirements for optimal indoor environments. The second constraint is the construction year of the case studies. Facade technologies evolve and develop over time. Hence, structures completed within the last 10 years have been chosen to ensure the selection of buildings employing similar technologies. The third constraint of the study is the utilization of intelligent facade technologies in the selected high-rise office case studies. For this purpose, searches have been conducted on web pages using phrases like "smart high-rise building facade" or "intelligent facade systems in high-rise building" to select buildings for which the most information is available (Table 2).

DOI: 10.15320/ICONARP.2024.274

Table 2. Selected case studies of high-rise office buildings from Turkiye and worldwide

Buildings	Year	Location	Height
Nida Tower Goztepe	2013	Goztepe/Istanbul	116 m
Allianz Tower	2014	Atasehir/Istanbul	186 m
Istanbul Tower 205	2019	Levent/Istanbul	220 m
Maslak No:1 Tower	2015	Sariyer/Istanbul	90 m
Soyak Crystal Tower	2014	Levent/Istanbul	169 m
Skyland Office Tower	2017	Sariyer/Istanbul	284 m
Zorlu Levent 199	2014	Levent/Istanbul	170 m
Vakif Bank HQ Tower	2023	Atasehir/Istanbul	221 m
Palladium Tower	2014	Atasehir/Istanbul	180 m
AND Kozyatagı	2015	Kadikoy/Istanbul	110 m
Torre Reforma	2016	Mexico City/Mexico	246 m
Al Bahar Towers	2012	Abu Dhabi/UAE	147 m
1 Bligh Street Building	2011	Sydney/Australia	133 m
Pearl River Tower	2013	Guangzhou/China	309 m
NBF Osaki Building	2011	Osaki/Japan	133 m
The Leadenhall Building	2014	London/England	224 m
Salesforce Tower	2018	San Francisco/USA	326 m
Doha Tower	2012	Doha/Qatar	238 m
PIF Tower	2021	Riyad/Saudi Arabia	385 m
One World Trade Center	2014	New York/USA	541 m

The methodology employed in this study consisted of three distinct stages to ensure a comprehensive analysis and evaluation of IFS in high-rise office buildings.

In the first stage, an extensive review of the international literature was conducted. This involved an in-depth examination of theses, articles, papers, and books related to high-rise office buildings and intelligent facades. The aim was to gather a comprehensive understanding of the existing knowledge and research findings in this field. This literature review served as a foundation for establishing a solid theoretical framework and identifying key concepts and trends in IFSs.

Moving on to the second stage, the focus was on examining the concept of intelligent facades and the various definitions and classifications present in the literature. Previous classification methods were thoroughly reviewed and discussed, providing insight into the different approaches used to categorize and characterize IFSs. Building upon the existing classifications, a classification system was proposed, taking into consideration the unique attributes and functionalities of intelligent facades in high-rise office buildings.

Finally, in the third stage of the study, a comprehensive dataset of high-rise office buildings completed or under construction after the year 2010 was compiled from both Turkiye and around the world. A total of 20 buildings meeting the specified criteria were identified. These buildings were then classified based on the IFS employed, and a detailed table was created to present the findings. A comprehensive evaluation was made by comparing the various smart façade systems used in the sample buildings, and Turkiye's position in the world in terms of smart façade application and innovation in the high-rise office building sector was shed light on. At the end of the study, suggestions for the development of smart façade systems in Turkiye are given.

Through this three-stage methodology, the study aimed to provide a thorough examination and analysis of IFS in high-rise office buildings. The findings and insights gained from this research will contribute to a deeper understanding of the current state and future directions of intelligent facade technologies, both in Turkiye and on a global scale.

CASE STUDIES

Technological advancements in high-rise building facades have gained significant momentum since the year 2000. To examine current technologies and materials, the sample group is limited to buildings constructed within the last 10 years. In this context, facade systems of 20 high-rise buildings, completed in Turkiye and around the world from 2010 onwards, with the highest accessible information, have been analyzed.

Findings on Examined Buildings in Turkiye

Nidakule Göztepe Building is classified as having passive technology due to the combination of aluminium sunshades and passive presence of glass on its façade (Web 1, 2023).

Allianz Tower is categorized as information technology and energy transforming material class due to the presence of displacement ventilation system using electro-mechanical technology, passive technology with low e coated glass curtain wall, the use of LED screens at the top of the structure, and regular advertising broadcasts. Additionally, integrated technology is utilized in this building through the integration of electro-mechanical, passive, and information technologies (Kaplan, et all).

Istanbul Tower 205 incorporates triple silver-coated glass curtain walls and fin-shaped shading elements, placing it in the passive technology class. Additionally, the presence of an electro-mechanical ventilation system with automatic ventilation through mechanically operated louvers, depending on the frequency of user usage, confirms the use of information technology and electro-mechanical technology in the tower. The integration of passive, information, and electro-mechanical technologies is evident in the building (Web 2, 2023).

Maslak No.1 Tower features semi-transparent film-coated facade and mechanical windows for ventilation. Both passive and mechanical technologies are utilized in this structure (Web 3, 2023).

Soyak Crystal Tower is equipped with automated blinds operated by electro-mechanical systems. Passive shading is achieved through double silver-coated glass. Moreover, the presence of automated blinds that adjust the direction of sunlight and respond to climate data, as well as systems that detect carbon levels and provide necessary ventilation, demonstrate the use of information technology in the building. The

DOI: 10.15320/ICONARP.2024.274

integration of passive, electro-mechanical, and information technologies is also evident in the structure (Akta, 2020).

Skyland incorporates electronic windows, electro-mechanical technology, passive shading glass facade, and information technology-integrated blinds that operate based on climate conditions, demonstrating the use of integrated technology in the building (Web 4, 2023).

The use of LED lighting *in Zorlu Levent 199* Building indicates the use of energy-transforming materials and the presence of fritted glass and horizontal band aluminum sunshades, indicating the use of passive technology (Dörter, 2015).

Vakıfbank Headquarters Tower ensures passive solar control with its glass curtain wall (Web 5, 2023).

Palladium preserves the interior space passively with the use of electro-mechanical facade systems and insulated glass on the exterior, indicating the presence of integrated technology (Web 6, 2023).

AND Kozyatağı features a perforated facade with aluminum sunshades. Additionally, the mention of operable surfaces for fresh air indicates the use of mechanical and passive technology in the building (Web 7, 2023).

When examining the data obtained from the studied buildings, it is observed that the most used intelligent system in the facades of high-rise office buildings in Turkiye is a passive technology. In all buildings, solar control is particularly achieved through passive technology. Integrated technology and electro-mechanical technology follow passive technology. Any facade system that incorporates an active system is classified as an integrated facade system. Electro-mechanical systems are used specifically in windows for natural ventilation and in louvers used for solar control on the facade. Information technology follows passive and electro-mechanical technology, and it is predominantly used in louver systems that learn climate data and user preferences. None of the buildings exhibit the use of shape-changing materials. Energy-changing materials are present in only two structures (Table 3).

Findings on Examined Buildings Worldwide

Torre Reforma Building utilizes a double-layered facade and fixed horizontal sunshades to provide passive control. The presence of windows that automatically open at dawn demonstrates the use of electro-mechanical and information technology in the structure (Miranda and Safarik, 2011).

Al Bahar Towers employ a simple curtain wall facade to passively control solar heat gain. However, the dynamic external sunshades, which move with actuators and simulate the movement of the sun while learning external weather conditions through sensors, fall under the classification of information technology due to their electro-mechanical operation. The integration of these systems confirms the presence of integrated technology in the building (Karanouh and Kerber, 2015).

1 Bligh Street Building is categorized under passive technology due to its high-performance double-skin facade. Louvers, operated by electro-mechanical technology, provide natural ventilation to the structure. These louvers also utilize sensor data such as rain and temperature for their operation, incorporating information technology (Web 8, 2023). The presence of photovoltaic solar panels indicates the use of energy-transforming materials. Moreover, the integration of passive and active systems confirms the existence of integrated technology in the building (Web 9, 2023).

Pearl River Tower indicates the use of passive technology using fritted glass. Additionally, the presence of automated louvers controlled by climate control systems in the building demonstrates the utilization of information and electro-mechanical technology. The integration of solar panels into the structure signifies the presence of energy-transforming materials in the building's facade. Thus, the building also falls under the category of integrated technology (Tomlinson et al., 2014).

NBF Osaki Building utilizes electro-mechanical systems on the facade to circulate water. The presence of solar panels powering this system indicates the use of energy-transforming materials in the building. The building, which possesses integrated technology, also achieves passive cooling through the evaporation of water based on ambient temperature, thereby cooling the interior and surrounding environment (Yamanashi et all, 2011).

The Leadenhall Building features a double-layered transparent glass facade for passive solar control. Additionally, motorized louvers connected to an electro-mechanical system prevent unwanted heat gains in the building. The combination of passive and electro-mechanical systems classifies the building under integrated technology (Young et all, 2013).

Salesforce Tower achieves passive shading through a transparent glass metal sunshade on a mother-of-pearl surface. LED screens installed on the lower six floors of the building display environmental data. This indicates the presence of both energy-transforming materials and information technologies in the building. Additionally, the facade-integrated ventilation system provides electro-mechanical ventilation. The combination of passive and active systems classifies the building under integrated technology (Web 10, 2023).

Doha Tower is classified as passive and electro-mechanical due to its double-skin facade and layers composed of aluminum components. The presence of both passive and electro-mechanical systems highlights the existence of integrated technologies (Web 11, 2023).

PIF Tower is classified under the headings of passive triple-insulated curtain wall and adjustable glass fins, indicating the use of information and electro-mechanical technologies. In addition to these integrated technologies, the presence of photovoltaics signifies the use of energy-transforming materials in the building (Soto and Al-Shihabi, 2015).

DOI: 10.15320/ICONARP.2024.274

One World Trade Center Building achieves passive solar control through its glass curtain wall that contains only low iron content (Web 12, 2023).

When examining the data obtained from the investigated structures, it is observed that the most used intelligent system in the facades of high-rise office buildings worldwide is passive technology. Like Turkiye, all buildings have employed passive technology, particularly for solar control. Passive technology is followed by integrated technology and electro-mechanical technology, which are present in 9 structures. Electro-mechanical systems are used in shading devices attached to the facade and in shading elements integrated into the building envelope to achieve solar control. Information technology, on the other hand, follows electro-mechanical and integrated technology, and it is found in 6 structures. This technology is primarily used in LED displays and for learning external weather conditions through sensors to optimize building performance. Unlike in Turkiye, the use of photovoltaics, which is an energy-changing material, is frequently encountered in the investigated structures worldwide. Photovoltaics are employed to provide the required energy for the operation of electro-mechanical components that require movement in the facade. Lastly, like Turkiye, none of the buildings exhibit the use of materials that can change their properties (Tablo 3).

Table 3. Findings on Examined Buildings in world and Turkiye

	BUILDINGS	Technology-based					Material-based	
		Mechanical	Electro-Mechanical	Passive	Information	Integrated	Property-Changing	Energy-Transforming
WORLD	Torre Reforma		✓	✓	✓	✓		
	Al Bahar Towers		✓	✓	✓	✓		
	1 Bligh Street Building		✓	✓	✓	✓		✓
	Pearl River Tower		✓	✓	✓	✓		✓
	NBS Osaki Building		✓	✓		✓		✓
	The Leadenhall Building		✓	✓		✓		
	Salesforce Tower		✓	✓	✓	✓		✓
	Doha Tower		✓	✓		✓		
	PIF Tower		✓	✓	✓	✓		✓
	One World Trade Center			✓				
TURKIYE	Nida Tower Goztepe			✓				
	Allianz Tower		✓	✓	✓	✓		✓
	Istanbul Tower 205		✓	✓	✓	✓		
	Maslak No:1 Tower	✓		✓				
	Soyak Crystal Tower		✓	✓	✓	✓		
	Skyland Office Tower		✓	✓	✓	✓		
	Zorlu Levent 199			✓				✓
	Vakif Bank HQ Tower			✓				
	Palladium Tower		✓	✓		✓		
	AND Kozyatagı	✓		✓				

CONCLUSION AND RECOMMENDATIONS

High-rise buildings have experienced significant advancements due to progress in material technology since their inception. Particularly, revolutionary changes in facade design occurred with the development of new materials and construction techniques following the industrial revolution. In the 1970s, there was a paradigm shift in facade design. The need to improve energy efficiency and indoor comfort conditions led to the emergence of facades aimed at reducing energy consumption and enhancing user well-being. It was during this transformative period that the concept of intelligent facades emerged. Considering that the concept of intelligent facades continues to evolve, it is evident that there is currently no standardized terminology or classification system. However, to comprehensively examine and understand IFSs, it is crucial to delve deep into the underlying mechanisms triggering facade transformations. To facilitate this understanding, a classification framework considering the use of materials and the complexity of devices integrated within these facades is necessary. In the context of this study, changes brought about by integrated devices and mechanisms are categorized into five groups: passive, mechanical, electro-mechanical, integrated technology, and information technology, while changes stemming from materials are classified under energy and property-transforming materials.

Based on the newly created classification, a comprehensive analysis of a total of 20 buildings selected from Turkiye and worldwide reveals that the predominant system used is passive technology. Passive technology, which harnesses energy from natural sources, emerges as the preferred choice due to its ecological and economic advantages. Following passive technology, the second most used system is integrated technology. This is because any active technology system added to systems that derive energy from nature and humans, such as passive and mechanical technology, falls into the category of integrated technology and operates in hybrid mode. The third preferred technology is electro-mechanical technology. The use of electro-mechanical technology has increased, especially in windows and blinds, which are important elements of the facade, allowing for remote control. Among all technologies, information technology, which is the latest and still rapidly developing technology, ranks fourth. When examining the materials used in buildings, only energy-changing materials such as photovoltaics and LED displays have been found. Mechanical technology is present in only two of the buildings examined in Turkiye. Although no materials with changing properties have been found in any of the investigated structures, they are used in facade applications in architecture. As a result of all the investigations, it can be said that energy-changing materials are used in more buildings worldwide than in Turkiye, but there is still parallel development in facade technology.

Analysis of facade systems in Turkiye reveals the prevalence of passive, integrated, and electro-mechanical facade technologies,

DOI: 10.15320/ICONARP.2024.274

indicating the increasing adoption of energy-efficient and technologically advanced solutions. However, there are still opportunities for further development and improvement in intelligent facade applications in Turkiye.

The following recommendations can be considered to increase the development of intelligent facades in Turkiye:

- Encouraging research and development efforts focused on intelligent facade technologies, materials, and systems specifically tailored to the climate, building regulations, and user requirements in Turkiye. This can facilitate the creation of innovative solutions that optimize energy performance, indoor comfort, and user experience.
- Promoting knowledge and expertise exchange among experts, including architects, engineers, manufacturers, and researchers. Industry-academia collaborations can be emphasized in this regard. Fiscal incentives, tax benefits, and building certification programs can encourage building owners and developers to invest in energy-efficient and intelligent facade technologies.
- Increasing awareness among architects, engineers, investors, and users about the benefits and potential of IFSs. Educational programs, workshops, and conferences can be encouraged to train professionals in the design, installation, and maintenance of IFSs, emphasizing their impact on energy conservation and environmental sustainability.

By implementing these recommendations, Turkiye can further contribute to the advancement of intelligent facade development, thereby supporting energy efficiency goals, sustainable building practices, and improved user experiences in high-rise office buildings and beyond.

This study provides an evaluation of intelligent facade systems in selected buildings from Turkiye and various regions worldwide. However, factors such as climatic region and budget were not considered in this analysis. Nonetheless, future studies could explore how the facades of high-rise office buildings may evolve by incorporating one or more of these criteria. Furthermore, by maintaining the same classification framework and examining more high-rise building examples tailored to different user profiles, a comparison can be made to highlight the differences between the facades of high-rise office buildings and those of other types of high-rise structures.

ACKNOWLEDGEMENTS/NOTES

The authors would like to acknowledge the reviewers who contributed to the improvement of the article.

This article is derived from the development of the master's thesis referenced below: ‘Aydinç, S. (2023). Investigation of Smart Façade

Technologies Used in High Rise Office Building, Gebze Technical University Graduate School of Natural and Applied Sciences.'

REFERENCES

Addington, Michelle., & Schodek, D. L. (2005). Smart Materials And New Technologies: For The Architecture And Design Professions. Architectural Press.

Akta, E. (2010). An Evolution of Skyscraper Facades in Terms of Sustainability: In Case of Buyukdere Avenue, Master Thesis, Fatih Sultan Mehmet Vakıf University, İstanbul.

Balali, A., & Valipour, A. (2020). Identification and selection of building façade's smart materials according to sustainable development goals. Sustainable Materials and Technologies, 26, e00213. https://doi.org/10.1016/J.SUSMAT.2020.E00213

Bedon, C., Honfi, D., Kozłowski, M., Machalická, K. V., Santos, F., Wüest, T., Eliášová, M., & Vokáč, M. (2018). Key Structural Aspects for Adaptive Facades - Activity Progress from the EU-COST Action TU1403 'Structural' Task Group. International Journal of Structural Glass and Advanced Materials Research, 2(1), 135–154.

Bertoldi, P., Cuniberti, B., Labanca, N., Toleikyte, A., Tsemekidi-Tzeiranaki, S., Zangheri, P., & European Commission. Joint Research Centre. (2019). Analysis of the Annual Reports 2018 under the Energy Efficiency Directive. https://doi.org/10.2760/22313

Buckman, A. H., Mayfield, M., & Beck, S. B. M. (2014). What is a Smart Building? Smart and Sustainable Built Environment, 3(2), 92–109. https://doi.org/10.1108/SASBE-01-2014-0003

Cheng, R., Wang, X., & Zhang, Y. (2014). Energy-Efficient Building Envelopes with Phase-Change Materials: New Understanding and Related Research. Https://Doi.Org/10.1080/01457632.2013.863674, 35(11–12), 970–984. https://doi.org/10.1080/01457632.2013.863674

Decker, M., & Zarzycki, A. (2013). Designing Resilient Buildings with Emergent Materials. www.njit.edu

Department of Energy, U. (2015). Chapter 5:Increasing Efficiency of Building Systems and Technologies, In An Assessment Of Energy Technologies And Research Opportunities, https://www.energy.gov/articles/chapter-5-increasing-efficiency-buildings-systems-and-technologies (Accessed date: 06.06.2023).

Dörter E., (2015), https://www.emredorter.com/tr/projeler/mimari/zorlu-levent-199, (Accessed Date: 22/12/22).

Fox, M. A., & Yeh, B. P. (2000). Intelligent Kinetic Systems in Architecture. Managing Interactions in Smart Environments, 91–103. https://doi.org/10.1007/978-1-4471-0743-9_9

Gruber, P. (2008). The signs of life in architecture*. Bioinspiration & Biomimetics, 3(2), 023001. https://doi.org/10.1088/1748-3182/3/2/023001

Habibi, S., Valladares, O. P., & Peña, D. M. (2022). Sustainability Performance by Ten Representative Intelligent Façade Technologies: A Systematic Review. Sustainable Energy Technologies and Assessments, 52, 102001. https://doi.org/10.1016/J.SETA.2022.102001

Halawa, E., Ghaffarianhoseini, A., Ghaffarianhoseini, A., Trombley, J., Hassan, N., Baig, M., Yusoff, S. Y., & Azzam Ismail, M. (2018). A review on energy conscious designs of building façades in hot and humid climates: Lessons for

DOI: 10.15320/ICONARP.2024.274

(and from) Kuala Lumpur and Darwin. Renewable and Sustainable Energy Reviews, 82, 2147–2161. https://doi.org/10.1016/J.RSER.2017.08.061

Harry, S. (2016). Dynamic Adaptive Building Envelopes – An Innovative and State-of-The-Art Technology. Creative Space, 3(2), 167–184. https://doi.org/10.15415/CS.2016.32011

Heidari Matin, N., & Eydgahi, A. (2022). Technologies used in responsive facade systems: A comparative study. Intelligent Buildings International, 14(1), 54–73. https://doi.org/10.1080/17508975.2019.1577213

Karanouh A., Kerber E., (2015). Innovations in Dynamic Architecture: The Al-Bahr Towers Design and Delivery of Complex Facades, Journal of Facade Design and Engineering, 3, 185 – 221.

Khaled Dewidar, Ayman Hassan Mahmoud, Norhan Magdy, & Safie el din Ahmed. (2010). The Role of Intelligent Façades in Energy Conservation. The Proceeding of International Conference on Sustainability and the Future: Future Intermediate Sustainable Cities.

Kolarevic, B., & Parlac, Vera. (2015). Building Dynamics : Exploring Architecture of Change. https://www.routledge.com/Building-Dynamics-Exploring-Architecture-of-Change/Kolarevic-Parlac/p/book/9781138791022

Liu, M., Wittchen, K. B., & Heiselberg, P. K. (2015). Control strategies for intelligent glazed façade and their influence on energy and comfort performance of office buildings in Denmark. Applied Energy, 145, 43–51. https://doi.org/10.1016/J.APENERGY.2015.02.003

Loonen, R. C. G. M., Rico-Martinez, J. M., Favoino, F., Brzezicki, M., Menezo, C., & Aelenei, L. (2015). Design for façade adaptability – Towards a unified and systematic characterization. Conference Proceedings of the 10th Energy Forum- Advanced Building Skins, 1274–1284. https://www.researchgate.net/publication/279955723_Design_for_facade_adaptability_-_Towards_a_unified_and_systematic_characterization#fullTextFileContent

Loonen, R. C. G. M., Trčka, M., Cóstola, D., & Hensen, J. L. M. (2013). Climate adaptive building shells: State-of-the-art and future challenges. Renewable and Sustainable Energy Reviews, 25, 483–493. https://doi.org/10.1016/J.RSER.2013.04.016

Meagher, M. (2014). RESPONSIVE ARCHITECTURE AND THE PROBLEM OF OBSOLESCENCE. International Journal of Architectural Research: Archnet-IJAR, 8(3), 95–104. https://doi.org/10.26687/ARCHNET-IJAR.V8I3.498

Miranda W., Safarik D., (2011). Sustainable Tall Building Design Exemplars, CTBUH Journal 2021, Issue III: 12 – 19.

Monthly Energy Review, T. 2. 1. W. D. E. I. A. (2013). Energy Information Agency. Monthly Energy Review September 2013, Table 2.1. Washington, DC: Energy Information Agency. http://www.eia.gov/totalenergy/data/annual.

Omar, O. (2018). Intelligent Building, Definitions, Factors and Evaluation Criteria of Selection. Alexandria Engineering Journal, 57(4), 2903–2910. https://doi.org/10.1016/J.AEJ.2018.07.004

Oró, E., de Gracia, A., Castell, A., Farid, M. M., & Cabeza, L. F. (2012). Review on phase change materials (PCMs) for cold thermal energy storage applications. Applied Energy, 99, 513–533. https://doi.org/10.1016/J.APENERGY.2012.03.058

Özbek Akta E., (2010), “An Evolution of Skyscraper Facades in Terms of Sustainability: In Case of Buyukdere Avenue”, Master Thesis, Fatih Sultan Mehmet Vakıf University, İstanbul.

Poppinga, S., Lienhard, J., Masselter, T., Schleicher, S., Knippers, J., & Speck, T. (2010). Biomimetic deployable systems in architecture. IFMBE Proceedings, 31 IFMBE, 40–43. https://doi.org/10.1007/978-3-642-14515-5_11/COVER

Ramzy, N., & Fayed, H. (2011). Kinetic systems in architecture: New approach for environmental control systems and context-sensitive buildings. Sustainable Cities and Society, 1(3), 170–177. https://doi.org/10.1016/J.SCS.2011.07.004

Sawyer, K. (2014). Windows and building envelope research and development. Roadmap for emerging technologies, https://www.energy.gov/eere/buildings/articles/research-and-development-roadmap-windows-and-building-envelope (Accessed date: 02.06.2023).

Schleicher, S., Lienhard, J., Poppinga, S., Masselter, T., Speck, T., & Knippers, J. (2011). Adaptive Façade Shading Systems inspired by Natural Elastic Kinematics.

Schnädelbach, H. (2010). Adaptive architecture-a conceptual framework. proceedings of Media City, 197, 522-538.

Selkowitz, S., Head, D., Aschehoug, Ø., & Lee, E. S. (2003). Advanced Interactive Facades — Critical Elements for Future Green Buildings? The Proceeding of Annual USGBC International Conference and Expo.

Soto R., Al-Shihabi B., (2015), “Iconic Office Tower Propels Saudi Arabia into the New Global Century: Challanges and Innovations”, The Middle East: A Selection of Written Works on Iconic Towers and Global Place-Making”, Conference Proceeding, 114-125.

Teuffel, P. (2004). Entwerfen adaptiver Strukturen [Universität Stuttgart.]. https://doi.org/10.18419/OPUS-195

Thalfeldt, M., Pikas, E., Kurnitski, J., & Voll, H. (2013). Facade design principles for nearly zero energy buildings in a cold climate. Energy and Buildings, 67, 309–321. https://doi.org/10.1016/J.ENBUILD.2013.08.027

Tomlinson R., Baker W., Leung L., Chen S., Zhu Y., (2014), “Case Study: Pearl River Tower, Guangzhou”, CTBUH Journal, Issue II.

Velikov, K., & Thün, G. (2013). Responsive Building Envelopes: Characteristics And Evolving Paradigms, In Design and Construction of High-Performance Homes (pp. 75-92). Routledge.

Vermillion, J. D. (2002). Phototropic architecture: intelligent responses to sunlight stimuli. http://cardinalscholar.bsu.edu/handle/20.500.14291/182349

Web 1 (2023). Nida Tower, https://www.ergunmimarlik.com.tr/proje-detay/nidakule-goztepe, (Accessed date: 05/07/2023).

Web 2 (2023). İstanbul 205 Tower, https://theplan.it/eng/award-2018-officebusiness/istanbul-tower-205-4, (Accessed date: 05/07/2023).

Web 3 (2023). Maslak no:1 Tower, https://emrearolat.com/project/maslak-no-1-office-tower/, (Accessed date: 05/07/2023).

Web 4 (2023). Skyland İstanbul Tower, https://www.skylandistanbul.com, (Accessed date: 05/07/2023).

Web 5 (2023). Vakıfbank HQ Tower, https://www.theplan.it/award-2022-mixed-use/vakfbank-head-office-service-building-and-facilities-a-symbol-of-islamic-architecture-tabanlioglu-architects, (Accessed date: 04/06/2023).

Web 6 (2023), Palladium Tower, https://www.altensis.com/proje/palladium-tower/, (Accessed date: 04/06/2023).

Web 7 (2023), And Tower, https://www.arkiv.com.tr/proje/and1/3207, (Accessed date: 03/06/2023).

DOI: 10.15320/ICONARP.2024.274

Web 8, (2023), 1 Bligh Street Building, https://architectus.com.au/projects/1-bligh-street/, (Accessed date: 05/12/2022).

Web 9, (2023), 1 Bligh Street Building, https://www.arup.com/projects/1-bligh-street-sydney, (Accessed date: 05/12/2022).

Web 10, (2023), Salesforce Tower, https://www.salesforcetower.com/about/, (Accessed date: 05/01/2023).

Web 11, (2023), Doha Tower, https://www.jeannouvel.com/en/projects/doha-9-hifgr-rise-office-tower/, (Accessed date: 05/01/2023).

Web 12, (2023), One World Trade Center, https://www.som.com/projects/one-world-trade-center/, (Accessed date: 07/01/2023).

Wigginton, M., & Harris, J. (2013). Intelligent Skins. Taylor & Francis. https://books.google.com/books?hl=en&lr=&id=7O8fjtbdFkcC&oi=fnd&pg=PR2&ots=jXqYUZapF_&sig=luD19n-zFEucOoRHKe_WUP9yTG0

Wong, J. K. W., Li, H., & Wang, S. W. (2005). Intelligent Building Research: A Review. Automation in Construction, 14(1), 143–159. https://doi.org/10.1016/J.AUTCON.2004.06.001

Yekutiel, T. P., & Grobman, Y. J. (2014). Controlling kinetic cladding components in building façades: A case for autonomous movement. Rethinking Comprehensive Design: Speculative Counterculture - Proceedings of the 19th International Conference on Computer-Aided Architectural Design Research in Asia, CAADRIA 2014, 129–138. https://doi.org/10.52842/CONF.CAADRIA.2014.129

Yamanashi T., Hatori T., Ishihara Y., Kawashima N., Niwa K., (2011), “Bio Skin Urban Cooling Facade”, John Wiley & Sons, Online Library.

Young A., Annereau N., Butler A., Smith B., (2013). Case Study: The Leadenhall building, London, CTBUH Journal, Issue II.

Resume

Fazilet TUĞRUL OKBAZ completed her undergraduate education with honors in the Department of Architecture at DEU in 2012. She has completed her master and PhD studies at Mimar Sinan Fine Arts University. She started as a research assistant at Gebze Technical University in 2013 and has been serving as an Instructor, PhD. since 2020. Her research areas include high-rise buildings, building technologies, and intelligent facades. She has published many national and international scientific paper and book chapters. She contributes building science, structural systems and technologies, tall buildings courses, and design studios.

Simay AYDİNÇ, received her bachelor’s degree from Gebze Technical University, department of Architecture in 2020 and her master’s degree in architecture in 2023 from Gebze Technical University. She currently works as a project coordinator at Aterko Construction. Her primary research interests are high-rise buildings, high-rise building facades and facade technologies.

Ferhat PAKDAMAR is an Associated Professor of the Department of Architecture at İstanbul Technical University since 2024. He has completed his master and PhD studies at Istanbul Technical University. He worked as an academic and served as the vice dean of the Gebze Technical University Faculty of Architecture. His research interests are artificial intelligence and performance analysis of structures in his PhD thesis. He has published many national and *international scientific paper and book chapters. He contributes structural courses, design studios and also conducts some graduate thesis.*

DOI: 10.15320/ICONARP.2024.274

Research Article

ICONARP
International Journal of Architecture and Planning
Received: 16.05.2023 Accepted: 14.12.2023
Volume 12, Issue 1/ Published: 30.06.2024
DOI: 10.15320/ICONARP.2024.275 E- ISSN:2147-9380

ICONARP

Tracing the Evolution of Sustainable Architecture: An Analysis Spanning Five Decades

Sustainable Architecture Evolution

Hande Eyüboğlu*
Serap Faiz Büyükçam **

Abstract

This study aims to reveal the relationship between architecture and sustainability in the approximately half-century history of sustainability. The study reveals bibliographic characteristics such as change, trend, period, country and author in the terminology of sustainable architecture. A systematic literature review was carried out using bibliometric analysis to produce a performance analysis and science mapping of scientific studies in the field. Bibliometric network visualisations were created using VOSviewer software to analyse the conceptual, social and intellectual structure of the field. This study contributes to the literature by deciphering the bibliographic parameters of sustainable architecture studies conducted between 1975 and 2022. It also identifies current trends in the field and provides a chronological perspective on scholarly studies based on environmentally conscious architectural approaches. The scope of the study is limited to sustainable architecture studies in the Web of Science database, taking into account the range of resources and the speed of indexing. The studies were carried out using 15 keywords, which were predetermined for the scope and focus of the research. This study has enabled real and legal researchers to follow the developments and current course in the field. The broad temporal scope of this study, with its unique combination of research and potential to inform practice, underlines its contribution to the discourse on sustainable architecture and firmly establishes its rightful place. The analysis shows that research has gained momentum in recent years. Today, concepts such as sustainable architecture, climate change, sociocultural sustainability and reuse have come to the fore.

Keywords:
Sustainability, Climate change, Socio-cultural sustainability, Reuse, Bibliometric analysis

* Faculty of Architecture and Design, Samsun University, Samsun, Turkey. (*Corresponding author*)
Email: hande.eyuboglu@samsun.edu.tr

** Faculty of Architecture, Ondokuz Mayıs University, Samsun, Turkey.
Email: serap.faizbuyukcam@omu.edu.tr

To cite this article: Eyüboğlu, H., & Faiz Büyükçam, S. (2024). Tracing the Evolution of Sustainable Architecture: An Analysis Spanning Five Decades. *ICONARP International Journal of Architecture and Planning,* 12 (1), 46-74. DOI: 10.15320/ICONARP.2024.275

INTRODUCTION

Sustainable architecture is an approach to the design and construction of buildings that do not harm the environment and natural resources, are suitable for human health, are economically efficient and long-lasting. This approach considers all processes from design to construction, operation, maintenance and waste management of buildings, taking into account the needs of future generations. Sustainable architecture aims to reduce the carbon footprint of buildings, increase energy efficiency, minimise waste production, and protect natural resources while acting with environmental and social responsibility (Clayton & Radcliffe, 2018). Sustainable architecture can use various technological and design methods to achieve these goals, such as renewable energy sources, green roofs and walls, rainwater harvesting systems, and recyclable materials. Sustainable architecture reflects a sense of social responsibility by protecting the health of the environment and human comfort (Eldardiry & Konbr, 2022; Konbr & Mamdouh, 2022; Owen & Dovey, 2008; Williams, 2007). Therefore, sustainable architecture is an important field contributing to sustainability goals, one of our most important issues.

In this study, which aims to reveal the relationship between architectural thought and production within the framework of environmentally sensitive approaches, the bibliography of representations of environmentally sensitive architectural approaches in the literature has been analysed. It aims to decipher the bibliographical parameters of these studies, such as changes and trends in terminology, chronological existence and relationships between publications. In this way, it ensures that researchers, as well as natural and legal persons who carry out or are interested in studies on the subject, can follow developments and current trends in the field. This study, which is important in showing the extent and evolution of environmentally sensitive approaches in architecture, which have been on the agenda for almost half a century, also offers a chronological perspective. Although a high level of public opinion has been created through various channels on the axis of environmentally sensitive approaches, it is important to analyse some quantitative and qualitative information from scientific studies that have gained a place in the international literature in order to follow the current course. Various bibliometric analysis studies on sustainability in architecture can be found in the literature. These studies are focused on the integration of building information modelling or geographic information systems with a sustainable built environment (Li, Rong, Ahmad, Wang, Zuo, & Mao, 2021; Udomsap & Hallinger, 2020; Wang, Pan, & Luo, 2019), city design (Feng, Gu, Ye, Jia, Zhang, Wang, & Yang, 2022; Xia, Liu, Maria, Liu, & Lin, 2022; Wang, Ho, & Fu, 2019), biomimicry (Varshabi, Arslan Selçuk, & Mutlu Avinç, 2022), material choices and facade designs (Pramesti, Hasan, & Ramandhika, 2021), green buildings (Oguntona, Aigbavboa, & Thwala, 2021; Zhao, Zuo, Wu, & Huang, 2019), and off-site construction (Wuni, Shen, & Osei-Kyei, 2020). However, since these studies focus on specific issues related to

DOI: 10.15320/ICONARP.2024.275

sustainability, are limited to scientific studies produced in a specific country, and cover limited time intervals on the subject, no study offers a general perspective on sustainability in the field of architecture. Therefore, this study aims to fill this gap by conducting a comprehensive and detailed bibliometric analysis of the field. Following a systematic review of the literature on sustainable architecture and data mining, the study analyses the studies retrieved from the Web of Science database using the VOSviewer program. This study contributes to the literature in terms of raising awareness and interest in how the issue is being addressed scientifically. The Web of Science (WoS) database was used to search for studies on green architecture in the international literature, given its wide range of sources and rapid indexing capabilities. The study is limited to the articles in this database.

LITERATURE REVIEW

On Environmental Sensitivity and Architecture

The increase in the world population and the rapid consumption of resources have raised concerns about the future. The realisation that natural resources are limited in the face of a growing population has put environmentally sensitive approaches on the agenda. Especially in the last quarter of the 20th century, awareness of the need to protect the environment and natural resources has become important (Williams, 2007). Many disciplines have worked on developing self-sufficient systems that minimize environmental and wildlife impacts. On the other hand, the discipline of architecture has been one of the main actors of environmentally sensitive theories and practices regarding its effects on the physical environment (Bennetts, Radford, & Williamson, 2002; Kim & Rigdon, 1998; Sassi, 2006). Architecture, as a production or an idea, has played an important role in the development of environmental and resource-sensitive approaches by being at the centre of various debates.

With the industrial revolution, changes in the way and amount of production, approaches to resource use and evolving patterns of consumption have started to have a negative impact on nature. In society, the protection of nature and the life of living beings has ceased to be valued, and the profit of big capital has become the measure of success. In this process, the reduction, degradation and even destruction of natural resources has become an agenda. The growth of industry and the associated waste problems have made environmentally sensitive approaches controversial on a global scale. Within the scope of the environmentalism movement that deepened and intensified in the 1960s, "sustainability" developed as a concept and various publications were made on the negative effects of human beings on nature (Tekeli & Ataöv, 2017). At the conference held in Stockholm in 1972, the United Nations Environment Programme (UNEP) was established to emphasize the compatibility of economic development with the environment, and June 5 was declared Environment Day. With the Brundtland Report published in the late 1980s, the concept of "sustainability" gained centrality (World

Commission on Environment and Development, 1987). During these years, the European Union's policies on natural resources and environmental protection have also evolved (Aydın & Çamur, 2017). In the early 1990s, 20 years after the Stockholm Conference, after the United Nations Conference on Environment and Development in Rio de Janeiro, the scope of environmental approaches expanded, and issues such as climate change and biodiversity conservation gained importance in the centre of sustainability (Tekeli, 2011). Within the European Union, the Amsterdam Treaty (1999) emphasized the need to address environmental protection sustainably, while the Nice Treaty (2001) emphasized managing water resources, waste, and land use. The Lisbon Treaty (2009) focused on measures on the environment, climate change, energy, and financing of related activities.

In the historical context, while sustainable architecture mainly draws attention to energy efficiency and environmental sustainability, it has gained a more layered and complex dimension over time. Various current concerns such as climate change, resource scarcity, green infrastructure, health, welfare, and social and cultural harmony have started to be addressed. Environmentalist approaches have been addressed in various scopes on the axis of the concept of sustainability and have been supported by various studies that have made a global impact. Many areas, such as agriculture, health, transportation, and construction, negatively impact the environment. Various interdisciplinary proposals and policies have been developed to prevent environmental problems, such as the re-organisation of resource use, the reduction of consumption, the reduction of carbon emissions in built environment applications, and the use of renewable materials (Clayton & Radcliffe, 2018). The discipline of architecture, one of the main actors in the study of the built environment, is one of the disciplines in which these proposals and policies are developed (Konbr, Bayoumi, Ali, & Shiba, 2022). Sustainability, which is discussed in terms of the ability to satisfy human needs without suffering from the depletion of natural resources, is one of the dominant fields of knowledge in today's and tomorrow's humanity within the relations of production and consumption. In particular, it is one of the dominant fields of knowledge in architecture, which is the science of designing and building physical environments (Williams, 2007). Approaches and practices related to sustainability in architecture; ensuring energy efficiency, from land settlement (site location, orientation, building location, size) to the use of climatic data (temperature, wind, air pollution, etc.) and the improvement of indoor quality (comfort level, ambient temperature, humidity, air quality) and from the determination of function in reuse to application methods in a wide range of buildings and cities. In the design of the sustainable architectural built environment, minimizing the negative environmental effects and necessitating a holistic, strategic, and planned construction, on the other hand, it includes social, cultural, and economic infrastructures as well as morphological features (Bauer, Mösle & Schwarz, 2009; Guy & Farmer, 2001; Konbr &

DOI: 10.15320/ICONARP.2024.275

Abdelaal, 2022; Owen & Dovey, 2008; Sassi, 2006). In this context, all building design activities that consider future generations, are environmentally sensitive and meet users' needs with effective and efficient use of resources are within the scope of environmentally sensitive architecture. The principles of resource management, life cycle design, and design for people are also within this scope. Efficient use of resources such as energy, water, etc., local facilities and building areas resource management, the period from the construction of the building to its demolition/transformation is considered as the life cycle. Design for people is considered within the scope of resource conservation and the provision of appropriate health and comfort conditions (Kim & Rigdon, 1998; Sev, 2009). Approaches that are sensitive to all these environmental challenges in the discipline of architecture, under the umbrella of sustainable architecture; it is represented by different terms such as environmental design, green architecture, ecological architecture, environmentally sensitive architecture, green architecture, and energy-efficient architecture. This diversity in terminology points to architectural practices, ideas, and studies developed on environmental issues (Durmuş Arsan, 2008).

From Data Mining to Bibliometric Analysis

Data mining is defined as transforming meaningless data collection into meaningful data through certain processes; it combines many disciplines, including technology, deep learning, and data science (Han & Kamber, 2006). The common point in data mining, which is used today in different fields such as education, engineering, and health, is that it is a process of knowledge discovery and analysis among the masses of data (Andrés, 2009; Kobayashi, Mol, Berkers, Kismihók & Den Hartog, 2018). One of the topics included in data mining studies is text mining. Text mining is an application area of study made using large volumetric data in the web environment. The whole set of applications preferred in making sense of data, such as clustering and classification, is called text mining. Identification of changing phenomena in any subject and bibliometric analysis is one of the studies in text mining used to identify the transformation in the literature (Artsın, 2020). Bibliometric analysis is a method that has gained importance in recent years to examine the level of development of scientific studies in any field and to determine the transformation in the process (Doğruer, 2022; Donthu, Kumar, Mukherjee, Pandey & Lim, 2021; Güdü Demirbulat & Tetik Dinç, 2017; Heberger, Christie & Alkin, 2010; Park & Lee, 2022).

Bibliometric analysis examines scientific research in a specific field with statistical and mathematical techniques in scientific information-sharing environments such as books, journals, etc. (Borgman & Furner, 2002; Pritchard, 1969). Bibliometric analysis, which is based on analyzing certain characteristics of research, aims to enable a broader perspective on the field of study and to reveal trends in the field (Al & Coştur, 2007; Samiee & Chabowski, 2012). In this way, it reveals the trends in the field for researchers who are or will be conducting scientific studies in a field and offers the opportunity to discover the structure of the research topic in the existing literature (Verma & Gustafsson, 2020). Bibliometric analysis is both descriptive of the publications produced in a certain region in a certain period on a subject and the relationships between publications and evaluative to determine the extent to which they affect other planned studies. In these analyses, findings on scientific communication are determined by examining research components such as author profile and number of authors, number, type, and language of publications, number of publications by country, topics covered in the field, preferred keywords, number of citations, etc. (Al, 2014; Donthu et al., 2021; Güdü Demirbulat & Tetik Dinç, 2017). Therefore, bibliometric analysis has an important place in performance evaluation for the quantitative and qualitative development of the research field (Al & Soydal, 2012; Van Eck & Waltman, 2010). In addition to identifying the change and transformation in the field, bibliometric analysis also plays an effective role in revealing the insufficient points on the subject and discussing new suggestions (Yılmaz, 2017).

In architectural research, bibliometric analyses provide convenience against various difficulties. Architecture is a broad discipline that includes many sub-disciplines such as interior architecture, landscape architecture, and urban planning. Bibliometric analysis studies help to organize data sets in architectural research, which usually contain large and complex data groups. At this point, bibliometric analyses make it easier to examine topics and trends by classifying research. On the other hand, as in every discipline, it is important to define keywords correctly in architectural studies. Bibliometric analyses guide researchers in the selection of effective keywords. On the other hand, architecture interacts with many different disciplines such as sociology, psychology, and art history. At this point, bibliometric analyses offer the opportunity to examine how the subject under consideration interacts in different disciplines and interdisciplinary connections. From all these points of view, bibliometric analyses in architectural research help to provide a more effective understanding by offering solutions to unique challenges. From another perspective, bibliometric analyses in architecture act as a complement to qualitative evaluations. Comparing the quantitative data obtained through analyses with qualitative data or evaluating them together contributes to more comprehensive and detailed studies. In addition, it provides an opportunity for researchers to better understand their fields of study and to increase the effects in their fields of study.

Bibliometric studies consist of two categories: performance analysis and science mapping. Performance analysis focuses on the contribution of research components to the field by creating metrics associated with titles such as publications, citations, etc. (Cobo, López-Herrera, Herrera-Viedma, & Herrera, 2011). Science mapping, on the other hand, is concerned with the relationships and interactions between research components such as citations, co-citations, bibliographic matches,

DOI: 10.15320/ICONARP.2024.275

common words, and co-authorship (Baker, Kumar, & Pandey, 2021; Donthu et al., 2021). In this mapping system, data visualizations are made through science mapping to cluster the data community and research components (Donthu et al., 2021; Özdemir & Selçuk, 2021).

Bibliometric analysis can be done manually or with the help of various software programs. Considering the high number of scientific research conducted today and the rapid advancement of technology, it is advantageous to prefer software programs in terms of both time and scope (Cobo et al., 2021; Oraee, Hosseini, Papadonikolaki, Palliyaguru & Arashpour, 2017; Özdemir & Selçuk, 2021). In addition, software programs also allow the creation of visual relationships and network maps between bibliometric data. In bibliometric analysis, data are obtained from databases such as Web of Science, Scopus, and PubMed (AlRyalat, Malkawi, & Momani, 2019; Chadegani, Salehi, Yunus, Farhadi, Fooladi, Farhadi, & Ebrahim, 2013). VOSviewer, CiteSpace, Gephi, Bibexcel, and Pajek software compatible with these databases stand out in bibliometric analysis with their different capabilities and powerful features (Donthu et al., 2021; Özdemir & Selçuk, 2021). In literature analyses, it is preferred to examine author and institutional collaborations in research field trends (Artsın, 2020; Park & Lee, 2022; Yıldız & Beyhan, 2021). Citespace is another software that provides various graphs, timelines, network maps, and visualizations for scientific network analyses. It allows various uses such as monitoring interdisciplinary studies, scientific collaborations, and identifying research trends. BibExcel is intended for basic bibliometric analyses. Gephi allows visualization by analyzing various networks. Pajek has various capabilities such as complex network analyses, social networks, and information maps (Herrera-Viedma, Santisteban-Espejo, & Cobo, 2020; Pan, Yan, Cui, & Hua, 2018). All these software tools offer visualizations by supporting different aspects of bibliometric analysis. Which software is preferred depends on the objective of the research, the level of complexity of the analysis, and the trend of the research.

MATERIAL AND METHOD

In the following sections of this study, all environmentally sensitive architectural approaches are represented by the concept of "sustainable architecture" to have a common terminology. In this study, which aims to reveal the place of sustainable approaches in architectural thought and production, answers are sought to the following questions:

- What is the distribution of sustainable architectural studies according to years?
- Which country stands out in studies on the field, which is the most productive author, which is the most publishing institution, and which is the most influential journal?
- Which is the most cited article and the most cited journal in sustainable architecture studies?

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

- What are the topics covered in articles on sustainability in the discipline of architecture?
- How do the study subjects change chronologically?
- What are the current research topics and trends in the field?

This study was carried out in four basic steps. In the first step of the study, a literature review was conducted. In the literature review, the development of environmental awareness and the emergence of the concept of sustainability and its scope in the discipline of architecture were emphasized. This step was completed with a comprehensive literature review of domestic and foreign publications on bibliometric analysis. The literature review step was used to identify and confirm the study's limitations and determine the possibilities of the analysis method. In the second step, the population and sample were determined. First of all, the Web of Science, an international database containing more than 4 million records covering more than 20.000 refereed and high-quality 2.000 art and humanities journals for more than 50 years from 1975 to the present, has been selected as the universe of the study, taking into account parameters such as its widespread use, range of sources and indexing speed. At the same time, the Web of Science has a widespread network in arts and humanities (Park & Lee, 2022; Web of Science Group, 2022). Web of Science contains in-depth citation and citation data and has a rigorous quality control process for journal selection. It includes old scientific studies in many fields (Web of Science Group, 2022). On the other hand, it includes essential indexes such as the Social Sciences Citation Index, and Arts & Humanities Citation Index, which are at the forefront in architecture.

Determination of the sample was completed in four stages. First, it aimed to reach all publications in the selected database sensitive to environmental problems. In this context, the range of keywords targeted to represent the studies in the literature on different terms was determined. In the keyword selection of the study, bibliometric studies previously conducted in this field were read (Wang, Pan, & Luo, 2019; Xia, Liu, Maria, Liu, & Lin, 2022; Varshabi, Arslan Selçuk, & Mutlu Avinç, 2022; Pramesti, Hasan, & Ramandhika, 2021; Oguntona, Aigbavboa, & Thwala, 2021; Zhao, Zuo, Wu, & Huang, 2019; Wuni, Shen, & Osei-Kyei, 2020). Then, the keywords in the study sample were determined by listing the keywords in various types of publications such as books, articles, and theses on sustainable architecture. In the study, the 15 most prominent keywords were included in a comprehensive literature review that provides a broad overview of the historical and theoretical background of sustainable architecture. The literature review within the scope of "sustainable architecture", "sustainable design", "sustainable building", "green architecture", "green building", "energy-efficient architecture", "energy-efficient design", "energy-efficient building", "ecological architecture", "ecological design", "ecological building", "eco-friendly design", "eco-friendly building", "eco-friendly architecture" and "environmental design" the keyword has been identified. In the selection

DOI: 10.15320/ICONARP.2024.275

of keywords, widespread use in the literature has been taken into account, and attention has been paid to creating a comprehensive keyword list. As a result of the search in the Web of Science database with keywords, abstracts, keywords, and titles, 485,606 scientific publications were reached. Subsequently, 6.484 publications were identified with research limited to "architecture". There are 3,564 articles, 55 of which are review articles, 2,442 are proceeding papers, 192 are book chapters, 160 are book reviews, and 126 are editorial materials. Finally, the search was limited to the "article" type, considering its widespread effect and active role in directing the academic community, and the research sample was determined to consist of 3,564 articles (Figure 1). In this study, it was assumed that there were no unethical practices such as data confidentiality, double publication, various citation practices (self-citation, inconsistent citation, misleading citation), and potential conflicts of interest in the studies obtained from the database during the data collection phase.

This sample consists of studies between 1975-2022. The database search identified various studies on the bibliometric analysis of sustainable approaches in the architecture category. The bibliometric analysis of sustainability-related articles made in the discipline of architecture between 1975 and 2022 over a comprehensive keyword list constitutes the original aspect of this study (Hu, 2019; Jiang, Liu, Liu, & Liu, 2022; Oguntona et al., 2021; Zhao et al., 2019; Wuni et al., 2020). In the third step of the study, a bibliometric analysis of the determined sample was made. This analysis was carried out in two scopes: performance analysis and science mapping as full-count algorithms. Within the scope of the study, firstly, performance analysis was performed on the relevant sample for year, author, country, institution, journal, and index information. In line with the parameters determined here, sustainable architecture studies were analyzed through numerical data. Then, analyses were carried out with science mapping, frequently used in bibliometrics studies. With these analyses, the relationships between the determined parameters were examined. Within the scope of the study, science maps were created for keywords, prominent journals, authors, and countries with the most publications. In the fourth step, the research results were tested in line with the visualizations, information about the study results was given, and recommendations were emphasized.

Science mapping was created through the VOSviewer program. VOSviewer is a free program widely preferred for creating and visualizing maps based on bibliometric network data. The program is compatible with various databases, including Web of Science, Scopus, PubMed, Dimensions, and Lens (Van Eck & Waltman, 2010). This program can create citation, author, institution, country, and keyword maps based on the data. The VOSviewer program has three different visualization options, namely network, layer, and density visualization, which allow reading the relationship, interaction, and data connections between the data.

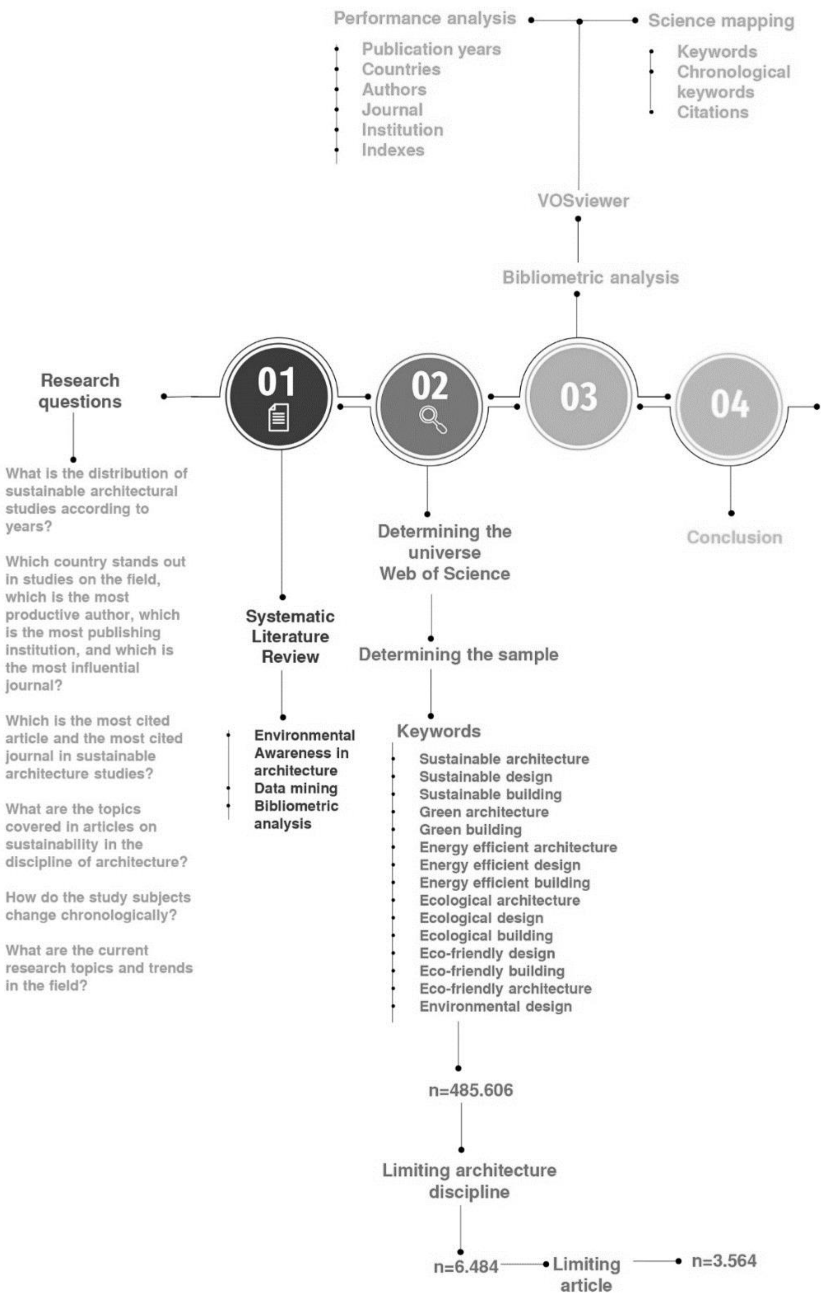


Figure 1. Research design.

In the network visualization, each data in the sample is represented as a circle with its bibliographic information, and the relationships between the data are shown with linear connections. The positions of the circles relative to each other are shaped according to the quantity of the relationship between the data communities, and their sizes are shaped in direct proportion to the density of the data in the sample. Depending on the sample size analyzed, some data whose quantitative values are not sufficient in the network visualization are not visible to avoid confusion of expression. The colour of the data is determined by the data collection to which it belongs. The layer visualization has the same characteristics as the network visualization except for how the elements are coloured. In this visualization, items are coloured according to their density in the

DOI: 10.15320/ICONARP.2024.275

data cloud, ranging from blue (lowest) to green to yellow (highest). The density visualization is the same as the layer visualization but is visualized as an areal distribution instead of a circle (Van Eck & Waltman, 2010; Van Eck, Waltman, Dekker, & Van Den Berg, 2010). The science mapping in this study is limited to network and layer visualizations. In this study, keyword network visualizations were made to identify the prominent keywords and to show their relationship with each other.

On the other hand, network visualizations of the most cited authors, countries, and journals were carried out within the scope of the study. In addition, layer visualizations were created to analyze the change in keywords over the years. These visualizations reveal the trends in the research field, the change of trends in the process, and their interactions within themselves.

RESULTS AND DISCUSSIONS

The findings regarding the bibliometric analysis of articles accessed from the Web of Science database are discussed under two separate headings: performance analysis and science mapping.

Performance Analysis

The findings obtained at this stage consist of five different scopes: the number of publications by years, the number of publications of countries, the most productive authors, the number of publications of institutions, the distribution of the number of publications according to journals and the most cited authors.

Number of publications by years: Although the publication year of the articles constituting the sample was spread over a wide range of time, it was observed that the number of articles generally increased over the years. This increase parallels sustainability approaches that have been on the agenda with various axioms for the last 20 years. The acceleration as of 2006 can be attributed to the various agreements that came into force within the scope of the European Union, especially in the 2000s. On the other hand, it has been observed that the pioneering studies on the subject date back to the 1975s. This is in line with the years when ideas on environmental problems intensified and the United Nations Environment Program was established in 1972. It has been observed that studies on the field have gained weight in the last 10 years. With 335 studies, the most articles were produced in 2021 (Figure 2). The climate crisis, which stands out within the scope of environmental problems, may be effective in this increase. This year, studies on housing sustainability and adaptation during and after the pandemic period came to the fore (Al Maani, Alnusairat, & Al-Jokhadar, 2021; Peters & Halleran, 2021; Porter, 2021; Saeed, Elkhatib, & Selim, 2021; Spennemann, 2021). In addition, studies on the climate factor in the sustainability assessments of buildings have been another prominent topic (Alawadi, Hernandez Striedinger, Maghelal, & Khanal, 2021; Fantozzi, Bibbiani, Gargari, Rugani, & Salvadori, 2021; Hao, Zhang, Xie, Wang, & Liu, 2021). The decrease in the number of articles in 2022 is noteworthy. This situation can be discussed within the scope of the limitations of the study. The first thing that comes to mind can be explained by the fact that the study data was obtained in September 2022. In addition, the effect of changing terminology and keyword selection can also be put forward. On the other hand, another reason may be that researchers focus especially on studies related to COVID-19, publishing institutions or organizations make calls on this issue, and special issues are published.

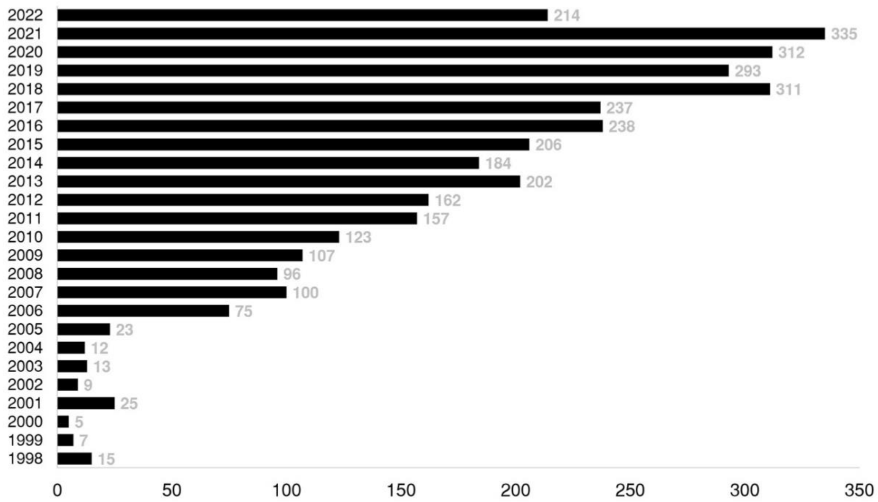


Figure 2. Distribution of publication numbers by years.

Number of publications of countries: According to the United Nations classification, the distribution of articles by country showed that developed countries contributed to the literature by producing more articles than developing and underdeveloped countries. The United States ranked first with 651 articles, followed by Italy with 371 articles, Turkey with 261 articles, China with 254 articles, and the United Kingdom with 225 articles. On the other hand, the fact that a developed country like Belgium is ranked below this ranking should be evaluated in the context of the country's surface area, population, and number of researchers (Figure 3). On the other hand, it should not be ignored that the number of publications is also related to the existence and number of various publication organs operating in the country. In addition to all these, based on the analyses made by the researchers in the database, it has been observed that the publication trends in developed countries have focused on issues such as social and cultural sustainability in recent years, while in developing countries, sustainable architecture is discussed through traditional architecture.

DOI: 10.15320/ICONARP.2024.275

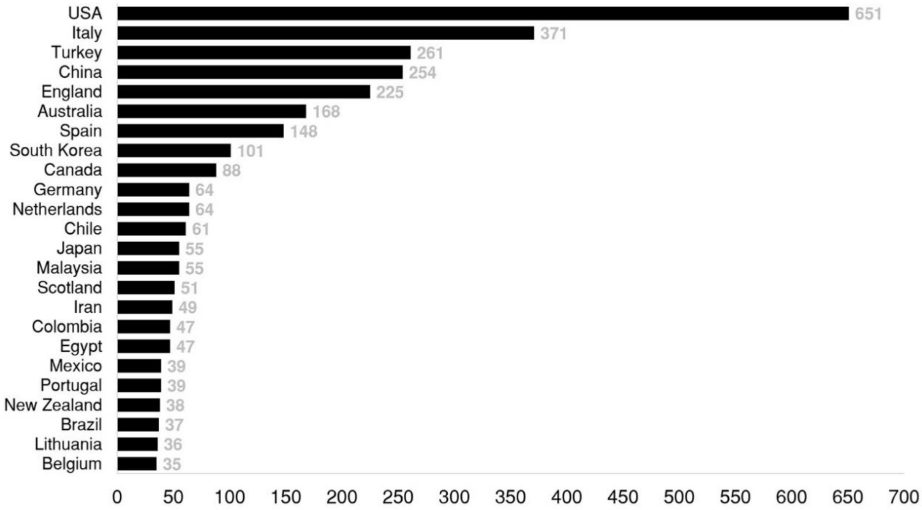


Figure 3. Distribution of the number of publications by country.

Number of publications by authors: Considering the distribution of authors, Kim S. has been the most productive author with 13 articles. Lee J, with 12 articles, Pushkar S, 12 articles, and Lehmann S, 11 articles, are other prolific authors in the field (Figure 4). Kim S's work is mainly related to the sustainability performance and design strategies of buildings (Ahn, Son, Park, and Kim, 2022; Han, Son, and Kim, 2022; Kim, Sanchez, Del Aguila and Kim, 2017; Oh, Lim, Lim and Kim, 2017).

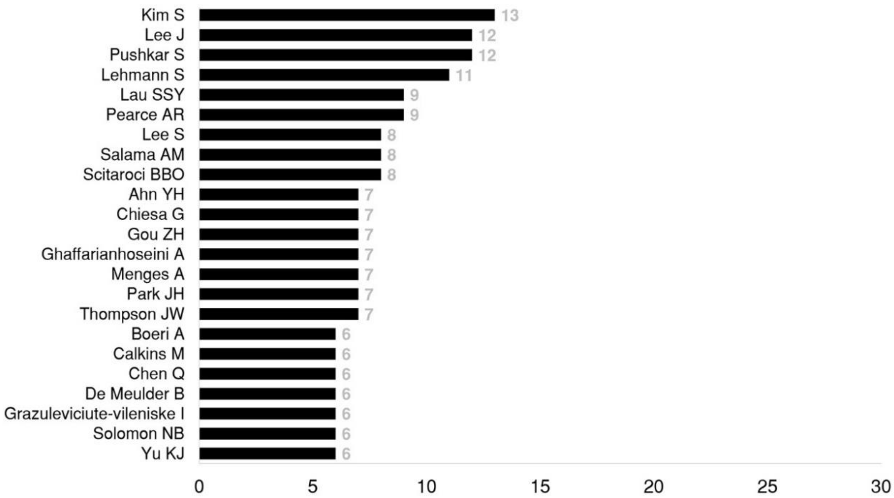


Figure 4. Number of publications by authors.

Number of publications of institutions: In terms of institutional distribution, the Polytechnic University of Milan is the most active institution, with 61 articles. This can be attributed to the fact that the Polytechnic University of Milan is a technical university with research opportunities in architecture and urban studies, architecture, built environment, and civil engineering. Following the Polytechnic University of Milan, Egyptian Knowledge Bank EKB, and Yıldız Technical University with 45 articles each, Polytechnic University Turin with 42 articles, and Sapienza University Rome with 41 articles are the other institutions contributing to the field (Figure 5). The top five institutions hosting the most publications are Italy, Egypt, and Turkey. It is noteworthy that no institution in the USA, the country with the highest number of publications in this ranking, is included in the list in the last ranks (Figure 3). This can be explained by the fact that the USA hosts a large number of institutions or organizations in the relevant field. The number of publications in institutions and organizations may be related to the number of researchers employed in the institution, as well as the publication organs operating within them.

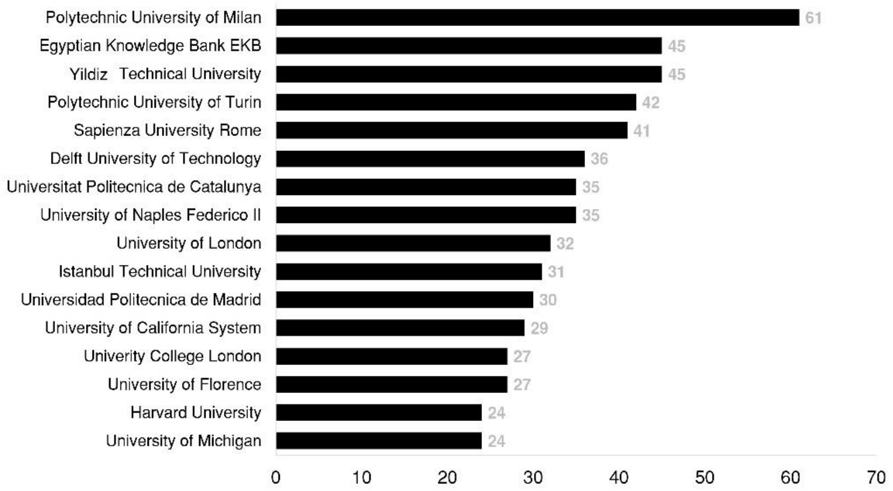


Figure 5. Distribution of publication numbers by institutions.

Number of publications of journals: When we look at the journals in which the studies were published, the Journal of Green Building ranks first with 490 articles, which includes sustainable built environment studies at the building, neighbourhood and urban scale, green building design policies and technological and innovative studies in the field. In addition, Open House International with 238 articles, Landscape Architecture Frontiers with 201 articles, and Techne Journal of Technology for Architecture and Environment with 195 articles are other journals that contribute to sustainable architecture (Figure 6). The number of sustainability-related publications in these publications is related to their tendency towards sustainability studies as well as their publication periods and the number of articles included in each issue. On the other hand, when the publishing houses or publishing institutions and organisations to which the publications are affiliated are taken into consideration, it is seen that the USA, the UK, China, Italy and Turkey stand out. There is a strong correlation between the countries hosting the most publications (Figure 3) and the publications that give the most space to sustainability-related publications.

Most cited publications: When we look at the most cited articles in sustainable architecture research, "Reinterpreting Sustainable Architecture: The Place of Technology," with 124 citations, the article discusses an interpretation of sustainable architecture within the technology framework. The article has been an important reference for other studies on the subject in these years when publications on sustainable architecture started to gain momentum.

DOI: 10.15320/ICONARP.2024.275

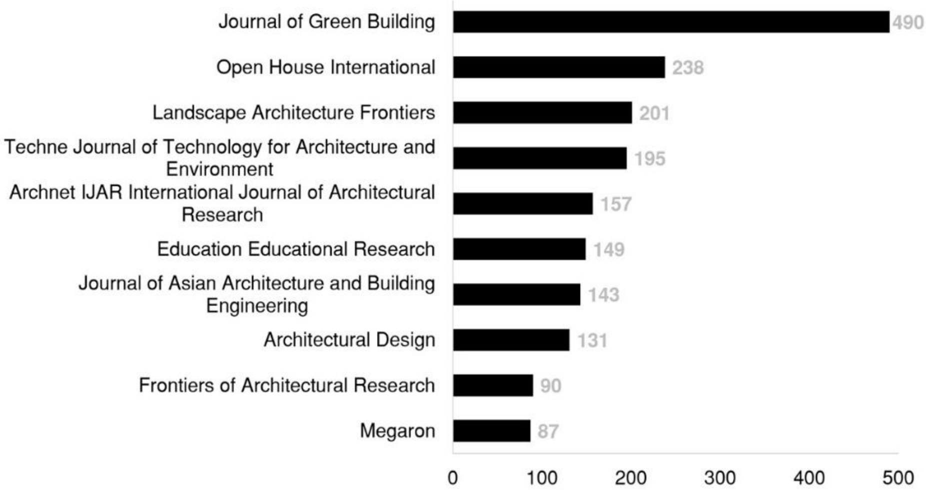


Figure 6. Distribution of publication numbers by journals.

Another most cited article is "A Bibliometric Review of Green Building Research 2000-2016", which presents a 16-year bibliography of green architecture studies. This article has received citations from studies on bibliometric analysis and green architecture. The article "Using Passive Cooling Strategies to Improve Thermal Performance and Reduce Energy Consumption of Residential Buildings in U.A.E. Buildings", which focuses on passive cooling strategies to ensure the energy efficiency of residential buildings, ranks third with 105 citations. It can be thought that the widespread use of energy efficiency studies, especially in the last seven years, has been effective in the number of citations (Table 1). When the publication dates of the most influential publications were evaluated, it was seen that the most influential publications were after 2010. Considering the relationship between prolific authors (Figure 4) and influential publications, Zhonghua Gou, who ranks 12th in terms of number of publications, ranks 4th in the list of influential publications. In addition, Amirhosein Ghaffarianhoseini, ranked 13th in terms of number of publications, is ranked 8th in the list of most influential publications. This shows that there is no direct proportional relationship between productivity and influential publications, while on the other hand, it is clear that there is no relationship between influential publications and publication year.

Looking at the indexes of the journals in which the studies were published, it was seen that 2023 articles were scanned in journals indexed in the Art & Humanities Citation Index (AHCI). This situation can be explained by the fact that the Art & Humanities Citation Index, which is an indexing type for arts and humanities, also covers the discipline of architecture. In addition, the fact that environmental problems are a problem of humanity also supports this situation. On the other hand, it was determined that 1385 articles were included in journals indexed in the Emerging Source Citation Index (ESCI), 300 articles in the Social Sciences Citation Index (SSCI), and 200 articles in Science Citation Index Expanded (SCI-Expanded).

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Table 1. List of the most cited journals.

Article Name	Authors	Journal	Citations
Reinterpreting Sustainable Architecture: The Place of Technology	Guy and Farmer, 2001	Journal of Architectural Education	124
A Bibliometric Review of Green Building Research 2000-2016	Chao et al., 2019	Architectural Science Review	123
Using Passive Cooling Strategies to Improve Thermal Performance and Reduce Energy Consumption of Residential Buildings in U.A.E. Buildings	Taleb, 2014	Frontiers of Architectural Research	105
Market Readiness and Policy Implications for Green Buildings: Case Study from Hong Kong	Gou, Lau and Prasad, 2013	Journal of Green Building	87
From Low-energy to Net Zero-energy Buildings: Status and Perspectives	Voss, Musall and Lichtmeß, 2011	Journal of Green Building	84
Decentering the Human in the Design of Collaborative Cities	Forlano, 2016	Design Issues	73
Building Integrated Agriculture: Utilising Rooftops for Sustainable Food Crop Cultivation in Singapore	Astee and Kishnani, 2010	Journal of Green Building	72
Sick Building Syndrome: Are We Doing Enough?	Ghaffarianhosein et al., 2018	Architectural Science Review	70
Thermal Comfort Effects of Urban Design Strategies in High- rise Urban Environments in A Sub-tropical Climate	Yang, Lau and Qian, 2011	Architectural Science Review	68
Planning for multifunctional urban green infrastructures: Promises and challenges	Madureira and Andresen, 2014	Urban Design International	65

Science Mapping

The findings obtained at this stage consist of five maps: keyword relationships, chronological development and relationships of keywords, most cited author, most cited country and citation relationship between countries, and most cited journal and citation relationship between journals.

Keyword relationships: A co-occurrence network was created from the key terms in the sample using the VOSviewer software. The conceptual framework of sustainable architecture and the main concepts addressed in the field were revealed in the co-occurrence network. To increase the readability of the network map, the first 100 concepts related to the field with the highest threshold value of 10 were shown, represented by different colours in eight clusters. The concepts with higher connectivity strength were emphasized as the clusters' main concepts and represented by larger circles. The sub-concepts related to the main concepts were shown in circles scaled according to their frequency of use. Some sub-concepts did not appear on the map due to overlaps. The prominent cluster on the map was the purple-coloured "sustainability" cluster with a frequency of 177, which supports the centrality and inclusiveness of sustainability in environmental issues in architecture. The topic titles related to the cluster are read through the length of the connecting lines. Other main concepts that stand out in the field include urban design, energy efficiency, green building, landscape architecture, built environment, sustainable design, and sustainable

DOI: 10.15320/ICONARP.2024.275

development (Figure 7). Considering the distribution and grouping of keywords, it is evident that the concept and approach of sustainability discussed in architecture are addressed in a wide range.

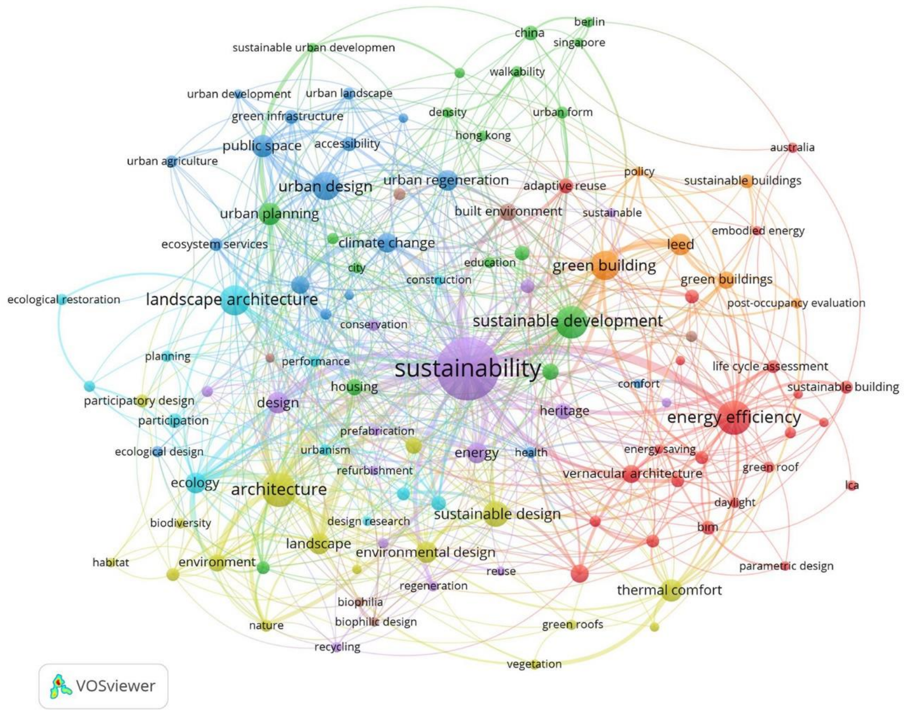


Figure 7. Keyword network visualization.

In the red cluster, energy efficiency is the main concept, with a frequency of 65. Keywords such as thermal comfort, daylight, energy consumption, and natural ventilation are used in energy efficiency studies, also associated with LEED and green building design. The orange cluster, with a frequency of 51, is focused on green building designs. Policies related to building design, post-occupancy evaluation, and environmental design are prominent concepts in articles using this keyword. Another prominent group is the green cluster, with a frequency of 60, which is related to sustainable development. In studies using this keyword, urban planning and building design are emphasized. Cultural heritage, reuse, walkability, and social and cultural sustainability are associated with sustainable development.

Meanwhile, in sustainable architecture, topics related to urban design and landscape architecture, expressed in dark blue and light blue clusters with frequencies of 32 and 31, respectively, are also prominent. Sustainable public space designs and ecology are emphasized in these clusters. The sustainable design cluster, represented by the yellow colour, is dominated by environmental design, comfort, and architecture. The brown cluster, with a frequency of 21, is related to the built environment and focuses on building envelope and environmental psychology (Figure 7).

Chronological development of keywords and their relationships: The chronological evolution of keywords is displayed on the map through colour and tone variations. The map is classified into four colour groups:

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

navy blue, turquoise, green, and yellow. Generally, it can be seen that changes and developments in the working areas are shaped within the framework of international agreements and various treaties that are common to United Nations or European Union member countries. In the early 2010s, studies related to sustainable environmental policies were conducted, focusing on environmentally friendly and long-lasting designs. In addition, the work during these years mainly highlighted the studies related to the LEED certification, which is very important in rating green buildings. The focus was primarily on the compliance of the identified structures with the criteria in the certification. In addition, studies on life cycle assessment were also among the topics focused on. Looking at the years between 2012-2016, it can be seen that the scope and boundaries of sustainability in the architectural discipline have expanded.

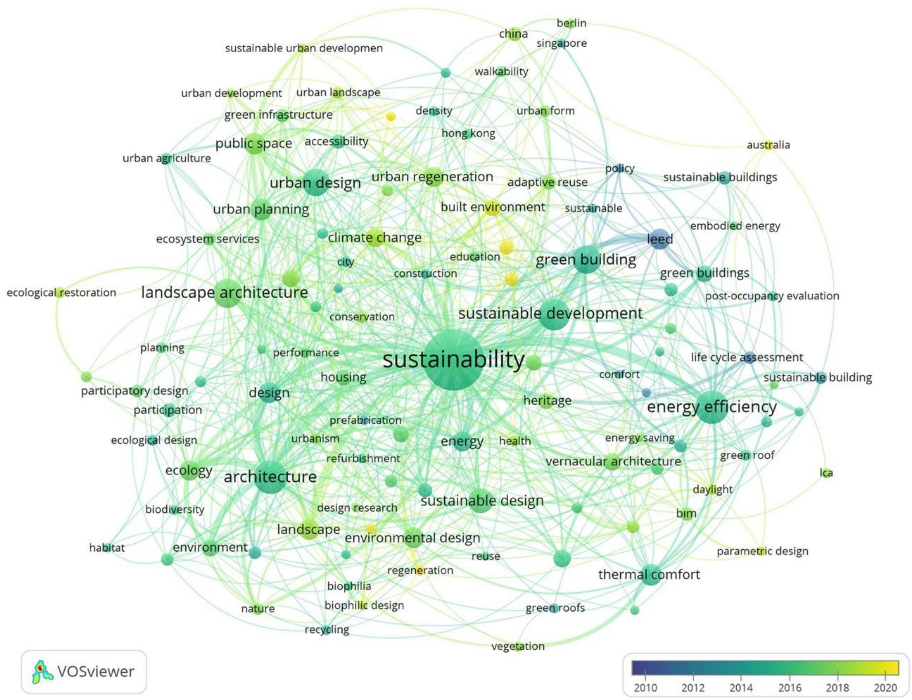


Figure 8. Chronological keyword network visualization.

Regarding subject trends, the sustainability approach in the architecture discipline has been addressed through green building, thermal comfort, natural lighting, water management, energy consumption, and sustainable development. Between 2016 and 2020, sustainable built environment studies focused on vernacular architecture, adaptive reuse, social sustainability, and climate change. Although interest in climate change, adaptive reuse, and social and cultural sustainability continues in current studies, the focus has shifted toward nature-based solutions and regeneration (Figure 8).

Most cited authors: When looking at the most cited authors (with a threshold value of at least 1 document and at least 100 citations) in sustainable architecture research, 17 researchers stand out. Zhonghua Gou is in first place with 7 studies and 257 citations. Amirhosein Ghaffarianhoseini comes in second place with 7 studies and 190 citations,

DOI: 10.15320/ICONARP.2024.275

while Ali Ghaffarianhoseini ranks third with 6 studies and 184 citations, and Jian Zuo is in fourth place with 4 studies and 175 citations (Figure 9). From this, it can be said that the work of Zhonghua Gou has a widespread impact on sustainable architecture research. On the other hand, when evaluating the citation status of researchers over time, it is possible to say that Xianbo Zhao, Can Huang, and Wu Guangdong's work has received more citations in recent years. This may be due to these researchers' analysis of the current state of their work and the inclusion of new data.

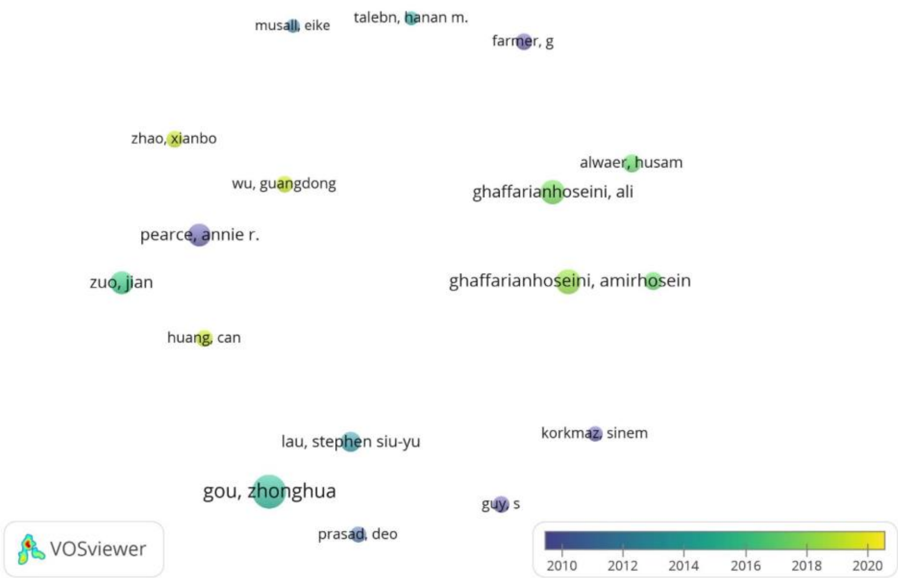


Figure 9. Most cited authors.

The most cited country and the relationship between countries: When looking at the network map of the most cited (threshold value of at least 5 documents and at least 10 citations) countries in sustainable architecture research, a total of 51 countries are included, with 46 countries shown to be interconnected. With 2912 citations, the USA is at the top as the most cited country (Figure 10). The USA mainly received citations from China, the UK, Canada, and Australia. Australia is in second place with 1377 citations, mainly receiving citations from China and the USA. On the other hand, the UK is in third place with a total of 1240 citations, mainly receiving citations from researchers in the USA. China is in fourth place with 1151 citations, mainly from the USA and Australia. From all of this, it can be said that the USA has a significant influence in this field. Furthermore, it is clear that the countries at the top are relatively more economically and technologically advanced and are, therefore, more active in this field. Considering the ranking of the countries with the highest number of publications (Figure 3), it is clear that publications in the UK and Australia have higher impact levels than Turkey and Italy.

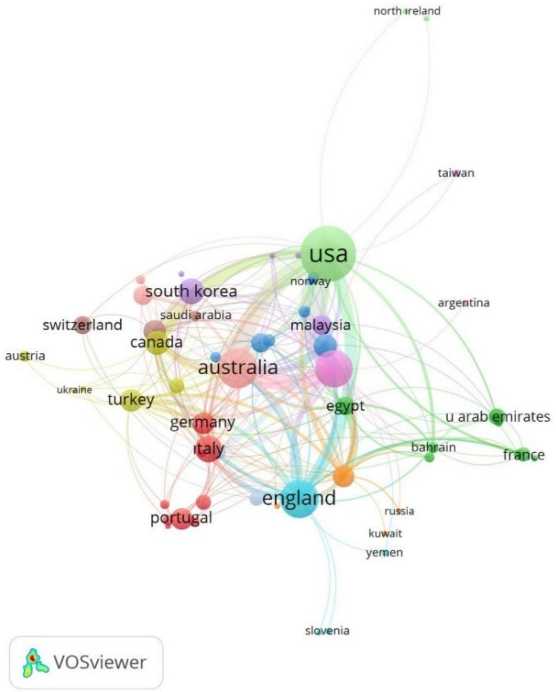


Figure 10. Most cited countries and citation. relations between

The most cited journal and the relationship between journals: When looking at the journals that have been most cited (at least 10 documents and at least 100 citations) from the database of article studies on sustainable architecture, the Journal of Green Building ranks first with 2608 citations. This shows that the Journal of Green Building is highly influential in the field of sustainable architecture, both in terms of hosting the most publications (Figure 6) and the citations it receives. The second most cited journal is the Architectural Science Review, with 1874 citations, followed by the Frontiers of Architectures, with 905 citations (Figure 11). The network relationship between the journals shows that the most citations are between these two journals. On the other hand, Architectural Science Review, which ranks second with the highest number of citations, is not among the journals with the highest number of publications (Figure 6) may be associated with the high impact values of the publications in this journal.

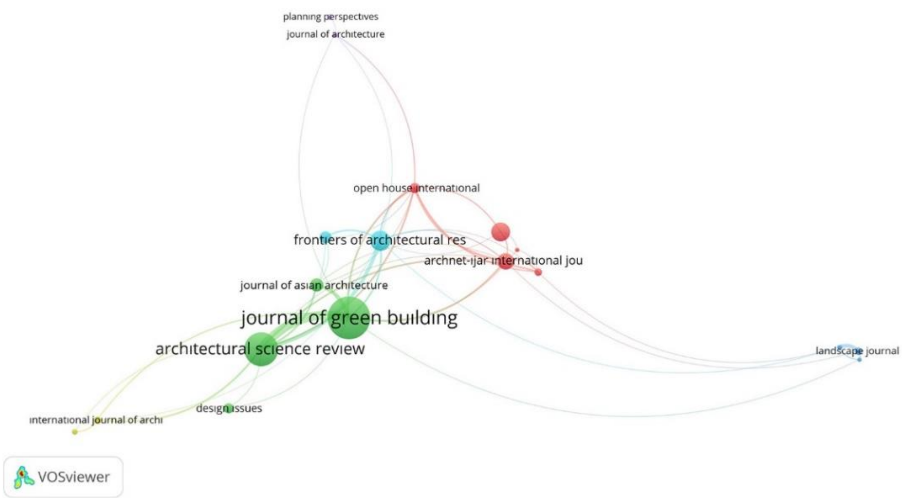


Figure 11. Citations relationship between the most cited journal and journals relations between countries.

DOI: 10.15320/ICONARP.2024.275

CONCLUSIONS AND RECOMMENDATIONS

Sustainable architectural research, which emerged with environmental problems, has been discussed around various research approaches and strategies, a wide conceptual framework, and various scales. In this study, the emergence, development, and current status of sustainable architectural research has been revealed by numerical and visual analysis. With the bibliometric analysis, which allows a comprehensive analysis and evaluation of a particular field of study, the findings related to the performance analysis of the field and science mapping were deciphered. In the performance analysis, numerical data were emphasized, and the distribution of the number of publications by years, countries, authors, institutions, journals, and indexes was discussed. Thus, prolific authors, the years in which the studies gained momentum, and the journals, indexes, and institutions that supported the subject were determined. In addition, numerical data on the most cited journal and article and the contents of qualified publications are emphasized. In science mapping, visual data is discussed. In this context, the relations between the keywords were deciphered to reveal the areas where the approaches related to the subject are concentrated and the course of development. In the light of the findings obtained from the performance analysis and science mapping regarding the bibliometric analysis, various evaluations, and suggestions are summarized below:

- This study contributes to the knowledge by presenting an overview of the studies on sustainable architecture that have emerged and developed within the scope of environmental problems and focus on various issues. From a theoretical perspective, it can provide ideas for the steps needed to understand the impact of sustainable architectural work on the amelioration of environmental problems and to identify actionable measures. In addition, it can be said that this study can contribute to developing new literature on sustainable architecture specific to environmental problems and the solution to possible future crises.
- The studies have particularly peaked in the last 5 years, and this development can be related to the 2030 Sustainable Development Goals adopted by the United Nations General Assembly in September 2015. At this General Assembly, which saw active participation from heads of state, UN representatives, numerous civil society organizations, and UNESCO from various countries, it is known that consensus was reached on various topics such as preventing climate change, energy, sustainable settlements, and cities. On the other hand, it can be said that the studies in the last few years have been shaped within the framework of the climate crisis and the COVID-19 global pandemic, focusing on the sustainability and adaptation of housing and the climate factor.
- Sunkuk Kim, Joohyun Lee, and Svetlana Pushkar stand out as the most published authors in this field. However, the work of any of

these authors did not have a similar effect of regarding the number of citations. On the other hand, Zhonghua Gou, Amirhosein Ghaffarianhoseini, and Ali Ghaffarianhoseini, who were among the authors of the most cited articles in performance analysis, were also the most cited authors. This can be explained by the high level of influence of these authors in the literature.

- While countries such as the USA, Italy, Turkey, and China stand out with the number of publications, it is noteworthy that China, New Zealand, and Australia are in first place when the top four most cited authors are considered. Considering the number of publications and citations in performance analyses, it would not be wrong to say that China is influential in the literature.
- Country-based number of publications and country-based number of citations for performance analysis and science mapping were evaluated together. Accordingly, the fact that the USA is the most cited country is directly related to the number of publications. However, after the USA, the most cited publications originated from Australia and the UK. The fact that these countries, which come after Turkey and Italy in terms of the number of publications, rank first in terms of citations can be explained by the production of high-impact publications. In inter-country citation relations, which enable the evaluation of academic communication, it was observed that the USA interacted intensively with China, Australia, and the UK. In addition, China, another country that stands out in the number of publications and citations, has an intense interaction with Australia, which is evidence of the high impact level of Australian publications.
- It can be argued that the prominence of the United States of America in terms of the number of publications and citations is directly related to the productivity of researchers. On the other hand, China and Australia lead in publication impact levels according to the number of author citations. In this comparison, European countries can rank third.
- The fact that journals published in the United States of America and Europe predominantly include studies in this field shows the importance attributed to the subject. On the other hand, the fact that China and Australia host influential publications indicates that researchers from all over the world, from America to Europe and Asian countries, focus on this issue.
- Keyword analyses that provide insight into the research areas, methods used, and evolving approaches demonstrate the scope of the studies. In this regard, the terms "vernacular," which refers to rural local architectural productions, and "biophilic," which points to elements such as natural materials, ventilation, and lighting, are prominent in the chronological decipherment of keywords. Sustainable architecture approaches can be reduced to specific points, such as returning to nature and locality. On the other hand,

DOI: 10.15320/ICONARP.2024.275

terms such as "energy-efficient," "climate change," "housing," "building use," "design," "green architecture," "physical form of building," "greywater", "cities," and "urban environment," which were on the agenda in previous years, are relatively broad-perspective terms.

- This study will guide researchers or planners working on sustainable architecture in many aspects, such as trends, terminology, reference studies, and dominant research topics on sustainable architecture between 1975 and 2022. Moreover, this study provides a comprehensive perspective on the field by revealing the most effective works, authors, journals, countries, and their relationships, allowing for a comprehensive view of the sustainable architecture field for new studies.
- From a practical point of view, this study enables practitioners working on environmental problems to have an idea of the development of sustainable architecture. Thus, being aware of the different scales and approaches of the subject can help reduce the negative effects and consequences of environmental problems in various decision-making processes. The trends highlighted in this study have provided information on various strategic urban planning decisions, especially planning and infrastructure development, innovations in green building applications, trend-building technology, and material preferences in practice. It is thought that the research results will play an important role in transforming them into practical applications. On the other hand, the study contributed to educational materials and public awareness raising by raising awareness for educational practice.
- Enterprises, universities, researchers, publishing houses, politicians, and governments should work Decisively to balance better the relationship between the effectiveness and efficiency of various theories and practices developed within the scope of sustainable architecture for environmental problems.
- The limitations of this study may be guided in the planning of future studies. A few limitations can be mentioned in this context. The first is the research period (1975-September 2022), and the other is that the data obtained is limited to the WoS database. Therefore, future studies can be built on databases such as Scopus and Science Direct or a combination of these databases. In addition, the inadequacy of the keywords defined for the search in the database may have caused the inability to include sufficient articles on the subject. New studies can be planned with different keywords.

Finally, proposals for the solution of environmental problems such as global warming, increasing population, and rapid consumption of natural resources will continue to be the target and direction that researchers and politicians should strive to achieve in the future.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

REFERENCES

Ahn, H., Son, S., Park, K., & Kim, S. (2022). Cost assessment model for sustainable health and safety management of high-rise residential buildings in Korea. Journal of Asian Architecture and Building Engineering, 21(3), 689-700.

Al, U. (2014). Türkiye'nin bilimsel yayın politikası: Atıf dizinlerine dayalı bibliyometrik bir yaklaşım (Doktora Tezi). Hacettepe Üniversitesi, Ankara.

Al, U., & Coştur, R., 2007. Türk Psikoloji Dergisi'nin bibliyometrik profili. Türk Kütüphaneciliği, 21(2), 142-163.

Al Maani, D., Alnusairat, S., & Al-Jokhadar, A. (2021). Transforming learning for architecture: Online design studio as the new norm for crisis adaptation under COVID-19. Open House International, 46(3), 348-358.

Alawadi, K., Hernandez Striedinger, V., Maghelal, P., & Khanal, A. (2021). Assessing walkability in hot arid regions: The case of downtown Abu Dhabi. Urban Design International, 1-21.

AlRyalat, S. A. S., Malkawi, L. W., & Momani, S. M. (2019). Comparing bibliometric analysis using PubMed, Scopus, and Web of Science databases. Journal of Visualized Experiments, 24(152).

Andrés, A. (2009). Measuring academic research: How to undertake a bibliometric study. Chandos Publishing, Oxford-Cambiridge-New Delhi. Elsevier.

Artsın, M. (2020). Bir metin madenciliği uygulaması: VOSviewer. Eskişehir Teknik Üniversitesi Bilim ve Teknoloji Dergisi B-Teorik Bilimler, 8(2), 344-354.

Astee, L. Y., & Kishnani, N. T. (2010). Building integrated agriculture: Utilising rooftops for sustainable food crop cultivation in Singapore. Journal of Green Building, 5(2), 105-113.

Aydın, A. H., & Çamur, Ö. (2017). Avrupa Birliği çevre politikaları ve çevre eylem programları üzerine bir inceleme. Bingöl Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 7(13), 21-44.

Baker, H. K., Kumar, S., & Pandey, N. (2021). Forty years of the journal of futures markets: A bibliometric overview. Journal of Futures Markets, 41(7), 1027-1054.

Bauer, M., Mösle, P., & Schwarz, M. (2009). Green building: Guidebook for sustainable architecture. Springer Science & Business Media.

Bennetts, H., Radford, A., & Williamson, T. (2003). Understanding sustainable architecture. Taylor & Francis.

Borgman, C. L., & Furner, J. (2002). Scholarly communication and bibliometrics. Annual Review of Information Science and Technology, 36(1), 1-53.

Chadegani, A. A., Salehi, H., Yunus, M. M., Farhadi, H., Fooladi, M., Farhadi, M., & Ebrahim, N. A. (2013). A comparison between two main academic literature collections: Web of Science and Scopus databases. Asian Social Science, 9(5), 18-26.

Clayton, T., & Radcliffe, N. (2018). Sustainability: A systems approach. Routledge.

Cobo, M. J., López-Herrera, A. G., Herrera-Viedma, E., & Herrera, F. (2011). An approach for detecting, quantifying, and visualizing the evolution of a research field: A practical application to the Fuzzy Sets Theory field. Journal of Informetrics, 5(1), 146-166.

Doğruer, F. S. (2022). Bibliometric analysis of the Anatolian vernacular architecture literature (1983-2021). The Journal of Kesit Academy, 8(30), 1-19.

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. Journal of Business Research, 133, 285-296.

DOI: 10.15320/ICONARP.2024.275

Durmuş Arsan, Z. (2008). Türkiye'de sürdürülebilir mimari. Mimarlık Dergisi, 340, 21-30.

Eldardiry, D. H., & Konbr, U. (2022). Using phenomenological theory for sustainable renovation of historical open spaces in Bahrain. International Journal of Sustainable Development & Planning, 17(2).

Fantozzi, F., Bibbiani, C., Gargari, C., Rugani, R., & Salvadori, G. (2021). Do green roofs really provide significant energy saving in a Mediterranean climate? Critical evaluation based on different case studies. Frontiers of Architectural Research, 10(2), 447-465.

Feng, Y., Gu, X., Ye, J., Jia, X., Zhang, H., Wang, S., & Yang, J. (2022). Study on Bibliometric Visualization of Sustainable City Based on VOSviewer (2008-2021). In E3S Web of Conferences, 350.

Forlano, L. (2016). Decentering the human in the design of collaborative cities. Design Issues, 32(3), 42-54.

Ghaffarianhoseini, A., AlWaer, H., Omrany, H., Ghaffarianhoseini, A., Alalouch, C., Clements-Croome, D., & Tookey, J. (2018). Sick building syndrome: Are we doing enough?. Architectural Science Review, 61(3), 99-121.

Gou, Z., Lau, S. S. Y., & Prasad, D. (2013). Market readiness and policy implications for green buildings: Case study from Hong Kong. Journal of Green Building, 8(2), 162-173.

Guy, S., & Farmer, G. (2001). Reinterpreting sustainable architecture: The place of technology. Journal of Architectural Education, 54(3), 140-148.

Güdü Demirbulat, Ö. G., & Tetik Dinç, N. (2017). Sürdürülebilir turizm konulu lisansüstü tezlerin bibliyometrik profili. Seyahat ve Otel İşletmeciliği Dergisi, 14(2), 20-30.

Han, J., & Kamber, M. (2006). Data mining: Concepts and techniques. Morgan Kaufmann.

Han, B., Son, S., & Kim, S. (2022). Cost assessment model for sustainable operation and maintenance of large public research infrastructures. Journal of Asian Architecture and Building Engineering, 21(1), 80-92.

Hao, Z., Zhang, X., Xie, J., Wang, J., & Liu, J. (2021). Building climate zones of major marine islands in China defined using two-stage zoning method and clustering analysis. Frontiers of Architectural Research, 10(1), 134-147.

Heberger, A. E., Christie, C. A., & Alkin, M. C. (2010). A bibliometric analysis of the academic influences of and on evaluation theorists' published works. American Journal of Evaluation, 31(1), 24-44.

Herrera-Viedma, E., Santisteban-Espejo, A., & Cobo, M. J. (2020). Software tools for conducting bibliometric analysis in science: An up-to-date review. Profesional de la Información, 29(1).

Hu, M. (2019). A review of life cycle research of the built environment at difference scales: A citation analysis using big data. Journal of Green Building, 14(3), 63-80.

Jiang, L., Liu, S., Liu, L., & Liu, C. (2022). Revealing the spatiotemporal characteristics and drivers of the block-scale thermal environment near a large river: Evidences from Shanghai, China. Building and Environment, 226, 109728.

Kim, J. L., Greene, M., & Kim, S. (2014). Economic impact of new green building code on residential project development from energy consumption perspectives. Journal of Green Building, 9(4), 105-123.

Kim, J. J., Sanchez, M. A., Del Aguila, M., & Kim, S. (2017). Green building strategies for LEED-certified recreational facilities. Journal of Green Building, 12(2), 149-166.

Kim, S., Kim, D., & Jung, S. (2017). Analysis of the effect of cul-de-sacs' permeability factors in low-rise residential areas on Burglary. Journal of Asian Architecture and Building Engineering, 16(3), 487-493.

Kim, J. J., & Rigdon, B. (1998). Sustainable architecture module: Introduction to sustainable design. National Pollution Prevention Center for Higher Education.

Kobayashi, V. B., Mol, S. T., Berkers, H. A., Kismihók, G., & Den Hartog, D. N. (2018). Text mining in organizational research. Organizational Research Methods, 21(3), 733-765.

Konbr, U., & Abdelaal, M. (2022). Utilizing smart systems to enhance the sustainability of Egyptian administrative buildings. Civil Engineering and Architecture, 10(7), 2779-2808.

Konbr, U., Bayoumi, W., Ali, M. N., & Shiba, A. S. E. (2022). Sustainability of Egyptian cities through utilizing sewage and sludge in softscaping and biogas production. Sustainability, 14(11), 6675.

Konbr, U., Elsayed, M., & Elboshy, B. (2023). A Framework for assessing the sustainability of Egyptian University Campuses. Transportation, 11(4), 1909-1939.

Konbr, U., & Mamdouh, H. (2021). A proposed strategy to evaluate nanomaterials in construction to boost sustainable architecture. Civil Engineering and Architecture, 10(7), 3206-3226.

Lattke, F., & Lehmann, S. (2007). Multi-story residential timber construction: Current developments in Europe. Journal of Green Building, 2(1), 119-129.

Lee, J., & Shepley, M. (2019). The green standard for energy and environmental design (g-seed) for multi-family housing rating system in Korea: a review of evaluating practices and suggestions for improvement. Journal of Green Building, 14(2), 155-175.

Lehmann, S., & Head, P. (2010). Conversation with the engineer: Beyond green buildings—entering the ecological age. Journal of Green Building, 5(3), 43-49.

Lehmann, S., & Xie, T. (2014). A post-fossil-fuel urban development agenda for China: New concepts of eco-efficient city and green infrastructure at precinct-scale. Landscape Architecture Frontiers, 2(3), 42-58.

Li, Y., Rong, Y., Ahmad, U. M., Wang, X., Zuo, J., & Mao, G. (2021). A comprehensive review on green buildings research: Bibliometric analysis during 1998–2018. Environmental Science and Pollution Research, 28, 46196-46214.

Madureira, H., & Andresen, T. (2014). Planning for multifunctional urban green infrastructures: Promises and challenges. Urban Design International, 19, 38-49.

Oguntona, O. A., Aigbavboa, C. O., & Thwala, W. D. (2021). A scientometric analysis and visualization of green building research in Africa. Journal of Green Building, 16(2), 83-86.

Oh, O., Lim, J., Lim, C., & Kim, S. (2017). A health performance and cost optimization model for sustainable healthy buildings. Journal of Asian Architecture and Building Engineering, 16(2), 303-309.

Oraee, M., Hosseini, M. R., Papadonikolaki, E., Palliyaguru, R., & Arashpour, M. (2017). Collaboration in BIM-based construction networks: A bibliometric-qualitative literature review. International Journal of Project Management, 35(7), 1288-1301.

Owen, C., & Dovey, K. (2008). Fields of sustainable architecture. The Journal of Architecture, 13(1), 9-21.

Özdemir, M., & Arslan Selçuk, S. (2021). Mimarlıkta makine öğrenmesi: Bibliyometrik bir analiz. Online Journal of Art and Design, 9(4), 194-207.

DOI: 10.15320/ICONARP.2024.275

Pan, X., Yan, E., Cui, M., & Hua, W. (2018). Examining the usage, citation, and diffusion patterns of bibliometric mapping software: A comparative study of three tools. Journal of Informetrics, 12(2), 481-493.

Park, E. J., & Lee, S. (2022). Creative thinking in the architecture design studio: Bibliometric analysis and literature review. Buildings, 12(6), 828.

Peters, T., & Halleran, A. (2021). How our homes impact our health: Using a COVID-19 informed approach to examine urban apartment housing. Archnet-IJAR: International Journal of Architectural Research, 15(1), 10-27.

Pramesti, P. U., Hasan, M. I., & Ramandhika, M. (2021). Research trend on sustainable architecture: a bibliometric analysis emphasizing on building, material, façade, and thermal keywords. In IOP Conference Series: Earth and Environmental Science (Vol. 896, No. 1, p. 012061). IOP Publishing.

Pritchard, A. (1969). Statistical bibliography or bibliometrics. Journal of Documentation, 25, 348-349.

Porter, P. F. G. (2021). Modern collective housing of modernity in times of COVID-19. Contributions of the housing paradigm. Arquitecturas Del Sur, 28-43.

Pushkar, S., and Verbitsky, O. (2019). Silver and gold LEED commercial interiors: Certified projects. Journal of Green Building, 14(3), 95-113.

Saeed, D. M., Elkhatib, W. F., & Selim, A. M. (2022). Architecturally safe and healthy classrooms: eco-medical concept to achieve sustainability in light of COVID-19 global pandemic. Journal of Asian Architecture and Building Engineering, 21(6), 2172-2187.

Samiee, S., & Chabowski, B. R. (2012). Knowledge structure in international marketing: a multi-method bibliometric analysis. Journal of the Academy of Marketing Science, 40, 364-386.

Sassi, P. (2006). Strategies for sustainable architecture. Taylor & Francis.

Sev, A. (2005). Sürdürülebilir mimarlık. Yem Yayınları.

Spennemann, D. H. (2021). Residential architecture in a post-pandemic world: Implications of COVID-19 for new construction and for adapting heritage buildings. Journal of Green Building, 16(1), 199-215.

Taleb, H. M. (2014). Using passive cooling strategies to improve thermal performance and reduce energy consumption of residential buildings in UAE buildings. Frontiers of Architectural Research, 3(2), 154-165.

Tekeli, İ. (2011). Türkiye açısından dünyada iklim değişikliği. Türkiye Bilimler Akademisi.

Tekeli İ., & Ataöv, A. (2017). Sürdürülebilir toplum ve yapılı çevre. İstanbul Bilgi Üniversitesi Yayınları.

The Treaty of Amsterdam. (1997). Accessed address (10 September 2022): https://www.avrupa.info.tr/sites/default/files/201608/amsterdamtreaty_0.pdf

The Treaty of Nice. (2001). Accessed address (10 September 2022): https://eur-lex.europa.eu/legalcontent/EN/TXT/PDF/?uri=CELEX: 12001C/TXT&rid=10

The Treaty of Lisbon. (2009). Accessed address (10 September 2022): https://www.europarl.europa.eu/factsheets/en/sheet/5/the-treaty-of-lisbon

Udomsap, A. D., & Hallinger, P. (2020). A bibliometric review of research on sustainable construction, 1994–2018. Journal of Cleaner Production, 254, 120073.

Van Eck, N., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. Scientometrics, 84(2), 523-538.

Van Eck, N. J., Waltman, L., Dekker, R., & Van Den Berg, J. (2010). A comparison of two techniques for bibliometric mapping: Multidimensional scaling and VOS.

Journal of the American Society for Information Science and Technology, 61(12), 2405-2416.
Varshabi, N., Arslan Selçuk, S., & Mutlu Avinç, G. (2022). Biomimicry for energy-efficient building design: A bibliometric analysis. Biomimetics, 7(1), 21.
Verma, S., & Gustafsson, A. (2020). Investigating the emerging COVID-19 research trends in the field of business and management: A bibliometric analysis approach. Journal of Business Research, 118, 253-261.
Voss, K., Musall, E., & Lichtmeß, M. (2011). From low-energy to net zero-energy buildings: Status and perspectives. Journal of Green Building, 6(1), 46-57.
Wang, H., Pan, Y., & Luo, X. (2019). Integration of BIM and GIS in sustainable built environment: A review and bibliometric analysis. Automation in Construction, 103, 41-52.
Wang, M. H., Ho, Y. S., & Fu, H. Z. (2019). Global performance and development on sustainable city based on natural science and social science research: A bibliometric analysis. Science of the Total Environment, 666, 1245-1254.
Web of Science Group. (2022). Why Web of Science data?. Accessed address: (30 January 2022): https://clarivate.com/webofsciencegroup/solutions/web-ofscience/
Williams, D. E. (2007). Sustainable design: Ecology, architecture, and planning. John Wiley & Sons.
World Commission on Environment and Development, (1987). Our common futures. University of Oxford Press.
Wuni, I. Y., Shen, G. Q., & Osei-Kyei, R. (2020). Sustainability of off-site construction: A bibliometric review and visualized analysis of trending topics and themes. Journal of Green Building, 15(4), 131-154.

Xia, H., Liu, Z., Maria, E., Liu, X., & Lin, C. (2022). Study on city digital twin technologies for sustainable smart city design: A review and bibliometric analysis of geographic information system and building information modeling integration. Sustainable Cities and Society, 84, 104009.
Yang, F., Lau, S. S., & Qian, F. (2011). Thermal comfort effects of urban design strategies in high-rise urban environments in a sub-tropical climate. Architectural Science Review, 54(4), 285-304.
Yıldız, M., & Beyhan, F. (2021). Bibliometric analysis of fire safety research in green buildings 2000-2021. Online Journal of Art and Design, 10(4), 140-153.
Yılmaz, G. (2017). Restoranlarda bahşiş ile ilgili yayınlanan makalelerin bibliyometrik analizi. Seyahat ve Otel İşletmeciliği Dergisi, 4(2), 65-79.
Zhao, X., Zuo, J., Wu, G., & Huang, C. (2019). A bibliometric review of green building research 2000–2016. Architectural Science Review, 62(1), 74-88.

Resume

Hande EYÜBOĞLU graduated from Karadeniz Technical University, Department of Interior Architecture in 2017. She completed her master's degree at the same university and same department in 2021. She is currently working as a research assistant at Samsun University, Department of Interior Architecture and Environmental Design. Currently, she is a PhD candidate in the Department of Architecture at Karadeniz Technical University.

Serap FAİZ BÜYÜKÇAM graduated from Karadeniz Technical University, Department of Interior Architecture in 2008. She completed her master's degree in 2012 and her doctorate in 2018 at Karadeniz Technical University. During her graduate education (2010–2018), she worked as a Research Assistant at Karadeniz

DOI: 10.15320/ICONARP.2024.275

Technical University, Department of Interior Architecture. Currently, she is working at Ondokuz Mayıs University, Faculty of Architecture, Department of Interior Architecture.

ICONARP
International Journal of Architecture and Planning
Received: 25.07.2022 Accepted: 21.12.2023
Volume 12, Issue 1/ Published: 30.06.2024
Research Article DOI: 10.15320/ICONARP.2024.276 E- ISSN:2147-9380

The *Site* Narrative: *Mimarlik* 1990-2020

Beste Şimşek *
Esin Kömez Dağlıoğlı **
Pelin Yoncacı Arslan ***

Abstract

Throughout history, various alternative approaches have been considered that conceptualize the dialogue between architectural objects and their sites. This study explores whether this conceptual richness is reflected in Turkey's contemporary architectural agenda by focusing mainly on the period from 1990 to the present. The *Mimarlık* Journal, one of Turkey's leading architectural journals, was chosen as the object of investigation, presenting the contemporary written language of academics and professionals. In this research, relevant and current literature was first reviewed to identify site-related terms (place, settlement, local, topography, context, environment, nature, history, social, culture and identity) as a toolkit for analyzing the *Mimarlık* Journal. The analysis of the toolkit has led to the creation of a digital database via the application of digital humanities methods of manual text mining and critical reading to highlight the diversity and richness of sites' language(s). The result is the mapping of the terms used in context to understand the diversity, actors, and systems of thought in site narrative. The results show that the discussions in the journal mainly focus on the critique of contemporary architectural practices, rather than theoretically expanding the topic and drawing on production in fields such as art, philosophy, and anthropology. The discussions in the journal refer to the canonical texts of international literature in the field of architectural theory and urbanism between the 1960s and the 1990s. However, there is an evident lack of current sources in the bibliographies, which shows that systems and patterns of thought do not change simultaneously. This study shows that the mapping and deep reading of journal articles represent a very effective research method in the field of architecture by contributing to the site narrative while making apparent the diversity and richness of its language.

Keywords:
Mimarlık journal, Site, Text-mining.

*Middle East Technical University, Department of Architecture, Ankara, Turkey. (*Corresponding author*)
Email: bestsimsekk@gmail.com

**Middle East Technical University, Department of Architecture, Ankara, Turkey. (*Corresponding author*)
Email: komez@metu.edu.tr

***Middle East Technical University, Department of Architecture, Ankara, Turkey.
Email: pyoncaci@metu.edu.tr

To cite this article: Şimşek, B., Kömez Dağlıoğlu, E., & Yoncacı Arslan, P. (2024). The *Site* Narrative: *Mimarlik* 1990-2020. *ICONARP International Journal of Architecture and Planning,* 12 (1), 75-94. DOI: 10.15320/ICONARP.2024.276

INTRODUCTION: THE *SITE* IN THE INTERNATIONAL ARCHITECTURAL LITERATURE

Since the mid-20th century, there have been various architectural discussions about the vacillation between the autonomy of architectural form-making processes and the shaping of these processes by the built environment's physical, social, and political conditions. Starting from the second half of the 20th century, the discussions conceptualizing the relationship between architectural products and their immediate environments has diversified, especially with the triggering of criticisms directed towards orthodox modern architecture and urbanism (Komez-Daglioglu, 2015 & 2017). Professionals and theoreticians from different areas of design (for instance, architecture, urban design, and landscape architecture) have reconceptualized the common material ground in various ways. In the early 1950s, Ernesto Rogers (1954) proposed the terms *ambiente* or *preesistenze ambientali*, calling for buildings to prioritize the reflection of their context's historical and formal qualities. In his 1966 book *The Architecture of the City*, Aldo Rossi famously discussed the uniqueness of place and its making through architectural objects in relation to the notion of *locus*. Vittorio Gregotti (1966) discussed the term *territorio* to explain the relationship between architectural objects to topography and geography. The pioneer of phenomenology in architectural discussion, Christian Norberg-Schulz (1980), as influenced by the philosopher Martin Heidegger in the 1970s, described the unique and idiosyncratic nature, essence, and spirit of place via the term *genius loci*.

The multiplicity of proposed terms about the subject of the site and its relationship with physical structure merely cooled down in the 1980s and 1990s. The architectural discussion about site became broader and more expansive. *Critical regionalism* (Frampton, 1983) opposed the historical mimicry of postmodern architecture and argued for the reconciliation of universal civilizational values with the local context's climatic, geographic, and topographic values. The article “Negation and Reconciliation,” written by Raimund Abraham (1982), described architectural design as conquering the site and transforming its topography. Alison and Peter Smithson (1990) described the *as found* approach as a new perspective on the ‘ordinary’ that focuses on the relationship between the built environment and social practices. Stan Allen (1997) discussed the concept of *field* as an alternative term to the traditional definition of site. Tadao Ando’s (1996) studies on the consideration of the site’s environment, nature, culture, and topography in the architectural design process demonstrated the multi-layered concepts that the notion of site occupied, and indeed still occupies, within architectural thinking.

This brief review demonstrates the multi-layered interpretations and the suggested terms relating to the idea of site since the mid-20th century. Despite their multiple justifications, these discussions are highly fragmented in terms of offering a holistic approach to the subject of site

DOI: 10.15320/ICONARP.2024.276

in architectural discourse. In 2005, to address this gap in the architectural literature, architect Carol J. Burns and landscape architect Andrea Kahn co-edited a book entitled *Site Matters: Design Concepts, Histories and Strategies*. (Burns & Kahn, 2005) The volume argued that the term "site" instead of "place" subsumes and bundles all the fragmented discussions about the understanding of place in architecture since the former term conceptually encompasses the latter. In 2020, Burns and Kahn co-edited a second volume, entitled *Site Matters: Strategies for Uncertainty through Planning and Design*, as a sequel to the first (Burns & Kahn, 2020). This second volume focused on the concepts of nature, environment, and sustainability in the face of threats facing today's earth such as global warming, climate change, and biodiversity loss. The volumes contribute to the language of site-related issues by utilizing a particular vocabulary when referring to the characteristics of the site, *per se*. The editors first describe and construct a site as a localized physical entity. Therefore, the term site conceptually encompasses a set of terms: *area, field, ground, land, local, location, locus, lot, parcel, place, plot, position, region, setting, settlement, situation,* and *terrain*. In addition, site provides a context for architectural design interventions and incorporates the concept of *context*, in its entirety, into architectural thinking. A site is part of an *environment, surrounding, nature,* and *topography*. A site has *cultural, historical,* and *social* references/values/dimensions that result from human interaction and intervention. And finally, a site has a *character* and *identity* that connects all these material and immaterial terms. As such, rather than formulating new terminologies such as *ambiente, locus,* or *genius loci*, the editors provide a thematic, multi-layered, and comprehensive framework through which to discuss contemporary site-related concepts that help to understand, construct, and describe the idea of site in architecture.

With a similar but more focused intention, this paper considers the contemporary language of site in Turkey's architectural discourse by focusing on the period from 1990 to the present. The *Mimarlık* Journal, one of the leading architecture magazines in Turkey, was chosen as the research venue, showcasing the contemporary written language used by professionals. The terminological set established in the *Site Matters* volumes provides a contemporary set of words, what we refer to as a "toolkit" within this research, framing possible site-related narratives in Turkish architectural media.

METHODOLOGY

The *Mimarlık* Journal, one of the leading actors in the architectural literary media in Turkey, is the primary medium that establishes the boundaries and scope of this study. The Journal has been published bimonthly by the Chamber of Architects since 1963 and is the longest-running and most widely circulated architectural journal in Turkey. The status and importance of the Journal in Turkish architectural and urban planning literature is unambiguous. Several studies conducted by

Turkish scholars underscore the Journal's outstanding influence on Turkish architectural culture in terms of its reshaping of architectural theory and practice in 1980s' Turkey (Goloğlu, 2011), the influence of advertisements in the media on architecture in Turkey (Ozdemir, 2015), and its contribution to architectural criticism (Evirgen, 2018).

Table 1. Site-Related Concepts in the *Site Matters* Volumes and Their Translation to the Turkish language

Site-Related Concepts in the *Site Matters* Volumes	**Translations to the Turkish Language**
Area/Field	Alan
Land/Site/Terrain/Lot	**Arazi**
Plot	Arsa
Context	**Bağlam**
Region	Bölge
Environment/Surrounding	**Çevre**
Nature	**Doğa**
Character	Karakter
Identity	**Kimlik**
Location/Position	Konum
Culture	**Kültür**
Location	Lokasyon
Locale/Position/Situation	Mevki
Parcel/Lot/Plot	Parsel
Social (Values/Layers/Dimensions)	**Sosyal**
History	**Tarih**
Topography	**Topoğrafya**
Place/Site/Locus/Locale/Position/Setting	**Yer**
Local	**Yerel**
Settlement	**Yerleşme**
Ground	Zemin

This study begins by borrowing the terminology of site-related concepts as a toolkit from the two *Site Matters* volumes and translating them into Turkish (Table 1). The goal in this translation is to associate the English terms with their corresponding Turkish translations while protecting the content integrity and architectural meaning of the original English to the greatest extent possible. Therefore, in this translation, the site-related concepts respond to the original word with the potentially closest architectural meaning in Turkish rather than necessarily offering a direct translation or, certainly, a literal definition. Regarding the growing number of studies that use digital mapping tools and data mining in architectural studies, the toolset was applied as a virtual "site-related filter" onto the articles published in *Mimarlık* that were digitized and presented online as open source by the Chamber of Architects.

DOI: 10.15320/ICONARP.2024.276

In the recent literature, Juan Cruz-Benito discusses the meaning of systematic literature review and mapping as a tool collecting and analysing studies through a systematic process (Cruz-Benito, 2016). Jaskot and Vaan der Graff discussed the possibilities of digitally documenting historical journals and mapping printed information in their article "Historical Journals as Digital Sources: Mapping Architecture in Germany, 1914-24." The authors created a digital map using an inventory created via text mining to indicate the locations of construction activities in Germany between 1914 and 1924 (Jaskot & Vaan der Graff, 2017). In Turkey, two dissertation studies completed at Middle East Technical University focused specifically on digital humanities tools as research methods and visualization of textual data in architecture (Acar, 2017, Ekinci, 2019). In another study, "Exploring the Perceived Landscape with the Local People: The Experience of Community Mapping in Orduzu District (Malatya/Turkey)", Ay and Tuna used the community mapping method to define the perceived landscape elements from the perspective of local people in Malatya, Turkey (2021). In addition, Çakır and Levent mined and analysed data from social media to explore user demands for green spaces in "Data Mining the City: User Demands through Social Media" (2021). Furthermore, as one of the digital humanities tools, text mining allows the mapping of textual information and, thus, the reproduction and interpretation of the knowledge. Such methodologies are used frequently, especially in literature review articles. One very recent example is Nessma A. Q. Al-Hammadi and Kokan Grchev's (2022) article entitled "Aspects of Contextual Architecture Regarding Traditional/Contemporary Architecture, Physical/Cultural and Place Identity: A Systematic Literature Review". The authors provided the mapping and systematic review of context literature in architecture using digital search engines and tools. After the initial quantitative phase, the authors offered a qualitative and more in-depth reading of the selected articles.

Our study also utilizes a similar scientific approach yet differs from those previously mentioned in terms of its context, source, the size of the dataset, and the operations included in the data preparation process. With a hybrid method combining manual text mining and critical reading, it analyses the discussions in the *Mimarlık* Journal over the last thirty years, i.e., 178 issues published between 1990 and 2020. This study counts the frequency of repetition of site-related concepts in each article and critically reads the articles to avoid misrepresentation. The frequency of discussion (repetition) of each concept in each article is recorded in a digital database. Using both manual and digital data review methods, this process is repeated for each of the 2.505 articles published in the Journal between 1990 and 2020. Figure 1 below exemplifies a paragraph showing how the manual text-mining and critical reading method is performed.

ICONARP – Volume 12 Issue 1 / Published: 30.06.2024

Yapının çevreyle bir bütün olarak tasarlanması gerekliliğini savunan ekolojik mimarlıkta, yapının konumlandırılacağı arazi verileri, topografya, iklimsel veriler, doğal çevre örtüsü, ekolojik tasarıma ön veri oluşturan kriterlerdir. Bu kriterler yapının konumlandırılmasında, yönlendirilmesinde, yapı formunun oluşturulmasında ve malzeme seçiminde etkilidir.

Yapının çevre ve doğa ile bağlantısı üzerinde bulunduğu arazi ile sağlanır. Yapının arazi üzerine doğru şekilde konumlandırılması ve yönlendirilmesi enerji gereksiniminin belirlenmesinde önemli rol oynamaktadır. (4) Ekolojik tasarımda yapının araziye yerleşiminde arazinin doğal formunun korunması, mevcut durumu bozacak hafriyat ve dolgu gibi maliyeti yüksek uygulamalardan kaçınılması önemlidir. (5)

Ekolojik bina tasarımını etkileyen iklimsel veriler, güneş ısınım, rüzgâr ve hava hareketleri, sıcaklık ve nemdir. Yağış faktörü de yapı tasarımını, kullanılan malzemelerin türünü ve detayları etkilemektedir. En uygun yönlendirme için güneş ve rüzgâr etkileri gözönünde bulundurulmalı gerektiğinde yapının çevresindeki bitki ve ağaçlardan yararlanarak yapının rüzgâr ve güneş etkilerinden korunması sağlanmalıdır.

Figure 1. A Sample Passage Illustrating the Manuel Text-Mining and Critical Reading Method
(The passage is taken from "Ekolojik Mimarlık: Doğu Karadeniz Kırsal Konutu," by T. Zorlu and S. Faiz, 2012, Mimarlık, (367).

The initial frequency counts of the proposed framework identified twelve concepts as the final word-set: *yer* (site/place/locus/locale/position/setting), *yerleşme* (settlement), *yerel* (local), *arazi* (land/site/terrain/lot), *topoğrafya* (topography), *bağlam* (context), *çevre* (environment/surrounding), *doğa* (nature), *tarih* (history), *sosyal* (social), *kültür* (culture), and *kimlik* (identity) (in bold in Table 1). In the following step, the digital database is re-analysed to limit the number articles and gain a deeper understanding of this predefined word-set used in these articles. Therefore, the 2.505 articles were sorted twelve times per concept in descending order based on the frequency with which each concept was discussed in the articles. In this regard, a total of 122 articles by 148 authors were selected and carried through to the next stage so that more specific and relevant sources are selected and evaluated through a deep reading process (Table 2).

Table 2. The Number of Selected Articles and Their Authors Discussing Site-Related Concepts in The *Mimarlık* Journal Between 1990 and 2020

Site-Related Concepts	Number of Selected Articles	Number of Authors
Çevre (Environment)	9	9
Kültür (Culture)	12	15
Tarih (History)	16	22
Doğa (Nature)	14	16
Yer (Place)	10	14
Yerleşme (Settlement)	19	25
Kimlik (Identity)	12	13
Bağlam (Context)	5	6
Sosyal (Social)	9	12
Topoğrafya (Topography)	9	12
Yerel (Local)	16	21
TOTAL	**122**	**148**

At this stage, the content and discussions in the selected articles, the authors' workplace, field of work, field of education, educational institution, and field of expertise, as well as the bibliographic entries used in the articles, were recorded in the database. Tables 3 and 4 show sample

DOI: 10.15320/ICONARP.2024.276

excerpts from the study of the articles and their authors for the term *çevre* (environment).

Table 3. The Selected Articles Which Discuss the Term *Çevre* (Environment) As A Site-Related Concept in The *Mimarlık* Journal Between 1990 and 2020

Çevre (Environment)			
Year-Issue-Article Number	**Article Name**	**Author Name**	**The Term *Çevre's* Discussion Frequency**
2014-379-Article 16	"Yenileyici (Rejeneratif) Tasarım Kapsamında Doğal Havalandırmaya Yönelik Bir Yaklaşım"	Polat Darçın	101
2019-409-Article 8	"Türkiye'de Sivil Toplum ve Çevre Politikası"	Defne Gönenç	80
1996-268-Article 8	"Hollanda'da Çevre Duyarlı ve Enerji Sakınımlı Konut Alanı Tasarımı"	Sevin Aksoylu	63
1996-269-Article 6	"Kentsel Ekoloji"	Semih Eryıldız	61
1995-264-Article 9	"Ataköy 7. Ve 8. Mahaller Bir Tasarım Deneyimi"	Baykan Günay	57
2004-318-Article 9	"Çevresel Duyarlık Bağlamında Davranış Biçimi Olarak 'SÜRDÜRÜLEBİLİRLİK'"	Deniz İncedayı	57
1999-290-Article 7	"Barajlar, Çevre ve Ilısu Barajı"	İlhan Avcı	56
1995-263-Article 12	"Mimari Çevre ile Toplum Yapısı ve Değişimin Etkileşimi"	Faruk Yalçın Uğurlu	44
1990-241-Article 8	"Fiziksel Mekândan İnsani ya da İnsanlı Mekâna"	Nuri Bilgin	43

Table 4. The Author Study of the Selected Articles Which Discuss the Term *Çevre* (Environment) As A Site-Related Concept in The *Mimarlık* Journal Between 1990 and 2020

Çevre (Environment)			
Author Name	**Work Place and Work Area**	**Education Institution and Area**	**Expertise Area**
Polat Darçın-Assistant Professor Dr.	Yıldız Technical University-Construction Information	Yıldız Technical University-Architecture	Construction Technologies/Systems in Architecture Quality Management in Construction and Environment
Defne Gönenç-Researcher	-	-	-
Sevin Aksoylu-Professor Dr.	Anadolu University-Architecture	-	-
Semih Eryıldız-Professor Dr.	Okan University-Architecture	-	-
Baykan Günay-Professor Dr.	TED University-Urban and Regional Planning	-	Urban Planning Urban History

Deniz İncedayı-Professor Dr.	Mimar Sinan Fine Arts University-Building Information	Mimar Sinan Fine Arts University-Architecture	Architectural Design Architecture and Psychology of Environment Criticism and Method in Architecture Planning and Design
İlhan Avcı-Professor Dr.	İstanbul Technical University-Hydraulics	-	-
Faruk Yalçın Uğurlu-Professor Dr.	Nuh Naci Yazgan University-Interior and Environmental Design	Middle East Technical University-Architecture	Architectural Design
Nuri Bilgin-Professor Dr.	Ege University-Social Psychology	Ankara University Strasbourg University	Social Psychology

MAPPING THE CONCEPTS OF *SITE*

The diversity and richness of contemporary language about site in the national architectural literature are somewhat remarkably reflected in books, journal issues, dissertations, and symposia on the subject. As the main motive behind selecting the 1990-2020 time period as this paper's study focus, the first master's theses and doctoral dissertations in architecture completed in Turkey with the term "site" in the title date back to the early 1990s. These studies focused on the study of methods for the preservation of archaeological sites (Turan, 1988; Beşkonaklı, 1990), the preservation of the historical heritage of urban sites (Yılmaz, 1991; Alanyalı, 1991; Baturayoğlu, 1997), and the site planning of mass housing and urban centers (Talı, 1994; Özhisar, 2003). In the 2010s, although there were dissertations that addressed contemporary concerns of site research, such as crowd behaviour algorithms, site organization models, and the relationship between the site and nature (Kruşa, 2013; Bingöl, 2017; Gürsoy, 2019; Yüksel, 2020), the preservation of cultural and historical urban sites was the focus of studies during this period, as it was in the 1990s (Yönetken, 2018).

In addition to these studies, the Second National Architecture Symposium of Turkey in 1993 addressed the relationship between place and architecture, and further discussed the task of architectural design in revealing the identity of a particular place (Guvenc & Erkmen, 1996). In 2014, *Dosya*, the publication of Turkey's Chamber of Architects, Ankara Branch, addressed the relationship between place and identity (Kılıckıran, 2014). The well-known Turkish architectural firm EAA published a book entitled *Emre Arolat Architects Context and Plurality*, which discusses the importance of the contextual qualities of a site for an architectural design (Judidio & Ozkan, 2013). Two volumes entitled *Mimari Bağlamsalcılık* (Architectural Contextualism) and *Mimari Bağlamsalcılık* 2 (Architectural Contextualism 2), published in 2017 and 2020, respectively, questioned contemporary architectural design problems and the role of contextual design in solving them (Ozten & Anay, 2017; Ozten & Anay, 2020). In the 2020s, there were further discussions about the relationship between architecture and place. The recent

DOI: 10.15320/ICONARP.2024.276

publication entitled *Mekân ve Yer* (Space and Place) highlights the relationship between space and place through patterns that constitute urban space, such as geography, politics, and social relations (Ozaydın & Akı, 2021). *Coğrafi Bir Mesele Olarak Mimarlık* (Architecture as a Geographical Matter) explains the scope and nature of how geographical understanding can inform architectural thinking. Sayın questions the meaning of grasping the characteristics of geographic places and barriers to reaching these understandings (Sayın, 2021).

In 148 articles published in the *Mimarlık* Journal between 1990 and 2020, this diverse language is quite remarkably reflected in discussions of the relationship between architecture and site in Turkey. The digital database described in the methodology section enabled distant reading and visualization of the textual information. Over the last thirty years, the terms *environment (çevre)* and *nature (doğa*) have been frequently discussed in the Journal (Figure 2). The discussions about these two terms are informative and critical, and make it clear that a site is a part of the natural environment in architectural understanding. These discussions often inform the reader about sustainable design practices and renewable energy sources. The intensity of the debates on the terms indicates the growing awareness of environmentally friendly architectural design methods, ecological and sustainable architectural design solutions, especially in the face of the threat of global warming and the ecological crisis, which have also been on the international architectural agenda since the early 2000s. The article entitled "Yenileyici (Rejeneratif) Tasarım Kapsamında Doğal Havalandırmaya Yönelik Bir Yaklaşım" (An Approach to Natural Ventilation within the Scope of Regenerative Design) (Darcın, 2014) provides discussions on the above issues. Few discussions criticize architects, planners, and designers of the physical design disciplines for their rejection and ignorance of the ecological crisis facing the earth today. In addition, local administrations are criticized for their inadequate strategies to protect natural areas and habitats. Sonmez's study titled "Dönüşü Olmayan Çevresel Tahribatların Bir Yenisi: Salda Gölü" (A New of Irreversible Environmental Destruction: Lake Salda) (2020) is one such example.

The terms *culture (kültür)* and *history (tarih)* are the second- and third-most discussed site-related concepts in the Journal (Figure 2). This shows that the frequent discussion of cultural heritage and historic preservation issues has become integral to architectural debates. Discussions of the terms *culture (kültür)*, *history (tarih)*, and *social* (values/layers/dimensions) *(sosyal)* revolve around criticisms of various actors involved in speculative real estate movements, rapid construction projects, and rent problems. The article entitled "Kültür Bakanlığı Kültürel Varlıklarımızı Koruyor mu?" (Does the Ministry of Culture Protect Our Cultural Heritage?) (Erder, 1994) contains examples of the above problems. Interestingly, a considerable number of discussions criticize the public for its ignorance of and indifference towards protecting cultural assets and heritage in Turkey. Some of the articles

ICONARP – Volume 12 Issue 1 / Published: 30.06.2024

dealing with these issues include: "Tarihî Kent Merkezlerinin Yaya Eksenli Olarak Yeniden Canlandırılması: Almanya Koblenz Örneği" (Pedestrian Revitalization of Historic City Centers: The Case of Koblenz, Germany) (Sahin & Darby, 2014) and "Hasankeyf'te Sona Yaklaşırken: Korumada İnsan Odaklı Yaklaşımlar ve İnsan Hakkı Olarak Kültürel Miras" (Approaching the End in Hasankeyf: People-oriented Approaches to Preserving and Protecting Cultural Heritage as a Human Right) (Aykac & Kaya, 2020).

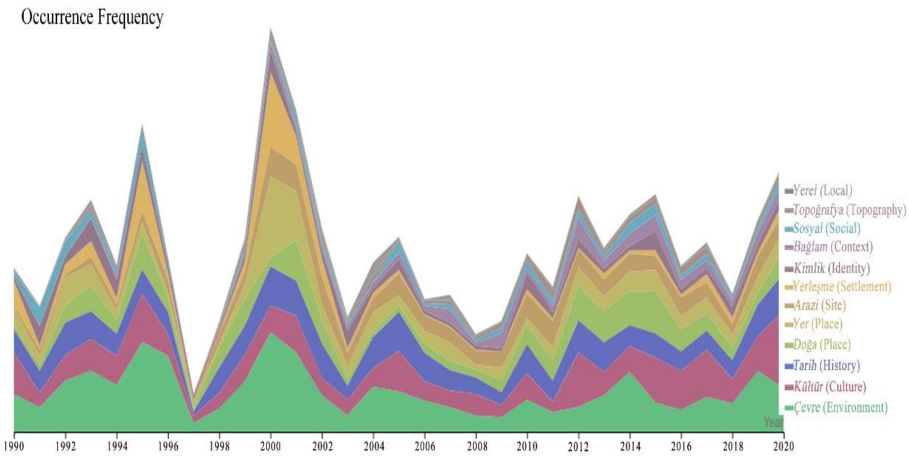


Figure 2. Changes in the Discussion Frequency of Site-Related Concepts in the *Mimarlık* Journal Between 1990 and 2020

The terms *place (yer)*, *settlement (yerleşme)*, and *local (yerel)* were present in the majority of discussions in the *Mimarlık* Journal in the 1990s; today, natural disasters such as fires, floods, and earthquakes in particular have led to an increase in the discussion of these terms. The term *local (yerel)* is the least frequently discussed site-related concept in the Journal in the past three decades. These three terms, which define the area in which the architectural product is located, have gradually decreased in 'interest' and given way to the terms *site (arazi)* and *topography (topoğrafya)* (Figure 2). The frequent discussions about topography imply a greater emphasis on a site's physical characteristics. The fact that topography has now come to the fore as a site-related concept indicates an effort to create/theorize/discuss architecture that interacts with its site's physical characteristics, landforms, and geographic formations. A similar shift in site description language can be observed in the international architectural literature. The terms that appeared in the 1950s and 1960s to describe the intangible depths of site understanding, such as *ambiente* and *locus*, are leaving their justification in discussing the physical conditions of a site, such as its topography, nature, and climate. The post-1980s, and especially post-1990s, studies of Frampton, Abraham, Allen, and Ando exemplify this shift. This observation is also largely consistent with the contemporary language of the *Site Matters* volumes. In general, discussions regarding these five concepts revolve around urban planning processes in Turkey. Unexpectedly, these discussions are political in nature, and result from criticism of local administrations for their exercise of power in the city's

DOI: 10.15320/ICONARP.2024.276

physical design and for allowing construction activities in naturally dangerous places. The discussions in the articles entitled "Kentsel Yapılı Çevrelerin Oluşumunda Aktörlerarası Güç İlişkileri Üzerine: Angora Evleri Örneği" (On Inter-Actor Power Relations in the Formation of Urban Built Environments: The Case of Angora Houses) (Tekel & Aras & Tekel, 2011) and "Menkulleştirilen Bir Kentten Kalan Notlar: Yusufeli" (Remaining Notes from a Securitized City: Yusufeli) (Turk & Erdoğan, 2020) offer similar discussions. Moreover, these five concepts are increasingly discussed in certain periods after natural disasters, especially earthquakes. An example of an article dealing with the relationship between earthquakes, urban planning, and policies are: "Türkiye Yeni Bir Deprem Stratejisi mi Geliştiriyor?" (Is Turkey Developing a New Earthquake Strategy?) (Balamir, 2000). In this context, these concepts are not discussed primarily as architectural problems/questions, but rather as issues related to technology and policy.

Discussions of the concepts of *context (bağlam)* and *identity (kimlik)* revolve around processes of urban formation. The globalization of the world, Westernization, industrialization, and the resulting denial of a specific context in the architectural design process place the loss of a city's unique identity at the center of criticism. Mass houses, shopping malls, and hotels are often cited as evidence of this language of contemporary global architectural style. The articles entitled "Mimarlık ve Kimlik Temrinleri- I: Türkiye'de Modern Yapı Kültürünün Bir Profili" (Architecture and Identity Practices-I: A Profile of Modern Building Culture in Turkey) (Balamir, 2003) and "Mimari Kimlik Temrinleri II: Türkiye'de Modern Yapı Kültürünün Bir Profili" (Architectural Identity Practices II: A Profile of Modern Building Culture in Turkey) (Balamir, 2003) addresses the above issues. There, market conditions, speculative rent-seeking, land use plans, local administrations, and developers/builders are criticized for losing a city's identity. In summary, the concepts of *environment-culture-history-nature-place-site*, which were widely used in international architectural discourse in the post-1970-1980 period as triggered by approaches such as postmodernism and critical regionalism, have remained influential in Turkey since the early 1990s. As such, the language of site narrative is influenced by current developments such as climate change, threats to cultural heritage preservation, and environmental issues.

MAPPING INSTITUTIONAL LANGUAGE OF *SITE*

To better understand the relationship between disciplines and their approach to site narrative, this step maps the professional specializations and related institutions of the 148 authors of the 122 articles that have frequently discussed site-related concepts in the *Mimarlık* Journal between 1990 and 2020. The results show that the disciplines of architecture and architectural design, urban and regional planning, criticism and method in architecture, theory in planning and design, conservation, and renewal and restoration play an essential role in discussing site narrative (Figure 3). These disciplines offer appropriate historical and cultural meanings in language when approaching site narrative. In addition to disciplines closely related to architecture, such as conservation, renewal, and restoration, various disciplines, from cadastre and real estate to cartography and urban economics, contribute to debates about the historical values of site in architectural thinking. On the other hand, the concept of culture is discussed alongside architecture in areas that directly affect the public, such as land management, public surveying, and social structure.

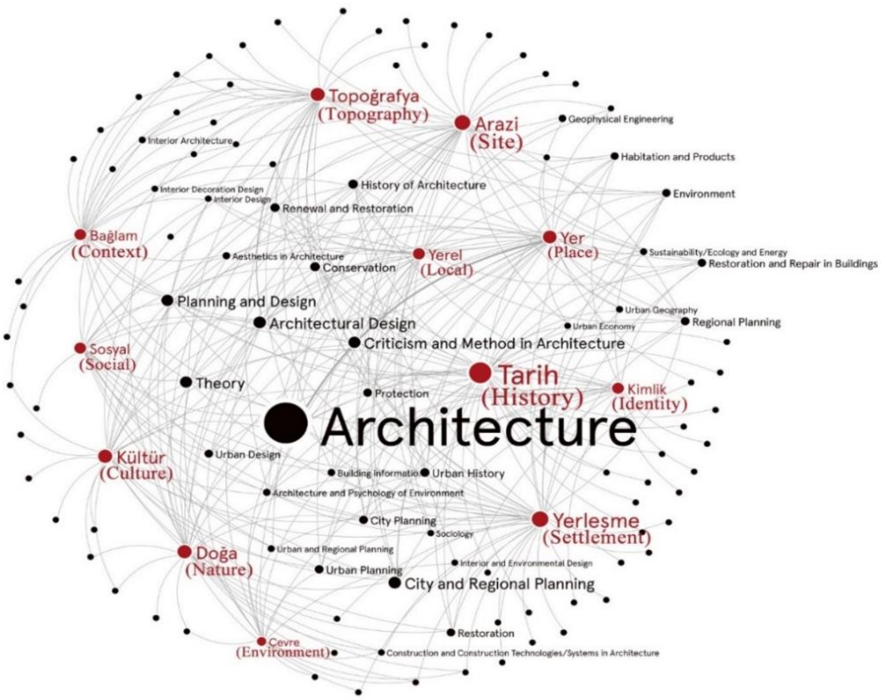


Figure 3. The Occupations of the 148 Authors of the 122 Selected Articles That Most Frequently Discuss Site-Related Concepts in the *Mimarlık* Journal Between 1990 and 2020

Authors writing about the concept of topography tend to come from the disciplines of spatial politics and contemporary architecture. This relation suggests that the topographical features of architectural understanding of site will adopt a more important place in the future of architecture. Authors writing about the concept of settlement tend to come from the fields of environmental engineering, architecture, environmental psychology, and urban planning. Interestingly, the term "site" often appears in articles written by authors who do not study architecture. Authors from the fields of economics, politics, and management sciences perceive architecture from the "outside" and prefer the term "site" instead of "place" in their discussions.

Figure 3 clearly shows the absence of contributions from philosophy, anthropology, and art specialists. However, well-known figures of the international literature nourish from the studies of various disciplines in addition to their own. Aldo Rossi criticizes the tabula rasa approach of modern architecture and urbanism in relation to place, and he is influenced by the philosopher and sociologist Maurice Halbwachs, Colin

DOI: 10.15320/ICONARP.2024.276

Rowe by the anthropologist Claude Lévi-Strauss and the philosopher Karl Popper, and The Smithsons by the Independent Group of Artists, especially the photographer Nigel Henderson. In *Mimarlık*, however, discussions of site in architecture are mainly led by disciplines concerned with constructing the built environment.

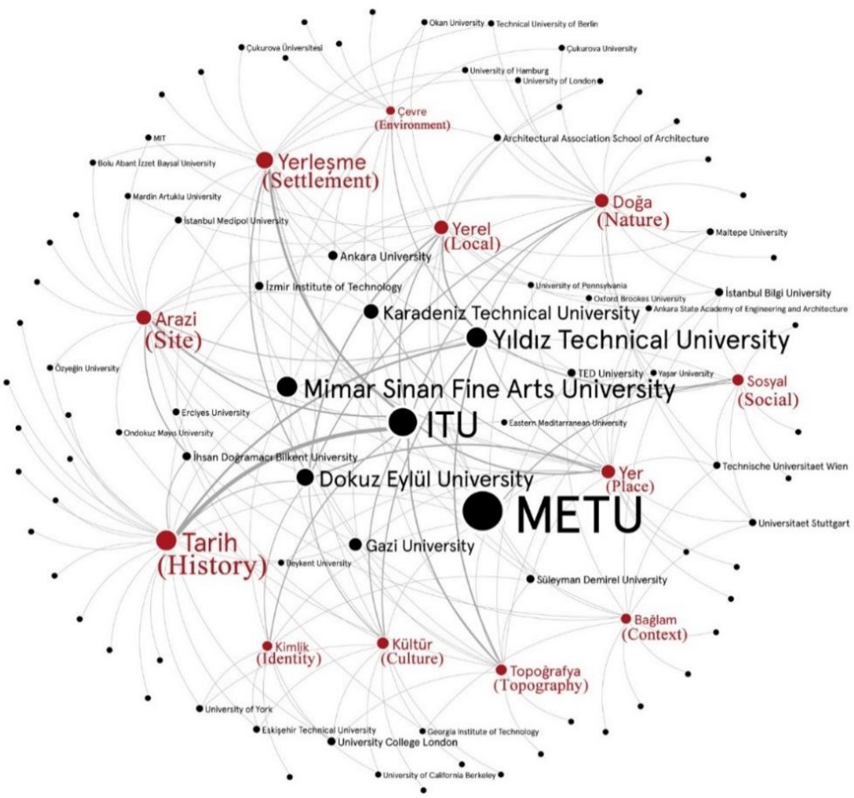


Figure 4. The Work/Education Institutions of the 148 Authors of the 122 Selected Articles Which Most Frequently Discuss Site-Related Concepts in the *Mimarlık* Journal Between 1990-2020

Notably, the authors of the selected articles mainly work or have received education at Istanbul Technical University, Middle East Technical University, Mimar Sinan Fine Arts, and Yıldız Technical University (Figure 4). These institutions have well-established and well-known architecture faculties and offer comprehensive architectural design and planning skills in their educational programs. The curricula of these institutions provide students in the physical design disciplines with knowledge in social, cultural, historical, management, natural and material sciences, conservation, preservation and restoration, industrial design, urban and regional planning, and art and aesthetics, in addition to the necessary knowledge in architecture and planning. Therefore, the studies of these institutions make a remarkable contribution to the discourses on the understanding of site in the architectural agenda of Turkey.

MAPPING THE SOURCES OF *SITE*

The final phase of this paper maps the sources referenced in the 48 articles from the 122 selected articles that frequently discuss site-related concepts in the *Mimarlık* Journal between 1990 and 2020 (Figure 5). Discussions of the *environmental (çevre(sel))* and *natural (doğa(l))* dimensions of the site narrative refer to studies dealing with sustainable design methods, renewable energy sources, and eco-technologies. The discussions dealing with the *cultural (kültür(el))*, *historical (tarih(i))*, and *social (sosyal)* levels of the understanding of site most often refer to the studies of well-known philosophers and prominent figures in 20th-century architecture.

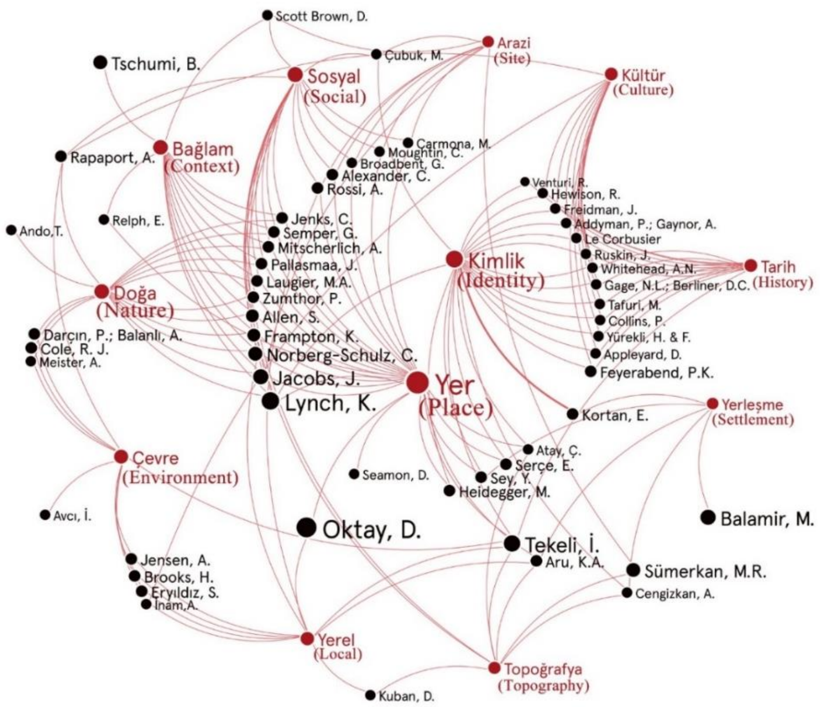


Figure 5. The Authors Referred in The Bibliographies of the 48 Selected Articles Which Most Frequently Discuss the Site-Related Concepts in The *Mimarlık* Journal Between 1990-2020

The most frequently cited authors are Kevin Lynch, Stan Allen, Kenneth Frampton, Jane Jacobs, Christian Norberg-Schulz, and İlhan Tekeli. The studies most frequently cited in this context are Kevin Lynch's *The Image of the City* (1961), Christian Norberg-Schulz's *Genius Loci: Towards a Phenomenology of Architecture* (1980), Kenneth Frampton's *Toward an Urban Landscape* (1995), and Stan Allen's *Landform Building: The New Terrain of Architecture* (2011). In addition to the international architectural figures mentioned above, İlhan Tekeli's studies on urban planning make him the most frequently cited national actor. Jane Jacobs added the element of public space to these discourses with her book *The Death and Life of Great American Cities* (1961), translated and discussed with the term *social (sosyal).*

The studies of these figures mainly deal with ethics, judgment, morality, gentrification, and social values. The discussions on the concepts of *place (yer), settlement (yerleşme), local (yerel), site (arazi),* and *topography (topoğrafya)* refer to studies of well-known international figures and Turkish scholars on urban and regional planning, earthquakes, and spatial planning laws. The discussions on the concepts of *context (bağlam)* and *identity (kimlik)* refer to the studies of well-known figures in 20th-century architecture. Turkish academics and their

DOI: 10.15320/ICONARP.2024.276

studies on Turkey's national architectural styles and the anthology of Turkish architects are also less represented in these discussions.

The network analysis of the most frequently cited authors reveals further information. It shows that there is a common grouping of authors who are frequently referred to when discussing certain site-related concepts. This group of authors, composed of representatives from different eras and discourses including Charles Jencks, Gottfried Semper, Juhani Pallasmaa, and Peter Zumthor, is closely related to the discussion of the concepts of *nature (doğa), context (bağlam), social (sosyal), and place (yer)*. In this sense, the most cited studies of some of these figures are Pallasmaa's *The Eyes of the Skin* (2005) and Zumthor's *Thinking Architecture* (2006). It is to be expected that among the authors associated with these concepts are Zumthor and Pallasmaa, who are known for their work on architecture and phenomenology.

The discussion of site through the concepts of *culture (kültür), history (tarih),* and *identity (kimlik)* draws on the studies of Le Corbusier's *Towards a New Architecture* (1946), Manfredo Tafuri's *Architecture and Utopia: Design and Capitalist Development* (1980), and Robert Venturi's *Complexity and Contradiction in Architecture* (1966). This finding reveals unexpected relationships between unpredictable actors. Corbusier, Tafuri, and Venturi generally do not represent the same architectural periods and discourses. However, their studies are often cited in discussions of site through an emphasis on its identity and cultural and historical values. The reference to these famous figures in discussions of these three concepts thus reveals an overlooked commonality between their studies and a particular approach to understanding site: a site is a cultural and historical entity that has an identity.

Discussions approaching the concepts of *place (yer)* and *social (sosyal)* draw primarily on the studies of Christopher Alexander, Geoffery Broadbent, Matthew Carmona, Cliff Moughtin, and Aldo Rossi. The most frequently cited studies by these authors make the impact of articles on urban design more apparent in studies where concepts related to site come to the fore. In this regard, the most frequently cited studies by these figures are Christopher Alexander's book *A New Theory of Urban Design* (1987), Geoffrey Broadbent's book *Emerging Concepts of Urban Space* Design (1990), Matthew Carmona's article “Controlling Urban Design-Part 1: A Possible Renaissance” (1996), Cliff Moughtin's book *Urban Design: Street and Square* (1992), and Aldo Rossi's book *The Architecture of the City* (1982). The fact that the terms most associated with these authors are *place* and *social* (values) suggests that urban design, located at the intersection of architecture and planning, bridges these concepts.

In summary, the various approaches to the discourse of site in architecture consider a site as being in a context consisting of natural and social qualities, as a cultural and historical entity that has an identity, as a place that has social values, and a design domain that focuses on human interaction; as an environment consisting of local qualities; and as a unique place with its own identity. The mapping of the sources used in the description of the site shows that the prominent sources in the field of urban design and architectural theory in the international architectural literature, especially between the 1960s and 1990s, strongly influence the contemporary architectural discourse in *Mimarlık* Journal. The reference to well-known and canonical studies, rather than more recent studies, proves that although the language adapts quickly to current developments, the systems and thought patterns do not change simultaneously.

CONCLUSION

This study analysed the articles published in the *Mimarlık* Journal between 1990 and 2020 using the tools of the digital humanities, consisting of manual and computer-based text mining and critical reading with a focus on the toolset of the concepts of place, settlement, local, site, topography, context, environment, nature, history, social, culture, and identity. The study created a digital database with the aim of mapping the conceptual language of the relationship between architecture and site and to understand the diversity, actors, and systems of thought in their narrative. The paper should also include a conclusion and recommendation section. This should identify the key issues, problems, and consequences for the findings of the research in conjunction with clear recommendations to the theory, methodology, industry, practitioners, the professions and for further research.

The results show that the language of site narrative generally consists of criticism. The critique is primarily directed at architects, planners, and other physical design professionals unwilling to respond to the current ecological crisis and natural disasters via adapted architectural solutions. Current developments that threaten the preservation of cultural and historic heritage, such as speculative real estate movements, and the political and economic interests of local governments, also critically impact the narrative of site. Social, economic, and political developments thus shape this narrative, but the system and patterns of thought do not change at the same pace. In this sense, the contemporary site narrative of the *Mimarlık* Journal attaches great importance to site design in architectural practice. However, the diversity of theoretical debates of site narrative in 20th-century architectural literature and Site Matters volumes does not occur in the language of the contemporary architectural discourse of the Journal. This is because the discussions in the Journal focus mainly on the critique of contemporary architectural practices rather than expanding the topic theoretically and drawing on production in fields such as art, philosophy, and anthropology. The discussions in the Journal refer to the canonical texts of international literature in the field of architectural theory and urbanism between the 1960s and the 1990s. However, there is an evident lack of current sources in the bibliographies.

Furthermore, the utilization of the tools and methods of digital humanities here underlines the diversity and richness of sites'

DOI: 10.15320/ICONARP.2024.276

language(s). By drawing conclusions about the discourse of site in contemporary architecture in Turkey, this study shows that mapping printed information is a very effective research method in architecture. It also identifies the references to the canonical texts in the international literature of architectural theory and urbanism between the 1960s and 1990s, highlighting the absence of contemporary sources in the Turkish written media. As authors of this article, whose research goal was to contribute to the conceptual expansion of architecture, we would like to emphasize the importance of the architecture's belonging to a place and wish that this mapping of site narrative also nourishes contemporary architectural practice in Turkey.

REFERENCES

Abraham, R. (1982). Negation and Reconciliation. Perspecta, (19), 6-13.

Acar, Y. (2017). Atlas of Urban Design: Textual Analysis and Mapping of Production of Knowledge in Turkish Context. [Doctoral Dissertation, Middle East Technical University].

Ahunbay, Z. (1999). Dünya Kültür Mirası Ölçütleri Açısından Hasankeyf ve Kurtarılma Olasılıkları. Mimarlık, (290), 29-34.

Alanyalı, S. (1991). Research About the Historical Site of Bergama Proposals Concerning Restoration and Conservation. [Master's Thesis, Dokuz Eylül University].

Al-Hammadi, N. A., & Grchev, K. (2022a). Aspects of Contextual Architecture Regarding Traditional/Contemporary Architecture, Physical/Cultural and Place Identity: A Systematic Literature Review. Open House International, 48(1), 119–140. https://doi.org/10.1108/ohi-01-2022-0007.

Allen, S. (2013). Field Conditions (1997). In Carpo, M. (Ed.), The Digital Turn in Architecture 1992-2012 (pp. 62-79). John Wiley & Sons.

Ando, T. (1996). Toward New Horizons in Architecture. In Nesbitt, Kate (Ed.), Theorizing a New Agenda for Architecture, An Anthology of Architectural Theory (pp. 458-461). New York: Princeton Architectural Press.

Ay, B., & Tuna, A. (2021). Exploring the Perceived Landscape with The Local People: The Experience of Community Mapping in Orduzu District (Malatya/Turkey). ICONARP, 9(2), 506-537. https://doi.org/10.15320/ICONARP.2021.170.

Aykaç, P. & Kaya, B. (2020). Hasankeyf'te Sona Yaklaşırken: Korumada İnsan Odaklı Yaklaşımlar ve İnsan Hakkı Olarak Kültürel Miras. Mimarlık, (411). http://www.mimarlikdergisi.com/index.cfm?sayfa=mimarlik&DergiSayi=425&RecID=4905.

Balamir, A. (2003). MİMARİ KİMLİK TEMRİNLERİ II: Türkiye'de Modern Yapı Kültürünün Bir Profili. Mimarlık, (314). http://www.mimarlikdergisi.com/index.cfm?sayfa=mimarlik&DergiSayi=26&RecID=260.

Balamir, A. (2003). Mimarlık ve Kimlik Temrinleri- I: Türkiye'de Modern Yapı Kültürünün Bir Profili. Mimarlık, (313), 24-29.

Balamir, M. (2000). Türkiye Yeni Bir Deprem Stratejisi mi Geliştiriyor? Mimarlık, (295), 44-47.

Baturayoğlu, N. (1997). Guideline for The Preservation and The Presentation of An Archeological Site Case Study: An Archeological Wasteland within the Selçuk Settlement Area. [Master's Thesis, Middle East Technical University].

ICONARP – Volume 12 Issue 1 / Published: 30.06.2024

Beşkonaklı, J. (1990). Re-Organization of Çankırıkapı Archeological Site Ankara. [Master's Thesis, Middle East Technical University].
Bingöl, E. (2017). Site as A Generative Force to Architectural Theory. [Doctoral Dissertation, İzmir Institute of Technology].
Burns, C. J., & Kahn, A. (Eds.). (2005). Site Matters: Design Concepts, Histories and Strategies. New York: Routledge.
Burns, C. J., & Kahn, A. (Eds.). (2020). Site Matters: Strategies for Uncertainty through Planning and Design. New York: Routledge.
Çakır, H., & Levent, V. (2021). Data Mining the City: User Demands through Social Media. ICONARP, 9(2), 799-818. https://doi.org/10.15320/ICONARP.2021.181.
Cruz-Benito, J. (2016), "Systematic Literature Review and Mapping", Education in the Knowledge Society PhD programme, GRIAL Research Group, Department of Computers and Automatics, University of Salamanca, Salamanca, pp. 4-62, doi: 10.5281/zenodo.165773, available at: https://repositorio.grial.eu/bitstream/grial/685/3/201611_PhD_EKS_SLR-1.pdf.
Darçın, P. (2014). Yenileyici (Rejeneratif) Tasarım Kapsamında Doğal Havalandırmaya Yönelik Bir Yaklaşım. Mimarlık, (379). http://www.mimarlikdergisi.com/index.cfm?sayfa=mimarlik&DergiSayi=393&RecID=3481.
Ekinci, B. (2019). An Exploratory Data Analysis on Architectural Research Agenda. Master's Thesis on Architecture. [Master's Thesis, Middle East Technical University].
Erder, C. (1994). Kültür Bakanlığı Kültürel Varlıklarımızı Koruyor mu? Mimarlık, (256), 60-61.

Evirgen, Ö. (2018). Architectural Criticism in Periodicals: The Case of Mimarlık. [Master's Thesis, İstanbul Technical University].
Frampton, K. (1983). Towards a Critical Regionalism: Six points for an architecture of resistance. In Foster, H. (Ed.), Anti-Aesthetic: Essays on Postmodern Culture, (pp. 16-30). Seattle: Bay Press.
Gökcü, M. (2020). Archeological Interpretation and Presentation of The Pilgrimage Site of Pisidian Antioch (Yalvaç). [Master's Thesis, Middle East Technical University].
Göloğlu, S. (2011). Analyzing the Mimarlık Journal: A Study on Architecture in Turkey in the 1980s. [Master's Thesis, Middle East Technical University].
Gregotti, V. (1966). Il Territorio Dell'Architettura. Milano: Feltrinelli.
Gürsoy, A. (2019). An Assessment of Disaster Risk Management in A World Heritage Site in Turkey: The Case of Bergama. [Master's Thesis, Middle East Technical University].
Güvenç, G., & Erkmen, A. (1996). (Eds.). Türkiye MimarlığI Sempozyumu II: Kimlik, Meşruiyet, Etik: 7-8-9 Ekim 1993. Ankara: TMMOB Mimarlar Odası.
İlter, T. (1998). A Site Analysis and Improvement Concept Project in A Small Anatolian Town: İskilip. [Master's Thesis, Middle East Technical University].
Jaskot, P. B., & Vaan der Graaff, I. (2017). Historical Journals as Digital Sources: Mapping Architecture in Germany, 1914-24. The Journal of the Society of Architectural Historians. 76(4), 483-505. Doi:10.1525/jsah.2017.76.4.483.
Judidio, P., & Özkan, S. (2013). Emre Arolat Architects Context and Plurality. Rizzoli International Publications, New York.
Kılıçkıran, D. (Ed.). (2014). Dosya 33 Kimlik ve Yer. TMMOB Mimarlar Odası Ankara Şubesi, (33), 3-84.
Komez-Daglioglu, E. (2015). The Context Debate: An Archaeology. Architectural Theory Review, 20(2), 266-279.

DOI: 10.15320/ICONARP.2024.276

Komez-Daglioglu, E. (2017), Reclaiming Context: Architectural Theory, Pedagogy and Practice since 1950, PhD diss. Delft University of Technology.

Kruşa, M. (2013). Human Crown Simulation as An Evaluation Tool for Generative Contemporary Site Organization. [Master's Thesis, Middle East Technical University].

Norberg-Schulz, C. (1980). Genius Loci: Towards a Phenomenology of Architecture. New York: Rizzoli.

Özaydın, G., & Akı, M. (Eds.). (2021). Mekân ve Yer. Yeni İnsan Yayınevi.

Özdemir, E. (2015). Advertisements as A Tool of Modern Myths in Architecture: Mimarlık Journal Example. [Master's Thesis, İstanbul Technical University].

Özhisar, H. (2003). The Cultural Policies and The Cultural Complexes of The Republican Period of Ankara: A Proposal of a Master Plan for The Atatürk Cultural Center Site. [Master's Thesis, Middle East Technical University].

Özten, Ü., & Anay, H. (Eds.). (2017). Mimari Bağlamsalcılık. Eskişehir Osmangazi Üniversitesi.

Özten, Ü., & Anay, H. (Eds.). (2020). Mimari Bağlamsalcılık 2. Eskişehir Osmangazi Üniversitesi.

Rogers, E. N. (1954). Le Preesistenze Ambientali e i Temi Pratici Contemporanei. Casabella Continuità, 204, 3-6.

Rossi, A. (1966). L'Architettura della Città. Padova: Marsilio.

Şahin, S. & Darby, D. (2014). Tarihî Kent Merkezlerinin Yaya Eksenli Olarak Yeniden Canlandırılması: Almanya Koblenz Örneği. Mimarlık, (379). http://www.mimarlikdergisi.com/index.cfm?sayfa=mimarlik&DergiSayi=393&RecID=3476.

Sayın, N. (Ed.). (2021). Coğrafi Bir Mesele Olarak Mimarlık. Yapı Kredi Yayınları.

Smithson, A., & Smithson, P. (1990). The 'As Found' and the 'Found'. In Robbins, D. (Ed.), The Independent Group: Postwar. Britain and the Aesthetics of Plenty (pp. 201-202). Cambridge, MA: MIT Press.

Sönmez, Recep. (2020). Dönüşü Olmayan Çevresel Tahribatların Bir Yenisi: Salda Gölü. Mimarlık, (414). http://www.mimarlikdergisi.com/index.cfm?sayfa=mimarlik&DergiSayi=429&RecID=5082.

Talı, F. O. (1994). A Mass-Produced Housing Project Proposal in Ankara Eryaman with Reference to Mass-Produced Housing Site Planning and Housing Design Methods. [Master's Thesis, Middle East Technical University].

Tanyeli, U. (2014). Yerötesilik Pratikleri ve Mimarlığın İcadı. In Kılıçkıran, D. (Ed.), Dosya 33: Kimlik ve Yer (pp. 8-21). TMMOB Mimarlar Odası Ankara Şubesi.

Tekel, A. & Aras, Ö. & Tekel, H. (2011). Kentsel Yapılı Çevrelerin Oluşumunda Aktörlerarası Güç İlişkileri Üzerine: Angora Evleri Örneği. Mimarlık, (358). http://www.mimarlikdergisi.com/index.cfm?sayfa=mimarlik&DergiSayi=372&RecID=2611.

Turan, A. B. (1988). Evaluation of Interventions for the Conservation of An Archeological Site Ostia Antica. [Master's Thesis, Middle East Technical University].

Türk, E. & Erdoğan, A. (2020). Menkulleştirilen Bir Kentten Kalan Notlar: Yusufeli. Mimarlık, (411). http://www.mimarlikdergisi.com/index.cfm?sayfa=mimarlik&DergiSayi=425&RecID=4913.

Yılmaz, Y. (1991). A Research About the Urban Site in Yeni Foça. [Master's Thesis, Dokuz Eylül University].

Yönetken, E. (2018). Evaluation of Current Conservation Activities in Kuşadası Urban Site. [Master's Thesis, İzmir Institute of Technology].

Yüksel, N. (2020). Implementation of Multi-Objective General Algorithms for Optimization of Site Layout Planning: TOKİ Ayazma and Şahinbey Cases. [Master's Thesis, Istanbul Technical University].

Resume

Beste ŞİMŞEK completed her undergraduate degree in architecture at Bilkent University and her master's degree in architecture at Middle East Technical University. She currently works as an assistant controller at Republic of Turkey Ministry of Culture and Tourism.

Esin KÖMEZ DAĞLIOĞLU is an Associate Professor Dr. at the METU Department of Architecture. She received her Ph.D. from TU Delft Architecture Department where she also worked as a design tutor and lecturer between 2012-2016. She has published in numerous journals including Architectural Theory Review, METU JFA, OASE, and Archnet-IJAR.

Pelin YONCACI ARSLAN is a licensed architect and an architectural historian currently teaching at the METU Department of Architecture. Her research focuses on the historical topography of pre-modern cities, urban history and architecture, digital technologies, and visualization tools applied in architectural history writing. Receiving her Ph.D. in Architecture and Urban Design from the University of California, Los Angeles (UCLA) in 2015, she has been involved in teaching and writing digital humanities projects and curating exhibitions.

DOI: 10.15320/ICONARP.2024.276

Research Article

ICONARP
International Journal of Architecture and Planning
Received: 07.03.2023 Accepted: 12.02.2024
Volume 12, Issue 1/ Published: 30.06.2024
DOI: 10.15320/ICONARP.2024.277 E- ISSN:2147-9380

ICONARP

The Transfer of Spatial Memory with Collective Practices Among the Generations of Lausanne Exchangees in Bursa

Elif Vurucular Kesimci *
Ayşen Ciravoğlu **

Abstract
The aim of this study is to reveal how exchangees construct their public spaces for collective practices in a built environment that is abandoned and analyse these places along with collective practices retrospectively through changing daily life practices. Exchangees migrated from Greece to Turkey because of the population exchange decision which was taken in the Treaty of Lausanne in 1923. Due to the fact that the exchangee's identity and culture are visible through collective practices in public spaces, eight collective practices, which are weddings, hıdrellez, religious celebrations, official holiday celebrations, seeing-soldiers-off, seasonal preparations, funeral ceremonies, and public announcements of bad news are selected. These places, where collective practices are performed, are the subject of the research. The first-generation exchanges, for their collective practices, besides building spaces of their own, also settled in places that were left by the Greeks. The study focuses on these public spaces. The sample group of this study is the exchangees in Bursa, Görükle village who migrated from Greece. The methods of the study are analysing archive materials in the form of text, photo and maps and memory interviews conducted with the second and third generation exchangees who still use these public places. As a result of the study, it was revealed that the exchangees restructured the collective practice places in order to establish a sense of belonging and reinterpreting their culture and identity in the new settlement. The study concluded that the places of collective practices, spatial memory, the identity of the exchangee and the public spaces left by the Greeks have been transferred by spatial memory. This study reveals the influence of spatial memory, the relevance of belonging, reinterpreting of exchangees' culture and identity over the restructuring of the physical environment and the transfer of these between generations.

Keywords:
Collective memory, Identity of exchangees, Population exchange, Public places of collective practices, Spatial memory

*Department of Architecture, Bursa Technical University (BTU), Bursa, Turkey. (*Corresponding author*)
E-mail: elifvurucular@gmail.com

** Department of Architecture, Yıldız Technical University (YTU), İstanbul, Turkey.
E-mail: aysenc@yildiz.edu.tr

To cite this article: Vurucular Kesimci, E. & Ciravoğlu, A. (2024). The Transfer of Spatial Memory with Collective Practices Among the Generations of Lausanne Exchangees in Bursa. *ICONARP International Journal of Architecture and Planning,* 12 (1), 95-124. DOI: 10.15320/ICONARP.2024.277

INTRODUCTION

In this century, described by Said (Said, 2020) as the age of refugees, migration, memory studies have diversified over time. Halbwachs's "Collective Memory" (Halbwachs, 2017) discusses the social containment of social (collective) memory. Studies on the effects of culture on social memory resemble culture to a lens/filter (Cuc et al., 2006; Hirst & Echterhoff, 2008; Hirst & Manier, 2008; Öymen Gür, 1996, 2000; Rapoport, 1969, 1977, 1980a, 1980b). In Nora's "Memory Places" (Nora, 2006), the impact of culture on the individual experience of space is discussed. Post-memory is a traumatic experience resulting because of war and migration, which remain in the next generations (Hirsch, 1996, 2008, 2014; Sarlo, 2012). Today, the fourth wave in memory studies has pushed the field to go beyond the anthropocentric and to think ecologically, often in such a way as to decenter (Olick et al., 2023).

Memory studies in individual and collective memory emerged in architectural literature in recent years. These studies are focused on abandoned places, places of migration routes, and settled places after the migration (Göregenli & Karakus, 2014; Sezginalp Özçetin & Rottmann, 2022; Türkoğlu & Akdemir, 2022).

One of the forced migrations that has a place in memory studies is the population exchange. On January 30, 1923, after the 'Agreement and Protocol for the Exchange of Turkish and Greek People' between Greece and Turkey was enacted at the Lausanne Peace Conference, mandatory exchanges between Turkey and Greece were effectuated (Aktar, 2005; Arı, 2000; Mavromatis, 2005). Because of the population exchange, 500.000 Muslim Turks migrated from Greece to Turkey and 1.200.000 Orthodox Greeks migrated from Anatolia to Greece. Emigrants were referred to as 'exchangee' in Anatolia. The exchangees tried to be settled in areas similar to the living and working conditions in the areas they came from, and agricultural labourers settled in areas where they could perform their jobs (Arı, 2000; Yıldırım, 2006). Studies have been carried out discussing the social and cultural effects (Hirchon, 2005; Kolektif, 2015; Pekin, 2005) and places of the exchange (Gökaçtı, 2005; Pekin, 2013; Tevfik, 2014). Cengizkan's (2004, 2005) and Hirschon's (2000) studies have important contributions to population exchange in the field of architecture. There is also significant amount of research on population exchange in architecture focusing on the places which are left by Greeks (Altinoluk, 2021; Başar & Acar Ata, 2019; İnce Güney, 2016; Özaydın et al., 2018; Özbek Eren et al., 2010; Yıldız & Şahin Güçhan, 2020).

Despite numerous publications about migration, there is still a lot to discover in terms of architectural facet of the population exchange. The exchangees were able to continue their own culture, customs, traditions, and habits in the new places they settled (Goularas Bayındır, 2012). This paper contributes to the memory and migration literature by introducing the concept of 'cross-generational spatial memory' discussed from a generational perspective. The concept of inherited exchangee identity

DOI: 10.15320/ICONARP.2024.277

(post-memory) represents the transfer of the identity phenomenon to a new generation via inheritance and places.

In this study, research was conducted on the intergenerational spatial memory of the exchangees who settled in Görukle Village, Bursa. Görükle was a Greek Village known as Kouvaklia before the population exchange and it was abandoned. The exchangees settled in the village that was empty in terms of population. However spatially, residences were remaining despite some of the Greek public spaces were demolished. Therefore, this study focused on the change of public spaces. Exchangees preserved their culture in the new place. In time, exchangees changed the spaces and built new places. The study searched the effect of places on the intergenerational transmission of exchangees' culture. Spaces of collective practices, which are weddings, hıdrellez, religious celebrations, official holiday celebrations, seeing-soldiers-off, seasonal preparations, funeral ceremonies, and public announcements of bad news, are the focus of the study. In this study, the exchangees' ability to continue their culture, and to transfer culture to the next generations has been read through places.

PLACES of MEMORY and PLACE ATTACHMENT

Memory is a reminder and descriptor of identity. The most distinctive attribute of long-term memory is persistence over time. Persistence is the capacity to reactivate, or reconstruct the original, or a similar representation by the process of retrieval (Dudai, 2002). The mind is able to recollect an event from what is told, and the person is able to recollect an event personally and essentially experienced (Figure 1.**Hata! Başvuru kaynağı bulunamadı.**). The feeling of reliving an event during recollecting is one of the characteristics that determines autobiographical memory (Gülgöz, 2018).

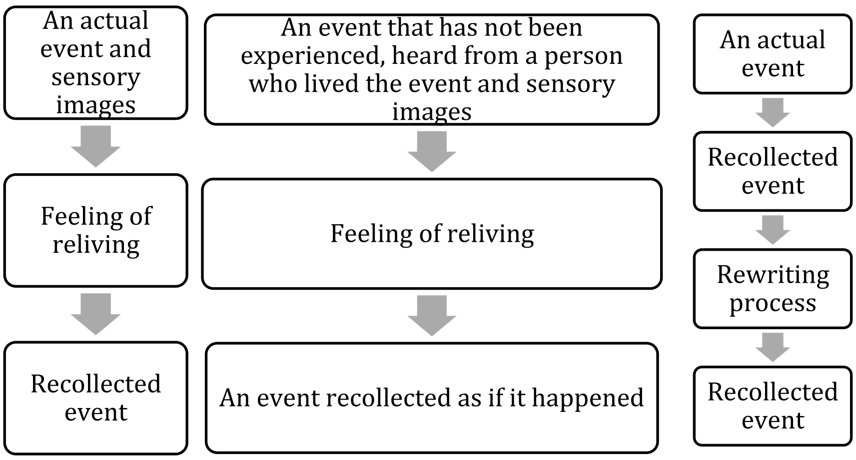


Figure 1. Types of Recollecting Events Experienced/ Not Experienced in Autobiographical Memory [visualized from the theories of (Dudai, 2002; Gülgöz, 2018)]

The considerations that memory is not only a property belonging to an individual, but determined socially, have produced the concept of collective memory. Recollecting is realized through places and objects. Places, an important tool of memory, gain more importance when it comes to undesirable and forcefully experienced events. Collective memory is formed through recollections of individual memories (Halbwachs, 2017).

According to the research in the fields on sociology and anthropology, the concept of collective memory is outside the mind of the individual and is formed and structured in a social context. Information about the shared past of a society is represented in cultural products, such as texts, images, rites, traditions, myths, commemoration ceremonies, buildings, monuments, even cities (Assmann, 1995; Irwin-Zarecka, 1994; Olick, 2014; Olick & Robbins, 1998). Those who consider collective memory from the perspective of psychology note that the processing, storage and recall of this information about the social past takes place in the human mind (Crane, 1997; Cuc et al., 2006; Hirst & Manier, 2008; Mutlutürk et al., 2018). For a social memory to be formed, personal memories of an event must be transferred between individuals and distributed and disseminated within the community (Cuc et al., 2006; Olick, 2014; Werstch, 2004). For an event to become a part of social memory, it does not have to be experienced by all members of a community (Crane, 1997; Hirst & Manier, 2008; Mutlutürk et al., 2018). What makes collective memory collective is the fact that members of a group share a similar set of cultural tools, especially narrative forms, when understanding the past (Werstch & Roediger, 2008) (**Hata! Başvuru kaynağı bulunamadı.**.).

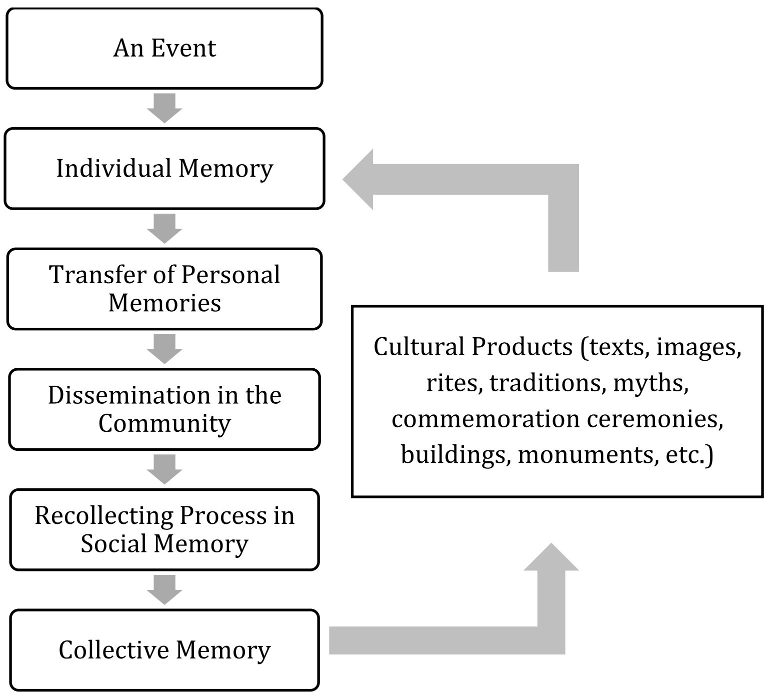


Figure 2. The Relationship Between Social Memory, Cultural Products and the Individual [visualized from the theories Hirst and Manier, (2008); Olick, (2014); Werstch, (2004); Werstch and Roediger, (2008)]

In "Places of Memory" Nora (2006) states that there are certain representations, indicators, symbols forming and strengthening the relationship between collective memory and places. The traces of the collective past form the 'memory of place' in the minds of the individuals is formed with personal, social, and historical values. The meaning given

DOI: 10.15320/ICONARP.2024.277

to places is based on physical settlement, psycho-social processes with the person's characteristics depending on social and cultural factors, and intangible cultural heritage elements such as ceremonies and celebrations held in those places (Canter, 1977; Relph, 1976; Stedman, 2002; Stokols & Schumaker, 1981). This process creates social and individual place attachment by attributing meaning to a place (Case, 1996; Greider & Garkovich, 2010; Stokowski, 2002). Values, memories, environment, residences, symbols and traditions have created the attachment to place in societies. Radical changes in places divide and disrupt the relationship between memory and identity, causing a disconnection of intergenerational memory. After being forced to leave or break away from any place, it is not feasible for a society to remain stable and continue its old life by maintaining their lives (Rennick, 2003). The effects of the place disruption that lead to a break or interruption of relations with the place can be understood by examining pre-demolition, moment of demolition and post-demolition stages through individual, social and constancy-change functions (Wieland, 2001). In post-demolition stages, individuals compare their old environment with their new environment. Even in crisis situations such as disasters and migration, people begin to create their daily functions and needs in the new environment. By recreating their social and physical environment process, society is normalized.

Since events such as war and migration cause great changes in the life of the individual/society, they are transferred to the next generations with the trauma effect. ‘Vicarious remembrance' is remembering the experiences of his/her ancestors, despite not having his/her own experience (Sarlo, 2012). Hirsch (1996, 2008, 2014) who theorizes intergenerational trauma transmission as ‘post-memory’, the traumatic event does not only affect those who experience it. Even if subsequent generations do not experience the event themselves, they psychologically experience the consequences of that event. Sarlo (2012) argues that, considering that it is not possible to remember an event that a person has not experienced, this remembering occurs through the transfer of memories within the family and society.

Along with migration, a breakaway from the physical environment creates problems in perceiving the environment due to post-traumatic effects. The exchangees, who leave the places where they had lived and created of a sense of belonging for centuries 'settle' in lands they had never seen before. This cause a spatial and cultural interruption. In the context of human-environment relations, forced migration requires a new adaptation process. The society enters into the normalization process with reconstruction efforts. The fact that immigrants search for places that are physically similar to their old places and settle in similar villages can be interpreted as preserving the integrity of cultural elements. Intergenerational spatial memory is a means of transferring the exchangee identity to subsequent generations. The argument of this paper is that spatial identity in the memory of the exchanged people was transferred to the current place by post-memory and by adapting the physical environment through cultural components.

METHODOLOGY

The methodology of this paper consists of a study including analyzing the archive material which is mainly texts, photos and maps in the first stage and conducting memory interviews with second and third generation exchanges as a second stage. Photographs regarding collective practices were taken from the Archives of Görükle Exchange House, and the photographs were discussed with the exchangees who were interviewed. The researcher interpreted the archive material combining with the information gathered from interviews. Interviews were made by most important memories method and life history timeline method.

Autobiographical memory is based on the theory of recollecting memories that are not personally experienced but are recollected as if they were experienced. In this study, it has been assumed that the second and third generations can have information about the environments they have not experienced. Therefore, in order to reveal social memory, the study focused on cultural products and public places where collective practices are performed.

There are two ways to build a memory: producing and recollecting it directly. In recollecting, the person tries to reach the information in autobiographical memory based on the hint given to him (Uzer, 2018). Therefore, in order to recollect spatial data in autobiographical memory, two individually performed methods were used which are already been used in psychology. These are "Most Important Memories Method" and "Life History Timeline Method".

In the 'Most Important Memories Method', participants are expected to remember a certain type of moment and share their memories in a long and detailed way. In the 'Life History Timeline Method', participants are asked to think of their lives as a book or novel, divide this book into eight certain positive and negative moments into specific chapters, and freely tell their life stories (Demiray, 2018; Weston et al., 2015).

In this study, Görükle from Bursa was chosen as a case study area. Exchangees chose the area where they would settle in Bursa which is the fourth city where the biggest amount of exchange of population occurred in Anatolia. First generation exchangees settled in Görükle Village because it was similar to the settlements in Greece in terms of topography and agricultural areas. Although Görükle has grown and changed in terms of settlement morphology, it is possible to read the village pattern of Görükle exchangees. The memories of exchangees were also recorded by the Görükle Exchange House. For these reasons, the study was conducted in the village of Görükle in Bursa. Görükle (Figure 4.) is one of the neigbourhoods of Nilüfer Municipality, and almost the last residential area at the western exit of Bursa, located next to the Bursa-İzmir highway. In the north of the settlement, the coastal Mudanya and Tirilye districts and the Marmara Sea; in the south, the still developing Hasanağa and

DOI: 10.15320/ICONARP.2024.277

Kayapa residential settlements; in the east, the central districts of Nilüfer and Osmangazi districts; in the west, touristic residential areas such as Gölyazı and Uluabat Lake exist (Figure 3.). In 1924, two years after the Greeks left the village of Görükle (formerly Kouvaklia), first Thessaloniki and then Kavala exchangees settled. The village, which was an exchangee settlement until 1976, when Uludağ University constructed in Görükle, started to grow due to its proximity to the university, and there were significant changes in its spatial morphology in the 2000s. Currently in the settlement, there are many apartments, flats, private and state dormitories along with social, commercial, culture-art, sports and recreation spaces for university students and young people. With this rapid construction process that has occurred in recent history, new settlement areas are constructed in natural and agricultural areas. Despite the new urban developments, the old exchangees' village pattern still can be read as spatial morphology.

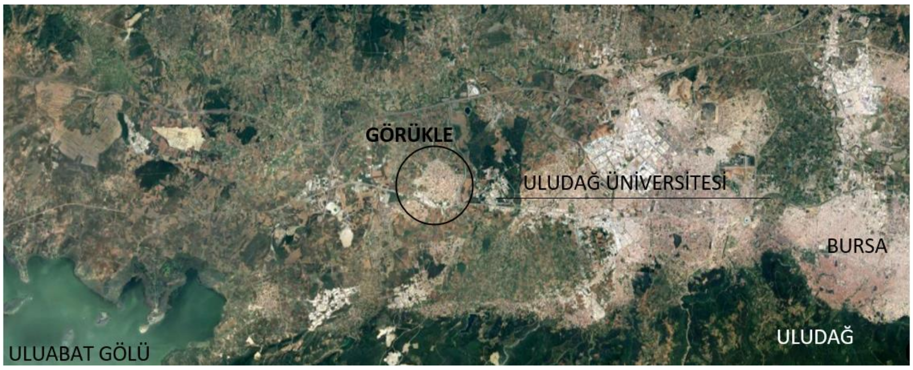


Figure 3. Görükle Settlement (*Bursa, Görükle Yerleşimi*, n.d.)

Figure 4. Görükle Exchangee Village within Görükle Settlement (*Bursa, Görükle Yerleşimi*, n.d.)

The interviews were shaped by a theoretical framework and consisted of a set of questions about the population exchange. Series of questions are asked during the research including these themes: the settlements of Greece where the ancestor lived before, the population exchange, the migration, the places of quarantine and the gathering spaces, the first settlement in Bursa, the searching stage of place to settle, how they decided to settle in Görükle, the ruined and preserved Greek public spaces when the first generation exchangees came and settled in. Memory interviews are aimed to reveal the changes that have occurred in the places of collective practices, over the course of a century, from the first generation exchangers to the present day. In this part of the interviews, the exchangees are expected to tell their memories with blending most important memories method and life history timeline method by assigning eight collective practices. Weddings, hıdrellez, religious celebrations, official holiday celebrations, seeing-soldiers-off, funeral ceremonies, public announcements of bad news and seasonal preparations (food kept for winters/traditions performed at certain times regarding economically changing production activities) were selected as collective practices. The study aimed to determine which places are referred to and which practices through the places are mentioned by the second and third generation exchangees.

Since the Thessaloniki and Kavala exchangees live together in Görükle, it was aimed to obtain information whether there is a difference in the use of places by conducting interviews with both groups (Table 1.). Memory interviews were conducted with these participants about eight collective practices. The participants are between 54 and 88 years old, all of them are second or third generation exchangees who were born in Görükle and lived there throughout their life.

Table 1. Participants in Görükle for the Study

Second Gen. Thessaloniki Exchangees		Second Gen. Kavala Exchangees		Third Gen. Thessaloniki Exchangees		Third Gen. Kavala Exchangees	
Woman	Men	Woman	Men	Woman	Man	Woman	Man
1	4	1	2	1	1	1	1

FINDINGS of the CASE STUDY

The Spatial Analysis of Kouvouklia Before the Population Exchange

After visiting Kouvaklia Village (today Görükle) in 1907-1908, Hasluck (1910) mentioned that there was a demolished Byzantine castle, there were 430 residents, and the villagers spoke Greek and maintained their traditions that they brought from Greece. The number of dwellings mentioned by Deligiannis, who taught in Kouvuklia before the exchange, is the same. The map and panorama of the region in Kouvouklia drawn by Deligiannis, provide information about the period when the Greeks lived in there (Figure 5., Figure 6.). There were a kindergarten and a primary school, a central coffeehouse (Adelfato), a bakery, a chapel, a well and a fountain known as ayazma in the Agios Georgios Church Square. Sterna Square is the second bustling square of the village after the church square (Ulutaş, 2014). Rituals and celebrations were held around the wells on holidays dedicated to saints throughout the year. On the last two days of Easter, young girls danced, and men watched from afar in the Church Square, the central square of the village (Ulutaş, 2014).

DOI: 10.15320/ICONARP.2024.277

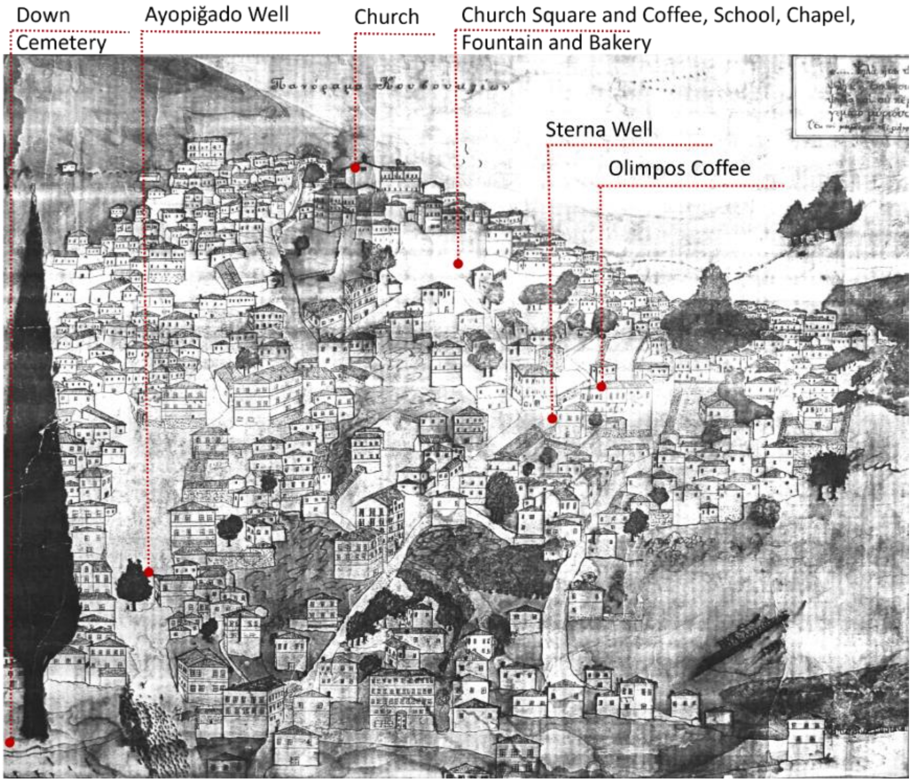


Figure 5. The Village of Kouvouklia (Görükle) before the Population Exchange in 1923 [(Drawn by the Greek Teacher, Deligiannis (*Personal archive of Vasileios Deligiannis obtained from Archives of Asia Minor Studies, Athens*, n.d.)]

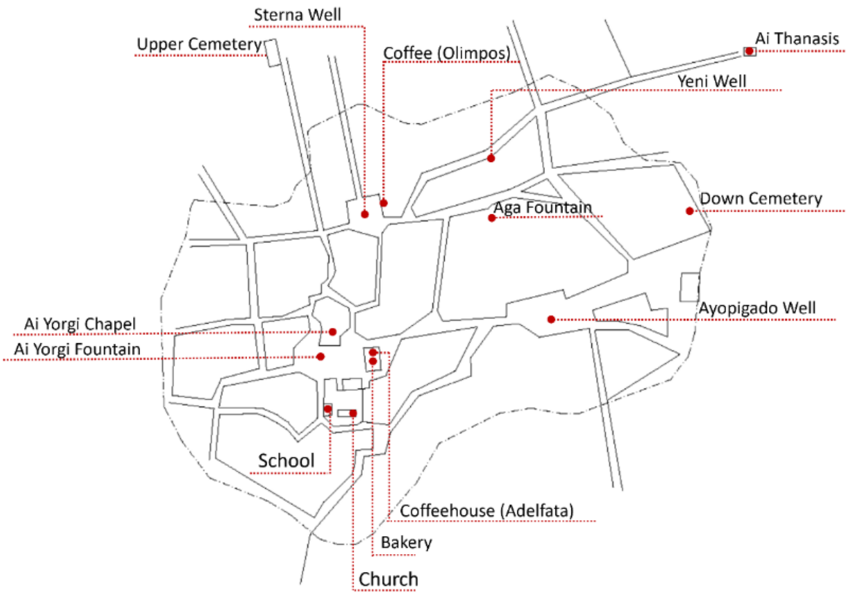


Figure 6. The Village of Kouvouklia (Görükle) before the Population Exchange in 1923 [(Drawn by the Greek Teacher, Deligiannis (*Personal archive of Vasileios Deligiannis obtained from Archives of Asia Minor Studies, Athens*, n.d.)]

The Spatial Analysis of Görükle Village After the Population Exchange

In this section, the information about the public places left by the Greeks which were not demolished until the first generation exchangees came, is presented. Also, public places where the collective practices occurred is studied. This data of this section is generated from memory interviews with second and third generations exchangees.

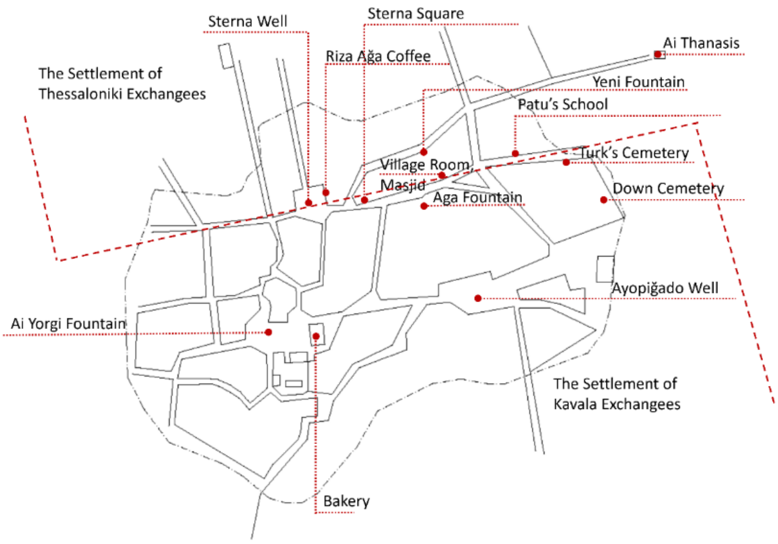


Figure 7. The Village of Görükle after the Population Exchange in 1924 [(The map was drawn by the Greek Teacher, Deligiannis (*Personal archive of Vasileios Deligiannis obtained from Archives of Asia Minor Studies, Athens*, n.d.)]; the places after the population exchange were prepared by researchers according to memory interviews

In the memory interviews, the places of the Görükle Village before (Figure.8) and after the population exchange were told by exchangees. According to the memory interviews, before the exchangees came to Görükle Village, the church and school in the first square (Kilise Meydanı, Church Square), Ai Yorgi Şapeli (Chapel) and the surrounding coffeehouse (Adelfato) had been destroyed. Olympus Kahvehanesi (Coffeehouse), Sterna Kuyusu (Well) in the second square (Sterna Meydanı/Square), Aga Çeşmesi (Fountain), Yeni Çeşme (New Fountain), Ai Thanasis and Ayopigado Kuyusu (Well) were not damaged. Olympus Kahvehanesi (Coffeehouse), located in Sterna Meydanı which is the second square of the Greeks, was started to be operated by Riza Aga —who was an exchangee— as a coffeehouse and the building is currently used as Riza Aga Mübadil Kahvehanesi (Coffeehouse). The Church Square (Kilise Meydanı) and Ai Yorgi Çeşmesi (Fountain) were not used by exchangees, and therefore it lost its character (Figure 7., Figure 9.).

The mosque was constructed across the Sterna Meydanı (Square) in 1936. In 1937, the first elementary school (Görükle İlk Okulu) was built opposite the Turkish Cemetery at the village exit. The school used to be located side by side in the main square with the church, fountain and ayazma during the Greek period. However, at first the exchangees preferred a house outside the village and they also built the new school in this area. So, the education area was created outside the village. In their construction activities for school and mosque, it has been observed that the exchangees chosen locations and used construction techniques according to their spatial data which were came from their homeland.

In the 1940s, tobacco cooperative building was built, but today it is out of use. The Greek cemetery was not used either and an area outside the village was delineated for the cemetery. The Greek Cemetery located at the intersection of the school was transformed into Görükle Spor Sahası (Sports Field). The places of exchangee from 1924 to 1940 are seen at Figure 10.

DOI: 10.15320/ICONARP.2024.277

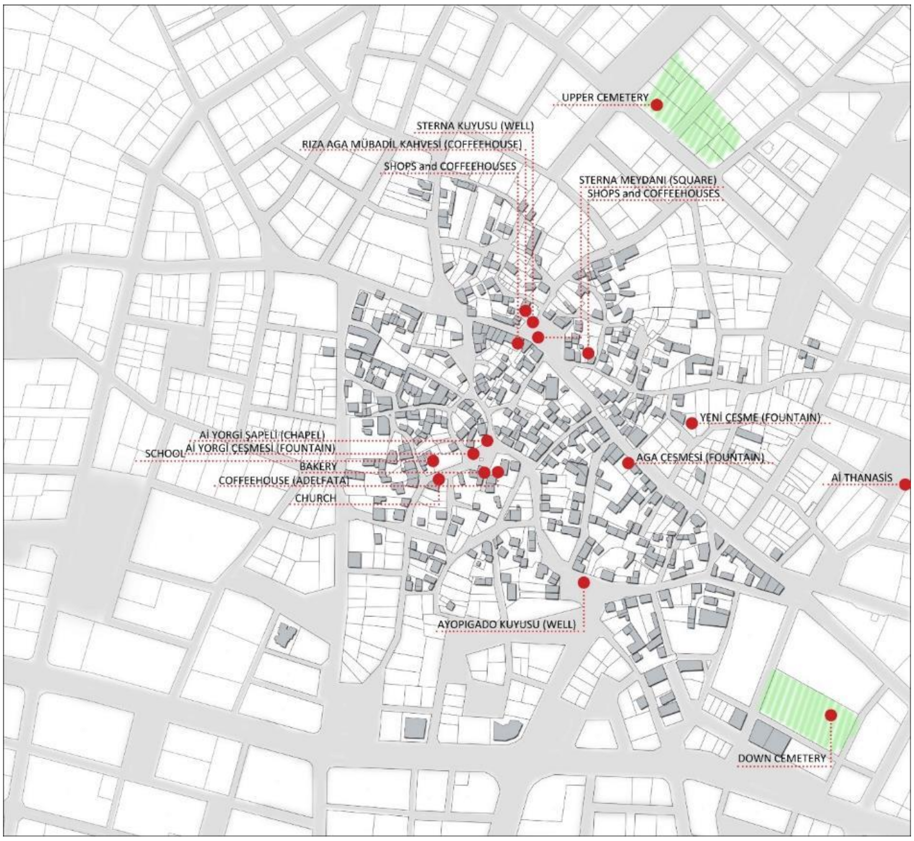


Figure 8. The Village of Kouvouklia*, Public Places for Collective Practices before the Population Exchange on current map (prepared by researchers according to memory interviews)

*The village name was Kouvaklia before the Population Exchange.

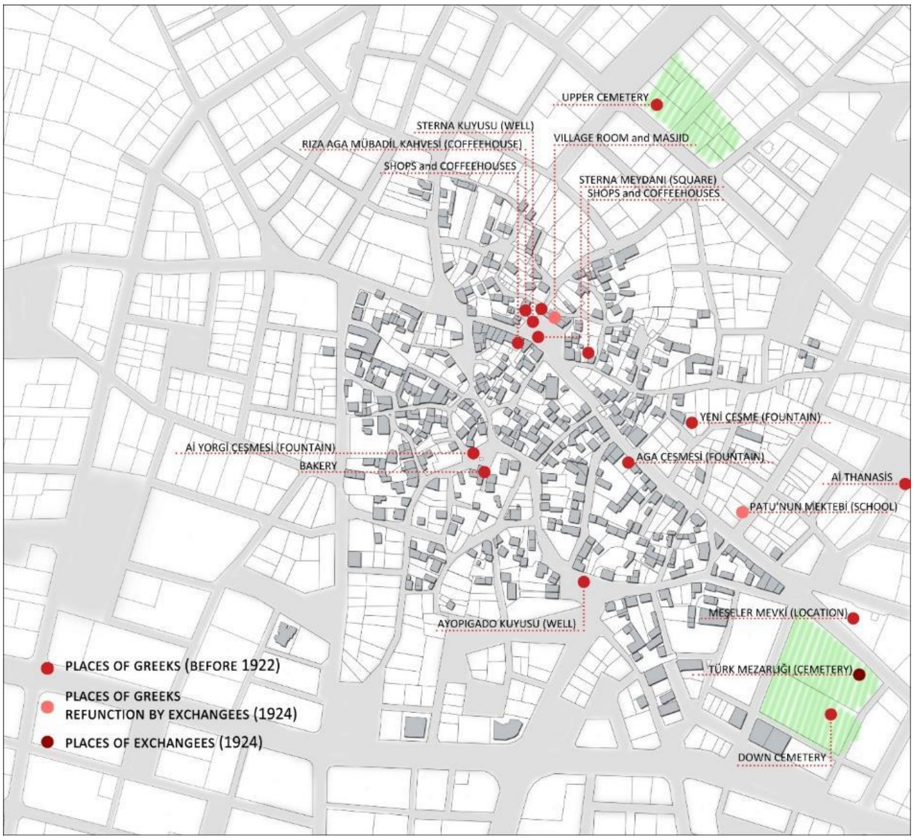


Figure 9. The Village of Görükle*, Places for Collective Practices after the Population Exchange on current map (1924) (prepared by researchers according to memory interviews)

* The village name was changed to Görükle after the Population Exchange.

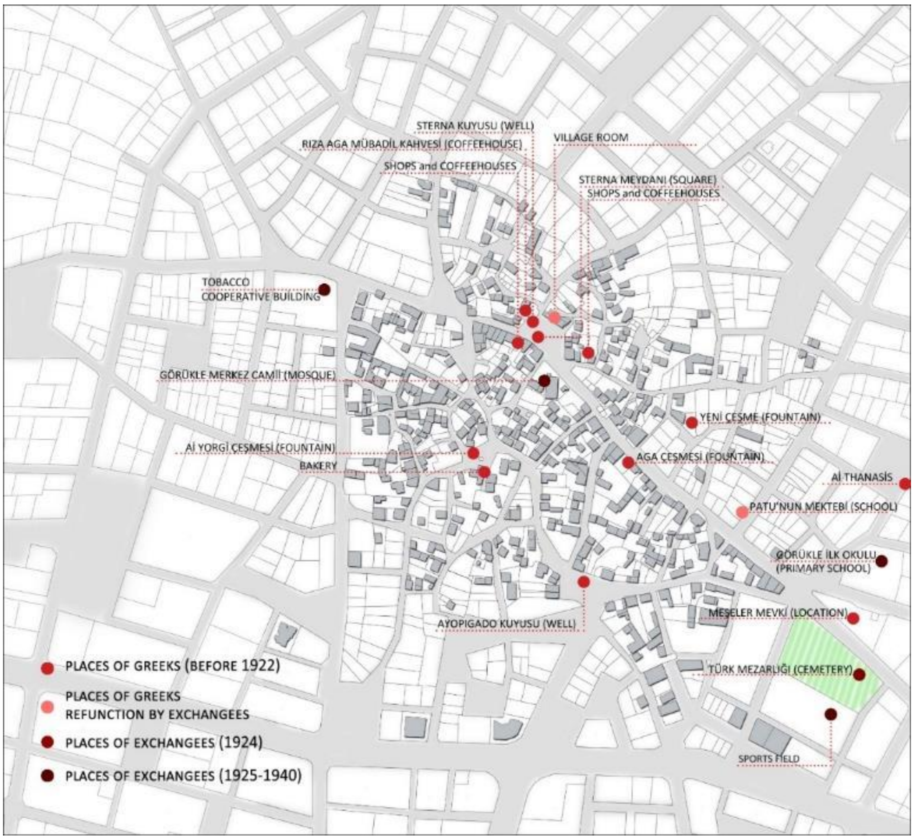


Figure 10. The Village of Görükle, Places for Collective Practices after the Population Exchange on current map (1940s) (prepared by researchers according to memory interviews)

Today, a covered marketplace is located on the site of the Görükle Spor Sahası (Sports Field). Ayopigado Kuyusu (Well) has become useless, so the well was destroyed. The place of the well was turned into a square and named as Taşpınar Mevkii (Location). Sculptures, which represented two women filling water at the well and a man looking at them, were built in this square. Yeni Çeşme (New Fountain) and Ai Thanasis Çeşmesi (Fountain) were demolished, and the Aga Çeşmesi (Fountain) was removed in 2020 being replaced with an apartment instead of the two-storey Greek residence behind the fountain. The Ai Yorgi Çeşmesi (Fountain), known as the church fountain, has survived. The two-storey Greek house used as Abdullah Aga/ Çukur Kahvehane (coffeehouse) in Sterna Meydanı (Square) was renovated by the Municipality of Nilüfer in 2016 and started to be used as the Mübadele Evi (Museum of Exchange House) (Figure 11.).

When the maps of Kouvaklia Village before the population exchange (Figure 8.) and Görükle Village after the population exchange in 1924 (Figure 9.) and 1940 (Figure 10.) are compared with the maps of today (Figure 11.), it has been observed that the square of the public spaces of the village has changed. The church square and the church fountain, still exist today. However, the square that is actively used in the village is Sterna Square. The important public spaces of the village are also clustered around the Sterna Square. Based on the old location data, exchangees delineated Sterna Square next to the coffeehouse as the village square. It has been determined that the religious concern led to this selection. The religious building, as reported by the exchangees,

DOI: 10.15320/ICONARP.2024.277

would be built by the first generation exchangee, even if the church was not destroyed. By taking a Greek coffee house and the Greek square next to it as the center, the first generation exchangees built the mosque in there and reconstructed the square where life flows in the village. The necessary shops for the villagers have been located around the square.

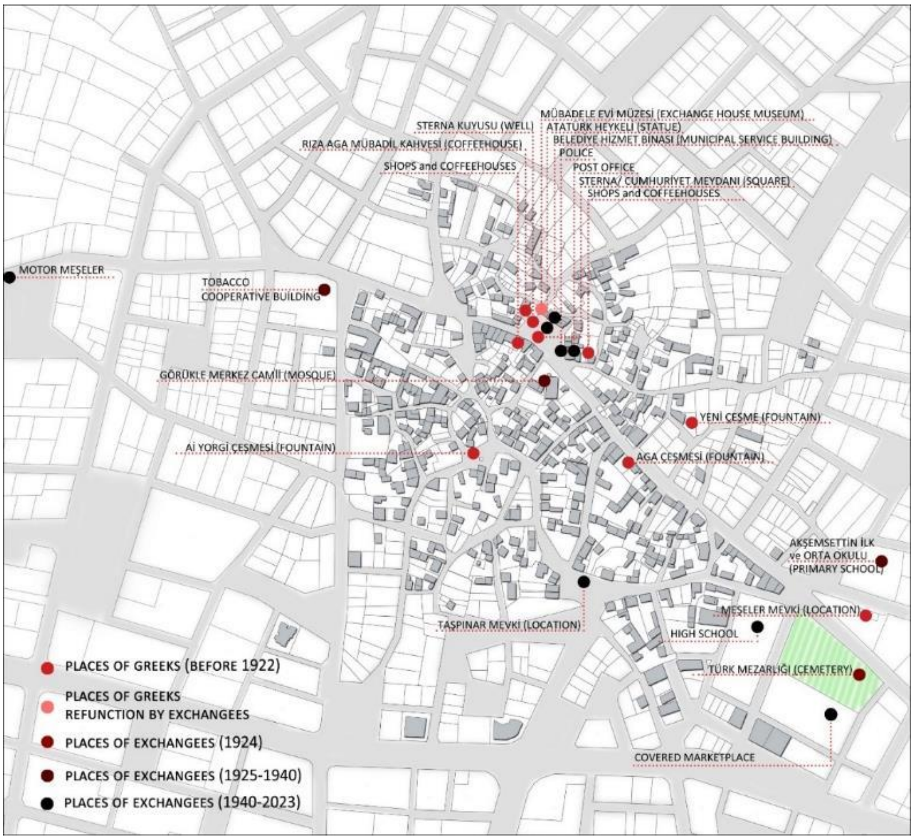


Figure 11. The Village of Görükle, Places for Collective Practices after the Population Exchange on current map (1940s) (prepared by researchers according to memory interviews)

The Analysis of Public Places Used for Collective Practices After the Population Exchange

Public places used for collective practices in Görükle (Kouvaklia) Neighborhood were discussed in the memory interviews with second and third generation exchangees. Results of the interviews will be presented focusing on eight collective practices. These are weddings, hıdrellez, religious celebrations, official holiday celebrations, seeing-soldiers-off, funeral ceremonies, public announcements of bad news and seasonal preparations. The data of the information provided by the exchangees are tabulated in Table 2. The map of public places and collective practices in Görükle Neighbourhood is prepared by researchers according to memory interviews. The places' names, which are used for collective practices, are represented in bold black and near the names, the collective practices are represented with a symbol of different colors for each practice. The places' names, which are not used for collective practices are grey. As can be seen in Table 2. and Figure 12., the places for collective practices in Görükle (Kouvaklia), Atatürk Caddesi (Street), Sterna /Cumhuriyet Meydanı (Square) and Meşeler Mevkii (Location) are the places where the most practices take place.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

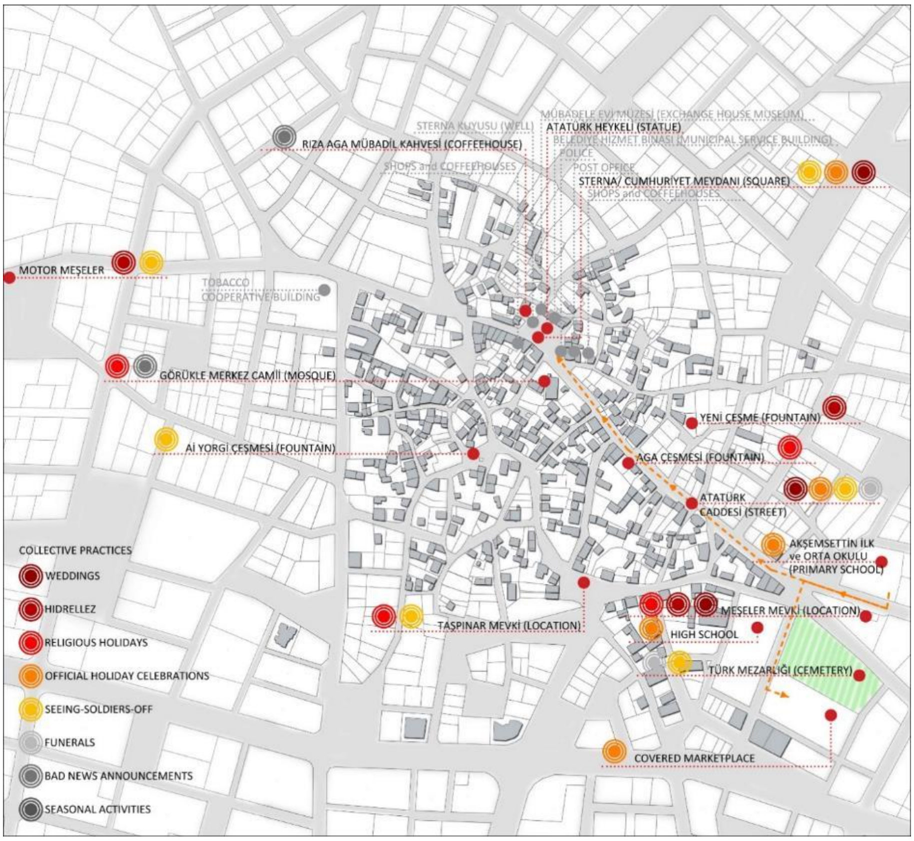


Figure 12. The map of public spaces and collective practices in Görükle Neighbourhood (prepared by the researchers according to memory interviews)

According to Table 2., Thessaloniki and Kavala exchangees pointed out the same public places for same collective practices. So, it can be concluded that exchanges coming from the two different cultures from two different cities in Greece, used the same public spaces with the same rituals in Görükle.

Before the population exchange, on the feast days, Greeks' ceremonies and celebrations were held around the wells, and young girls and boys used to gather and dance on the church square (Kılıç & Ulutaş, 2016). After the population exchange, the first generation exchangees chose wells, fountains, and Sterna Meydanı (Square) where there was a well, for collective practices. It is evident from these data that the exchangees transferred their culture to the new environment.

According to the memory interviews *weddings*, which are one of the collective practices, are usually held in the gardens of the houses. Wedding owners who did not have a home garden, celebrated their weddings on Sterna/Cumhuriyet Meydanı (Square) or Atatürk Caddesi (Street). "Ruba" clothes and the groom's suits were taken away on Atatürk Caddesi (Street). An exchangee explained the wedding ceremony with the following sentences:

"On Friday, 'ruba' goes from the boy's house to the girl's house. Ruba is the wedding dress of the girl who will get married. After Friday prayer, men come from the boys' house to the girls' house with a ceremony, and a meal is served in the garden of the girls' house. The groom's suit is given to the arriving youth on a tray, and the youth ceremoniously go from the girl's house to the boy's house on the same route. This route is from

DOI: 10.15320/ICONARP.2024.277

Atatürk Street so that all the villagers can see it. Henna is held at the girl's house on Saturday, it is also held at the boy's house. We call it a wedding, but the wedding continues Sunday. On Sunday mornings, dowry is taken from the girl's house to the boy's house, accompanied by entertainment, previously on horse-drawn carts, later on tractors, and today by cars. The girl does not go to the groom's house, the girl's family spreads the dowry in this house. The groom shaves in the afternoon, if his house is nearby, in the square, if not, on the Atatürk Street. After the marriage ceremony with the prayers of the imam in the evening, there is entertainment until the time of the night prayer. On Monday, at the bride's house, women eat trotters and have fun. All celebrations have drums and pipes. Drummers come to the village on Friday and are hosted at the man's house or at the Rıza Aga Cafe in the village until Sunday." (B.A.)

Table 2. Görükle (Kouvaklia) Neighborhood, Places for Collective Practices' Places Mentioned by the Exchangees in the Memory Interviews

		2nd Gen. Thessaloniki Exchangees		3rd Gen. Thessaloniki Exchangees		2nd Gen. Kavala Exchangees		3rd Gen. Kavala Exchangees	
		Woman	Men	Woman	Men	Woman	Men	Woman	Man
Weddings	Home Gardens	●	●	●	●	●	●	●	●
	Sterna/ Cumhuriyet Meydanı (Square)	●	●	●	●	●	●	●	●
	Atatürk Caddesi (Street)	●	●	●	●	●	●	●	●
	Meşeler Mevkii (Location)				●				
	Şantiye Alanı (Construction Site)	●	●	●			●	●	
Hıdrellezs	Meşeler Mevkii (Location)	●	●	●	●	●	●	●	
	Koca Çınar (Big Plane)	●	●		●	●	●		●
	Motor Meşeler (Oaks)	●	●	●	●	●	●	●	●
	Yeni Çeşme (New Fountain)	●				●			
Religious Celebrations	Görükle Merkez Camii (Mosque)		●		●		●		●
	Taşpınar Mevkii (Location)		●	●	●	●	●	●	●
	Meşeler Mevkii (Location)		●		●		●		●
	Aga Fountain				●				
	Pomegranate Trees	●							
Official Holidays	School Garden	●	●	●	●	●	●	●	●
	Atatürk Caddesi (Street)	●	●	●	●	●	●	●	●
	Sterna/ Cumhuriyet Meydanı (Square)	●	●	●	●	●	●	●	●
	Sports Area	●	●		●	●	●	●	●

Table 2. Continued Görükle (Kouvaklia) Neighborhood, Places for Collective Practices' Places Mentioned by the Exchangees in the Memory Interviews

		2nd Gen. Thessaloniki Exchangees		3rd Gen. Thessaloniki Exchangees		2nd Gen. Kavala Exchangees		3rd Gen. Kavala Exchangees	
		Woman	Men	Woman	Men	Woman	Men	Woman	Man
Soldier Farewells	Sterna/ Cumhuriyet Meydanı (Square)	●	●		●	●	●		●
	Kilise Meydanı (Church Square)						●		●
	Taşpınar Mevkii (Location)					●	●		●
	Atatürk Caddesi (Street)	●	●			●	●		●
	Cemetery	●	●			●	●		●
	Motor Meşeler (Oaks)		●					●	●
	Şantiye Alanı (Construction Site)				●				
Funerals	Home Gardens	●	●	●	●	●	●	●	●
	Cemetery	●	●	●	●	●	●	●	●
	Atatürk Caddesi (Street)	●	●	●	●	●	●	●	●
Announcements of the bad news	Görükle Merkez Cami (Mosque)	●	●	●	●	●	●	●	●
	Rıza Aga Mübadil Kahvesi (Coffeehouse)	●	●	●	●	●	●	●	●
Seasonal Activities									

Nowadays, weddings cannot be celebrated in squares and streets. This is due to the prohibition of celebrations in squares and streets by the Municipality. This prohibition has caused the wedding, which is one of the most important means of preserving the customs and traditions of the villagers alive, to change. Participants are concerned that the wedding traditions will be lost. It is observed that the wedding traditions are desired to be celebrated today in the same way as the first generation exchangees celebrated. The wedding tradition, which passed on to the third generation of exchangees, has taken its current form with the change of wedding venues. Today, weddings are celebrated in the closed area of the municipality called the 'Şantiye Alanı' (Construction Site).

DOI: 10.15320/ICONARP.2024.277

Figure 13. A Wedding in Sterna Meydanı (Square) in 1960s (*Archive Catalogue of Photographs from Exchange House*, 2021)

Figure 14. A Groom Shave at Atatürk Caddesi (Street) in 1960s (*Archive Catalogue of Photographs from Exchange House*, 2021)

Figure 15. A Wedding Meal in 1970s (*Archive Catalogue of Photographs from Exchange House*, 2021)

Figure 16. A Wedding in 1970s (*Archive Catalogue of Photographs from Exchange House*, 2021)

Figure 17. A Groom Shave at Atatürk Caddesi (Street) in 1960s (*Archive Catalogue of Photographs from Exchange House*, 2021)

Figure 18. A Wedding in 1990s (*Archive Catalogue of Photographs from Exchange House*, 2021)

Hıdrellez is as important as weddings for exchangees. Four different places are mentioned for celebrations. Meşeler Mevkii (Location) and Koca Çınar (Big Plane) were the hıdrellez places, but the oak tree in Meşeler Mevkii (Location) and the plane tree in Koca Çınar dried up. So, the Motor Meşeler (oaks) is used as the only celebration area today. Hıdrellez activities organized in Motor Meşeler (oaks) are supported by the Municipality nowadays. Also, The Yeni Çeşme (New Fountain) has been a place where only young girls go to perform the custom called 'mantufar', but today this tradition is not pursued. The practice of mantufar was explained by the second generation female exchangee.

"When I was a young girl, we would put any item we wanted into a clay pot and leave it under the rose overnight. In the morning, we would all gather and go to Yeni Çeşme, wash our hands and faces, and take out the contents of the pot one by one, we call this mantufar extraction. Then we would go to Motor Oaks, playing dümbelek and singing songs. We used to celebrate it in Meşeler Mevki and Koca Çınar, but the trees dried up. Swings are set up on the oak tree, meals are cooked, celebrations are held. Young girls stayed there all day, and the man they love swinged the girl on the swing set up on the oak tree." (F.A.)


Figure 19. Hıdrellez at Koca Çınar (Big Plane) in 1950s (*Archive Catalogue of Photographs from Exchange House*, 2021)

Figure 20. Hıdrellez at Meşeler Mevkii (Location) in 1970s (*Archive Catalogue of Photographs from Exchange House*, 2021)


Figure 21., Figure 22. Hıdrellez at Motor Meşeler (oaks) in 2012 (*Nilüfer'de Hıdrellez Coşkusu*, 2012)


Figure 23. Hıdrellez at Motor Meşeler (oaks) in 2012 (*Nilüfer'de Hıdrellez Coşkusu*, 2012)

Figure 24. Hıdrellez at Motor Meşeler (oaks) in 2023 (*Görükle'de Hıdırellez Kutlaması*, 2023)

Religious Celebrations for men take place in the mosque. The exchangees mentioned Taşpınar Mevkii (Location), Meşeler Mevkii (Location), Aga Çeşmesi (Fountain) and pomegranate trees location as the places for the young people to 'stroll' during the holidays. In the past, young girls and boys used to meet and flirt in these places. 'Strolling' was one of the important practices that takes place in the youth of every participant, and it is understood that it continued to survive in every period until today's communication technology.

The official holiday celebrations starting at the school continue in front of the Statue of Atatürk by walking to Sterna/Cumhuriyet Meydanı (Square) with a ceremony from Atatürk Caddesi (Street). On The Commemoration of Atatürk, Youth and Sports Day, Sterna/ Cumhuriyet Meydanı (Square) was not visited, but sports shows were held on the sports field built in the area that was the Greek cemetery before the exchange. Nowadays, celebrations are held only in schoolyards. A covered marketplace was built in the sports area. It is determined that it is important to celebrate the holidays that Atatürk bestowed to the Turkish nation and to commemorate the day of his death in Görükle. Public holidays were the only collective practices in which all villagers

DOI: 10.15320/ICONARP.2024.277

took part, regardless of age and gender. The importance of the official holiday celebrations was noted by the third generation exchange as follows:

"Ataturk is the most important leader in the exchangee population in Görükle. Thanks to him, we came to Turkey. It is also important to celebrate the holidays he gave as a gift and to commemorate the day of his death. The fire of the torch lit in front of his statue on the day of his death never goes out for a day. Students keep watch 24 hours." (A. K.)

Figure 25. Official Holiday Celebrations in Sterna/ Cumhuriyet Meydanı (Square) in 1973 (*Archive Catalogue of Photographs from Exchange House*, 2021)

Figure 26. Official Holiday Celebrations in Spor Sahası (Sports Field) in 1923 (*Archive Catalogue of Photographs from Exchange House*, 2021)

Figure 27., Figure 28. Official Holiday Celebrations at Atatürk Caddesi (Street) in 1970s (*Archive Catalogue of Photographs from Exchange House*, 2021)

Figure 29. Official Holiday Celebrations in Sterna/ Cumhuriyet Meydanı (Square) in 1990s (*Archive Catalogue of Photographs from Exchange House*, 2021)

Figure 30. Official Holiday Celebrations at Atatürk Caddesi (Street) in 1990s (*Archive Catalogue of Photographs from Exchange House*, 2021)

Figure 31. Seeing-soldiers-off at Atatürk Caddesi (Street) (*Archive Catalogue of Photographs from Exchange House*, 2021)

The cemetery at the end of Atatürk Caddesi (Street) and the street and at the exit of the village are places for *seeing-soldiers-off*. Other places where young soldiers have fun with their friends are also included in the seeing-off ceremonies of the soldier. These are the Kilise Meydanı (Church Square), Taşpınar Mevkii (Location), Motor Meşeler (Oaks) and Şantiye Alanı (The Construction Site) in recent years.

Funerals make their way through the house in Görükle and funeral prayers are performed at the cemetery. Funerals do not make their way out of mosques. *Bad news announcements* are made from Görükle Merkez Camii (mosque) and Rıza Aga Mübadil Kahvesi (coffeehouse). There are no *seasonal activities*.

According to the memory interviews, public places from Greeks and collective practices are tabulated on Table 3-4-5-6. It is observed that today, the same places are still used for these practices. Therefore, it can be said that, due to these practices, some Greek venues have been preserved. Collective practices formed around fountains and wells have been transferred from the first generation of exchangees to today's generations. Thus, the paper revealed that the exchangees built their new environment with reference to spatial memory.

Some places were built by the first and second generation exchangees for their collective practices in Görükle Neighbourhood (Tablo 7.). The places are still used for collective practices.

When comparing the data in Table 3-4-5-6. and Table 7., it is seen that the exchangees used the Greek places for their collective practices where exchangee's identity and culture are visible. The first generation exchangees had no economic opportunities for construction activities, nevertheless, they built the school and mosque for their education and religious needs. The second and third generation exchangees had economic opportunities for construction activities but, they have not built places. So, it was concluded that the public spaces left by the Greeks were sufficient for the collective practices of the exchangees.

The places, which were chosen among existing public spaces for collective practices and new places that were built by first generations, are still used by second and third generation exchangees. So, the research revealed that the identity of the exchangee has been transferred to the present time by spatial memory.

DOI: 10.15320/ICONARP.2024.277

Table 3. Görükle (Kouvaklia) Neighborhood, Greeks' Places for Collective Practices, which were ruined before the population exchange, mentioned by the exchangees in the memory interviews

Public Places	**Collective Practices Took Place in There**	**Current Situation**
Aziz Georgias Church	Religious Celebrations	 Today, there are some houses in the place of the church.
Ai Yorgi Chapel	Religious Celebrations	Today, there are some houses in the place of the chapel.
Adelfata Coffeehouse	Announcements of Bad News	Today, there are some houses in the place of the coffeehouse.
School		Today, there are some houses in the place of the school.

Table 4. Görükle (Kouvaklia) Neighborhood, Greeks' Places for Collective Practices, which were ruined after the population exchange, mentioned by the exchangees in the memory interviews (*Photographs taken by Muharrem Vurucular for this study*, 2021)

Public Places	**Collective practices take/took place in there**	**Current Situation**
Bakery		Today, there is a house in the place of the bakery.
Ai Thanasis		Today, there is a house in the place of Ai Thanasis.
Greek Cemetery	Funerals	Today, there is a closed marketplace in the place of Greek Cemetery.
Koca Çınar	Hıdrellez	There is an apartment in the place of Koca Çınar location.
Pomegranate Trees	Hıdrellez	Today, there are apartments in the place of pomegranate trees.
Ayopiğado Well	Hıdrellez, Seeing-soldiers-off	Today, there is Taşpınar Sculpture in the place of Ayopiğado Well.
Aga Çeşmesi (Fountain)	Religious Celebrations	 The photograph taken in 2019, today there is an apartment there.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Table 4. Continued Görükle (Kouvaklia) Neighborhood, Greeks' Places for Collective Practices, which were ruined after the population exchange, mentioned by the exchangees in the memory interviews (*Photographs taken by Muharrem Vurucular for this study*, 2021)

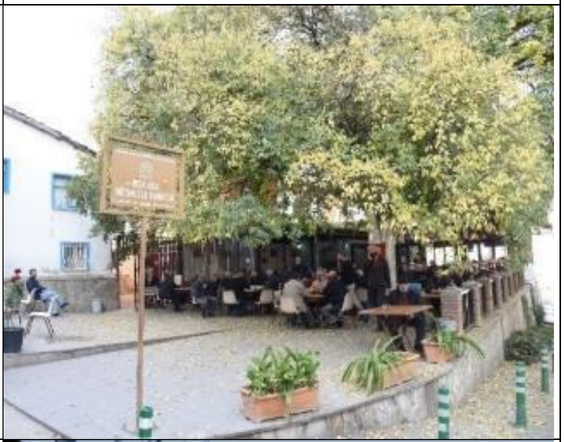
Public Places	**Collective practices take/took place in there**	**Current Situation**
Meşeler Mevki (Location)	Hıdrellez	

Table 5. Görükle (Kouvaklia) Neighborhood, Greeks' Places for Collective Practices, which are continuing its function, mentioned by the exchangees in the memory interviews (*Photographs taken by Muharrem Vurucular for this study*, 2021)

Public Places	**Collective practices take/took place in there**	**Current Situation**
Church Fountain Ai Yorgi Çeşmesi (Fountain) Kilise Meydanı (Church Square)	Seeing-soldiers-off	
Sterna Square	Weddings, Official Holiday Celebrations, Seeing-soldiers-off	

DOI: 10.15320/ICONARP.2024.277

Table 5. Continued Görükle (Kouvaklia) Neighborhood, Greeks' Places for Collective Practices, which are continuing its function, mentioned by the exchangees in the memory interviews (*Photographs taken by Muharrem Vurucular for this study*, 2021)

Public Places	Collective practices take/took place in there	Current Situation
Olimpos Coffeehouse	Announcements of Bad News	
Atatürk Street	Weddings, Official Holidays, Sending off/ Welcoming Soldiers, Funerals	
Home Garden	Weddings, Funerals	

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Table 6. Görükle (Kouvaklia) Neighborhood, Greeks' Places for Collective Practices, which changed its function, mentioned by the exchangees in the memory interviews (*Photographs taken by Muharrem Vurucular for this study*, 2021)

Public Places	**Collective practices take/took place in there**	**Current Situation**
Sterna Well	Weddings, Official Holiday Celebrations, Seeing-soldiers-off	

Table 7. Görükle (Kouvaklia) Neighborhood, Exchangees' Places for Collective Practices, which are built after the Population Exchange mentioned by the exchangees in the memory interviews (*Photographs taken by Muharrem Vurucular for this study*, 2021)

Public Places	**Collective practices take/took place in there**	**Current Situation**
School Garden	Official Holiday Celebrations	
Görükle Merkez Cami (Mosque)	Religious Celebrations, Announcements of Bad News	

DOI: 10.15320/ICONARP.2024.277

Table 7. Continued Görükle (Kouvaklia) Neighborhood, Exchangees' Places for Collective Practices, which are built after the Population Exchange mentioned by the exchangees in the memory interviews (*Photographs taken by Muharrem Vurucular for this study*, 2021)

Public Places	**Collective practices take/took place in there**	**Current Situation**
Motor Meşeler	Hıdrellez, Seeing-soldiers-off	
Cemetery	Seeing-soldiers-off, Funerals	
Sports Area	Official Holiday Celebrations	Today, there is the Closed Marketplace in in the place of Greek Cemetery/ Sports Area.
Closed Marketplace		 In the place of Sports Area
Taşpınar Mevki (Location)	Hıdrellez, Seeing-soldiers-off	 In the place of Ayopiğado Well
Şantiye Alanı (The Construction Site)	Wedding, Seeing-soldiers-off	

DISCUSSION and CONCLUSION

In the age of mass migration, people migrate from one country to another or are forced to migrate because the minimum conditions to ensure their survival cannot be provided where they live. The migrations experienced today have also been encountered in recent history with the world wars of the last century. One of the largest mass migrations experienced was the population exchange happened a century ago, after World War I, between Turkey and Greece.

The study aimed to determine how to sustain culture and identity despite forced relocation, namely population exchange. In the old Greek settlements where the exchangees settled, the existing and newly built public places where collective practices were carried out were investigated within the scope of the study. Case study was carried out in the exchangees settlement Görükle, by memory interviews with second and third generation exchangees. In this research, the transfer of the 'exchangees' identity through spatial memory between generations in a century-long process after the exchange, were examined. With collective actions, the exchangees' identity is transferred to the next generations through spatial memory. Public spaces, which are places for collective practices, continue to be protected as these practices express the exchangees' identity.

According to this research, exchangees searched for ways to preserve, transfer and adapt their collective practices, which are the expression of their own identity and culture, to the new place. The expression of collective practices took place in open public spaces. The transfer of these places and collective practices has become possible with post-spatial-memory.

The continuity of post-spatial memory is possible by preserving the spaces, which have been adopted, used and protected by a different society for a century and can be transferred to the next generations by protecting collective practices. The case study area, which is not preserved as exchangee settlement and has changed with today's conditions, weakens the intergenerational transfer of exchangees' identity and places. Görükle settlement has grown from the scale of the village of exchangee to the scale of a neighborhood where the young population lives intensively today, and examples of Greek civil architecture and public spaces such as fountains are subject to change. Exchangees' collective practices began to change with the changing population. In Görükle, it becomes difficult to transfer the collective practices and Greek/exchangee public spaces to the next generations as post-spatial-memory today.

This research pioneers studies to understand the multicultural structure of Anatolia today, where communities from different cultures settled, the use of existing spaces and the construction of new spaces. It gives clues for the post-spatial memory and migration studies which will undoubtedly be a more important topic in future as the globe is subject to increasing amount of migration related issues day by day. In future

DOI: 10.15320/ICONARP.2024.277

studies, the scope of this study can be expanded with exchangee settlements in many cities of Anatolia, especially in other exchangee settlements in Bursa. This study is a guide for any society that has established itself elsewhere as result of migration that cause sudden spatial interruption and wants to preserve its identity.

REFERENCES

Aktar, A. (2005). Türk- Yunan Nüfus Mübadelesinin İlk Yılı: Eylül 1922- Eylül 1923. In M. Pekin (Ed.), *Yeniden Kurulan Yaşamlar, 1923 Türk- Yunan Zorunlu Nüfus Mübadelesi* (pp. 41–74). İstanbul Bilgi Üniversitesi Yayınları.

Altinoluk, Ü. (2021). *1924 Mübadelesi Öncesinde ve Sonrasında Erenköy (Çanakkale) Yerleşiminin Morfolojisi ve Konut Tipolojisi Üzerine Ön Çıkarım Preliminary Results of the Morphology and the Housing Typology of Erenköy (Çanakkale) Settlement Before and After the 1924 Popu*. *4*(2), 98–110.

Archive Catalogue of Photographs from Exchange House. (2021).

Arı, K. (2000). *Büyük Mübadele Türkiye'ye Zorunlu Göç (1923-1925)* (2. Baskı). Tarih Vakfı Yurt Yayınları.

Assmann, J. (1995). Collective Memory and Cultural Identity. *New German Critique*, *Spring-Sum*(65), 125–133.

Başar, M. E., & Acar Ata, İ. (2019). The Evaluation of Architectural Tourism Potentials of Greek Heritage Structures Remained after the Population Exchange in Niğde's Settlements. *Iconarp International J. of Architecture and Planning*, *7*(1), 251–285. https://doi.org/10.15320/iconarp.2019.75

Bursa, Görükle Yerleşimi. (n.d.). Google Earth Programı

Canter, D. (1977). *The Psychology of Place*. The Architectural Press.

Case, D. (1996). Contributions on Journeys Away to the Definition of Home: An Empirical Study of a Dialectical Process. *Journal of Environmental Psychology*, *16*(1).

Cengizkan, A. (2004). *Mübadele ve Konut Yerleşimi* (1. Baskı). Arkadaş Yayıncılık.

Cengizkan, A. (2005). Türkiye'de Mübadele Konut ve Yerleşim Politikası. In M. Pekin (Ed.), *Yeniden Kurulan Yaşamlar, 1923 Türk- Yunan Zorunlu Nüfus Mübadelesi* (1. Baskı, pp. 303–337). İstanbul Bilgi Üniversitesi Yayınları.

Crane, S. A. (1997). Writing the Individual Back into Collective Memory. *The American Historical Review*, *102*(5), 1372–1385.

Cuc, A., Ozuru, Y., Manier, D., & Hirst, W. (2006). On the formation of collective memories: The role of a dominant narrator. *Memory and Cognition*, *34*(4), 752–762. https://doi.org/10.3758/BF03193423

Demiray, B. (2018). Otobiyografik Bellek Araştırmalarında Kullanılan Yöntemler ve Metadolojik Gelişimler. In S. Gülgöz, B. Ece, & S. Öner (Eds.), *Hayatı Hatırlamak, Otobiyografik Belleğe Bilimsel Yaklaşımlar* (1st ed., pp. 27–49). Koç Üniversitesi Yayınları.

Dudai, Y. (2002). Molecular bases of long-term memories: A question of persistence. *Current Opinion in Neurobiology*, *12*(2), 211–216. https://doi.org/10.1016/S0959-4388(02)00305-7

File of Vasileios Deligiannis, Archives of Asia Minor Studies, Athens. (n.d.).

Fotoğraf: Muharrem Vurucular tarafından bu çalışma için çekilmiştir. (2022).

Gökaçtı, M. A. (2005). *Nüfus Mübadelesi, Kayıp Bir Kuşağın Hikayesi* (4. baskı). İletişim Yayınları.

Göregenli, M., & Karakus, P. (2014). Göç Arastirmalarinda Mekan Boyutu: Kültürel ve Mekansal Bütünlesme. *Türk Psikoloji Yazıları*, *17*(34), 101–115.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Görükle'de hıdırellez kutlaması. (2023). https://www.lifebursa.com/gorukledehidirellez-kutlamasi

Goularas Bayındır, G. (2012). 1923 Türk-Yunan Nüfus Mübadelesi Ve Günümüzde Mübadil Kimlik Ve Kültürlerinin Yaşatılması. *Alternatif Politika*, *2*(4), 129–146.

Greider, T., & Garkovich, L. (2010). Landscapes: The Social Construction of Nature and the Environment. *Rural Sociology*, *59*(1), 1–24. https://doi.org/10.1111/j.1549-0831.1994.tb00519.x

Gülgöz, S. (2018). Otobiyografik Bellek: Tanımı ve Temel Kavramlar. In S. Gülgöz, B. Ece, & Ö. Sezin (Eds.), *Hayatı Hatırlamak, Otobiyografik Belleğe Bilimsel Yaklaşımlar* (1st ed., pp. 13–26). Koç Üniversitesi Yayınları.

Halbwachs, M. (2017). *Kolektif Hafıza* (1. Baskı). Heretik Yayınları.

Hasluck, R. W. (1910). *Cyzicus, Being some accotunt of the history and antiquities of that city, and of the district adjacent to it, with the towns of Apoilonia ad Rhyndacum, Miletupolis, Hadrianutherae, Priapus, Zeleia etc.* Cambridge University Press.

Hirchon, R. (2000). *Mübadele Çocukları* (3. Baskı). Tarih Vakfı Yurt Yayınları.

Hirchon, R. (2005). Neler Yitirdik, Neler Öğrenebiliriz? Lozan Antlaşmasının Geriye Doğru İncelenmesi. In M. Pekin (Ed.), *Yeniden Kurulan Yaşamlar, 1923 Türk- Yunan Zorunlu Nüfus Mübadelesi* (1. Baskı, pp. 1–12). İstanbul Bilgi Üniversitesi Yayınları.

Hirsch, M. (1996). Past Lives: Postmemories in Exile. *Poetics Today*, *17*(4), 659–686. https://doi.org/10.2307/1773218

Hirsch, M. (2008). The generation of postmemory. *Poetics Today*, *29*(1), 103–128. https://doi.org/10.1215/03335372-2007-019

Hirsch, M. (2014). Postmémoire. *Témoigner. Entrehistoire et Mémoire*, *118*(Septembre 2014), 200–213. https://doi.org/10.4000/temoigner.1274

Hirst, W., & Echterhoff, G. (2008). Creating shared memories in conversation: Toward a psychology of collective memory. *Social Research*, *75*(1), 183–216.

Hirst, W., & Manier, D. (2008). Towards a psychology of collective memory. *Memory*, *16*(3), 183–200. https://doi.org/10.1080/09658210701811912

İnce Güney, Y. (2016). Appropriation and Authenticity: The case of Transforming Churches into Mosques in Ayvalık. *Iconarp International J. of Architecture and Planning*, *4*(2), 35–35. https://doi.org/10.15320/iconarp.2016.8

Irwin-Zarecka, I. (1994). *Frames of Remembrance: The Dynamics of Collective Memory* (1st Editio). Routledge.

Kılıç, Ş., & Ulutaş, O. (2016). *Bir Mübadil Köyü Görükle ve Nilüfer Belediyesi Mübadele Evi* (1. Baskı). Nilüfer Belediyesi.

Kolektif. (2015). *Hasretin İki Yakasından Mübadele Öyküleri* (1. baskı). Lozan Mübadilleri Vakfı.

Mavromatis, Y. (2005). Yunanistan'da Hristiyan Göçmenler ve Müslüman Azınlıklar: Eğitimin Milli Homojenleşmedeki Rolü. In M. Pekin (Ed.), *Yeniden Kurulan Yaşamlar, 1923 Türk- Yunan Zorunlu Nüfus Mübadelesi* (pp. 357–364). İstanbul Bilgi Üniversitesi Yayınları.

Mübadele Evi Fotoğraf Arşivi Kataloğu. (2021).

Mutlutürk, A., Boduroğlu, A., & Tekcan, A. İ. (2018). Kişisel ve Toplumsal Bellek. In S. Gülgöz, B. Ece, & S. Öner (Eds.), *Hayatı Hatırlamak, Otobiyografik Belleğe Bilimsel Yaklaşımlar* (1st ed., p. 243264). Koç Üniversitesi Yayınları.

Nilüfer'de Hıdrellez coşkusu. (2012). https://www.nilufer.bel.tr/haber/nilufer-de-hidrellez-coskusu

DOI: 10.15320/ICONARP.2024.277

Nora, P. (2006). *Hafıza Mekanları* (1. Baskı). Dost Kitapevi.
Olick, J. K. (2014). Collective Memory: The Two Cultures. *Moment Journal*, *1*(2), 175–211. https://doi.org/10.17572/mj2014.2.175211
Olick, J. K., & Robbins, J. (1998). Social Memory Studies: From "Collective Memory" to the Historical Sociology of Mnemonic Practices. *Annual Review of Anthropology*, *24*, 105–140.
Olick, J. K., Sierp, A., & Wüstenberg, J. (2023). Introduction: Taking stock of memory studies. *Memory Studies*, *16*(6), 1399–1406. https://doi.org/10.1177/17506980231207934
Öymen Gür, Ş. (1996). *Mekan Örgütlenmesi*. Gür Yayıncılık.
Öymen Gür, Ş. (2000). *Konut Kültürü*. Yem Yayınları.
Özaydın, G., Özkan Özbek, M., Özaydın, L., & Yağcı, E. . . (2018). Traces of Religion-Focused Spatial Development in Ayvalık, a Coastal Town. *... Journal of Architecture and ...*, *2018*, 1–18. https://dergipark.org.tr/en/pub/aarch/issue/43750/536975%0Ahttps://dergipark.org.tr/en/download/article-file/665660
Özbek Eren, İ., Aksel, B., & Postalcı, E. (2010). Ege Yerleşmelerinde Kültürel Etkileşimin Mimari İzleri. In *Sanatta Kimlik ve Etkileşim* (p. 119).
Pekin, M. (2005). *YENİDEN KURULAN YAŞAMLAR, 1923 TÜRK- YUNAN ZORUNLU NÜFUS MÜBADELESİ* (M. Pekin (Ed.); 1. Baskı). İstanbul Bilgi Üniversitesi Yayınları.
Pekin, M. (2013). *Mübadil Kentler: Türkiye* (M. Pekin (Ed.); 1. Baskı). Lozan Mübadilleri Vakfı.
Photograpy: Taken by Muharrem Vurucular for this study. (2021).
Rapoport, A. (1969). *House Form and Culture, Prentice-Hall*. Inc. Englewood Cliffs.
Rapoport, A. (1977). *Human Aspects of Urban Form*. Pergamon Press.
Rapoport, A. (1980a). *Cross-Cultural Aspects of Environmental Design, Human Behavior and Environment: Environment and Culture, Vol. 4*. Plenum Press.
Rapoport, A. (1980b). *Vernacular Architecture and the Cultural Determinants of Form*.
Relph, E. (1976). *Place and Placelessness*. Pion.
Rennick, K. L. (2003). *Process: A Strategy for Developing Community Life and Place Attachment*. Virginia Polytechnic Institute.
Said, E. (2020). *Kış Ruhu*. Metis Yayınları.
Sarlo, B. (2012). *Geçmiş Zaman Bellek Kültürü ve Özneye Dönüş Üzerine Bir Tartışma*. Metis Yayıncılık.
Sezginalp Özçetin, P., & Rottmann, S. B. (2022). (Lived) Spaces of Belonging, Culture, and Gender: Spatial Practices of Home for Syrian Women in Istanbul. *Space and Culture*, 1–19. https://doi.org/10.1177/12063312221089213
Stedman, R. C. (2002). Toward a Social Psychology of Place: Predicting Behavior from Place-Based Cognitions, Attitude and Identity. *Environment and Behavior*, *34*, 561–581.
Stokols, D., & Schumaker, S. A. (1981). People in Places: A Transactional View of Settings. In J. Harvey (Ed.), *Cognition, Social Behavior and the Environment*. Erlbaum.
Stokowski, P. A. (2002). Languages of Place and Discourses of Power: Constructing New Senses of Place. *Journal of Leisure Research*, *34*, 368–382.
Tevfik, İ. (2014). *İnsan ve mekân yüzüyle Mübadele: 1923'ten bugüne zorunlu göç* (1. Baskı). İnkılap Kitabevi.
Türkoğlu, E., & Akdemİr, İ. O. (2022). *Göçlerin Mekânın Dönüşümüne Etkisi :*

Güney Marmara Bölümü Örneği The Impact of Spatial Transformation : The Case Study of Southern Marmara Region.
Ulutaş, O. (2014). *Nilüfer'in Hikayesi, Nilüfer Belediyesi Sözlü Tarih ve Araştırma Projesi* (2. Baskı). Nilüfer Belediyesi.
Uzer, T. (2018). Nasıl Hatırlarız, Nasıl Unuturuz: Kuramsal Yaklaşımlar. In S. Gülgöz, B. Ece, & S. Öner (Eds.), *Hayatı Hatırlamak, Otobiyografik Belleğe Bilimsel Yaklaşımlar* (1st ed., pp. 51–69). Koç Üniversitesi Yayınları.
Werstch, J. V. (2004). *Voices of Collective Remembering*. Cambridge University Press. https://doi.org/https://doi.org/10.1017/CBO9780511613715
Werstch, J. V., & Roediger, H. L. (2008). Collective Memory: Conceptual Foundations and Theoretical Approaches. *Memory*, *16*(3), 318–326. https://doi.org/10.1080/09658210701801434 To
Weston, S. J., Cox, K. S., Condon, D. M., & Jackson, J. J. (2015). A Comparison of Human Narrative Coding of Redemption and Automated Linguistic Analysis for understanding Life Stories. *Journal of Personality*, *84*(5), 594–606. https://doi.org/10.1111/jopy.12183
Wieland, R. L. (2001). *Place attachment and place disruption the perceptions of selected adults and high school students on a rural school district reorganization*. Kansas State Universtiy, Manhattan.
Yıldırım, O. (2006). *DİPLOMASİ Ve GÖÇ TÜRK-YUNAN MÜBADELESİNİN ÖTEKİ YÜZÜ* (1. Baskı). İstanbul Bilgi Üniversitesi Yayınları.
Yıldız, G., & Şahin Güçhan, N. (2020). Rethinking the Industrial Heritage of Ayvalik through Trajectories on Extracting Olive Oil and Soap Making. *Space and Culture*. https://doi.org/10.1177/1206331220962730

Resume

Elif VURUCULAR KESİMCİ was received her Ph.D. (2023) in Building Research and Programming about spatial memory in department of Architecture from YTU. In her 14-year-professional-life, she worked in several architectural offices in the building design. She is a full time Asst. Prof. Dr. enrolled in research and educational activities in undergraduate level in the fields of architectural education, architectural design, philosophy of architecture, building typologies on architecture in Bursa Technical University, Faculty of Architecture and Design, for over 9 years.

Ayşen CİRAVOĞLU has received her PhD (2006) from YTU on sustainable architecture. She is a full time Professor enrolled in research and educational activities in both graduate and undergraduate levels in the fileds of architectural education, sustainable architecture, architectural design, environmental issues and critics on architecture in Yıldız Technical University, Faculty of Architecture. Ciravoğlu has won EAAE (European Association for Architectural Education) Prize in 2002 with her article entitled "On Formal and Informal Studies in Architectural Design Education". She is a council member of UIA (Union of International Architects).

DOI: 10.15320/ICONARP.2024.277

ICONARP
International Journal of Architecture and Planning
Received: 26.10.2023 Accepted: 29.04.2024
Volume 12, Issue 1/ Published: 30.06.2024
Research Article *DOI: 10.15320/ICONARP.2024.278 E- ISSN:2147-9380*
ICONARP

The Place of the Concept of Value in Architectural Space in User Perception: Cafe Example

Tolga Cürgül*
Şengül Yalçınkaya**

Abstract

Although the definition and perception of architectural space change under the influence of transformations, the relationship and interaction between people and space have always maintained its existence. This relationship is established both functionally and semantically for the users of the spaces. Semantic relations bring about the creation of "value" between architectural space and people. Today, as a result of consumption-oriented lifestyles and culture, this situation is changing, causing the commodification of space and the weakening of relationships between people and space. Therefore, the value of space for humans has changed radically in terms of definition and meaning. The study was conducted to determine the effect of the globalization process and the resulting consumer culture on the value of the architectural space. In this context, first of all, value definitions and concepts in different disciplines, especially architecture, are brought together. The created value model was applied to the users of cafe venues, which are considered the pioneers of consumption venues today, through a survey study. By analyzing the obtained data in the SPSS program, the factors affecting the value of the architectural space today were determined and their impact levels were revealed. When the data were examined, it was seen that today individuals belonging to the consumption culture perceive and prefer places based on their consumption-oriented features rather than their aesthetic, functional or cultural features. According to the analysis results, the concept of belonging was ranked last in relationship levels, while business quality and subjective relationship titles were ranked first. When the results are examined, traces of the consumer society are seen in the context of users' spatial preferences and their relationships with space. It can also be stated that the consumption-oriented approaches of today's architecture and the users of the spaces mutually feed each other and ensure the continuity of this process.

Keywords:
Value, Consumption, Architectural space, Cafe

*Faculty of Architecture, Karadeniz Technical University, Trabzon, Turkey. (*Corresponding author*)

E-mail: tolgacurgul@ktu.edu.tr

**Faculty of Architecture, Karadeniz Technical University, Trabzon, Turkey.

E-mail: sengulyalcinkaya@ktu.edu.tr

To cite this article: Cürgül, T. & Yalçınkaya, Ş. (2024). The Place of the Concept of Value in Architectural Space in User Perception: Cafe Example. *ICONARP International Journal of Architecture and Planning,* 12 (1), 125-143. DOI: 10.15320/ICONARP.2024.278

INTRODUCTION

Architecture, in its most basic function, is the art of producing a space. While architecture provides the physical conditions for the continuity of life, it also turns an area into a space where versatile values are produced. Considering the determining, transformative and symbolic powers of architectural spaces, it can be seen that every new space production actually sets out to protect existing values and produce new ones (Onat, 2013). Therefore, the relationship between the discipline of architecture and values is continuous, and what these values are have varied throughout the historical process. The values that Vitruvius put forward for the first time in the history of architecture as "durability, usefulness and beauty" (1993) have changed and been interpreted differently over time with the influence of social, technological, aesthetic etc. changes.

In parallel with the transformation experienced by designers and users in terms of value production over time, the change in the meaning given to architectural spaces has also caused a change in value. In particular, factors such as users' relationships with space, living arrangements, technological developments, etc. have caused changes in the value scales of architectural spaces. According to the value definitions made in the process as "Use value defined by the benefit of the product, aimed at meeting the needs of the user, and exchange value determined by the emergence of the architectural or artistic product, especially as a marketing product", two different value headings can be proposed for the architectural space (Altaş, 2008). In parallel, Karl Marx divided the concept of value, which he defined in terms of economy and labor, into two: use value and exchange value. However, considering that space is directly related to many different components, especially people, these value definitions are thought to be inadequate for architectural spaces. Hershberger explained contemporary values in architecture under three headings: "permanent values, institutional values and conditional values" (Hershberger, 1985). Onat classified the values that should be considered in the design process as follows: Values arising from the subject, values arising from the architectural program, values arising from the place/environment, values arising from the investor and the designer, values arising from the designer (Onat, 2013). Accordingly, it can be concluded that although the discipline of architecture are handled in different periods, by different people or with different thought systems, the concept of value and the space-value relationship have always existed.

Today, in order to decide the value of space, it is necessary to analyze first the current conditions and look at the duties and meanings assigned to space. The change and transformation experienced in space also move it beyond its subjective status and place it in a social position. Today, architectural space has ceased to be an object that exists on its own and has turned into an object produced as a result of capitalist social relations (Işık, 1994). Man, who has broken away from nature and time, has

DOI: 10.15320/ICONARP.2024.278

completely changed his relationship with space with modernity and turned space into a commodity. The fact that space is a commodity also means that it is open to ideological tradition and human control.

The transition to a consumption-centered perspective for architectural space, which has been turned into a commodity, has also followed these processes. The rapid and temporary relationships that humans establish with time and space have turned space into an object of consumption. John Urry explains this situation with the concept of "consume the space" (1999). Accordingly, it occurs as a result of places being seen and passed through quickly, not being adopted, not being experienced, and being consumed. In parallel with this, Baudrillard says that today's spaces should be defined and perceived as hyper-space (1997). Therefore, rather than the physical reality of the spaces, the transformation of the spaces into a virtual space and this network of virtual relationships come to the fore.

Lefebvre describes space not as a mere void as a part of space, but as a "living space" that is directly related to humans and continues its existence through various actions and experiences. According to him, space sometimes consists of space, sometimes body, sometimes minds, and even a combination of all of them (Lefebvre, 2014). In parallel with this approach, Giedion compares space to a text named in different ways, drawing attention to its variability and reproducibility through human actions. Being reproducible also emphasizes the temporality of space. According to Giedion, there is no absolute space independent of time (Giedion, 1967). Therefore, describing space as a pure void, independent of people and time, or as a physical element that occupies space-time would be a very inadequate and incomplete definition.

To date, space has been defined in countless different ways such as cartesian space, perceived space, lived space, abstract space, etc. With the influence of globalization, over time, spaces and objects have become a part of rapid consumption (Bekar and Erbay, 2023), and in addition to these definitions, the concept of "consumption space" now finds its place in the literature within the framework of today's globalization and modernity processes. As a reflection of consumption-oriented lifestyles, spaces that are far from concepts such as experience, belonging and sustainability, and that do not promise anything other than consumption to their users, have now settled at the center of architecture.

The changes experienced have led to rapid and radical changes in the relationships that humans establish with time and space in recent years. This situation has changed the dimension of the semantic relations that humans establish with space. In addition, it has brought about the rapid consumption of these created meanings. At this point, where space is subject to consumption, the aim of the study is to define the concept of current value and to determine the factors affecting the value of today's space. For this purpose, the subject is limited within the framework of defining the concept of value by conducting a literature study and determining the impact of these value concepts in a field of study.

CURRENT CONCEPT OF VALUE

The concept of value is a construct that frequently finds a place in numerous disciplines such as philosophy, economics, sociology, education, architecture, etc. For this reason, the definitions of this concept differ for each discipline. Before elaborating on the relationship between current architecture and value, it is necessary to explain the concept of "value" regarding its definitions in different disciplines in order to handle it correctly.

In the TDK dictionary, value is defined as "an abstract measure that helps determine the importance of something, the value that something touches" (URL-1, 2023). According to this definition, the first point that should be emphasized is that value is a measure that emerges to determine the importance of something. As a result of an evaluation, determining the value of something is seen as quite difficult at the point of determining value as an "abstract unit of measurement". This abstraction also makes value relative. Value definitions that are frequently mentioned in daily life, such as social values, cultural values, etc., can be given as examples of this situation. These concepts, which are accepted by the vast majority and describe certain situations, are actually quite variable and abstract concepts.

The concept of value is defined in the Philosophy Dictionary as "a feature or quality that shows the degree of importance of something and makes it meaningful, desirable, useful or a matter of interest" (Cevizci, 2012). This concept, which is mostly discussed in the field of "ethical philosophy" in the discipline of philosophy with names such as value theory or axiology, cannot be given a general definition because it is handled in different ways by different thinkers. Schroeder places this concept at the intersection of all philosophies related to evaluation, including all branches of moral philosophy, social and political philosophy, aesthetics, sometimes feminist philosophy, and even philosophy of faith (2018). However, many philosophers say that this concept is basically located in the fields of ethics and aesthetics.

The concept of value finds its place in many different disciplines in the field of social sciences. Especially in the fields of education and business-economics, the concept of value has a very important position among many issues such as social values, perception of value towards education, value gains of students, perceived value, etc. When we look at the definitions of the concept of value in social sciences, it is seen that use value is mostly mentioned. However, it is possible to talk about a different definition at this point, especially when looking at the values created between the product and the buyer. The value created by consumers' use and experience of products is defined as "perceived value" (Oliver, 1999). This concept is also given many different names such as "service value, consumer value, customer value, perceived customer value, acquisition value, etc." The concept of "perceived value" emerges as a result of the joint evaluation of customers' product experiences and criteria such as the price or effort spent on the product.

DOI: 10.15320/ICONARP.2024.278

THE CONCEPT OF VALUE IN ARCHITECTURE	THE CONCEPT OF VALUE IN SOCIAL SCIENCES				CURRENT VALUE APPROACH IN ARCHITECTURE
Vitrivius • Stability • Usefulness • Beauty **Arnheim** • Technology • Function • Aesthetic	**Sheth vd. (1991)** • Social value • Emotional value • Functional value • Epistemic value • Situational value	**Babin (1994)** • Hedonistic value • Pragmatic value	**Groth (1995)** • Perceived benefit • Psychological value • Intrinsic value • Extrinsic value	**Katamneni ve Coulson (1996)** • Social value • Experimental value • Functional value • Market value	• Functional value • Economic value • Service value • Place/Context/Environment value • Socialization value • Image value • Social value • Intrinsic/Extrinsic value • Psychological value • Semantic value • Meaning (Symbolic) value • Plastic (Formal) value • Hedonic value • Originality value • Artistic value • Intellectual value • Historical value • Identity value • Memory value • Symbolic value • Globality/Locality value • Use and Exchange value • Permanence value • Value resulting from design/designer • Brand/Reputation value
Schulz • Physically • Cultural • Social **Sedlmayr** • Machine • Human • Organic	**DeRuyter (1997)** • Emotional aspect • Logical aspect • Functional aspect	**Grewal (1998)** • Gain value • Exchange value	**Parasuraman ve Grewal (2000)** • Gain value • Exchange value • Use value • Wear value	**Sweney ve Soutar (2001)** • Emotional value • Docial value • Functional value (price/value) • Functional value (performance/quality)	
Venturi • Structure • Expression • Program **Tschumi** • Action • Movement • Proportion	**Petrick ve Backman (2002)** • Quality • Monetary price • Non-monetary price • Fame • Emotional responses	**Kwun ve Oh (2004)** • Brand value • Price value • Risk value	**Sanchez vd. (2006)** • Functional value • Emotional value • Social value	**Smith ve Colgate (2007)** • Functional value • Experiential value • Symbolic value • Price value	

Figure 1. Different approaches to the concept of value

Within the scope of the study, the current concept of value for the field of architecture was reinterpreted and defined by looking at the meaning of the concept of value in different disciplines. In addition to the basic value concepts that always find a place in evaluating architectural spaces such as functional, social, social, historical, identity value, etc., new value concepts such as image, globality/locality/brand/reputation, etc., which are used to evaluate the spaces where today's globalization and consumption-oriented architectural approaches are reflected, were added to the model. Finally, in the context of the study, based on the assumption that spaces are turned into commodities and treated as consumption objects, value concepts under the title of "perceived value scales", which have found a place in social sciences, were also included in the model. Accordingly, 25 different value concepts were brought together: Functional value, economic value, service value, place/context/environmental value, socialization value, image value, social value, intrinsic/extrinsic value, psychological value, semantic value, meaning (symbolic) value, plastic (formal) value, hedonic value , originality value, artistic value, intellectual value, historical value, identity value, memory value, symbolic value, globality/locality value, use and exchange value, permanence value, value resulting from design/designer, brand/reputation value (Figure 1).

INVESTIGATION OF THE EFFECT LEVEL OF THE FACTORS THAT ARE DETERMINANT ON THE VALUE OF THE ARCHITECTURAL SPACE

Research Model

When the concepts of globalization and consumption and the transformations experienced within the scope of these concepts are examined, it can be said that all social changes are also reflected in architecture. Therefore, these processes have brought many innovations to the design and use of architectural spaces. However, the basic features of space, such as its "place" feature, the semantic relationships it establishes with individuals, and its importance for individual and social memory, maintain their importance for people despite the transformations.

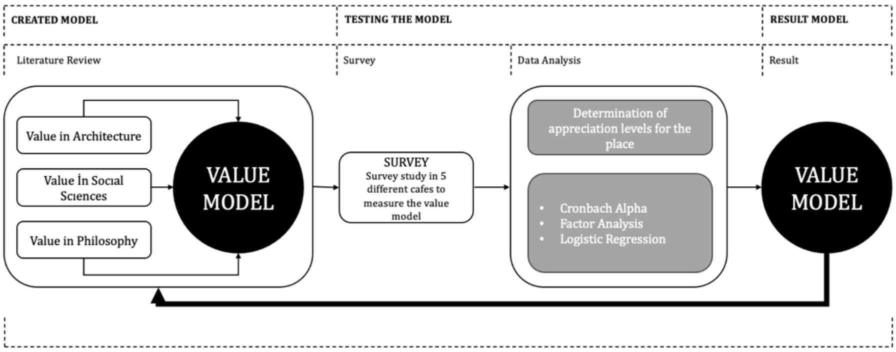


Figure 2. The structure of the study

The main purpose of the study is to question the "value" of architectural spaces, whose importance for people has not changed, in today's conditions, with the rapid changes between people and spaces within the framework of globalization and modernity processes. It is aimed to look at space, which has become an object of consumption, from a new perspective by creating a value scale by considering the concept of "value", which is perceived in different meanings in the discipline of architecture, in terms of the relationships that people establish with space. For this purpose, the concept of value was redefined in the study depending on current conditions, and the impact levels of the factors effective in determining the value were determined by means of the prepared survey (Figure 2).

Value model used in research

A value model was created by bringing together the value facts obtained as a result of the literature review within the scope of the study. Since the scope of the study is drawn within the framework of architectural space and globalization processes, all value criteria that define or can define this situation and have been recorded in the literature were determined. As a result of the research, 25 value concepts were reached by which the value of the space can be questioned.

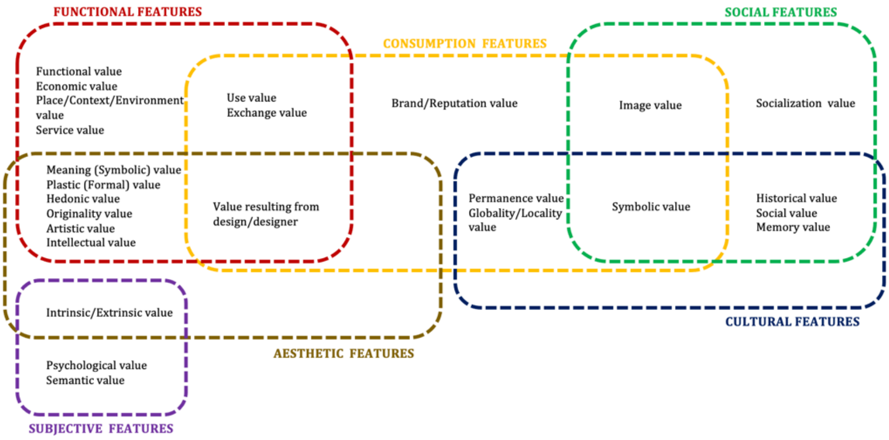


Figure 3. Value model

DOI: 10.15320/ICONARP.2024.278

The concepts selected to create the model were examined and divided into 6 headings in total: functional features, social features, subjective features, aesthetic features, cultural features and consumption features. The value model shown in Figure 3 was created by looking at the relationships of the 25 selected value features with one or more headings. Some value features in the model are at intersection of more than one heading according to their definitions. These criteria, which are related to many features in parallel with the multifaceted definition of the value criterion, were evaluated under the title with which they are most closely related, according to their definitions in the literature and the methods of their handling within the scope of the study. In this way, it was aimed to avoid repetitive expressions in the survey and to reach directly related and meaningful results. The value model shows the spatial features and the relationship of these features that can be used to measure the value of an architectural space.

Obtaining data

As a result of the study, a value model was created. A survey study was prepared to test this model in cafes that stand out as consumption venues. In the survey form, there are 8 questions under the title "Participant Profile", including age, gender, marital status, education level, income level, employment status, sector and profession. The survey form was created with 1 question on a 5-point Likert scale questioning the value of the cafe under the title "Equivalent of the Concept of Value in Space" and 52 statements on a 5-point Likert scale regarding the value model.

Analysis of data

With the data obtained, first of all, the participants' taste levels for the space were determined and evaluated. Afterwards, these data were transferred to SPSS 23 program and the analysis of the results was conducted. In order to determine the reliability of the data, the "Cronbach Alpha" test was first applied. As a second step, "Factor Analysis" was applied and meaningful factor groups that were different from the 6 main value headings were determined. In the last step, the "Logistic Regression" test was applied to obtain results on the relationship between newly formed factor groups and demographic information.

Determining the study area

Considering the spatial counterpart of consumption culture, shopping malls, restaurants and cafes can be considered as the leading places of this situation. Within the scope of the study, not only spatial value characteristics but also both perceived value scale and service-operation quality were included in the research. Shopping malls were not included in the study area because the time spent in these places varies depending on various factors and many stores and brands affect the user experience. Cafes were chosen as research venues in the study because they provide experience to a larger number of users with various demographic characteristics, offer new usage habits, and enable them to find a place for themselves in social life. The main and subheadings selected in the model and the structure of the survey questions were prepared in accordance with this selection.

Kalkınma Neighborhood, which has the highest concentration of cafes in the city of Trabzon, was chosen as the study area. This area, located in the immediate vicinity of Karadeniz Technical University, consists of spaces used by both students and citizens. It was thought that if the research was conducted in a metropolis, predictable results would emerge in line with the consumption behaviors of the users. For this reason, one of the questions of the research is what the results will be in terms of the relationships that users will establish with the space in the city of Trabzon, which has limited social opportunities compared to metropolises.

Figure 4. Locations of cafes selected within the scope of the research, Kalkınma Neighborhood, Ortahisar, Trabzon

There are nearly 70 cafes in Kalkınma Neighborhood. Various selection criteria were determined to determine suitable cafes for the study. The selection criteria for cafes were that the business had been in service for at least 1 year, that the place had been designed by a designer or a design firm, that it appealed to different social groups, and that it had a capacity to serve at least 40 people at the same time. In addition, it was preferred that the selected cafes were not branded, franchised, etc. on a local or global scale. The reason for this is that they have standard design styles and it is thought that the brand value that will impress the users may override other features sought within the scope of the study. 20 cafes that met these criteria were identified in Kalkınma Neighborhood, and as a result of negotiations, the necessary permissions were obtained from these cafes, and ultimately the work was carried out in 5 cafes: Nevre Cafe, Bikka Cafe, Magness Cafe, Mia Cafe and Hokka Cafe (Tablo 1).

DOI: 10.15320/ICONARP.2024.278

Table 1. Information about the cafes selected within the scope of the research

Venue Name	NEVRE CAFE	BİKKA CAFE	MAGNESS CAFE	MİA CAFE	HOKKA CAFE
Venue Photo					
Designer	Architecture / Interior Arc. Olcay Köse	(The designer did not find it appropriate to share his name)	Architecture İbrahim Hakkı Ömeroğlu	Interior Arc. Selin Kadıoğlu	Interior Arc. Selin Kadıoğlu
Opening date	January 2017	September 2016	October 2016	September 2015	September 2016
Area (m2)	340	400	200	300	150
Service Capacity	120	150	80	120	50
Daily Average Number of Customers	500	600	150	400	120
Number of Employees	20	30	13	20	7

Determination and characteristic of the sample

Within the scope of the study, a survey was conducted with a total of 221 participants, at least 40 in each cafe. Participants completed the survey during the time they spent in the cafe, taking into account the cafe they were in. 21 surveys were excluded from the study due to lack of information or various errors, and a total of 200 surveys were used in the study. Demographic data of these participants are included in Table 2.

Table 2. Demographic information of participants

		%			%			%
Gender	Female	**56,5**	**Income Status**	Lower income	**10,5**	**Education Status**	Less than high school degree	**0,5**
	Male	**43,5**		Lower-middle income	**10**		High school degree	**7**
Age	19 years and under	**12,5**		Middle income	**53,5**		Associate Degree	**15,5**
	20-24 years old	**60,5**		Upper-middle income	**22**		Bachelor degree	**67**
	25 years and above	**27**		Upper income	**4**		Master/Ph.D	**10**
			Working Status	Working	**28,5**	**Marital Status**	Single	**91,5**
				Not working	**4**		Married	**8,5**
				Student	**67,5**			

Findings

The aim of the study is to determine the factors affecting the value of the architectural space and to reveal their impact levels. By examining the data obtained, it is aimed to determine the factors that affect the value of the space in cafes and the impact power of these factors. First of all, the percentage values of the data regarding the items determined in the survey study to reveal the value of the space were included, and in the second step, the items were reclassified with factor analysis. In the third step, "logistic regression" analysis was applied to determine the factor groups affecting the value of the space and the relative impact of each factor. In this way, the impact level of the factors that determine the value was revealed.

Evaluation of the level of place appreciation and the general distribution of factors determined based on the literature

To determine the value of space, participants were asked to determine the value of the cafe they were in. For this purpose, first of all, the value of space was defined in the survey and accordingly, they were asked to mark the value of the cafe they were in by choosing one of the options as follows: "very worthless, worthless, medium value, valuable and very valuable". Data regarding the results obtained are included in Table 3. Considering the general average, it was concluded that users gave moderate value to cafes.

Table 3. Participants' appreciation levels of the place

Value (%)	NEVRE	BIKKA	MAGNESS	MIA	HOKKA	TOTAL
Very worthless	0	0	0	2,5	2,5	1
Worthless	2,5	5	5	2,5	20	7
Medium value	47,5	30	30	37,5	47,5	43,5
Valuable	45	55	55	37,5	25	38,5
Very valuable	5	10	10	20	5	10

In order to test the value model created for the place, the participants were asked to evaluate the section under 6 main headings which consisted 52 statements in total. These expressions were prepared for the users to evaluate the cafe they were in, based on the headings in the previously presented model. Information about the answers is given in Table 4.

Table 4. Answers to the statements of the value model

CODE	(%)	I strongly disagree	I do not agree	I'm undecided	I agree	I strongly agree
FUNCTIONAL FEATURES						
FF1	I find the functional analysis of the cafe successful.	3	11	35	41,5	9,5
FF2	I find the spatial organization of the cafe (the relationship between seating areas, toilets, etc.) successful.	4,5	11	16,5	52	16
FF3	When I enter the cafe, I can easily perceive the place.	5	12	19	48	16
FF4	I find the equipment (tables, chairs, etc.) in the cafe comfortable.	4,5	14,5	17,5	50	13
FF5	The cafe is in an easily accessible location.	5	7	10,5	44	33,5
FF6	I prefer the cafe due to its environmental advantages (parking lot, view, etc.).	21	30	20,5	20	8,5
FF7	I find the service quality of the cafe successful.	1	5	18	52	24

DOI: 10.15320/ICONARP.2024.278

FF8	I think the cafe is safe.	3	4	23	47	23
FF9	I think the cafe is clean.	0,5	5	18	51	25,5
FF10	I think the prices in the cafe are reasonable.	4,5	14	24	41	16,5
SOCIAL FEATURES						
SOF1	This cafe gives me the opportunity to socialize with my friends.	2,5	10,5	11	52	24
SOF2	This cafe gives me the opportunity to meet different people and socialize.	10,5	26,5	31	22,5	9,5
SOF3	I think those who prefer this cafe have a certain social level and/or style.	12	18	28,5	30	11
SOF4	I think choosing this cafe is a sign of status.	26	28,5	25,5	15,5	4,5
SOF5	I think the image it has is effective in choosing this cafe.	18,5	25,5	24	26,5	5,5
SOF6	I think that people who prefer this cafe belong to a higher socio-cultural level than other cafes in the surrounding area.	25,5	25,5	27,5	17,5	4
SOF7	This cafe is a place that is approved by the environment/receives positive comments.	6	7,5	26,5	48	12
SOF8	Many people around me prefer this cafe.	4	8,5	20	53	14,5
SOF9	I choose this cafe because of the positive opinions of the people around me.	8	23	20,5	37,5	11
CONSUMPTION FEATURES						
COF1	I think this cafe is suitable for its intended use.	2,5	4	12	64	17,5
COF2	I think this cafe is open to change and innovation.	1,5	5,5	25	50,5	17,5
COF3	I think this cafe will serve for many years.	3	5	21	52,5	18,5
COF4	I think the design of the cafe adds value to the place.	4	12	18	42	24
COF5	I think the designer of the cafe adds value to the place.	6	15	25	35,5	18,5
COF6	I think the cafe has a brand value and/or reputation.	9	16,5	25	37	12,5
SUBJECTIVE FEATURES						
SUF1	I feel like I belong to this cafe.	16	28,5	29	19,5	7
SUF2	I feel familiar with this cafe.	8	13	27	44	8
SUF3	I feel in harmony with this cafe.	8	13,5	28	42	8,5
SUF4	I feel safe in this cafe.	7	9	20,5	53	10,5
SUF5	I feel respected in this cafe.	11	18,5	30	34	6,5
SUF6	I think my experiences at this cafe were positive.	6,5	9,5	27,5	44,5	12
SUF7	I feel psychologically comfortable in this cafe.	3,5	10	24	45	17,5

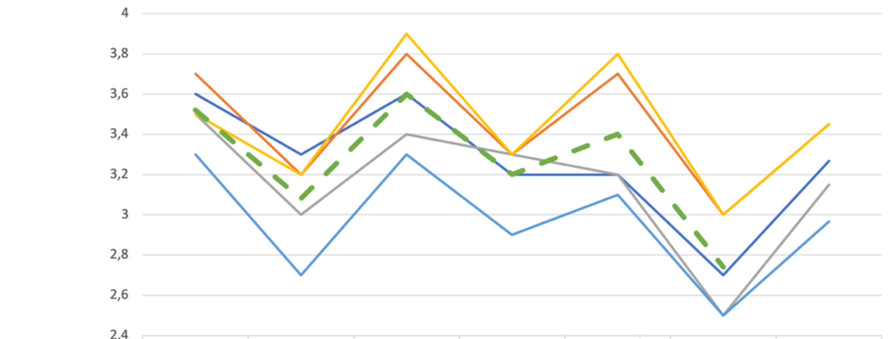
ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

SUF8	I feel comfortable with privacy in this cafe.	7,5	15	23,5	43	11
SUF9	This cafe means many different things to me individually.	11	22	30	31	6
AESTHETIC FEATURES						
AF1	I find the design of this cafe successful.	4	12,5	21	41	21,5
AF2	I think the design of this cafe developed based on a concept.	3	16,5	20	43	17,5
AF3	The design of the cafe is one of the factors that made me choose this place.	8	26	21	31	14
AF4	I think the design of this cafe reflects the requirements of the age.	3,5	11	27	44	14,5
AF5	I find the colors and textures used in this cafe successful.	5	6,5	15,5	50,5	22,5
AF6	I think that concepts such as form, proportion and size were applied well in the design of this cafe.	4,5	12,5	23,5	44,5	15
AF7	I think the design of this cafe is innovative.	4,5	10	25,5	43,5	16,5
AF8	I think the materials, colors and their design used in this cafe are holistic.	4,5	8	19,5	52	16
AF9	The design of the cafe really impresses me.	13	23	28,5	24,5	11
AF10	I find the concept/design of the cafe original.	8,5	15	30	33	13,5
AF11	I think the cafe has an artistic/intellectual atmosphere/design.	12	18,5	25,5	33,5	10,5
CULTURAL FEATURES						
CUF1	I think this place has a historical background/texture.	39	34,5	19	4	3,5
CUF2	I think this cafe has social importance.	20	31,5	26,5	20	2
CUF3	I think this cafe has a different identity.	12	22,5	26	30	9,5
CUF4	I think this cafe helps its users accumulate good memories.	5,5	10,5	34	41,5	8,5
CUF5	I think this cafe symbolizes some meanings and/or values to its users.	9,5	18,5	36,5	30	5,5
CUF6	I think this cafe has an international design and service approach.	17,5	25	32	21	4,5
CUF7	I think this cafe has a design and service approach that highlights local values.	18,5	23	29	20,5	9

In order to convert the obtained data into numerical data, the statement "Strongly Disagree" was given a value of 1, "I Disagree" was given a value of 2, "I am Undecided" was given a value of 3, "I Agree" was given a value of 4, and "I Strongly Agreed" was given a value of 5. Average

DOI: 10.15320/ICONARP.2024.278

values were calculated for each cafe in the sample group. Accordingly, the data obtained is seen in Figure 5.



	FUNCTIONAL FEATURES	SOCIAL FEATURES	CONSUMPTION FEATURES	SUBJECTIVE FEATURES	AESTHETİC FEATURES	CULTURAL FEATURES	AVERAGE
NEVRE	3,6	3,3	3,6	3,2	3,2	2,7	3,27
BIKKA	3,7	3,2	3,8	3,3	3,7	3	3,45
MAGNESS	3,5	3	3,4	3,3	3,2	2,5	3,15
MIA	3,5	3,2	3,9	3,3	3,8	3	3,45
HOKKA	3,3	2,7	3,3	2,9	3,1	2,5	2,97
AVERAGE	3,52	3,08	3,6	3,2	3,4	2,74	

Figure 5. Evaluation of cafes according to 6 main headings and general average

When the general average of the answers to these criteria is taken, it is seen that Mia and Bikka Cafe have more positive answers and share the first rank. It has been found that participants prefer different features in their cafe preferences and these features come to the fore at different points for each cafe location.

Testing the groups created based on the literature with factor analysis

First of all, the "Cronbach Alpha" test, a reliability analysis method, was applied to the value model consisting of 52 expressions through the SPSS program. In the next step, by applying "Factor Analysis" to the expressions in the model, the spatial feature headings predicted as a result of the literature research were tested and these headings were rearranged. The factor scores obtained at this stage also formed the data for the next step, "Logistic Regression" analysis.

A total of 52 items of Likert-type expressions were presented for the value model created as a result of the literature review. A reliability analysis was applied to these statements given to the participants through the survey with the SPSS program. This analysis was used to measure whether the questions in the scale represent a homogeneous whole. As a result of the analysis, the "Cronbach Alpha" value was found to be 0,945. Since this value was in the range of $0.8 \leq \alpha < 1$, the result of the reliability analysis was considered "highly reliable" (Albayrak et al., 2014).

Factor analysis was applied to the model using the "varimax rotation method" with the SPSS program. From the factor groups that emerged as a result of the first analysis, it was decided to remove the items that could not be divided into a meaningful group and whose factor load was below 0,5. These items are statements coded COF1 and SOF3.

As a result of the factor analysis applied after removing these two items, the KMO (Kaiser-Meyer-Olkin) value, which indicates the suitability of the sample group, was found to be 0,902. For this value, below 0,5 is considered inadequate, between 0,5 and 0,7 is considered sufficient, and 0,7 and above is considered good (Can, 2013). Since the obtained value was above 0,7, the sample was considered to be at a good level. As a result of factor analysis, 11 factor groups were formed, explaining 68,036% of the total variance. In these factor groups, when the expressions with factor loads below 0,5 were ignored, a total of 9 factor groups were obtained.

When the obtained factor groups were examined, it was found that they were clustered differently from main six headings suggested in the model. It can be said that these new factor groups are actually formed by the combination of different interrelated expressions or by dividing the proposed headings into more than one subgroup. Accordingly, factor groups have been renamed according to the value characteristics they express:

- Design and Aesthetics
- Subjective Relationship
- Belonging
- Image
- Business Quality
- Socialization
- Function
- Environmental Impact
- Location/Environment

The resulting 9 new factor groups emerged by combining various expressions suggested in the model and forming new defined groups. These factor groups and the factor scores obtained as a result of the factor analysis formed the basic data for the "Logistic Regression" analysis, which is the next stage of the study.

Determining the impact level of factors that show the value of the place

The next stage of the study is the "Binary Logistic Regression" analysis applied in the SPSS program. This test is a logistic regression analysis method with dependent variables containing binary answers. It reveals the connection between the binary response variable and one or more explanatory variables (Karagöz, 2016). This test was used to analyze the relationships between the value that participants give to the cafe they are in, factor groups (Design and Aesthetics, Subjective Relationship, Belonging, Image, Business Quality, Socialization, Function, Environmental Impact, Location/Environment) and demographic information (Age, Gender, Marital Status, Educational Status, Income Status).

Before logistic regression analysis, dependent and independent variable data were rearranged. In the study, the value that the users who

DOI: 10.15320/ICONARP.2024.278

participated in the survey gave to the cafe they were in was accepted as the dependent variable. In order to apply the analysis, this data had to be converted into a binary variable data set. For this reason, the data obtained was revised. The answers to this question, which was asked to the participants on a 5-point Likert scale as "very worthless, worthless, medium valuable, valuable and very valuable", were divided into two groups. 103 answers such as "very worthless, worthless and medium value" were accepted as "WORTHLESS". 97 answers that came in the form of "valuable and very valuable" were accepted as "VALUABLE" and dependent variable data were obtained.

Factor groups and demographic information were accepted as independent variable data in the analysis. Factor scores obtained as a result of factor analysis were used as analysis data. The data obtained as a result of demographic information was organized according to the data consisting of Age 3, Gender 2, Marital Status 2, Educational Status 5, Income Level 5 and Working Status 3 groups and was used in the analysis. The most important table to be interpreted within the scope of this test is the variables table. This test continued in 7 steps, starting from the first step and removing variables with high Sig values and negatively affecting the significant relationship from the model, respectively. The final model obtained in step 7, which includes significant variables, is given in Table 5. A Sig value of less than 0,05 indicates that the variable has a significant relationship with the value of the cafe. In this case, comments continued to be made by looking at Exp(B) and B values (Karagöz, 2016). It can be interpreted that when the B coefficient is positive, it increases the value positively, and when it is negative, it affects it negatively. Looking at the Exp(B) value, the effect level of the factor on the value of the space is interpreted. For example, since the Sig value for the Design and Aesthetics factor is 0.002<0.05, it can be said that this factor affects the value of the cafe. Since the B coefficient of this factor is positive (0.603), it can be interpreted that it affects the positive increase in the value. Looking at the Exp(B) value, it can be seen that the increase in the Design and Aesthetics factor increases the value towards the cafe by 1,829 times.

Table 5. Variables table

		B	S.E.	Wald	df	Sig.	Exp(B)	95% confidence interval	
								Bottom	Top
Step 7	Design and Aesthetics	,613	,193	9,798	1	,002	1,829	1,253	2,668
	Subjective Relationship	,783	,213	13,475	1	,000	2,188	1,441	3,325
	Belonging	,446	,190	5,485	1	,019	1,561	1,075	2,267
	Image	,523	,189	7,631	1	,006	1,686	1,164	2,443
	Business Quality	,779	,203	14,716	1	,000	2,178	1,463	3,242
	Socialization	,534	,182	8,607	1	,003	1,706	1,194	2,439
	Environmental Impact	,569	,193	8,699	1	,003	1,766	1,210	2,578
	Age	-,850	,361	5,561	1	,018	,427	,211	,866
	Gender	-,604	,272	4,917	1	,027	,547	,321	,932
	STABLE	3,414	1,225	7,770	1	,005	30,380		

Accordingly, it can be seen that the most important value groups that directly affect the value of the cafe are business quality (2,178) and subjective relationship (2,188). Supporting the assumption that users accept cafes as a commodity within the framework of their consumption-oriented habits, the relationship they establish with the product and the benefit they perceive for the service provided come to the fore, confirming the assumptions of the study. In addition, the fact that the heading "belonging" (1,561) among the factor groups is the last in terms of significance appears as an indicator of the temporary nature of the relationship between the architectural space as a product and its user.

Table 6. Classification table

			Guess		
			VALUE		VERIFICATION RATE
			VALUABLE	WORTHLESS	
Step 7	**VALUE**	**VALUABLE**	87	16	84,5
		WORTHLESS	24	73	75,3
	AVERAGE				80,0

Another information obtained as a result of the analysis is how predictable the results are depending on the relationship of the variables. According to the data in Table 6, the algorithm that operated during the analysis was able to correctly predict 84.5% of the questions marked as "worthless" by the participant. Again, the algorithm correctly predicted 75.3% of the questions marked as "valuable" in the survey. The general average is 80%. Therefore, it can be stated that the degree of "value" given to the place is 80% predictable by looking at the answers given to the statements considered as variables. This rate shows that the "value model", which is put forward as an evaluation model for architectural spaces, is successful at an acceptable level.

CONCLUSIONS

The transformations of architectural spaces within the framework of globalization and consumption processes were examined within the scope of the study. With the emergence of the concept of modernity, the development of consumption-oriented lifestyles was reflected in the discipline of architecture and changed the production and perception of space. While consumption-oriented space production is at the basis of today's architecture, users have been given new habits in terms of establishing temporary relationships with space. The transformations experienced in today's architecture and the status of the concept of "spatial value" in the re-established relations between space and people are discussed within the scope of the study. It is aimed to bring a new perspective to the field by questioning the short-term relationships established between the user and the space in consumption-oriented spaces through the value concepts determined for space.

DOI: 10.15320/ICONARP.2024.278

When we look at the information obtained through the "value model" put forward to evaluate architectural spaces, it is seen that concepts within the scope of "consumption" come to the fore in terms of value. Accordingly, it was concluded that the expressions under the heading of consumption characteristics had higher results than the other expressions for the 5 cafes to which the model was applied. The fact that consumption features come to the fore in all spaces while functional, cultural and aesthetic features remain in the background stands out as an important result for users' perception of the space.

As a result of examining the value model through factor analysis, 9 new meaningful factor groups were obtained, different from the headings predicted at the beginning of the study: Design and Aesthetics, Subjective Relationship, Belonging, Image, Business Quality, Socialization, Function, Environmental Impact, Location/Environment. It was found that the most important value groups that directly affect the value of the cafe are business quality and subjective relationship. The fact that users' subjective relationships with the product and the benefit they perceive for the service provided come to the fore, confirming the assumption that they accept cafes as a commodity within the framework of their consumption-oriented habits. In addition, the fact that the "belonging" factor is left behind at the relationship level is an indicator of the temporary nature of the relationship between the architectural space and its user.

The validity of the model put forward within the scope of the study was determined according to the data in the classification table (Table 6), which is the last step of the logistic regression analysis. Accordingly, when the significant relationship between the statements in the model and the answers to the question about the value of the cafe was examined, it was seen that the model was at a level that could predict this relationship 80% accurately. In other words, the model is capable of making value predictions with 80% success rate. This rate shows that the "value model", which is put forward as an evaluation model for spaces, is successful at an acceptable level.

In the study conducted on the value of architectural spaces considered within the framework of globalization processes, it was observed that the spatial preferences of the participants were consumption-oriented. It is possible to see all the traces of the consumer society in the users' perception of space, the relationships they establish, their preferences, and the time period they allocate. It can also be said that the consumption-oriented approaches of today's architecture and the users of the spaces mutually feed each other and ensure the continuity of this process.

The resulting model obtained from the analysis based on this study can be applied in different places such as restaurants, shopping malls and museums, where the user experience and consumption relationship are intense. Since the literature on the relationship between consumption culture and architecture renews itself rapidly, new model suggestions can

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

be developed with different subheadings. In addition, the model proposal tested with quantitative methods within the scope of the study can be addressed in different ways using qualitative research methods (in-depth interview, expert opinion, etc.). In this context, it is thought that the study will shed light on many different new studies.

REFERENCES

Albayrak, A., Eroğlu, A., Kalaycı, Ş., Küçüksille, E., Ak, B., Karaatlı, M., Keskin, H., Çiçek, E., Kayış, A., Antalyalı, Ö., Uçar, N., Demirgil, H., İşler, D. & Sungur, O. (2014). SPSS uygulamalı çok değişkenli istatistik teknikleri. Asil Yayın.

Babin, B. J., Darden, W. R. & Griffin, M. (1994). Work and/or fun: measuring hedonic and utilitarian shopping value. Journal of Consumer Research, 20, 644-656.

Baudrillard, J. (1997). Tüketim toplumu. Ayrıntı Yayınları.

Bekar, İ., Erbay, M. (2023). Küreselleşme ve mobilya etkileşiminde yerel kavramlar. Mimarlık, Planlama ve Tasarımda Öncü ve Çağdaş Çalışmalar, Duvar Yayınları, İzmir, 243-258.

Can, A. (2013). SPSS ile bilimsel araştırma sürecinde nicel veri analizi. Pegem Akademi.

Cevizci, A. (2012). Felsefe sözlüğü. Say Yayınları.

DeRuyter, K., Wetzels, M., Lemmink, J, & Mattsson, J. (1997). The dynamics of the service delivery process: a value-based approach. International Journal of Research in Marketing, 14, 231-243.

Giedion, S. (1967). Space, time and architecture. Harvard University Publications.

Grewal, D., Krishnan, R., Baker, J. & Borin, N. (1998). The effect of store name, brand name and price discounts on consumers' evaluations and purchase intentions. Journal of Retailing, 74(3), 331-352.

Groth, J. C. (1995). Exclusive value and the pricing of services. Management Decision, 33(8), 22-29.

Işık, O. (1994). Değişen toplum mekân kavrayışları: mekânın politikleşmesi, politikanın mekânsallaşması, Toplum ve Bilim Dergisi, 64-65, 7-38.

Karaarslan, F., (2014). Modern dünyada toplumsal hafıza ve dönüşümü. (Doktora Tezi), Selçuk Üniversitesi, Konya.

Karagöz, Y. (2016). SPSS ve Amos 23 uygulamalı istatistiksel analizler. Nobel Yayın.

Katamneni, S. P. & Coulson, K. R. (1996). Measuring perceived value: findings from preliminary research. Journal of Marketing Management, 6(2), 72-86.

Kwun, J. & Oh, H. (2004). Effect of brand, price, and risk on customers' value perceptions and behavioral ıntentions in the restaurant ındustry. Journal of Hospitality & Leisure Marketing, 11(1), 31-49.

Lefebvre, H. (2014). Mekânın üretimi. Sel Yayıncılık.

Oliver, R. L. (1999). Whence consumer loyalty? The Journal of Marketing, 63(4),33-44.

Parasuraman, A. & Grewal, D. (2000). The impact of technology on the quality-value-loyalty chain: a research agenda. Journal of the Academy of Marketing Science, 28(1), 168-174.

Petrick, J. F. & Backman, S. J. (2002). An examination of the construct of perceived value for the prediction of golf travelers' ıntentions to revisit. Journal of Travel Research , 41, 38-45.

Sanchez, J., Callarisa, L., Rodríguez, R. M. & Moliner, M. A. (2006). Perceived value of the purchase of a tourism product. Tourism Management, 27, 394-409.

DOI: 10.15320/ICONARP.2024.278

Schroeder, M. (2021). Value theory. In E.N. Zalta (Ed), The Stanford encyclopedia of philosophy (Fall 2021 ed.), <https://plato.stanford.edu/archives/fall2021/entries/value-theory/>.

Sheth, J. N., Newman, B. I. & Gross B. L. (1991). Why we buy what we buy: a theory of consumption values. Journal of Business Research, 22, 159-170.

Smith, J. B. & Colgate, M. (2007). Costumer value creation: a practical framework. Journal of Marketing Theory and Practise, 15(1), 7-23.

Sweeney, J. C. & Soutar, G. N. (2001). Consumer perceived value: the development of a multiple item scale. Journal of Retailing, 77, 203-220.

URL-1, http://www.tdk.gov.tr/, 21.09.2023.

Urry, J. (1999). Mekânları tüketmek, Ayrıntı Yayınları.

Resume

Tolga CÜRGÜL received his B.Arch. (2012) and M.Arch (2018) degrees at Karadeniz Technical University, Department of Architecture. He continues to work as a research assistant at KTU Interior Architecture Department. He is a PhD candidate in the Department of Architecture at KTU Institute of Natural and Applied Sciences.

Şengül YALÇINKAYA received her Bachelor's degree from K.T.U. Faculty of Engineering-Architecture in 2011, and her Master's (2015) and PhD (2011) degrees from K.T.U. Institute of Natural and Applied Sciences, Department of Architecture. She is currently working as a professor at KTU Faculty of Architecture. She continues her studies in the field of environmental psychology. She has publications especially on child users, health structures, and stress in space.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

ICONARP
International Journal of Architecture and Planning
Received: 25.11.2023 Accepted: 12.02.2024
Volume 12, Issue 1/ Published: 30 .06.2024
Research Article *DOI: 10.15320/ICONARP.2024.279 E- ISSN:2147-9380*
ICONARP

The Role of Architecture Documentaries in The Adoption of Contemporary Design Approaches in Mosque Architecture: A Research on Architecture Students

Begüm Aköz Çevrimli *
Ceyhan Tazefidan **
Hande Büşra Geyikli ***

Abstract

In the historical process, mosques have exhibited different architectural features depending on various factors such as culture, geography and construction techniques, and have generally been defined by elements such as domes and minarets. Although mosque architecture has maintained its characteristic features for many years, new design approaches emerged with the Republican Era. In mosque architecture, which has been reinterpreted from a contemporary perspective, elements such as domes and minarets have undergone formal changes and interior elements have been reconsidered. However, the traditional image of the mosque in the minds of the public has created a resistance to contemporary design approaches and modern mosque designs have become a current topic of discussion. This study was carried out to understand the role of architectural documentaries in the perceptual change regarding the adoption of contemporary approaches by determining the tendencies of individuals regarding mosque architecture. In the research conducted on architecture students, the documentary 'Sancaklar Mosque' broadcasted in TRT2's Eşik program was used. Following an experimental method, user perception was evaluated with questionnaires applied before and after screening the documentary.The results were analyzed with "Dependent Groups t-test" in SPSS and the statistical significance of the change in user perception was discussed. The findings of the study showed that architecture documentaries significantly changed architecture students' acceptance of contemporary mosque designsIn addition, after screening the documentary, it was determined that the perception that architectural elements such as dome and minaret can be included in mosque architecture in different forms was strengthened.The results obtained show that mass media can be used not only as a tool in architectural education, but also as a method for informing the society and adopting contemporary design approaches to mosques.

Keywords:
Mass-media, Mosque design, Traditional-contemporary, Perception, Sancaklar Mosque

*Department of Architecture, Konya Technical University, Konya, Türkiye. (Corresponding author)
E-mail: bacevrimli@gmail.com

**Department of Architecture, Konya Technical University, Konya, Türkiye.
E-mail: ceyhantazefidan@gmail.com

***Department of Architecture, Ondokuz Mayıs University, Samsun, Türkiye.
E-mail: hbkobya@gmail.com

To cite this article: Aköz Çevrimli, B., Tazefidan, C. & Geyikli, H.B. (2024). The Role of Architecture Documentaries in The Adoption of Contemporary Design Approaches in Mosque Architecture: A Research on Architecture Students. *ICONARP International Journal of Architecture and Planning,* 12 (1), 144-161. DOI: 10.15320/ICONARP.2024.279

INTRODUCTION

Perception is the process of receiving information from the environment and interpreting and comprehending this information in the mind (Rapoport, 1977; Shulz, 1966). In this process that develops between human beings and their environment, stimulus effects are perceived sensually, interpreted, comprehended and made sense of in the mind (Rapoport, 1977). Our different senses such as sight, hearing, taste, smell and touch play an active role in perception. Visual perception has an important place especially in the perception of architectural environment (Gehl, 1987). Yürekli (1977) states that the visual features coming from the objects in the architectural environment are form, color and texture. Specially form stands out as an important element that provides distinction in the architectural environment and plays an important role in the perceptual process (Akbarishahabi, 2022; Bower & Hilgard, 1981).

The forms created in architecture gain symbolic value with the meanings attributed by societies beyond meeting physical needs (Şentürer, 1995). Together with the meaning given to the form, these elements become symbols and form the character and identity of the building. These elements with symbolic value create an acceptance for societies both psychologically and physically and can be used as representation. Especially in religious buildings, these symbolic elements have an important place in defining the type of religious building (church, mosque, cathedral, etc.). For example, the bell tower is a prominent element used in the recognition and identification of a church building, while elements such as minarets and domes are generally accepted as architectural elements that symbolize the mosque and form its building form.

Belief systems are one of the most important elements that shape the social structure and living spaces of society (Güleç Demirel, 2017). Worship, which is one of the basic elements of belief, covers all the behaviors that believers fulfill as a result of their respect and love for the creator. Worship can be performed individually or collectively. In order for worship to be performed collectively, places called temples are needed (Certel, 1999). According to Islamic belief, the first temple is a place where simplicity is at the forefront with the understanding that the main goal is to gather and worship (Bloom, 2013; Omer, 2010). With the prominence of monumentality in the historical process, places of worship have undergone a transformation and mosques have emerged as a type of building that reflects the architectural, artistic, social and cultural structure of the period (Akın, 2016).

Over time, it has been seen that mosques are not only a place of worship but also one of the important structures symbolizing the power of Islamic states. During the Great Seljuk period, due to the prominence of monumentality, magnificent mosques consisting of large domes and vaults are seen. The entrance doors are usually large and decorated with high pediments and have an impressive appearance. In addition, stone

DOI: 10.15320/ICONARP.2024.279

ornaments seen on the exterior facade and crown gates were also applied in architectural elements such as mihrab, minbar and dome transitions (Öney, 1978). In the mosque architecture of the Ottoman Period, architectural elements, structural elements and plan elements were reinterpreted and developed. Mimar Sinan, who brought a new interpretation to the mosque architecture of the classical period, used a single large central plan scheme in his mosque design and covered it with a dome (Özçakı, 2018). In cases where a single large dome was insufficient, he expanded the interior space by using half domes and domes smaller than the diameter of the half dome (Bilgin, 2006). With this approach of Mimar Sinan in mosque architecture, the building gained a pyramidal form (Alioğlu, 2023). These mosques, which have an imposing architecture with their high minarets and large domes (Çiçek, 2021), became landmarks in cities and took place in city silhouettes. These mosques in the Seljuk and Ottoman periods are seen as mosques designed with a traditional design approach.

Traditional mosque architecture has maintained its characteristic features for many years. With the establishment of the Republic of Turkey, Turkish architects, influenced by the rational and functionalist international movement, adopted a design approach that moved away from the symbols that would remind the Ottoman Period (Civelek, 2009). With the interest in international architecture that started in the 1960s, new mass layouts were developed in mosque architecture, different from the classical order, architectural elements were reinterpreted, and this approach was called contemporary mosque design. This approach, which is also referred to as modern mosque design, can be explained as the reinterpretation of architectural elements that have become symbolic in mosque architecture and constitute traditional mosque architecture in different forms and styles with new building technologies (Eyüpgiller, 2006).

Since the early 20th century, the search for contemporary mosque design continues today and modern mosque designs are being developed (Özçakı, 2018). In this process, on the one hand, mosque designs are developed and implemented with a contemporary approach, and on the other hand, these designs become the subject of discussion in many media such as newspapers and magazines (Taşar & Düzenli, 2020). Today, some designers tend to copy traditional mosque models, while others develop designs that have no connection with traditional models (Asfour, 2016). In some mosque designs, the combination of traditional and contemporary design approaches leads to identity confusion (Güzer, 2009; Oral, 2020; Oral, 2006; Özkaynak & Oral, 2023). On the other hand, people's general perception of taste includes mosque models designed with a traditional approach (Arslan & Yıldırım, 2017; Eyüpgiller, 2006; Sarıhan, 2015). All these situations bring about the situation of maintaining today's mosque architecture in uncertainty and confusion.

In the literature on contemporary mosque design, Şahin Çelik (2013) identified the thoughts and expectations of young mosque users towards

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

contemporary mosques. Shah et al. (2015) investigated the dominant factors affecting the stereotypical thoughts of the local community towards mosque design and how aesthetic values affect the thoughts of the local community. Özkaynak and Oral (2023) evaluated the place of mosque designs imitated from traditional interpretations in contemporary mosque approaches in the perception of local people. Parto et al. (2021) investigated the factors affecting the spatial atmosphere for mosque users. Hiçsönmezler et al. (2023) aimed to reveal the differences in user perception of traditional and contemporary mosque styles. Arslan and Yıldırım (2017) investigated perceptual differences through 3 different mosques from the Ottoman, Seljuk and Republican periods in order to determine how mosque facades are perceived by people and the level of appreciation in user perception. Dural (2017) aimed to examine the perceptual effect of the dome, which stands out as a structural and symbolic element, according to the level of architectural education. Taib and Rasdi (2012) experimentally analyzed the place of decorative ornaments used in interior spaces in user perception. Mazloomi et al. (2014) aimed to determine the importance of structural elements and interior space elements in contemporary and traditional mosque architecture and revealed that users consider the dome and minaret important in traditional mosque architecture, and the mihrab and other interior space elements important in contemporary mosque architecture. Arslan et al. (2018) aimed to determine the perceptual differences between architect and non-architect users of mosque buildings belonging to the Ottoman, Seljuk and Republican periods.

The research in the literature provides a wide range of information on contemporary mosque design, from the opinions of young mosque users to the perception of the local community, from differences in user perceptions of traditional and contemporary mosque style to the importance of structural elements and interior space. In most of the studies, he conducted a comprehensive analysis using qualitative and quantitative methods such as questionnaires, focus group discussions and in-depth interviews. These studies constitute an important resource for understanding the relationship between contemporary mosque design and user perception and for guiding future design.

This study aims to investigate how contemporary mosque design can be adopted by the users and what are the changing preferences in this direction by approaching it from a different perspective than other studies in the literature. In this context, the question "Can architectural documentaries be used as a tool for the acceptance of contemporary mosque designs in today's architectural environment?" is taken as a basis. This research makes an important and original contribution by revealing the potential of the use of architectural documentaries for the development and adoption of contemporary mosque designs and by providing suggestions on mosque design.

DOI: 10.15320/ICONARP.2024.279

Role of Mass Media on The Individual and Society

The first steps of the concept of communication are based on the fact that people have been interacting with each other using various sounds and movements since the earliest times of history. Apart from sound and movement, people aimed to interact with future generations by drawing pictures on walls and floors in the places where they lived (Gombrich, 1992). The fact that people wanted to interact with their own sex in this way, wanted to get to know the outside world, and the need to transfer information led to the formation and spread of communication tools (Furat, 2009). Especially with the invention of writing, written communication was started in addition to verbal communication and the information transfer of all historical and social events could be transferred to future generations (Yılmaz, 2020). It is seen that the concept of communication is used directly or indirectly not only among humans but also by almost all living things in nature (Gürocak, 2013).

Communication literally means sharing in Latin. In other words, it can be thought of as sharing and dividing information and knowledge. In its simplest form, TDK defines it as the transfer of feelings and thoughts to other people through any conceivable means, notification and communication. In addition to these definitions, communication is defined as a bridge of meaning between individuals, the reproduction of oneself and society for a certain purpose (Erdoğan & Alemdar, 2005), the process by which something is translated into symbols and symbols and transferred from one person to another (Berelson & Steiner, 1964), the sharing of all kinds of knowledge and feelings and thoughts using words, pictures and various symbols, and the exchange of messages between two individuals (Cüceloğlu, 2000).

Communication is a process in which information is exchanged between two parties that can be defined as the sender and the receiver (Aynan, 1995). With communication being so widespread among all individuals, interaction has become easier and the concept of mass communication has been formed. As the name suggests, mass communication is a type of communication that appeals to a community, where information exchange is provided quickly and easily through various communication tools (Yılmaz, 2020). Mass communication became widespread with the invention of writing, the invention of the printing press, the emergence of newspapers and magazines, and gained a different dimension especially with the invention of the internet.

These tools that provide the target audience with information in the fastest and easiest way are television, telephone, radio, newspapers, magazines and the internet (Yılmaz, 2020). All of these are written, verbal and visual mass media where communication is one-sided. Today, however, mass media come together in the concept of media, where two-way communication and interaction between users are at the forefront, and feedbacks for videos and visuals that are accessible at any time are realized through a fast communication network.

Media, as the factor that has the most impact on the perception of the individual after individual experiences (İplikçi, 2015), enables individual and social perceptions and attitudes to change (Gürocak, 2013; Satır & Çetin, 2019). Therefore, mass media play an important and effective role in today's society by raising public awareness, strengthening the social structure and forming public opinion with opinions, information and attitudes on certain issues (Gürocak, 2013).

The general purpose of mass media is to entertain, inform, provide cultural continuity and socialize the audience it reaches (Begtimur, 2021). Yılmaz (2020) stated that the most important of these purposes are notifying and informing. The concept of communication also supports an education that continues in every process of human life by developing the learning process. In this education process, the individual reflects what he/she learns from mass media to his/her life (Furat, 2009). The individual, who obtains information in various ways, directs and manages their perspectives on events (Yılmaz, 2020). It contributes to both socialization and information of the individual and causes him/her to be perceptually affected by building a bridge between his/her past and future. Many positive situations have also been encountered, such as students gaining social skills through mass media, sharing, communication, and transferring information quickly and easily (Bharucha, 2018; Ha et al., 2017; Öztürk & Talas, 2015; Solmaz et al., 2013).

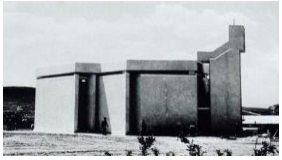
Mass media and documentaries are powerful tools for sharing information, introducing new ideas and designs, and initiating social debates in the field of architecture (Salama, 2009). Therefore, it is important to include architecture-related content on these platforms to increase architectural culture and awareness.

MATERIAL

Traditional mosque architecture, reflecting the characteristics of the period in which it is located, has been put forward by societies with different examples for centuries in line with the possibilities offered by local materials. In the post-Republic period in Turkey, mosque designs that can be classified as contemporary or modern were made. Ankara Etimesgut Mosque, Kınalıada Mosque, TBMM Mosque, TEK Mosque, Batıkent Mosque, Derinkuyu Mosque are among the important examples built with a modern approach in Turkey (Table 1).

DOI: 10.15320/ICONARP.2024.279

Table 1. Examples of contemporary mosque design in Turkey.

		
Ankara Etimesgut Mosque (http-1)	Kınalıada Mosque (http-2)	TBMM Mosque (http-3)
		
TEK Mosque (Ürey, 2010)	Batıkent Mosque (http-4)	Derinkuyu Mosque (Ürey, 2010)

In this study, research was conducted on the Sancaklar Mosque, which was designed with a contemporary approach, which is the subject of the 3rd episode of the documentary called "Eşik", broadcast on TRT2 channel. The Threshold program is broadcast in the 2021-2022 season under the title "Architectural Culture in 21st Century Turkey" with a content that includes all kinds of details about the architects and buildings that have crossed the threshold of Turkey's Architectural History, from design ideas to construction solutions, from construction stages to today's use. In the Sancaklar Mosque documentary broadcast in the "Eşik" program, the intellectual background of the design is expressed by the architect of the building and different perspectives on mosque design are presented.

Sancaklar Mosque, which is both up-to-date and one of the most discussed building among the contemporary mosques with different examples in Turkey, was designed by architect Emre Arolat and opened in 2013 in Büyükçekmece, Istanbul (Figure 1).

Figure 1. Sancaklar Mosque, İstanbul / Turkey (http-5).

In the documentary Sancaklar Mosque, Emre Arolat stated that he aimed to design the mosque as simple and modest, away from ostentation, based on the essence of Islam. He also emphasizes that the focus is only on the essence of a religious space by staying away from all these discussions based on the view that the place of worship can be any clean place and does not have any shape (http-6). In terms of architectural design, the building is intended to be compatible with its location and topography and to integrate with nature by using natural materials such as stone, exposed concrete and wood (Figure 2).

Figure 2. Sancaklar Mosque, material use (http-6).

In the interior design of the building, Emre Arolat has implemented a design idea that will allow sunlight to filter into the interior in order to evoke the feeling of being alone with God and to make the space awe-inspiring for its users. The interior of the building is supported by artificial lighting as well as natural lighting. In addition, a simple, modest design was applied by avoiding exaggeration and unnecessary ornamentation in the interior design of the mosque (http-7). In the interior design of this mosque, the elements of the minbar and the mihrab have also been redesigned and applied in accordance with the building language (Figure 3).

Figure 3. Sancaklar Mosque, interior visuals (http-6).

With this design, Emre Arolat broke the mold of traditional mosque architecture and brought a simple and impressive mosque to Istanbul. At the same time, it has played an important role in the re-discussion of the formal elements of places of worship and in the current debates on the contemporary mosque.

RESEARCH METHOD

An experimental model was used in the study, which aimed to discuss the effect of mass media on the perception of mosque image. Experimental models are research models in which comparisons are

DOI: 10.15320/ICONARP.2024.279

made for cause-effect relationships and the effect of one or more independent variables on the dependent variable is investigated (Kıncal, 2013). In this study, the experimental research model was used to explain the following hypotheses through the Sancaklar Mosque documentary broadcasted in the Eşik program.

H1: The idea that interior and exterior identity elements in traditional mosque designs can be used in similar forms and features in today's contemporary mosque designs creates a perceptual difference before and after the documentary screening.

H2: In traditional mosques, features such as the mosque being large and magnificent due to the design and being recognizable from a distance are perceptually different before and after the documentary screening.

H3: Documentary screening plays an important role in the change and diversification of formal preferences for dome and minaret elements in mosque designs for today's contemporary designs.

With the experimental research model, the perceptual change in the user's perception of the design approach to mosque architecture before and after the documentary screening was analyzed. Questionnaires were used as data collection tools in the study. The questionnaire was prepared in three parts. Gender, class and nickname information about the participants were taken. In the first part; general information questions such as whether the students have been educated about the traditional mosque, the most frequently used mass media in daily life, mosque design in modern style and whether they have interacted with Sancaklar Mosque with any mass media before were included. In the second part, visuals were given through the traditional view of the dome, minaret, fountain, minbar, mihrab, sermon pulpit over the elements of traditional mosque architecture that make up the mosque. For each question, statements containing definite judgments about the use of these traditional forms of mosque architecture in the appearance given in the mosque architecture were used, and the participant was asked to score the degree of participation of the participant in the statements containing definite judgments with a 5-point Likert scale. In this section, it was also aimed to measure the general perception of the general appearance of the mosque. In this context, statements such as the mosque being large and magnificent, being visible from a distance, or being simple and modest were used to score the user's degree of agreement with the statement. In the third part, various symbolic forms were created in the context of architectural design for the dome and minaret, two prominent elements in the formation of the traditional mosque image in the Islamic faith. The usability of these forms in today's mosque architecture was asked with multiple choice questions and design approaches were determined.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

In the experimental study in which the one-group pretest-posttest model was applied, the questionnaire application to the sample group was carried out face-to-face. In the study, which was carried out in three stages, the questionnaire questions prepared for the purpose of the study were applied to the students in the first stage. In the second stage, Sancaklar Mosque Documentary was shown. In the third stage, the same questionnaire was reapplied to the participants in order to determine the change of this documentary on the perception of the image of the mosque. At the stage where the documentary was shown and the questionnaire was applied, there was no directive factor and the experiment was carried out impartially. The findings obtained from the questionnaires applied in the first and last stages were statistically analyzed with the Dependent Groups t-test in the SPSS program. This analysis reveals whether there is a statistically significant difference between the answers given by the students before the documentary screening and the answers given after the documentary screening.

Study Participants

The sample group of the study consists of students who have completed their 1st year education in the department of architecture and have taken two semesters of architectural design courses. It is considered important to address the perspective of the selected sample group on contemporary mosque design in terms of the production of era-specific mosque architecture. The fact that the students who will participate in the study have not previously watched the documentary Sancaklar Mosque, which is the subject of the Eşik program, has been important in order to measure the effect. The number of students to participate in the survey was calculated with the G-power program. Accordingly, with a power of 0.95, an effect level of 0.5 and an error of 0.05, the sample size was found to be at least 54. However, in order to obtain more efficient results, the questionnaire was administered to 106 volunteer students. Since the first questionnaire administration and the final questionnaire administration after the documentary screening took place in a similar time period, the control group was not included in the study.

RESULTS AND DISCUSSION

A total of 106 students, 68 female students and 38 male students, participated in the study to determine the role of mass media in the formation of the image of the contemporary mosque. Of these students, 16% stated that they had previously received training about the traditional mosque through different communication channels. The respondents used the internet the most during the day with 48.5%, followed by social media platforms with 44.2%, newspapers-magazines and radio-television with 3.70%. 28.9% of the respondents have never interacted with an example of a mosque designed with a contemporary mosque approach through any mass media. Those who interacted with the contemporary mosque outside of their architectural education mostly

DOI: 10.15320/ICONARP.2024.279

used social media platforms to obtain information with 29.6%. This was followed by the internet with 22.6%, radio-television with 9.6%, newspapers-magazines with 5.9% and other means with 3.7%.

Among the students who participated in the survey, 48.8% had no previous knowledge about Sancaklar Mosque. The students who had information about Sancaklar Mosque interacted with the internet with 24%, social media platforms with 12.4%, other tools with 7.8%, television with 4.7%, newspapers and magazines with 2.3%.

In order to determine the statistical method to be used in testing the hypotheses in the study, the homogeneity of the data was first tested. The normality test and kurtosis - skewness values of the data collected through the questionnaire were examined. According to Tabachnick and Fidell (2013), these values between -1.5 and +1.5 indicate a homogeneous distribution. In the analyzes conducted in the study, it was observed that these values were between -1.5 and +1.5, thus the data showed a homogeneous distribution. Dependent Groups t-test, which is a parametric test, was used for this normally distributed data set. The results obtained from these analyzes are given in the table below (Table 2)

Table 2. First-test and post-test dependent t-test results of formal and general perception of mosque image

	Test	N	Mean	Std.Error Mean	Dependent	One Sample	t-test
					sd	t	p(.sig)
Hypothesis1	First-Test	106	3,29	0,09	0,88	15,9	<0,001
	Last-Test	106	1,91	0,07			
Hypothesis1	First-Test	106	3,57	0,09	1,01	8,73	<0,001
	Last-Test	106	2,71	0,1			

* If p<0.05, there is a significant difference.

When the table is examined, the first hypothesis, the change in user perception of the situation regarding the use of interior and exterior elements used in traditional mosque design in the same form and feature in today's contemporary mosque design, was tested. According to this analysis, there is a significant difference between the first and last tests (p<0.05), so this hypothesis is confirmed. While the average of the answers given by the survey participants in the first test was 3.29, it was obtained as 1.91 in the post-test. From this point of view, it is seen that the participants' perceptions and acceptance of the traditional forms of the elements of the mosque have changed significantly after the documentary and the perception that the use of these elements with their traditional appearance in today's mosque design is necessary has decreased.

In the second hypothesis, a significant difference was found between the first and the last test in the evaluations made regarding the general appearance of the mosque ($p<0.05$). While the average of the answers given in the first test to the questions about the mosque being large and magnificent and being visible from a distance, which are prominent in traditional mosque design, was 3.57 in the first test, this average decreased to 2.71 in the post-test, and it is seen that the judgments about the mosque being simple and modest started to form after the documentary screening. Therefore, the results obtained also confirm the second hypothesis.

In the test of the third hypothesis, it was tested whether there were differences between the first test and the post-test in terms of the formal diversity of the minaret and the dome, the two most prominent traditional elements of mosque architecture. Within the scope of these questions, the participants were first asked a multiple-choice question consisting of 11 images about the minaret form. Among the students participating in the survey, 28% preferred the classical minaret form in the first test phase. In the post-test phase, this rate decreased to 14.7% and it was observed that 4 different forms received values above 10% among all options. In addition, while in the first test, students made the majority preference between 2-3 options on average among all options, this ratio increased to 4 options on average in the post-test phase. When the options were compared among themselves, it was seen that the view that the minaret is generally necessary was supported among the preferences made, and in formal preferences, it was seen that the forms that narrow and rise towards the sky were mostly preferred, and the options expressed as linear were behind the other options (Figure 4).

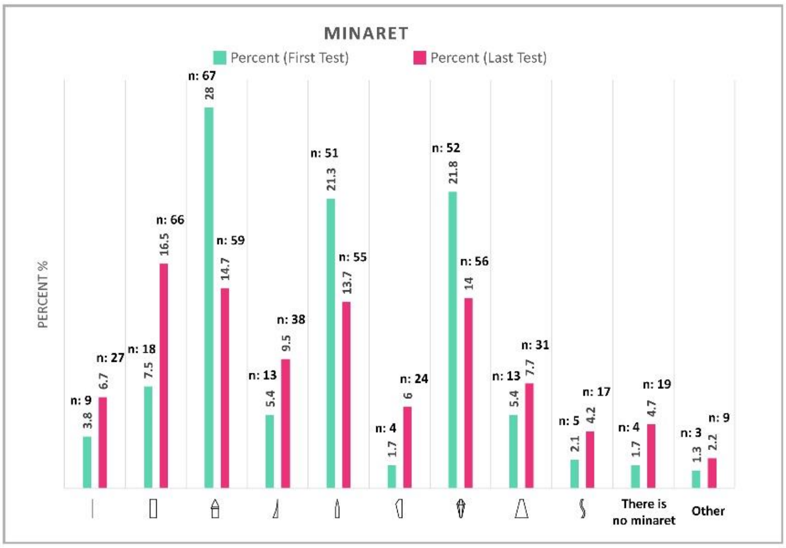


Figure 4. First-test and post-test comparison graph of the formal preference of the minaret element

A multiple-choice question consisting of 10 images was asked to the participants about the the mosque roof shape. Among the students participating in the survey, 28% preferred the classical dome shape in the

DOI: 10.15320/ICONARP.2024.279

first test phase. When the same question was asked again after the documentary screening, the number of students who preferred the classical dome form decreased to 13.7% among the participants. Although the classical dome form ranked 2nd among all the preferred visuals with this rate, it is seen that 6 different forms among the 10 options presented received values above 10%. In addition, while in the first test, students preferred 2 options on average among all options, this ratio increased to 5-6 options on average in the post-test. When the options are compared among themselves, it is seen that the fact that the mosque roof shape creates a convex volume effect is important among the preferences of the participants (Figure 5).

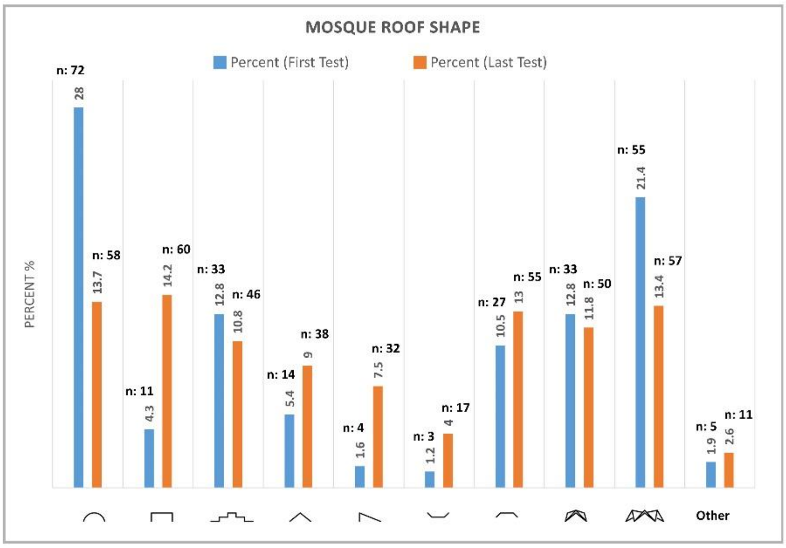


Figure 5. First-test and post-test comparison graph of the stylistic preference of the mosque roof shape

According to the results obtained from the questionnaires, it was observed that there was a diversification in people's preferences after the screening. Due to the increase in the diversity of preferences, the percentage of traditional and traditional-like forms decreased compared to the first test. The third hypothesis was also confirmed with these results.

CONCLUSION

The mosque has an important place as it is the sacred place of the Islamic faith and allows people to perform their prayers. Mosque architecture has reflected the climatic characteristics of the region and the cultural structure of the society until today and was built with contemporary construction techniques. Mosques, which were designed and built as large, voluminous and magnificent spaces in the past, created the image of a mosque in the human mind with elements such as domes, arches and minarets. These elements also became the symbolic elements of the mosque and the mosque gained an identity with these elements. In the post-Republic period in Turkey, a contemporary style has developed in mosque architecture with the development of technology, changes in

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

construction systems and new design approaches. In the mosque architecture designed in a contemporary style, especially the dome element and minaret element were reinterpreted and formal changes occurred in the structural form of the mosque. However, these new approaches in mosque architecture were not adopted by many people and were subject to criticism.

However, in order to perform worship, it is sufficient to meet the user requirements and create a suitable environment in the place. With the adoption of this idea, changing people's perspective on contemporary mosque design and adopting innovative approaches will prevent the problems experienced in today's mosque architecture. Therefore, the adoption of an approach that goes beyond the traditional patterns of mosque architecture by both the designer and the public is important in the development of contemporary mosque architecture.

In this study, a solution to this problem was sought and a way to overcome the stereotyped thoughts in the mind was sought. In this context, in this study, the role of architectural documentaries, which are thought to be important in the formation of architectural awareness, in changing people's perspective on contemporary mosque architecture was investigated. The findings of the research have shown that architectural documentaries have an important role in the perceptual change of architecture students regarding mosque design. It was seen from the analysis that this difference in the students' perception before and after the documentary was shown to be statistically significant. In addition, the idea that the dome and minaret, which are the elements that symbolize mosque architecture, can be designed in different ways, has developed in minds and design approaches have diversified.

Another result of the study is that although students have previously encountered examples of modernly designed contemporary mosques, screening documentaries can be used as a more effective learning method. Therefore, the dissemination of these tools and even their use as an auxiliary tool in architectural education alongside courses on contemporary mosque design are important for the development of perspective in mosque design approaches.

All these results show that documentaries can be used as an important tool in the development of contemporary style in today's mosque design approaches. It is considered important to determine the effectiveness of documentaries, which are an important tool in informing the society and increasing awareness, by testing them on individuals with different social, cultural and demographic structures in future research. Thus, an important step will be taken in order to prevent the identity confusion experienced in mosque architecture today and to carry it into the future by creating mosque designs in accordance with the conditions, requirements and technology of the day and to reflect the characteristics of the period to which the building belongs.

DOI: 10.15320/ICONARP.2024.279

REFERENCES

Akbarishahabi, L. (2022). Perceptual evaluation of street geometry by different groups based on pedestrian preferences. *MEGARON / Yıldız Technical University Faculty of Architecture E-Journal*, *17*(3), 486-500. https://doi.org/10.14744/megaron.2022.03411

Akın, A. (2016). Tarihi süreç İçinde cami ve fonksiyonları üzerine bir deneme. *Hitit Theology Journal*, *15*(29), 177-209. https://doi.org/10.14395/hititilahiyat.268627

Alioğlu, E. F. (2023). Şehzade Mehmet Camisi modüler tasarımı. *Belleten*, *87*(308), 87-111. https://doi.org/10.37879/belleten.2023.087

Arslan, D. K., Yıldırım, K., & Gülşeker, E. (2018). Investigation of architect and non-architect participants' perceptual evaluations on different period mosque facades. *ICONARP International Journal of Architecture Planning*, *6*(2), 358-370. https://doi.org/10.15320/ICONARP.2018.58

Arslan, H. D., & Yıldırım, K. (2017). Perceptual evaluation of the mosque facades of different periods: Preference, complexity, impressiveness, and stimulative. *MEGARON / Yıldız Technical University Faculty of Architecture E-Journal*, *12*(4), 511-523. https://doi.org/10.5505/megaron.2017.34635

Asfour, O. S. (2016). Bridging the gap between the past and the present: A reconsideration of mosque architectural elements. *Journal of Islamic Architecture*, *4*(2), 77-85. https://doi.org/10.18860/jia.v4i2.3559

Aynan, R. E. (1995). *Mimarlık-iletişim-dil bağlamında mimarın işine bir yaklaşım* [Doctoral Thesis, Mimar Sinan University, Graduate School of Natural and Applied Sciences]. Istanbul.

Begtimur, M. E. (2021). Uygur diasporasında kullanılan kitle iletişim araçlarını üzerine bir değerlendirme. *The International Journal of Uyghur Studies*(18), 27-41. https://doi.org/https://doi.org/10.46400/uygur.918191

Berelson, B., & Steiner, G. A. (1964). Human behavior: An inventory of scientific findings. *American Journal of Sociology*, *115*(4), 1345-1350.

Bharucha, J. (2018). Exploring education-related use of social media: business students perspectives in a changing India. *Education+ Training*, *60*(2), 198-212. https://doi.org/https://doi.org/10.1108/ET-07-2017-0105

Bilgin, H. (2006). Mimar Sinan yapılarında kubbeli örtü sistemlerinin yapısal analizi. *Selcuk University Journal of Engineering, Science and Technology*, *21*(3), 119-128.

Bloom, J. (2013). *The Minaret*. Edinburgh University Press

Bower, G. H., & Hilgard, E. R. (1981). Theories of learning In (Fifth edition ed.). Englewood Cliffs. N.J.: Prentice-Hall.

Certel, H. (1999). Dinî hayatta ibadetin yeri ve önemi. *Dini Araştırmalar Dergisi*, *2*(4), 209-222.

Civelek, Y. (2009). Mimarlık, tarihyazımı ve rasyonalite: XX. Yüzyılın ilk yarısındaki modern Türk mimarisinde biçime dayalı sembolik söylem meselesi. *Türkiye Araştırmaları Literatür Dergisi*(13), 131-152.

Cüceloğlu, D. (2000). *İnsan İnsana*. Istanbul: Remzi Bookstore.

Çiçek, T. (2021). Güzel sanatlar temelinde Selçuklu camileri ve Osmanlı camilerinin form olarak farklılıklarının İncelenmesi. *Atatürk Üniversitesi Türkiyat Araştırmaları Enstitüsü Dergisi*(72), 173-187. https://doi.org/doi.org/10.14222/Turkiyat4558

Dural, M. (2017). *Çağdaş cami mimarisinde kubbe ögesinin algısal etkisinin mimari eğitim seviyesine göre farklılaşması* [Master Thesis, Yıldız Technical University, Graduate School of Natural and Applied Sciences]. Istanbul.

Erdoğan, İ., & Alemdar, K. (2005). *Popüler Kültür ve İletişim*. Ankara: Erk Publications.

Eyüpgiller, K. K. (2006). Türkiye'de 20. yüzyıl cami mimarisi. *Mimarlık*, *331*, 20-27.

Furat, A. Z. (2009). Yaygın din eğitiminde kitle iletişim araçlarının yeri: Televizyon örneği. *Journal of Istanbul University Faculty of Theology*(19), 38-61.

Gehl, J. (1987). *Life Between Buildings: Using Public Space*. New York: Van Nostrand Reinhold Company.

Gombrich, E. H. (1992). *The Story of Art* (B. Cömert, Trans.). Istanbul: Remzi Bookstore Publications.
Güleç Demirel, B. N. (2017). *Osmanlı mimarlığında selatin camilerinde avlu* [Master Thesis, Yıldız Technical University, Graduate School of Natural and Applied Sciences]. Istanbul.
Gürocak, K. (2013). *Toplumsal davranışlara etkisi açısından kitle iletişim araçlarının stratejik değerlendirilmesi* [Master Thesis, Ege University, Institute of Social Sciences]. Izmir.
Güzer, A. C. (2009). Modernizmin gelenekle uzlaşma çabası olarak cami mimarlığı. *Mimarlık*, *348*, 21-23.
Ha, L., Joa, C. Y., Gabay, I., & Kim, K. (2017). Does college students' social media use affect school e-mail avoidance and campus involvement? *Internet Research*, *28*(1), 213-231. https://doi.org/DOI 10.1108/IntR-11-2016-0346
Hiçsönmezler, İ., Cilasun Kunduraci, A., & Ek, I. (2023). The perception of spatial atmosphere in traditional and modern mosques in aesthetic context. *Tasarım+Kuram*, *19*(38), 16-39. https://doi.org/https://doi.org/10.59215/tasarimkuram.2023.370
İplikçi, H. G. (2015). İletişimde temel modeller ve kitle iletişim modelleri. *Sosyal ve Beşeri Bilimler Dergisi*, *7*(2), 15-25.
Kıncal, R. Y. (2013). *Bilimsel Araştırma Yöntemleri*. Ankara: Nobel Academic Publisher.
Mazloomi, S. M., Ariffin, S. I., & Shahminan, R. N. R. (2014). Impact of architecture on sense of place and public perceptions in contemporary mosques in Malaysia. *Journal of Architectural and Planning Research*, *31*(3), 233-253.
Omer, S. (2010). Some lessons from Prophet Muhammad (SAW) in architecture: The prophet's mosque in Madīnah. *Intellectual Discourse*, *18*(1), 115-140.
Oral, B. (2020). Muhafazakâr tutumun estetik sorunsalı bağlamında çağdaş cami mimarisi. *Journal of Art History*, *29*(2), 489-519. https://doi.org/10.29135/std.669243
Oral, M. (2006). *Günümüz cami mimarisinde kimlik ve nitelik sorunu-Konya örneği* [Doctoral Thesis, Selcuk University, Graduate School of Natural and Applied Sciences]. Konya.
Öney, G. (1978). *Anadolu Selçuklu mimarisinde süsleme ve el sanatları*. Istanbul: Türkiye İş Bankası Kültür Publisher.
Özçakı, M. (2018). Kubbenin cami mimarisindeki yeri ve önemi. *İdil Journal of Art and Language*, *7*(44), 383-402. https://doi.org/10.7816 /idil-07-44-04
Özkaynak, Y. M., & Oral, M. (2023). Çağdaş cami mimarisinin biçimsel algısında toplumsal yanılsamalar. *INTERNATIONAL REFEREED JOURNAL OF DESIGN AND ARCHITECTURE*(28), 1-27. https://doi.org/10.17365/TMD.2023.TURKEY.28.01
Öztürk, M. F., & Talas, M. (2015). Sosyal medya ve eğitim etkileşimi. *Zeitschrift für die Welt der Türken*, *7*(1), 101-120.
Parto, S., Norouz Borazjani, V., & Mirshahzadeh, S. (2021). Reading the effective factors of spatial atmosphere of contemporary mosques, based on grounded theory approach. *The Monthly Scientific Journal of Bagh-e Nazar*, *18*(95), 5-18. https://doi.org/10.22034/bagh.2020.241593.4613
Rapoport, A. (1977). Human Aspects of Urban Form: To- wards a Man Environment Approach to Urban Form and Design. In (pp. 48-201). Oxford: Pergamon Press.
Salama, A. M. (2009). Shaping architectural discourse by architecture students at Queen's University Belfast. *ArchNet-IJAR: International Journal of Architectural Research*, *3*(2), 130-173.
Sarıhan, F. Z. (2015). *Türk mimarisinde cami imajı algısı (Biçim-form üzerinden bir yaklaşım)* [Master Thesis, Fatih Sultan Mehmet Vakıf University, Graduate School of Natural and Applied Sciences]. Istanbul.
Satır, M. E., & Çetin, C. (2019). Toplumsal gerçekliğin ideolojik inşasında bir kitle iletişim aracı olarak sinemanın rolü: Potemkin Zırhlısı filmi örneği. *Anadolu Üniversitesi İletişim Bilimleri Fakültesi Uluslararası Hakemli Dergisi*, *27*(2), 129-146.

DOI: 10.15320/ICONARP.2024.279

Shah, M., Utaberta, N., Mohd Yunos, M. Y., Ismail, N., Ismail, S., & Mohd Ariffin, N. (2015). A critical review on society's perception on the usage of mosque. *RESEARCH JOURNAL OF FISHERIES AND HYDROBIOLOGY*, *10*(14), 38-41. https://doi.org/doi.org/10.31436/id.v18i1.140

Shulz, C. N. (1966). *Intentions in Architecture*. Cambridge, Mass.: The MIT Press.

Solmaz, B., Tekin, G., Herzem, Z., & Demir, M. (2013). İnternet ve sosyal medya kullanımı üzerine bir uygulama. *Selçuk İletişim*, *7*(4), 23-32.

Şahin Çelik, E. (2013). *Çağdaş cami tasarımlarına yönelik kullanıcı algısı* [Master Thesis, Gazi University, Graduate School of Natural and Applied Sciences]. Ankara.

Şentürer, A. (1995). *Mimaride estetik olgusu*. Istanbul: ITU Faculty of Architecture Print Workshop.

Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics: Pearson new international edition*. Pearson Higher Edition.

Taib, M., & Rasdi, M. (2012). Islamic architecture evolution: Perception and behaviour. *Procedia - Social and Behavioral Sciences*, *49*, 293–303. https://doi.org/10.1016/j.sbspro.2012.07.027

Taşar, E. S., & Düzenli, H. İ. (2020). Türkiye'de cami gündemi, medya ve mimarlık (2009-2013): Şakirin, Mimar Sinan, Çamlıca ve Sancaklar Camileri üzerine. *Milel and Nihal*, *17*(2), 299-332. https://doi.org/https://doi.org/10.17131/milel.804017

Ürey, Ö. (2010). *Use of traditional elements in contemporary mosque architecture in Turkey* [Master Thesis, Middle East Technical University]. Ankara.

Yılmaz, A. (2020). *Küreselleşme ekseninde kitle iletişim araçları ve toplumsal olaylara etkisi* [Master Thesis, Akdeniz University, Department of Radio, Television and Cinema]. Antalya.

Yürekli, K. F. (1977). *Çevre görsel değerlendirmesine ilişkin bir yöntem araştırması* [Doctoral Thesis, Istanbul Technical University]. Istanbul.

Web Page

http-1.Etimesgut Mosque. Retrieved from https://www.arkitera.com/haber/mekan-kimligi-ve-onu-modelleyen-isigin-siiri-etimesgut-camii-1965-1966/ [Access Date: 10.03.2024]

http-2.Kınalıada Mosque. Retrieved from https://www.arkitera.com/gorus/turkiyenin-en-iyi-modern-camileri/ [Access Date: 10.03.2024]

http-3. TBMM Mosque Retrieved from https://www.arkiv.com.tr/proje/tbmm-camisi/1815 [Access Date: 10.03.2024]

http-4.Batıkent Merkez Mosque. Retrieved from https://tr.foursquare.com/v/bat%C4%B1kent-merkez-camii/5217316111d2f480beaa51a8?openPhotoId=59352983e65d0c4629f7c33c [Access Date: 10.03.2024]

http-5.Sancaklar Mosque. Retrieved from https://www.arkitera.com/proje/sancaklar-camii/ [Access Date: 10.03.2024]

http-6.Sancaklar Mosque. Retrieved from https://emrearolat.com/project/sancaklar-mosque/ [Access Date: 10.03.2024]

http-7.Sancaklar Mosque. Retrieved from https://www.arkitektuel.com/sancaklar-cami/ [Access Date: 10.03.2024]

Resume

Begüm AKÖZ ÇEVRİMLİ. *In 2015, she completed her undergraduate studies in Architecture at Süleyman Demirel University. She participated in a one-year Farabi exchange program at Dokuz Eylül University. Starting her career as a research assistant at Nevşehir University's Architecture Department in 2017, she earned her master's degree from Süleyman Demirel University's Architecture Department in 2018. In the same year, she was assigned to Konya Technical University for her doctoral studies. In 2024, she obtained her Ph.D. in the Department of Architecture*

at Konya Technical University. She continues to work at Nevşehir Hacı Bektaş Veli University. Her research interests include environmental psychology, architectural design and urban design.

Ceyhan TAZEFİDAN. He graduated from the Department of Architecture in 2014. He started to work as a Research Assistant at Aksaray University in 2017. He received his master's degree from Selcuk University in 2018 and still continues his PhD. His areas of interest are historical buildings, architectural restoration, space syntax studies, data mining, artificial intelligence in architecture. He has been working as a Research Assistant at Konya Technical University since 2018.

Hande Büşra GEYİKLİ is an architect, academic, and researcher. After graduating from the Department of Architecture at Selçuk University in 2014, she worked as an architect in an architectural office for 1.5 years. In 2016, she started working as a research assistant in the Department of Architecture at Ondokuz Mayıs University. During this time, she completed her master's thesis titled "Examination of vertical green facades and green roofs in terms of ecological criteria and evaluation of energy efficiency" at Selçuk University's Department of Architecture. Subsequently, in 2018, she began her doctoral studies in the Department of Architecture at Konya Technical University while continuing her role as a research assistant. In 2023, she completed her doctoral thesis titled "The effect of built environment parameters on microclimate and outdoor thermal comfort in different urban textures: The case of Konya city." Currently, she continues her duties and research at the Department of Architecture at Ondokuz Mayıs University, focusing on urban heat island effect, outdoor thermal comfort, and microclimate studies.

DOI: 10.15320/ICONARP.2024.279

ICONARP
International Journal of Architecture and Planning
Received: 10.04.2023 Accepted: 11.12.2023
Volume 12, Issue 1/ Published: 30.06.2024
Research Article *DOI: 10.15320/ICONARP.2024.280 E- ISSN:2147-9380*
ICONARP

Layering Analysis of Typomorphology Dynamics in Rural Settlements Using the AHP Method

Begüm Demiroğlu İzgi*

Abstract

The objective of this study is to identify the typomorphological dynamics of rural settlements and to prioritize them hierarchically using the Analytical Hierarchy Process (AHP) method. Furthermore, the study aims to investigate changes in the top three dynamics over time in a sample village through the application of fractal and space syntax analysis. The dynamic and sub-dynamic elements of typomorphology were gathered from previous studies carried out at the urban and rural scales, and their equivalents in the rural settlement context were determined. The study participants, including 26 academics and independent architects and urban planners, were asked to participate in an online survey to rank the 12 typomorphological dynamics identified. The results were analyzed to determine the weighted outcomes of the dynamics and to form a hierarchical order of importance. The consistency ratio was also calculated. A fractal and space syntax analysis were conducted for the first three dynamics in a sample village to analyze the adaptation and mutation processes of the settlement region. The AHP results showed that cultivated and natural areas, socio-spatial references, and road/path networks are the key dynamics in the typomorphological analysis of rural settlements. The results emphasize the importance of enacting rural protection laws to regulate settlement and agricultural activities, given the significant impact of economic and demographic changes on rural settlement morphology. The study also highlights the need for sustainable land use practices that balance human settlement and agricultural activities with the preservation of natural ecosystems. Furthermore, the study underscores the role of road/path networks in shaping occupancy and emptiness. The results offer valuable insights into monitoring rural dynamics and managing rural settlements. The identified dynamics and their weighted values can guide decision-makers in rural planning and development.

Keywords:
Morphological dynamics, Typomorphology, Analytical hierarchy process (AHP), Rural settlements, Layer analysis

** Yozgat Bozok University, Department of Architecture, Yozgat, Türkiye.
(*Corresponding author*)

Email: begum.demiroglu@yobu.edu.tr

To cite this article: Demiroğlu İzgi, B. (2024). Layering Analysis of Typomorphology Dynamics in Rural Settlements Using the AHP Method. *ICONARP International Journal of Architecture and Planning*, 12 (1), 162-188. DOI: 10.15320/ICONARP.2024.280

INTRODUCTION

Housing has been a fundamental human need from ancient times to the present day. It follows the need for sustenance, which is considered a basic requirement for daily life, and is followed by the need for protection and shelter. Once individuals have satisfied their personal basic needs, they make efforts to understand their relationship with the environment, which is both an individual and a sociological aspect of living. Economic, social, cultural, and political factors play a continuous role in shaping the concept of housing.

Giddens (1971) analyzed the perspectives of prominent social theorists Marx, Durkheim, and Max Weber concerning the relationship between individuals and the environment within the framework of capitalism and the theory of modern society. Within this context, Giddens scrutinized the views of these three great sociologists on class struggles and the economy, the perspective of social integration and order, and ideal types. Giddens delves into how these theoretical frameworks can be applied to contemporary social structures and how they serve as the underpinnings of modern social theory. He further examined how people's responses to their natural environment impact their social structures, illustrating the interconnectedness of these reactions with culture, technology, and economic factors. Berger & Luckmann (1966) stated that individuals' reactions to their environment are an integral part of the social construction process and shape perceptions of their environment. Their work emphasises how people's interactions with the environment contribute to the ongoing construction of social reality. They argue that the ways in which individuals interpret and respond to their environment are deeply intertwined with the broader social frameworks within which these interactions take place. This perspective underlines the spatial implications of the dynamic and reciprocal relationship between individuals and their environments in the context of social construction.

The concept of space is defined not only by the dwelling itself but also by the combination of families, culture, and the evolution over time (Tanoğlu, 2010). Lefebvre (2014) and Stavrides (2016) view space not only as a physical entity but also as a reflection of social relationships and the social world. Beyond being a product of social, cultural, and communicative memory, space also functions as a guide(Ata & Başar, 2023). Space, while exhibiting subjective variations among individuals in its definition, possesses common qualitative and quantitative characteristics depending on shared reference points (Lefebvre, 2014). Social spaces such as settlements are formed through the harmonious and subjective syntax of qualitative and quantitative actions. Spatial studies focus on the concept of "genius loci," emphasizing the objectivity of collective unity and encompassing not only the subjectivity of individuals but also the collective actions of the community (Norberg-Schulz, 2019). This perspective establishes the integrity of space through a balance between meaning and structure. Place identities are expressed

DOI: 10.15320/ICONARP.2024.280

through various qualifications such as personal experience, ethnographic narrative, literary traditions, and popular culture, forming cultural hierarchies (Ching & Creed, 2013). The identity of a city and the formation of space progress parallelly over time, with urban transformation shaping the identity of the city (Lukez, 2007).

The long-term evolution of rural settlements has been shaped by the influence of collective living examples inherited from ancient times. These settlements, with economies based on agriculture and livestock, have maintained similar settlement characteristics from the past to the present (Taş, 2016). According to Taş (2016), settlement includes the housing units that people create depending on the space in order to sustain their lives. According to Cromartie & Bucholtz (2008), the concepts of rural and urban areas cannot be separated by a single definition and are multifaceted. The definition of rural areas differs in demographic, economic and scale dimensions and according to Tacoli (1998), these areas reflect the social, cultural and political aspects of the society in which they are located.

The definitional distinction between urban and rural areas is established by parameters such as economy, settlement size, demography, administrative boundaries, and more. In broad terms, cities can be characterized as settlements with sizable populations, a specific labor-power structure, social order, and a distinct settled culture (Sencer, 1979). Architects and urban scientists classify cities based on environmental, historical, social, economic, and planning theories (Keleş, 1990). While rural settlements also encompass all these abstract and concrete parameters that define a city, their definitions diverge from those of urban areas. Globally, rural areas are commonly defined based on land use, demographics, and economic factors; however, these definitions vary depending on local policies and characteristics (Sazak, 1990). With the transition to a production-based economy, the initial permanent settlements of humans are referred to as rural areas (Erkan, 2002). Classifications based on population density and numbers blur the relationship between rural and urban areas (URL 1). Rural areas can be characterized as intervention areas created either by natural processes or human activities; simultaneously, they encompass regions outside urban areas where geography plays a determinative role (Kurt, 2003). The definition of rural areas in the literature has been shaped through the utilization of administrative organizations, economic data, and demographic boundaries. Unlike urban areas defined by their sizes, rural areas can generally be characterized as diverse landscapes hosting various human economies. Although there are settlement forms with similar dynamics, rural and urban settlements are considered to be socially distinct from each other beyond dimensional differences. However, it cannot be ignored that each rural settlement can enter the urbanisation process over time and evolve its settlement identity into an urban one. Therefore, rural settlements are not merely a collection of residences; rather, they represent structural associations based on

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

settlement patterns, social organizations, and the aggregate of economic activities of regional users (Hill, 2003).

The dynamics used in the analysis of settlements are largely shaped at the urban scale, which has a regular settlement pattern. On the other hand, rural settlements are not only textures formed by organic dynamics. The formation of settlements with the subjective combination of abstract and concrete, built and natural environment data originates from a temporal stratification process and finally takes its present form. Rural typomorphological settlements can be analyzed through various methods. In their study, Ozorhon & Ozorhon (2021) emphasized the instructive potential of traditional rural living spaces for sustainable living. Utilizing a multi-layered model, they systematically explained the relationship between physical features and environmental sustainability parameters. Tian et al. (2014) examined rural areas based on expansion factors. In this context, they utilized criteria such as agricultural land, water, roads, and distance to the center for evaluation. The study revealed the changes in rural areas and demographics in the Beijing metropolitan region from 1978 to 2008. Yao & Wu (2023) analysed the spatial and temporal characteristics of rural settlements in the middle Yangtze River region using remote sensing monitoring data covering the period from 1990 to 2020 and revealed the factors affecting spatial change. They analysed a total of 13 parameters under two main headings of natural factors and socio-economic factors. Wang et al. (2022) employed eight datasets for rural settlement detection in China. Using a digital-based rural settlement analysis, they utilized spatial stratification techniques to group rural settlements, taking into account spatial autocorrelation and heterogeneity of rural settlements in China. Zhou et al. (2013) analysed rural settlement stratification in four stages: initial, transition, development and maturity stages. In the analysis, they analysed the effects of natural environment, infrastructure, urbanisation and rural industrial transformation, land use reform and innovation, regional cultural heritage and integration, rural household behavioural transformation and macro control policy dynamics on rural settlement evolution. In addition, they applied a new integrated method to rural settlement analysis by dividing rural settlements into three basic groups as basic, new type and mutation according to their formation and development stages. Xiao et al. (2023) studied seven multi-ethnic villages in the Dadu River Basin of Ganzi County and analysed the spatial patterns and influencing factors of different ethnic villages. The findings reveal commonalities in the location of the villages, how environmental influences shape spatial configurations, and how ethnic culture affects their internal structure. The study also shows how the rural area has evolved into a complex unit with a diverse and multi-layered character. Jia et al., n.d. (2023) examined the dynamics of the Rural-Urban Interface (RUI) through a comparative socio-spatial analysis approach and revealed the mechanisms of differentiation. Designed with the integration of geospatial analysis and qualitative methodologies, this

DOI: 10.15320/ICONARP.2024.280

study analyses the evolutionary stages of the RUI in detail in relation to historical and contextual factors. Yang et al. (2019) establishes a quantitative perspective with a scientific basis for the preservation and development of traditional rural spatial forms in rural settlement studies using the space syntax method. The spatial form of Baishe Village, characterized by historical and cultural features, and the relationship between spatial form and social activities of the users, are employed as fundamental analysis parameters in the study. Li & Mao (2022) address the transformation of the original rural culture and rural appearance of villages as the main problem. In their study, they applied the space syntax method in the form of axial analysis to the formal analysis of village streets. This study on rural settlement morphology and road trace change provides quantitative and interpretation of the stratification and chronological change of rural settlement morphology features. Hu et al. (2019) presented an integrated analysis of rural settlement with rural restructuring by selecting traditional villages in Huizhou as a sample. In this study, the researchers use the shape index of rural settlements to express the shape and compactness of rural settlements. They use the parameters of material space, social space and cultural space for a multidimensional analysis. In addition, the dynamics of the interaction of social, political and capital forces are also included in the conceptual analysis to understand the structuring mechanism. In their rural area study focusing on Pinggu District, Yanbo et al. (2018) constructed a multidimensional character assessment index system and a combination matrix to elucidate the depth and main components of rural settlement layout characteristics. Parameters such as rural settlement morphology, spatial scale, form and location were used in the research to typologically distinguish settlements. They also revealed the effects of infrastructure elements such as urban expansion and transport on the spatial status of rural settlements.

It is seen that many studies have been carried out in the morphological analysis of rural settlements. In these analyses, natural and built environment morphological parameters determined by the researcher are frequently used. In addition, there are studies in which many analysis parameters such as sustainability, rural policy, user mobility, rural character, expansion, etc. are applied in an integrated manner. However, concepts such as how the dynamics used in the morphological stratification analysis of rural settlements will be hierarchically ordered are unclear. The objective of this study is to assess the factors influencing rural settlements, categorizing them into abstract and concrete criteria, and establishing a hierarchical order for the concrete parameters through the Analytical Hierarchy Process (AHP) method. Furthermore, the study aims to examine the temporal evolution of the top three dynamics identified through hierarchical ranking in a sample village, Beyceğiz, employing fractal and space syntax analyses. This provides a realistic and analytical approach to reveal the change and transformation in the stratification process of the rural settlement. This study establishes a methodological intersection for the morphology of rural settlements among urban disciplines, digitization methods, and architecture. Furthermore, it will contribute the scholarly analysis of the evolution of rural settlements over time, a concept inherently multidisciplinary in nature.

DYNAMICS OF RURAL TYPOMORPHOLOGY

Residential areas are dependent on both abstract and concrete parameters that define their identity. Although these parameters may be the same for all settlement structures, the effects they create as a whole may vary. The same variable can have different effects in different settlements. The dynamics used in settlement morphology analysis can be referred to as dependent and independent variables.

Independent dynamics are relatively more abstract concepts in the morphological formation of settlements. They are variables that individuals cannot directly intervene in and are either management-related or matured within a process and made visible. Dynamics such as culture, socio-economics, and politics exist in every society, forming social cohesion;

CULTURE

According to Eker (2014), culture describes an organization in life and forms concepts such as identity, personality, understanding, and autonomy through the shaping of refined elements of this organization. Rapoport (1969) focuses on culture as the basis for the formation of architectural components in rural settlement structures. Cloke (2006) mentions that rural settlements encompass all types of cultures and can serve as a permanent living network for some, while for others, they may provide an alternative visitation destination to the city. In addition to its inherent cultural identity, today's mixed interaction culture also emerges in rural settlements.

SOCIO-ECONOMICS FACTORS

Residential areas are influenced directly by various demographic, social and economic factors that shape the lifestyle, personal and social use of time and space, and self-fulfillment tendencies of the individuals that make up the community (Gür, 2000). Hoggart (1988) characterizes urban socio-economic conditions as essentially similar to those of rural and surrounding rural areas. In contrast to urban areas, rural settlement patterns are more closely tied to the region's commonalities, such as language, religion, and ethnicity. The rural economy is primarily based on agriculture and animal husbandry. According to Geray (2011), the rural economy is typically evaluated in terms of the marketing, production, and problems of agriculture and animal husbandry, but it is also a comprehensive sociological phenomenon that includes human relationships, land organization, unemployment, rural infrastructure, administrative, educational and legal governance.

POLICIES

DOI: 10.15320/ICONARP.2024.280

Rural settlements are subject to government policies specific to their province, district, and country. According to Hillery (1955) the concept of a rural community is diverse, but its structural and relational issues can be addressed regionally and nationally through popular and political solutions recognized among social groups, families, and regions. However, all these policies have primarily examined regional development within the economic and political framework, providing support for urban development and subjecting the rural identity, which has a different spatiotemporal concept from the city, to major effects while providing minor benefits. Thus, the mutation/adaptation process of the subjective identity of each rural settlement pattern has been sidelined.

The morphological formation of settlements is dependent on dynamic variables that can be read through concrete data. The differentiation of one or more of these variables can change or transform the regional identity. To analyze the layering processes in settlements, dependent variables are often used by urban scientists. However, urban structures are usually selected as the sample for these studies, while rural settlement areas are grouped by geographical and economic data in morphological studies, making subjective analysis less detailed compared to urban areas. Nonetheless, the historical or touristic value of a rural region has made subjective analysis important for that region's analysis. In contrast, each rural settlement undergoes layering processes and experiences mutation/adaptation processes subjectively, similar to urban settlements, from their establishment to the present day.

In rural settlement patterns, dependent variables have a descriptive equivalent as in independent variables. However, they may be subject to a different hierarchy of importance than in urban settlements. This ranking is important for the numerical interpretation of the mutation/adaptation process of rural settlement patterns. Briefly, these dynamics can be defined as follows;

Cultivated And Natural Areas

Keleş (1998) and Çubuk (1985) define the design of spaces that benefit countries with rural areas where the economy is based on agriculture, animal husbandry, and forestry, and where there is a high level of individual relationships and a lack of division of labor. These researchers examine the form of cultivated and natural areas in rural settlements. While these areas ensure the region's economic sustainability, they undergo functional changes that directly affect the rural identity. Cultivated areas support agricultural activities, while natural areas conserve the region's natural resources and contribute to their sustainable use. Therefore, this dynamic contributes to the vitality of sectors such as farming and animal husbandry and the conservation and sustainable use of natural resources. These studies are important in understanding the future development and sustainability of rural settlements.

Socio-Spatial References

The socio-spatial references of rural settlements include factors such as the settlement's history, cultural roots, social structure, economic activities, physical structure, and ecological environment. These references are useful in determining the layers of settlement structures and developing strategies for their future development. The formation of the socio-spatial structure in rural settlements is a result of the interaction of internal and external factors. Internal factors include cultural fabric, traditions, social structure, and economic activities, while external factors include the dynamics of the natural and built environment. Changes in the functions of the natural and built environment lead to the emergence of socio-spatial references. The examination of the socio-spatial structure of rural settlements is important in identifying the factors that preserve and develop the identity of the settlement.

Establishment Years

In the analysis of rural settlement typomorphologies, the establishment years play a significant role. These years indicate how old the settlement is and the level of technology and resources available during that period. As the establishment years increase, the physical structure and planning of the settlement become more dependent on geographical features. Consequently, as we go back in time and move away from modern technology and resources, the typomorphology of rural settlements also changes. Additionally, as the establishment years increase, the layering of changes and transformations in the settlement's needs also increases. This allows for the reading of the settlement's adaptation and mutation process and directly affects other underlying dynamics.

Geomorphological Structure

The geomorphological features of a region play a crucial role in the formation of rural settlements. The landscape identity of settlement areas is determined by the characteristics of land form, land cover, and land use (Hernandez, 2007). Natural resources, land slope, geographical form, and agricultural and livestock potential are all important factors in the comprehensive selection of settlement areas. These dynamics are also significant in the identity classification of rural settlements. The comprehensive structure of this dynamic enables the identification of the landscape identity and the interpretation of its changes in rural settlements.

Demography

Rural areas undergo significant functional changes with shifts in their demographics (Selman, 2006). Demographics, which is a defining and classifying feature of rural settlements, varies in density across different rural settlement areas. Particularly, rural areas may face negative

DOI: 10.15320/ICONARP.2024.280

consequences due to emigration and the disappearance of rural residents (rural abandonment) or uncontrolled internal migration (sudden urbanization). However, ensuring a proportional distribution of the existing demographics rather than concentrating on a single age group is more beneficial for rural settlements.

Hydraulic Structure

Water resources are one of the main factors determining the location of rural settlements. Prior to modern technologies, proximity to water sources was a significant determinant in the location of settlements in traditional agriculture. For rural settlements with agriculture and arable land-based economies, proximity to water sources is a critical requirement (Christaller, 1933). The geographic location of settlements must be close to water for the region's economy and compact structure's self-sufficiency. (Hill, 2003) identifies the hydraulic structure, which is the most important determinant and classifier of the location of villages, as one of the five fundamental elements of rural settlement (Figure 1).

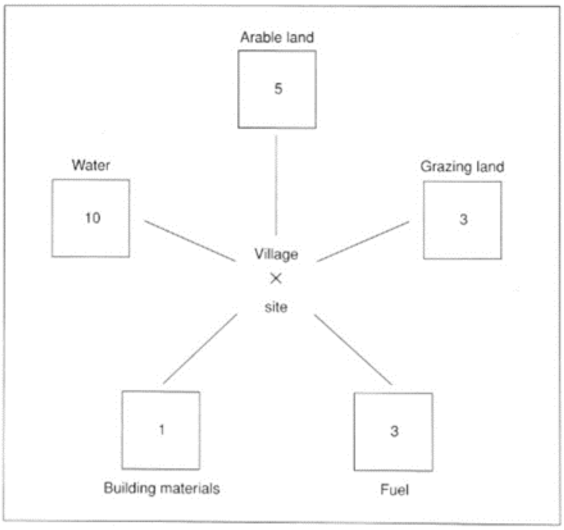


Figure 1. Chisholm's model of settlement location (Hill, 2003)

Attributes And Form Properties

Settlement areas are formed by many factors such as geographical characteristics, socio-cultural characteristics, climate conditions, and state and private policies. Rural area economy also directly affects settlement patterns. Rural settlements with different qualities and living styles may show different formations even in the same geography. Settlement patterns are shaped according to hinterlands, road traces, and political planning. Initial settlements in rural areas usually started as clustering for defense and mutual assistance purposes, and with time, formal differentiations occurred through other dynamic changes. Essentially, there are two types of settlement patterns, clustered and dispersed (Antrop, 1988; Sharp, 1946).

When examining this topic, Sharp (1946) classified settlement types as clustered, dispersed, and mixed; and classified settlement patterns as

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

linear and clustered forms. These forms can also be classified as regular, irregular, and mixed settlement patterns.

Landmarks

The morphological structures of rural settlements are shaped by various factors such as subjective values, structural/natural topography, and the influence of the region. Unlike cities, each rural settlement is subjectively designed according to the region and its users, and has fewer buildings. Landmarks are important settlement features that stand out visually within the settlement silhouette in rural areas (Nita, 2015). In rural areas, landmarks are determined jointly by natural geography and human intervention, and the role of religious elements is also significant in characterizing users and settlements in rural areas. Mosques, squares, local government cafes, fountains, village halls, and other common areas in rural settlements are also considered landmarks. Topographic details such as sharp peaks, water sources, and landscape elements found in rural areas can also represent landmarks. Landmarks undergo changes and transformations over time, with new ones added to meet current needs. Existing landmarks may disappear, continue to coexist with new ones, or lose their importance.

Road/Path Networks

Settlements are dynamic spaces that interact both socially and physically with each other and their surrounding environment. The morphology of a settlement is influenced by neighborhood relationships and main transportation axes within and surrounding the settlement. The form of roads in a rural region, connecting it to other rural areas and urban centers, largely determines the spatial structure. Internal road networks shape daily activities, neighborhood relationships, and transportation within the region, while external road networks establish connections between the region and neighboring rural and urban centers. Rural roads have a significant impact on the development index (Barrios, 2008).

The transportation networks in rural areas were initially formed in a haphazard and organic manner. However, over time, various factors such as technology, trade, and communication have led to the differentiation of these networks, influencing their spatial forms. This differentiation has been instrumental in shaping the protection of rural settlements, farms, and agricultural areas, along with other non-abstract dynamics such as climate conditions, terrain data, and religious factors. In rural areas, networks that connect settlements, farms, and agricultural areas are important for regional accessibility (Kılınçaslan et al., 2012).

Solid-Void Composition of Buildings and Building Bocks

Particularly for settlements with a founding year dating back to a distant past, the geography plays the most determining role in the formation of building clusters. Depending on whether the region is flat or

DOI: 10.15320/ICONARP.2024.280

hilly, the building clusters can either follow each other or be spaced apart. The concept of fullness and emptiness is essentially related to the scale of the site; it concerns the proportional distribution of built and natural environmental factors. Within the built environment, user interventions in the region such as residences, vegetable gardens and orchards, gathering areas, squares, and agricultural fields are taken into consideration. In addition, for rural settlements with an economy based on agriculture, agricultural fields constitute an important parameter. The evolution of rural settlements is closely related to economic development and its supporting parameters (Oldfield, 2005). Over time, the built and natural environment-derived ratio of fullness and emptiness in rural areas changes.

Height of Buildings

In rural settlements, both changes in location and the vertical impacts of the built environment are crucial factors in the construction of buildings. Generally, the construction materials used in these settlements can be obtained from natural resources and are used in a manner that is in harmony with the region's natural landscape. Structures that are initially in harmony with the natural environment in the early settlements tend to differentiate over time due to the effects of building materials, heights, and changes in the landscape.

METHOD

The methodology and flow chart utilized in the study are presented in Figure 2. The AHP, fractal analysis, and space syntax methods utilized are elaborated upon in detail in this section.

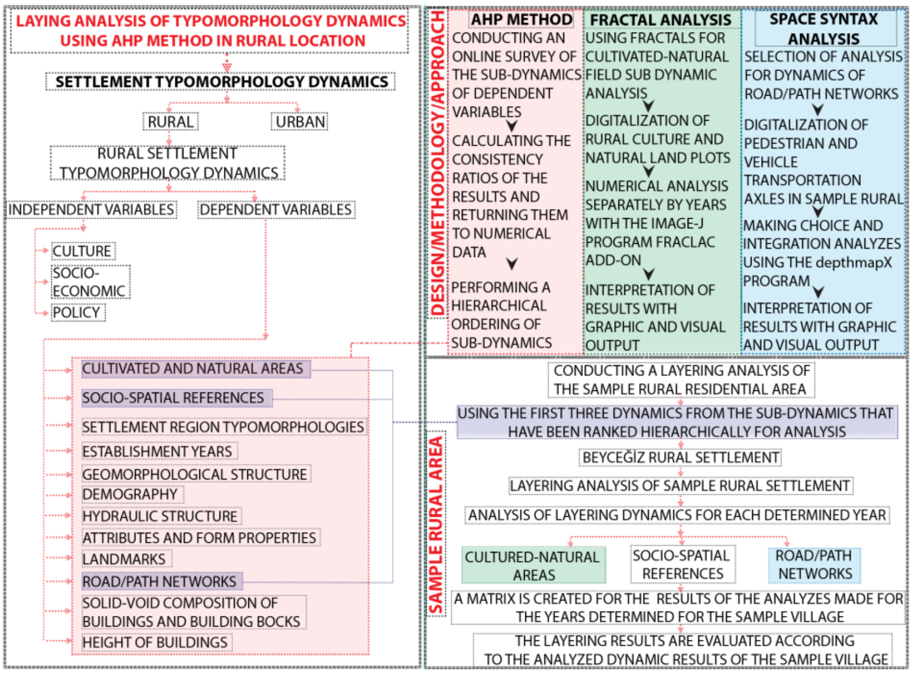


Figure 2. Research and flow chart

Fractal Analysis Method

The term "fractal" is derived from the Latin word "fraktus". It was coined by Mandelbrot to describe the combination of multiple pieces into a single large object (Mandelbrot & Mandelbrot, 1982). Fractal mathematics, which connotes fragmentation and brokenness, is employed in numerous disciplines to explain the relationship between parts and the whole.

Fractal geometry is a mathematical approach used to define and depict irregular and fragmented natural phenomena (Mandelbrot & Mandelbrot, 1982). Fractal calculations can be performed on objects with varying shapes, as defined by Euclidean geometry. The concept of dimension, which is crucial to the analysis, is used to describe objects in geometry. Both the object or group of objects to be analyzed and the abstract grid measures and scales used in the description are completely defined. Self-similarity, iterative measurement, and box counting methods are sub-analytic computations in fractal analysis (Kanatlar, 2012).

Housing and building blocks, which are important parameters of settlement morphology, are in a diachronic semantic relationship rather than instantaneous analysis. The settlement patterns of structures and building blocks with different forms can be analyzed using the fractal box-counting method. A semantic pixel grid is defined on the settlement patterns reduced to two dimensions. Boxes forming the pixel grid are reduced and enlarged in the aspect ratio, and the solid-void counts are performed at each different scale. While proportional growth occurs, the starting points for box counting can also be selected multiple times. The situation between two different box sizes is calculated as (Bovill, 1996):

$$D = \frac{\log(a) - \log(b)}{\log(c) - \log(d)} \qquad (1)$$

where D is fractal value (2 > D > 1), a and b are the number of filled boxes counted in the next and previous iterations; c and d are the number of boxes on the bottom line in the next and previous iterations.

An average fractal value (D) is expected to be between 1 and 2. As the result approaches 1, the presence of regular, simple, and linear geometric forms is indicated, while a result close to 2 shows a combination of irregular geometric shapes. This method, which emphasizes the mathematical balance between filled and empty space, helps to perceive the entropy status of the same or different types/tipologies. However, the situation where different density building regions are in the same order will cause fractal values to be similar. The lacunarity value in this situation will show the density difference. The method can be performed manually or through software programs. In this study, the FaracLac plugin of Imagej program was used to calculate the lacunarity and fractal values of the settlement area in different years. The maximum given by the program's grids was used for analysis. The method was used to

DOI: 10.15320/ICONARP.2024.280

understand the changes/transformations of cultivated-natural areas over time. The solutions made for determined years will show the relational status of the settlement's cultivated-natural areas with structural boundaries in layering analysis.

Space Syntax

The space sytntax method of the spatial configuration approach within the field of urban morphology is utilized in the analysis of multiple relational networks. This method is used to establish a hierarchical ranking of objects' movement areas, identify their relational situations, and analyze many spatial and urban settlement aspects, such as visibility, street-road-parcel configuration. Configuration is defined as a relationship network that calculates other relationships, and the quantitative expression technique of part-whole relationships is used in architectural and settlement locations with space syntax. The space syntax method demonstrates that the structural density and the constant symbiotic relationship between the road-street voids constitute the urban built environment within a dynamic lifestyle. The diachronic semantic relationships of changing/transforming settlement dynamics can be read quantitatively using the space syntax method (Hillier, 2007).

Based on the studies conducted by Hillier (2007), this method can provide strong predictions on pedestrian movement networks. The method successfully reads the movement corridors of urban settlements and allows for comparison over time (Penn et al., 1998). Multiple analytical tools are utilized for the analysis of transportation network dynamics, leveraging the segment map sub-analysis. This method aims to quantitatively read the transformation process of rural settlements by analyzing the movement corridors between the identified years.

The likelihood of a specific area being selected for development can be emphasized through the utilization of segment analysis, which employs the reading of choice and integration values. The results of this analysis can be used to determine which areas are more or less preferred over time. Additionally, the accessibility of a particular area within a settlement can be demonstrated through integration analysis. By comparing the results of this analysis over time, it is possible to identify which areas are more or less accessible for development.

The application of the method was realized through the Depthmap software. In the analysis to be calculated using the program, more heavily used axes are represented in shades of red, while relatively sparser axes are represented in shades closer to blue (İlhan, 2019).

AHP Method

The Analytic Hierarchy Process (AHP), developed by Thomas L. Saaty, is a mathematical-based method that provides solutions to multi-criteria decision-making problems involving more than two alternatives. This method solves problems by allowing decision makers to rank the criteria and sub-criteria in order of importance and then rank the alternatives found accordingly using Saaty's 1-9 scale, based on the priority of the criteri (Saaty, 1980) . AHP is a commonly used measurement method in multiple decision-making choices, and it is applied using measurable criteria and mathematical operations. The success of this method depends on the careful selection of criteria and the creation of a hierarchy based on those criteria. The importance of data and experience in selecting criteria cannot be overstated. The simplicity and versatility of this method are among its key strengths, as it can be applied under various conditions (Tombus & Ozulu, 2007).

The AHP method involves the following steps:

1. Hierarchical Structuring: The problem is structured hierarchically with a goal at the top, followed by a set of criteria and sub-criteria, and finally a set of alternatives.
2. Pairwise Comparisons: Pairwise comparisons are made between each criterion and sub-criterion to determine their relative importance. A scale of values from 1 to 9 is used to represent the relative importance (Table 1)
3. Consistency Check: The consistency of the pairwise comparisons is checked to ensure that the judgments are coherent and logical. A consistency ratio (CR) is calculated to measure the consistency of the judgments. A CR value of less than 0.1 indicates an acceptable level of consistency.
4. Weight Calculation: The weights of each criterion and sub-criterion are calculated by synthesizing the pairwise comparison judgments. The weights are calculated by multiplying the normalized weights of each criterion by the corresponding normalized weights of its sub-criteria.
5. Aggregation: The weights of the alternatives are calculated by aggregating the weights of the criteria and sub-criteria that are relevant to each alternative (Figure 3)

Table 1. Saaty's 1-9 scale

Scale	Description
1	Equal importance
3	Moderate importance
5	Strong importance
7	Very strong importance
9	Extreme importance
2, 4, 6, 8	The importance between each of the above two scales

DOI: 10.15320/ICONARP.2024.280

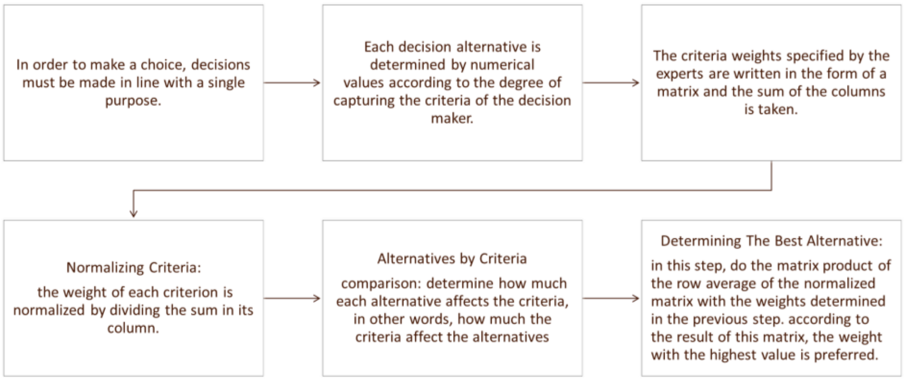


Figure 3. AHP method flow chart

SAMPLING AREA

This study focuses on analyzing the morphological layering of rural settlement patterns using multiple methods. A rural settlement, Beyceğiz neighborhood (village) in Polatlı district of Ankara, was selected as the study area (Figure 4). Polatlı is located in the southwest of Ankara and is 78 km away from the city center. It was established as an independent town under the jurisdiction of Haymana district in 1908 during the reign of Sultan Abdulhamid II. Polatlı, which has developed during the Republic era, consists of numerous villages (neighborhoods) outside the district center. Some of these villages were established even before the establishment of Polatlı center (Erdoğan, 2013).

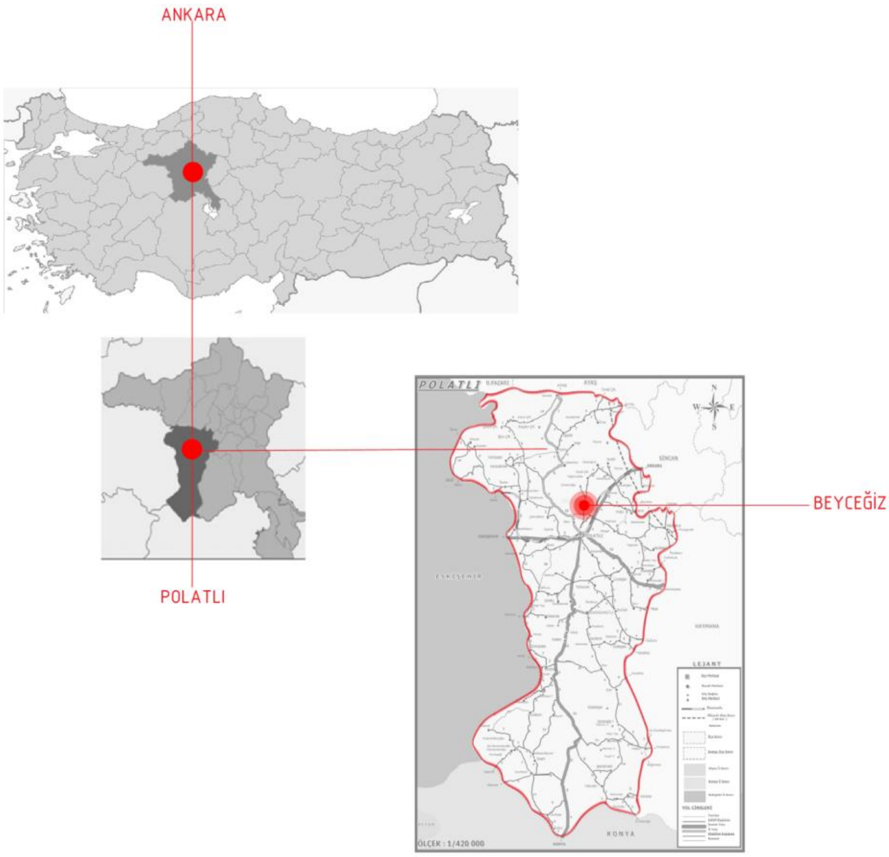


Figure 4. Ankara-Polatı and Polatlı-Sample Villages location

Beyceğiz Village is located 7 km north of Polatlı city center and 3.6 km away from the Ankara-Polatlı highway, on the natural valley slope formed by hilly terrain (Figure 5). The proximity of the village to the Ankara highway has provided an opportunity for settlement development along the road axis. The main source of livelihood in the village is agriculture and animal husbandry. The areas outside the settlement center are predominantly used as agricultural land, showing a natural morphological pattern. The village has been inhabited since ancient times and features the "Karatepe" mound and the "Belkavak" tumulus. The Ankara-Polatlı road, which intersects the village along a north-south axis, forms a threshold for the new settlement area while passing through the first settlement area. (Demiroğlu, 2020; Erdoğan, 2013).

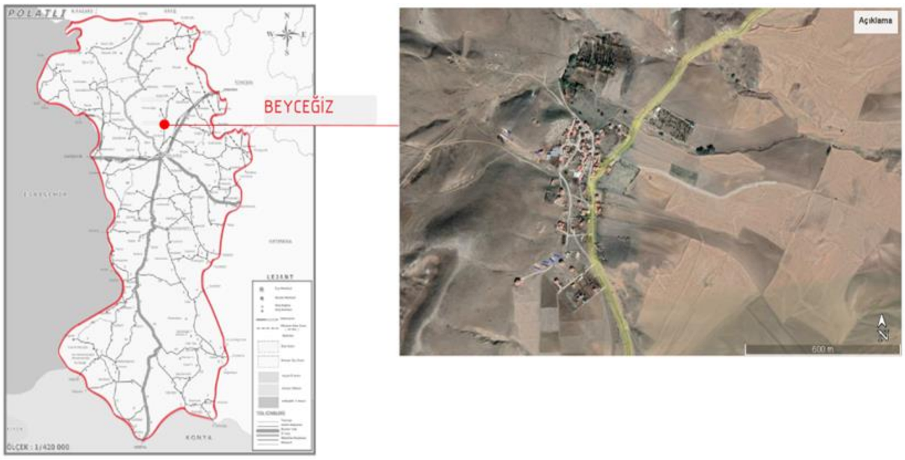


Figure 5. Polatlı-Beyceğiz village location/Google earth image

FINDINGS AND RESULTS

AHP Results

After conducting a literature review, 12 morphology dynamics were determined and applied online via Google Forms by architects. All responses provided in the survey were evaluated for consistency using the Analytic Hierarchy Process (AHP) method. For this purpose, the consistency of each dynamic was tested through a 12x12 matrix generated by pairwise comparisons, and responses with a consistency ratio <0.10 were selected to determine their weightings. In the survey conducted via Google Forms, 10 consistent responses were found among the 28 participants. Based on these data, the weighted values of each dynamic were calculated, and their averages were ranked.

Table 2 presents the hierarchical ranking of 12 dependent variables based on their average weight values. As seen in Figure 6, cultivated and natural areas have been identified as the most important dynamics in the typomorphological analysis of rural settlements. Socio-spatial references, which play a significant role in shaping the identity and formation of settlement areas, are ranked as the second degree of importance. Road/Path networks, which serve as corridors for vehicular and pedestrian movements, are ranked third in the analysis.

DOI: 10.15320/ICONARP.2024.280

Table 2. 10 questionnaires and weighted dynamics that were taken into consideration in the AHP method

Number Of People/ Dynamics	1	2	3	4	5	6	7	8	9	10	Average Weight
Cultivated And Natural Areas	0,136	0,115	0,119	0,106	0,048	0,114	0,064	0,186	0,136	0,186	**0,121**
Socıo-Spatial References	0,129	0,108	0,142	0,226	0,091	0,077	0,037	0,104	0,129	0,104	**0,115**
Settlement Region Typomorphologies	0,094	0,057	0,104	0,083	0,279	0,169	0,070	0,017	0,094	0,017	**0,098**
Establishment Years	0,037	0,033	0,087	0,066	0,027	0,029	0,035	0,085	0,037	0,085	**0,052**
Geomorphological Structure	0,072	0,139	0,101	0,048	0,048	0,139	0,059	0,036	0,072	0,036	**0,075**
Demography	0,148	0,036	0,066	0,088	0,030	0,029	0,052	0,085	0,148	0,085	**0,077**
Hydraulic Structure	0,069	0,127	0,071	0,045	0,048	0,063	0,077	0,016	0,069	0,016	**0,060**
Attributes And Form Properties	0,099	0,089	0,061	0,093	0,132	0,098	0,075	0,038	0,099	0,038	**0,082**
Landmarks	0,095	0,069	0,079	0,040	0,087	0,039	0,114	0,194	0,095	0,194	**0,101**
Road/Path Networks	0,072	0,127	0,061	0,049	0,035	0,119	0,117	0,188	0,072	0,188	**0,103**
Solid-Void Composition of Buildings and Building Bocks	0,028	0,059	0,056	0,087	0,091	0,058	0,173	0,018	0,028	0,018	**0,062**
Height Of Buildings	0,023	0,040	0,053	0,068	0,085	0,066	0,128	0,033	0,023	0,033	**0,055**

In the hierarchical ranking, the "establishment year" dynamic is located at the bottom of the table. The establishment year plays a significant role in the layering history of the settlement area. However, it is observed that it has a less influential role compared to the other 11 dynamics in typomorphological analysis.

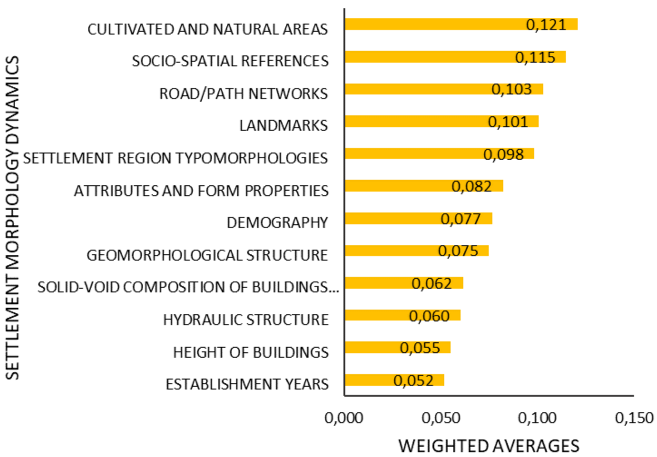


Figure 6. Weighted rankings of dynamics

Based on the AHP results, the top three dynamics selected for conducting a layering analysis on a sample area were "cultivated-natural areas, socio-spatial references, and road/path networks." Fractal analysis was used for the cultivated-natural areas dynamics, matrix analysis for socio-spatial references, and space syntax for the road/path networks dynamics.

Fractal Analysis Results of Cultivated-Natural Areas

The fractal analysis method was used to analyse the dynamics of the cultivated-natural area in the sample region, the village of Beyceğiz. The changes in agricultural and residential parcels of settlement areas over the years were overlaid on top of each other on a photo and vector map and subjected to fractal analysis. Changes that occurred in agricultural and residential parcels over the years were converted into a 2D jpeg format and individually analyzed at 8-bit, 2446x2726 pixel with a 300 dpi resolution. For each year, 12 starting points were selected and the average error rate was minimized using the fractal analysis method. The numerical results of the fractal analysis, including the lacunarity (λ) and fractal mean (DB), were presented in line graph form using Excel.

Beycegiz village is located in a rural area where agricultural activities play a significant role in shaping the landscape and settlement patterns. The fractal analysis conducted in this study aimed to assess the changes in settlement typomorphology and cultivated-natural areas over time, particularly between 1953 and 2019 (Aerial photographs were obtained from HGM) (Demiroğlu, 2020). The results of the fractal analysis are illustrated in Figure 7 and, the numerical results of fractal analysis, which include lacunarity (λ) and fractal mean (DB), are presented in Figure 8. The results of the fractal analysis showed that the fractal dimension value (DB) increased between 1953 and 1978, indicating a more irregular and fragmented settlement pattern due to the increasing number of built-up areas and cultivated lands. This increase can be attributed to the use of new agricultural machinery that enabled the use of previously uncultivated lands for agriculture. However, no significant differences were observed between 1978 and 1991, indicating a relatively stable settlement typomorphology during this period. Between 2013 and 2019, new settlement blocks were added to the south of the region, which led to an increase in fractal value due to the changes in the balance of cultivated-natural areas caused by the emergence of a secondary center.

DOI: 10.15320/ICONARP.2024.280

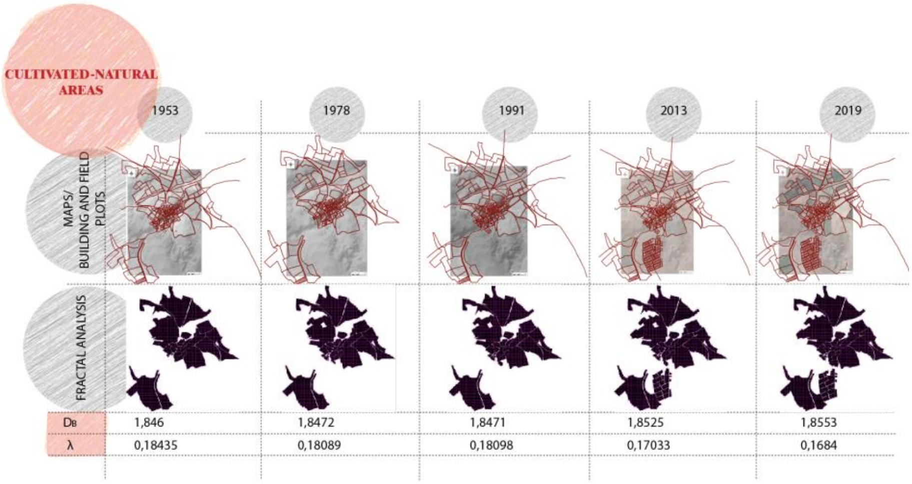


Figure 7. Beyceğiz village fractal analysis matrix

The lacunarity (λ) values also provided insights into the spatial distribution of built-up areas and their relationship with natural elements. The results showed that the lacunarity values decreased between 1953 and 1978, indicating a more homogenous and clustered settlement pattern. However, between 2013 and 2019, the lacunarity values increased, indicating a more fragmented and irregular settlement pattern due to the emergence of new settlement blocks.

Overall, the results of the fractal analysis suggest that the dynamics of settlement typomorphology and cultivated-natural areas in Beycegiz village have been shaped by human interventions such as the construction of new settlements and the conversion of agricultural lands for building constructions.

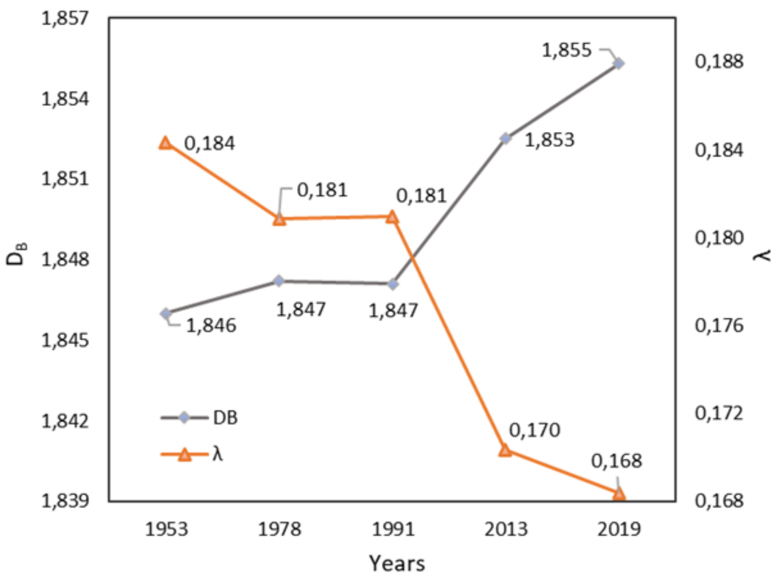


Figure 8. Beyceğiz village fractal analysis values

Space Syntax Results of Road/Path Networks Dynamics

Transportation routes were analyzed using the space syntax method. As a result of this analysis, the sparse and dense usage axes of residential structures and road/path networks were determined numerically. The generated axis map was analyzed in the Depthmap program, and integration and selection maps were created for transportation axes using the spatial arrangement method for the village of Beyceğiz. The values obtained from these analyses were calculated separately at global and local scales and were examined using two different standards for walking distance, namely 500 and 1000 meters. The transportation network was examined through segment analysis based on selection and integration averages. Choice analysis indicates the likelihood of a specific region being selected, while integration analysis determines its accessibility within the settlement area.

Space syntax results are illustrated in Figure 9 and the evolution of choice and integration outcomes for R500 and R1000 over years are presented in Figure 10. The results reveal significant changes in the settlement pattern over time, shaped by the dynamics of road networks and parcel textures, as well as the emergence of weekend houses and new settlement areas. In 1978, the Polatlı-Beyceğiz road served as the primary arterial road, which contributed to the formation of a linear and square-shaped road network, following the traces of neighboring parcels. The integration and choice values for both radii were relatively high, indicating good accessibility and connectivity within the settlement. However, the subsequent increase in housing and new parcel textures led to the emergence of new road networks, which partially disrupted the old network's hierarchy and coherence.

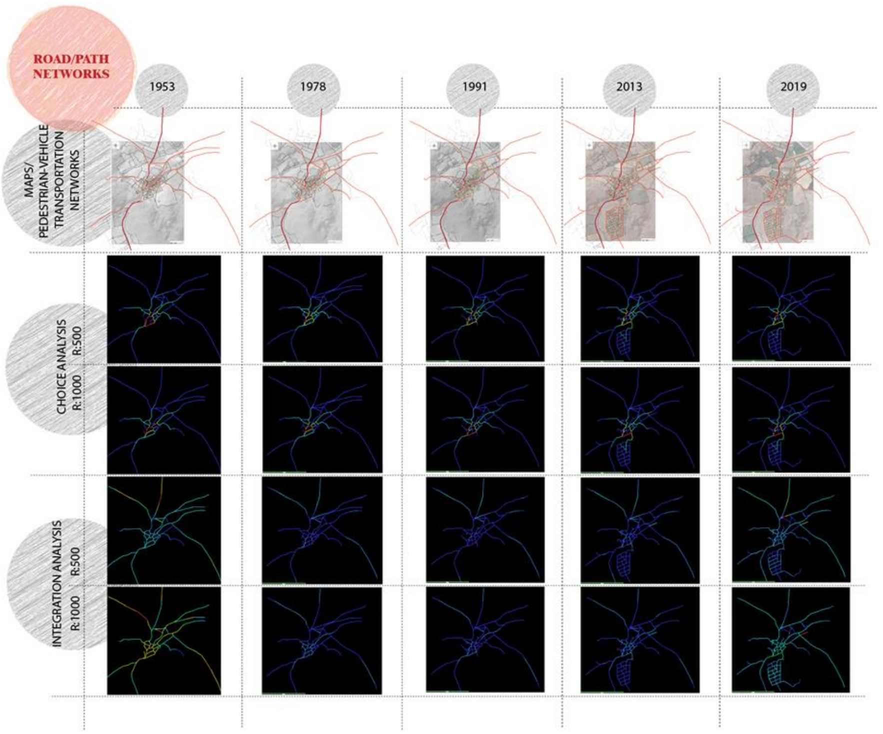


Figure 9. Beyceğiz village space syntax analysis matrix

In 1991, the integration and choice values for R500 radius decreased slightly, while those for R1000 remained stable. This suggests that the settlement's internal coherence and accessibility were partially

DOI: 10.15320/ICONARP.2024.280

compromised by the new road networks' emergence. However, the settlement maintained its connectivity with the surrounding region due to the continuous utilization of the Polatlı-Beyceğiz road as the primary transportation route

In 2013, the weekend houses' emergence and the formation of a new settlement area significantly affected the settlement pattern, leading to the formation of new road networks within and outside the settlement. The integration and choice values for R500 decreased further, indicating a less integrated and coherent settlement pattern. However, the values for R1000 increased significantly, reflecting a higher level of connectivity and accessibility to the surrounding area.

In 2019, the integration and choice values for both radii decreased again, indicating a continued decline in the settlement's coherence and accessibility. However, the values for R1000 remained relatively high, suggesting that the settlement still had a good level of connectivity to the surrounding area.

These findings have implications for architectural management, as they highlight the importance of considering the spatial configuration and accessibility patterns when designing and managing buildings in Beyceğiz Village. Specifically, the design and management of buildings should take into account the settlement's hierarchical road network and parcel textures, as well as the dynamics of the surrounding area's road networks. This can ensure that buildings are integrated into the settlement pattern and enhance the settlement's overall coherence and accessibility.

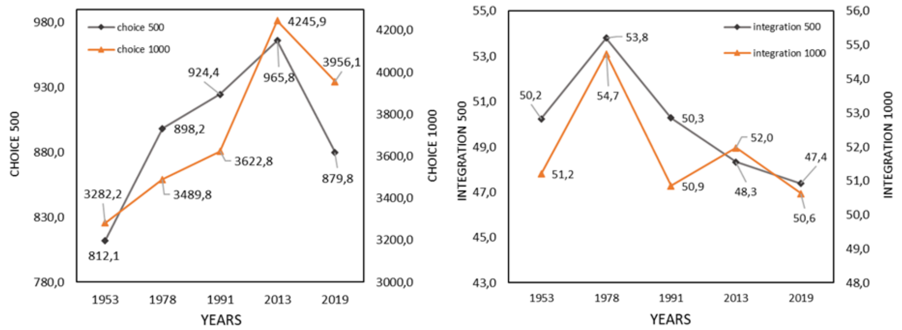


Figure 10. Beyceğiz space syntax Choice and Integration analysis values

Results of Socio-Spatial References

The Socio-spatial reference analyses covered the settlement pattern of the village, agricultural areas, clustered settlements, and proximity to the Polatlı district center as illustrated in Figure 11. The analyses conducted in Beyceğiz village have been examined over the years, and the results have been presented visually and in written form in a matrix format (Figure 12).

The expansion of the collective settlement over time has resulted in a new urban fabric around the reference points in the region. The areas outside the built-up zone are covered by agricultural fields, while the forested areas are less dense within the built-up zone. This settlement pattern has emerged along the Polatlı road due to its proximity to the district center and its connection to other villages. Over time, a second settlement pattern has been added to the growing built-up zone, which is located closer to the city and district center. This new settlement, established in the 2000s, encompasses dynamic structures such as seasonal residences and grid-like road systems.

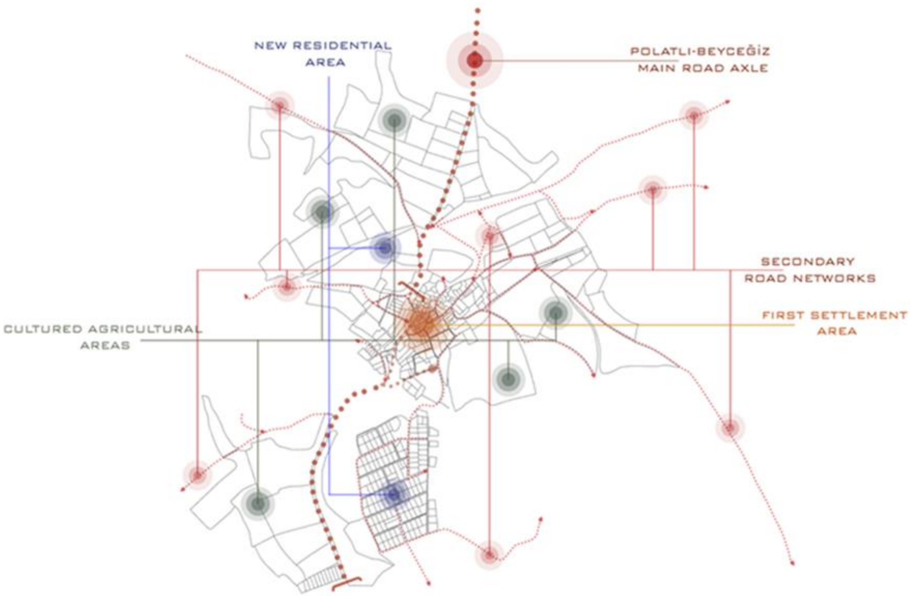


Figure 11. Beyceğiz Village Socio-Spatial settlement sketch

In the village, agricultural areas with rugged terrain are widely found outside the settlement area. The distant areas between these agricultural lands are filled with temporary, single-story houses for seasonal use. Footpaths and farm tracks made for these houses and agricultural vehicles have played a decisive role in the transportation network and structural partitioning of the region. In 1953, the settlement area in the village was used outside the agricultural fields, and the Beyceğiz-Polatlı road passes through the settlement pattern, and linear lateral roads were constructed to access the agricultural fields. Due to the morphological pattern of the village, agricultural fields are more densely developed than residential areas. The organic vegetation of the agricultural fields followed the natural topography of the village and was intervened for livestock farming. The structures built for the animals were constructed close to the residential area. In 1978, migration movements increased and agricultural areas increased slightly. New structures were built only as individual houses in the agricultural fields. The residential area increased in the southeast direction towards the Polatlı and Ankara Road. After 1991, the number of weekend houses with gardens increased, and the homeowners came from Polatlı, Ankara or nearby villages. Transportation roads and footpath axes increased, and morphological arrangements were formed. The residential area moved again towards the east side of the Polatlı road.

DOI: 10.15320/ICONARP.2024.280

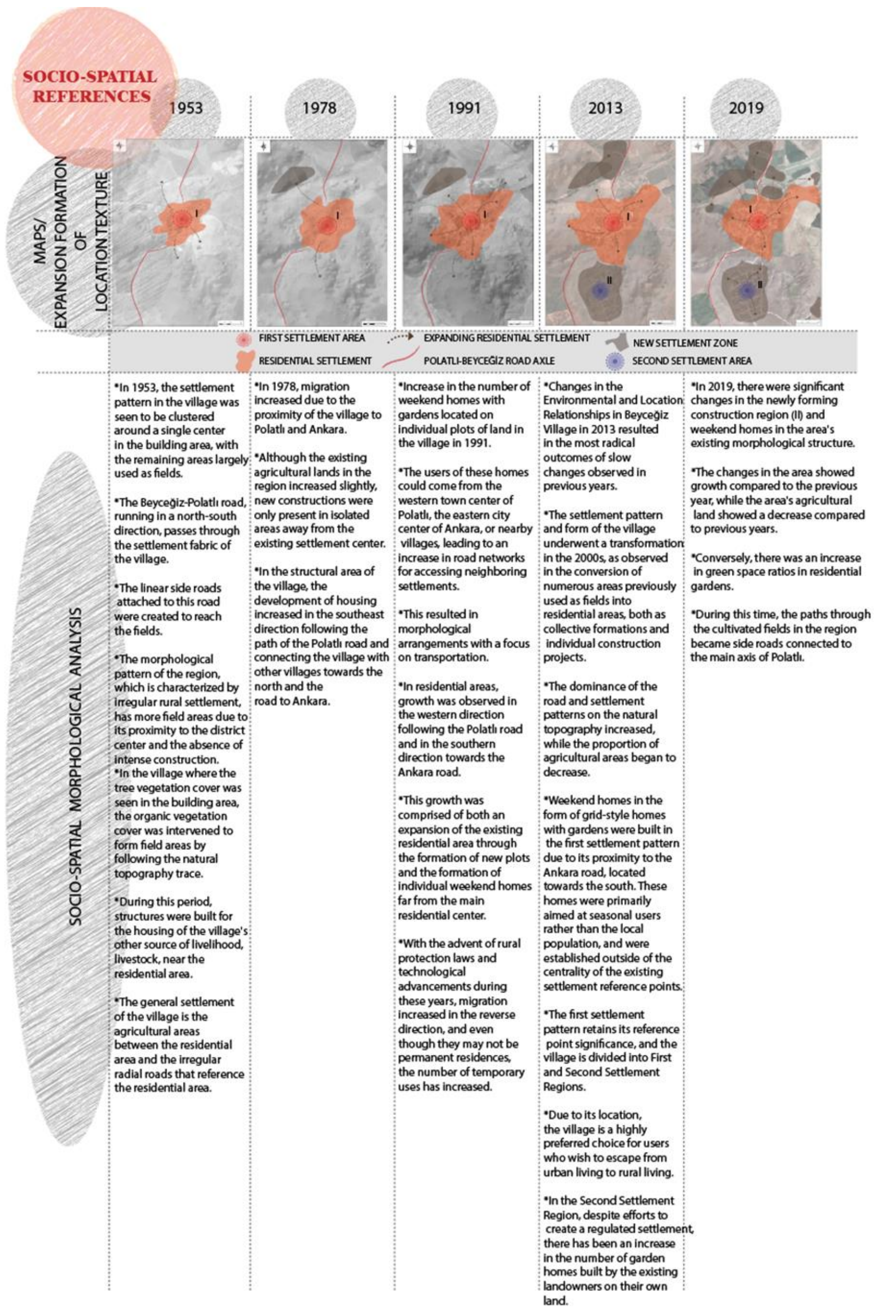


Figure 12. Beyceğiz Socio-Spatial analysis matrix

CONCLUSIONS AND RECOMMENDATIONS

The aim of this study is to determine the morphological dynamics of rural settlements in relation to typomorphology. Analytical Hierarchy Process (AHP) method is used to evaluate the factors affecting rural settlements and a hierarchical order was generated for concrete parameters. The study also analyses the change of the first three dynamics over time in Beyceğiz, a sample village, using fractal and space syntax analysis.

AHP results showed that cultivated and natural areas, socio-spatial references and road/path networks are the main dynamics in the typomorphological analysis of rural settlements. Cultivated-natural areas were analysed by fractal analysis method, which enabled the reading of the temporal change of interventions such as new settlements, agricultural lands and building constructions on the settlement texture not only by observation but also numerically. With this method, it was also possible to observe lacunarity values, which indicate a more fragmented and irregular settlement pattern over time. The second parameter, road/path networks, was analysed using the Space syntax method. The method shows that there are significant changes in the settlement pattern influenced by various dynamics such as road networks, plot patterns, the emergence of weekend houses and new settlements. These results emphasise the importance of spatial configuration and accessibility patterns when designing and managing buildings in the village, allowing for a rational reading of mobility. The layering analysis of socio-spatial references at micro and macro scales has allowed the integrated results to read the change/transformation process of the settlement. It clearly shows the changes in the settlement centre, main road axis, side roads, new constructions and expansion networks of the settlement. This analysis reveals the pattern of development, change and transformation of the settlement.

The results of this study provide valuable information on monitoring rural dynamics and managing rural settlements. The identified dynamics and their weighted values can guide decision-makers in rural planning and development. The findings reveal the significant impact of economic and demographic changes on rural settlement morphology and emphasise the need for rural protection laws to regulate settlement and agricultural activities. The study underlines the importance of sustainable land use practices that balance human settlement and agricultural activities with the conservation of natural ecosystems. The study also emphasises the importance of road/path networks in shaping occupancy and emptiness. These findings can be extended to other rural areas to monitor changes in rural settlements and determine their identity and morphological characteristics in the future.

The presence of numerous parameters in the analysis of rural and urban settlement areas frequently poses challenges in making an impartial selection in scientific investigations. In this regard, the AHP method employed in this study's data can be employed for rural areas, or the parameters may be extended/modified and incorporated into comparable studies with a parallel AHP selection. The utilization of various techniques like fractal and space syntax, offering numerical outputs, will yield logical outcomes in rural/urban settlement studies, given their ability to analyze multiple parameters.

REFERENCES

Antrop, M. (1988). Invisible connectivity in rural landscapes. *Proceedings of the Second International Seminar of IALE, Connectivity in Landscape Ecology*, *29*, 57–62.

DOI: 10.15320/ICONARP.2024.280

Ata, İ. A., & Başar, M. E. (2023). Application of digital urban memory transmission model for sustainability of cultural heritage. *ICONARP International Journal of Architecture and Planning*, *11*(1), 271–292.
Barrios, E. B. (2008). Infrastructure and rural development: Household perceptions on rural development. *Progress in Planning*, *70*(1), 1–44.
Berger, P. L., & Luckmann, T. (1966). *The Social Construction of Reality: A Treatise in the Sociology of Knowledge Anchor Books, Garden City, NY.*
Bovill, C. (1996). *Fractal geometry in architecture and design*. Springer.
Ching, B., & Creed, G. W. (2013). *Knowing your place: Rural identity and cultural hierarchy*. Routledge.
Christaller, W. (1933). Die zentralen Orte in Suddeutschland: Eine okonomisch-geographische Untersuchung uber die Gesetzmassigkeit der Verbreitung und Entwicklung der Siedlungen mit stadtischen Funktionen. *Jena*.
Cloke, P. (2006). Conceptualizing rurality. *Handbook of Rural Studies*, *18*, 18–28.
Cromartie, J., & Bucholtz, S. (2008). *Defining the" rural" in rural America*.
Çubuk, M. (1985). *Türkiye'de kentleşme süreci ve kırsal alan sorunları kolokyumu* (Vol. 2). Mimar Sinan Üniversitesi.
Demiroğlu, B. (2020). *Ankara Polatlı Bölgesindeki Kırsal Yerleşim Yerlerinin Oluşum Ve Gelişim Analizi* [Doktora Tezi]. Konya Teknik Üniversitesi, Lisansüstü Eğitim Enstitüsü.
Eker, M. (2014). Kültürel Etkileşimin Niteliksel Dinamikleri Olarak Sanatta Norm'al Ve Form'al Çelişkiler. *Ondokuz Mayıs Üniversitesi Eğitim Fakültesi Dergisi*, *11*(1), Article 1.
Erdoğan, A. (2013). *Polatlı tarih ve kültür atlası*. Polatlı Belediyesi Yayınları.
Erkan, R. (2002). *Kentleşme ve sosyal değişme*. Bilimadamı Yayınları.
Geray, C. (2011). *Dünden bugüne kırsal gelişme politikaları*. Phoenix.
Giddens, A. (1971). *Capitalism and modern social theory: An analysis of the writings of Marx, Durkheim and Max Weber*. Cambridge University Press.
Gür, Ş. Ö. (2000). *Doğu Karadeniz örneğinde konut kültürü*. Yapı-Endüstri Merkezi Yayınları.
Hernandez, L. (2007). The Loss of an Ordinary Landscape. *New Plymouth District Council*.
Hill, M. R. (2003). *Rural settlement and the urban impact on the countryside*. Hodder & Stoughton.
Hillery, G. A. (1955). Definition of community. *Rural Sociology*, *20*, 111–123.
Hillier, B. (2007). *Space is the Machine_ A Configurational Theory of Architecture*.
Hoggart, K. (1988). Not a definition of rural. *Area*, 35–40.
Hu, X., Li, H., Zhang, X., Chen, X., & Yuan, Y. (2019). Multi-dimensionality and the totality of rural spatial restructuring from the perspective of the rural space system: A case study of traditional villages in the ancient Huizhou region, China. *Habitat International*, *94*, 102062.
İlhan, C. (2019). *Sayısal Analiz Yöntemleriyle Mimari Dokuyu Okumak: Bursa—Hisar Bölgesi* [Yüksek Lisans Tezi]. T.C. Bursa Uludağ Üniversitesi Fen Bilimleri Enstitüsü.
Jia, K., Huang, X., Qiao, W., & Zhong, S. (n.d.). Unpacking the Divergent Trajectories of the Rural-Urban Interface in China: A Comparative Socio-Spatial Analytics Approach. *Available at SSRN 4646151*.
Kanatlar, Z. (2012). *ULUDAĞ ÜNİVERSİTESİ FEN BİLİMLERİ ENSTİTÜSÜ* [Yüksek Lisans Tezi]. Uludağ Üniversitesi.
Keleş, R. (1990). *Kentleşme politikası*. İmge Kitabevi.
Keleş, R. (1998). *Kentbilim terimleri sözlügü*. Imge Kitabevi.

Kılınçaslan, T., Elker, C., & Sutcliffe, E. B. (2012). *Kentsel ulaşım: Ulaşım sistemi-Toplu taşım-Planlama-politikalar*. Ninova.
Kurt, H. (2003). *Türkiye'de kent-köy çelişkisi*. Siyasal Kitabevi.
Lefebvre, H. (2014). *Mekanın üretimi* (I. Ergüden, Trans.). Sel Yayıncılık.
Li, R., & Mao, L. (2022). Spatial Characteristics of Suburban Villages Based on Spatial Syntax. *Sustainability*, *14*(21), 14195.
Lukez, P. (2007). *Suburban transformations*. Princeton Architectural Press, Princeton, NJ.
Mandelbrot, B. B., & Mandelbrot, B. B. (1982). *The fractal geometry of nature* (Vol. 1). WH freeman New York.
Nita, J. (2015). The importance of the determinants and discriminants in the landscape research. *Diss. Cult. Landsc. Commis*, *30*, 59–70.
Norberg-Schulz, C. (2019). Genius loci: Towards a phenomenology of architecture (1979). *Historic Cities: Issues in Urban Conservation*, *8*, 31.
Oldfield, P. (2005). Rural settlement and economic development in Southern Italy: Troia and its contado, c. 1020-c. 1230. *Journal of Medieval History*, *31*(4), 327–345.
Ozorhon, I. F., & Ozorhon, G. (2021). Rural architecture and sustainability: Learning from the past. *Journal of Asian Rural Studies*, *5*(1), 30–47.
Penn, A., Hillier, B., Banister, D., & Xu, J. (1998). Configurational modelling of urban movement networks. *Environment and Planning B: Planning and Design*, *25*(1), 59–84.
Rapoport, A. (1969). *House Form and Culture*. Prentice-Hall.
Saaty, T. L. (1980). The analytic hierarchy process. Mcgrawhill international. *New York*.
Sazak, Ş. (1990). *Belediye ve mücavir alanlar dışında kırsal alanlarda planlama süreci üzerine bir araştırma ve planlama için ussal bir yöntem önerisi*. Mimar Sinan University, İstanbul.
Selman, P. (2006). *Planning at the landscape scale*. Routledge.
Sencer, Y. (1979). *Türkiye'de kentleşme: Bir toplumsal ve kültürel değişme süreci* (Vol. 345). Kültür Bakanlığı yayınları.
Sharp, T. (1946). *The Anatomy of the Village. [With Illustrations and Plans.].*
Tacoli, C. (1998). Rural-urban interactions: A guide to the literature. *Environment and Urbanization*, *10*(1), 147–166.
Tanoğlu, A. (2010). İskan Coğrafyası: Esas Fikirler, Problemler ve Metod. *Türkiyat Mecmuası*, *11*, 1–32. https://doi.org/10.18345/tm.91824
Taş, B. (2016). *Türkiye'nin kırsal yerleşmeleri*. Yeditepe Yayınevi.
Tian, G., Qiao, Z., & Gao, X. (2014). Rural settlement land dynamic modes and policy implications in Beijing metropolitan region, China. *Habitat International*, *44*, 237–246.
Tombus, F. E., & Ozulu, I. M. (2007). Uzaktan algılama ve cografi bilgi sistemleri kullanılarak erozyon risk belirlemesine yeni bir yaklasım, Corum ili örnegi. *TMMOB Harita ve Kadastro Mühendisleri Odası Ulusal Cografi Bilgi Sistemleri Kongresi*, *30*.
Wang, J., Georganos, S., Kuffer, M., Abascal, A., & Vanhuysse, S. (2022). On the knowledge gain of urban morphology from space. *Computers, Environment and Urban Systems*, *95*, 101831.
Xiao, H., Xue, C., Yu, J., Yu, C., & Peng, G. (2023). Spatial Morphological Characteristics of Ethnic Villages in the Dadu River Basin, a Sino-Tibetan Area of Sichuan, China. *Land*, *12*(9), 1662.

DOI: 10.15320/ICONARP.2024.280

Yanbo, Q., Guanghui, J., Yuting, Y., Qiuyue, Z., Yuling, L., & Wenqiu, M. (2018). Multi-scale analysis on spatial morphology differentiation and formation mechanism of rural residential land: A case study in Shandong Province, China. *Habitat International*, *71*, 135–146.

Yang, X., Kong, Z., & Li, X. (2019). Research on the spatial pattern of traditional villages based on spatial syntax: A case study of baishe village. *IOP Conference Series: Earth and Environmental Science*, *295*(3), 032071.

Yao, X., & Wu, D. (2023). Spatiotemporal Changes and Influencing Factors of Rural Settlements in the Middle Reaches of the Yangtze River Region, 1990–2020. *Land*, *12*(9), 1741.

Zhou, J., Lin, J., Cui, S., Qiu, Q., & Zhao, Q. (2013). Exploring the relationship between urban transportation energy consumption and transition of settlement morphology: A case study on Xiamen Island, China. *Habitat International*, *37*, 70–79.

URL-1. https://www.oecd.org/cfe/regionaldevelopment/OECD_regional_typology_Nov2012.pdf (Accessed: 10.04.2023)

Resume

Begüm DEMİROĞLU İZGİ graduated from Selçuk University Faculty of Architecture, Department of Architecture in 2013. She received her MSc degree from Selçuk University Master of Architecture in 2017. She holds PhD in the field of architecture at Konya Technical University in 2020. Her main research interests are urban/rural morphology, AHP metodogy, urban communities, urban/rural resistance and architectural history. She is currently working as an academician at Yozgat Bozok University.

ICONARP
International Journal of Architecture and Planning
Received: 07.02.2024 Accepted: 22.03.2024
Volume 12, Issue 1/ Published: 30.06.2024
Research Article
DOI: 10.15320/ICONARP.2024.281 E- ISSN:2147-9380
ICONARP

Typomorphology: A Methodological Approach to Context Analysis in Architectural Design Education

Seda Saylan*
Tan Kâmil Gürer**

Abstract

The study aims to demonstrate the importance of typomorphological knowledge as a method of contextual analysis in architectural design education. The Architectural Design Studio is a place for students to experience design tools, methods, and practice, and focuses on developing the ability to design and teach. Design, with its phases of analysis, synthesis, and evaluation phases, is a dynamic process that consists of adapting and transforming the information obtained from past experiences and making it suitable for the creation of new designs. The analysis phase is one of the most crucial stages in the architectural design process, as it involves the study of the context. The context typically includes tangible data such as topography, the built environment, functional relationships, the history of the area, and its current significance. The typomorphological approach is a method for studying context and is crucial to introduce into design education. The study intends to reveal the contribution of supporting imaginative education with theoretical knowledge to the design process and how typomorphological knowledge can be taught, in architectural design education. The paper analyzes the significance and role of context in architectural design education and process, provides knowledge on typomorphological approaches, and explores through examples the contributions of researchers using these approaches to design education in this field and how they produce solutions. The conclusion discusses the concepts, issues, and analytical techniques addressed by four different researchers in their architectural/urban design courses integrating typomorphology and the contributions of this knowledge to the architectural design process and the education of students.

Keywords:
Architectural context, Architectural design education, Typomorphology, Architectural and urban design.

*Department of Architecture, Yıldız Technical University, İstanbul, Türkiye. (*Corresponding author*)
Email: saylanseda@gmail.com

**Department of Architecture, İstanbul Technical University, İstanbul, Türkiye.
Email: tgurer@itu.edu.tr

To cite this article: Saylan, S., & Gürer, T. K. (2024). Typomorphology: A methodological approach to context analysis in architectural design education. *ICONARP International Journal of Architecture and Planning,* 12 (1), 189-210. DOI: 10.15320/ICONARP.2024.281

INTRODUCTION: DEFINING THE RESEARCH PROBLEM AND OBJECTIVES

Cities are organisms that undergo physical transformations over time as a result of socioeconomic factors. New design ideas often embody these modifications, responding to the needs of the time they occur. How can new design concepts be integrated into the urban fabric with a significant historical background while preserving the city's character and satisfying present needs?

A new urban design should be integrated into the existing built environment while taking into account contemporary demands and preserving the city's identity, all within the existing urban fabric. In order to convey new meanings, it is imperative to comprehend and interpret characteristic elements. A design that demonstrates consideration for historical development, existing forms, and current demands enables the incorporation of contemporary spatial characteristics that can effectively contribute to the ongoing evolution of urban environments (Gygax, 2007). The concept of 'urban fabric' encompasses the physical structure and historical development of urban areas, as well as the relationship between urban spaces and individual buildings. Furthermore, it serves as an instrument for analysis and explanation (Kropf, 1998). The typomorphological approach can be an essential starting point for analyzing the urban fabric to inform the development of a modern structure that aligns with the unique characteristics of the surrounding district within an established built environment. While this approach is crucial within their respective domains of application, it can also function as a valuable instrument in the realm of architectural design education.

The works of Kropf, Oliveira, Hayward & Samuels, and Maretto are analyzed because they are key figures in the field of typomorphology and have made significant efforts to incorporate this subject into architectural and urban planning education. Therefore, this study aims to demonstrate the importance of typomorphological knowledge as a method of contextual analysis and its integration into architectural design education. It does this by comparing the approaches of four contributors to architectural and urban design education that incorporate typomorphological knowledge and by formulating predictions about the fundamental concepts, issues, techniques, and their contribution to students.

CONTEXT IN ARCHITECTURAL DESIGN EDUCATION AND PROCESS

Architecture is a discipline that exists in a potential environment between logic, emotion, and intuition (Salama, 2008; Schön, 1984). While it provides physical structures for social functions, it is also concerned with the aesthetic dimension of the human experience. As a representative of research and design, architecture faces a multitude of problems and strives to find solutions (Schön, 1984).

DOI: 10.15320/ICONARP.2024.281

The Architectural Design Studio, which allows students to combine their talents, values, and architectural terms and focuses on developing the ability to design and teach design, is the "center" of architectural education, prioritized in the program (Dutton, 1987; Schön, 1984; Uluoğlu, 1990). The architectural design studio provides an environment for students to engage with their ideas and social interactions. It is a place for students to experience design tools, methods, and practice, i.e., *learning by doing*, and creates a productive environment that enables students to switch between different modes of thinking through actions such as drawing, talking, and making models (Dutton, 1987; Schön, 1984). In the studio, students acquire both theoretical and practical knowledge, which they apply to their design process in response to critique and guidance from their instructor in a virtual environment. According to Schön (1984, 1987, 1988), designing education based on the *"reflection-in-action"* approach, relying on the strategies of "telling and listening" and "showing and imitating" between the instructor and the student, creates a cycle in which the student and the teacher work together, generate ideas, and evaluate the results.

Cross (2021) states that different approaches view design as a cyclical process involving the analysis phase of defining the problem and listing the requirements of the design, the synthesis phase of finding the solution, and the evaluation of the performance of alternative designs against a set of criteria before determining the final design.

Architectural design is associated with both a program and a site. During the initial stages of the design process, the architect evaluates and interprets information about the site through the analysis of data pertaining to the natural, built, and social environment, commonly referred to as the context. This analysis serves to unveil the underlying ideas and principles that will serve as guiding principles for the design. In the concept phase, designers utilize diagrams, visuals, and written materials to specify the ideas forming the basis of the design and organize decisions. During the composition phase, which is a creative process related to form, the designer generates products in various shapes that conform to the program's specifications, evaluates these products, and determines whether to proceed with the predetermined concept. Through feedback, the designer determines whether any changes are necessary. Upon achieving the desired form, the designer formulates the ultimate outcome as a structure and material. During the use phase, people experience it through light, sound, and spatial terms after construction (Figure 1) (Farrelly, 2007; Leupen et al., 1997).

One of the most crucial stages in the design process is the study of the context. The context typically comprises tangible data such as topography, the built environment, functional relationships, the history of the area, and its current significance. Developing the design subsequent to comprehending and analyzing this data ensures that the proposal is understandable and open to discussion (Leupen et al., 1997).

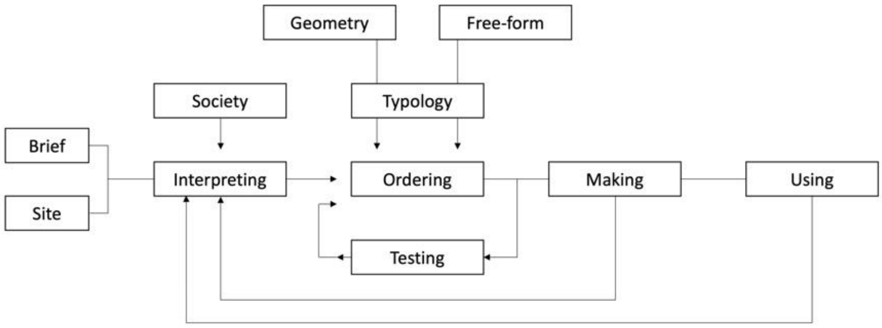


Figure 1. Architectural design process scheme (Leupen et al., 1997).

Studies on the design process have a role in learning the design in architectural design education (Uluoğlu, 1990). Studies conducted in the 1990s concerning design theories emphasize that design is a form of knowledge and regard basic types such as concepts, prototypes, and examples as an internal part of design. This approach views design as a dynamic process that involves adapting and transforming information from past experiences to meet current requirements (Oxman, 1990). This perspective reveals the importance of including typomorphological approaches as knowledge in design education.

TYPOMORPHOLOGY

Type and Analytical Typology

Typology is a theoretical approach that enables the classification and interpretation of buildings according to their specific characteristics. The Age of Enlightenment and positivist thought orientations influenced the emergence of this approach. The most influential theorists in the creation of typological analysis as a method of classification were Quatrémere de Quincy, Guadet, and Milizia, as well as J.N.L. Durand, who conducted research on building type (Yücel, 1979). These approaches, which remained as a "classification of forms," were far from the content of today's analytical typology.

In response to modern architecture, Saverio Muratori led the reintroduction of typological studies in Italy in the 1960s; M.R.G. Conzen developed geography-based analyses in England; and the Versailles School in France developed typological and morphological studies to examine the structure of urban space (Gürer, 2016).

Typomorphological approaches perceive urban structure as a constantly changing organism and use the concepts of type and typology to understand the urban structure. In the seventeenth century, the classification of objects according to their particular and common characteristics played a crucial role in adapting the concept of type to architecture. Type in architecture emphasizes the shared features within the urban fabric and the group of buildings (Panerai & Castex, 1970). Typologically, the building is not regarded as a separate entity, distinct from the other buildings that form the urban fabric. The objective of typology is to examine and define the structural relationship between the part and the whole: to categorize buildings, streets, walls, gardens, or, in other words, all the structural elements within this urban

DOI: 10.15320/ICONARP.2024.281

fabric in relation to the urban form of a particular era (Panerai, 1979). Panerai discusses the analytical typological procedure in three distinct steps: an inventory, a comparison of elements, and a classification of types (Panerai & Castex, 1970). Inventorying is the process of separating the components of an element, which is the analysis phase. The comparison of elements involves the analysis of similarities and differences as well as the identification of factors contributing to change and development. Clustering of types enables the analysis of specific types by focusing on a limited number of patterns that emerge from them (Yücel, 1979).

Typology in architecture pertains to the examination of the classification of certain types of forms, and architectural typologies reveal the structural characteristics of buildings. Conversely, urban morphology studies analyze the city as the habitat for human life, examining its elements, their development and transformation processes, and the social and economic impacts of these changes. The integration of the concepts of typology and morphology in the late 20th century has resulted in the development of a new and comprehensive framework for describing urban space, known as typomorphology (Moudon, 1994).

Typomorphology

According to Moudon (1994), typomorphological studies comprise typological and morphological methods to define the urban form based on the typological classification revealed by buildings and open spaces. The studies deal with all scales of the built environment, from a small room or garden to a large urban area. It describes the urban form as a dynamic structure, constantly changing between those who produce it and those who use it. In this respect, typomorphology provides a basis for examining the nature of building design and its relationship with the city and the society in which it exists.

Traditions: Determining the Typomorphological Approach

Typomorphological schools have developed different approaches to understanding the built landscape. These schools propose a methodology to explore the production and construction of cities, anticipating changes, transformations, and developments in design and planning. An examination of the studies carried out reveals three distinct schools: Italian, English, and French.

- **Italian School: Muratori and Caniggia**

Typomorphological studies were introduced in Italy in the 1940s by Gianfranco Ganiggia and his followers under the guidance of Saverio Muratori. Italian morphological studies seek harmony between the old and the new. Researchers carry out typological studies to examine the relationship between the modern approaches that emerged in the urban form before and after the industrial period (Marzot, 2002).

Saverio Muratori argues that the foundations of architecture lie not in the fantastic products of modernism but in the continuous tradition of city-building from antiquity to the 1930s. (Moudon, 1994). In his work, Muratori treats the formation and development of the city as the result of cultural behavior, criticizing the laws that define them as natural and the modern urban sciences that handle urban design as a technical subject (Marzot, 2002). He regards building typology as the basis for urban analysis and asserts that cities' structures can only be perceptible by analyzing their historical development. According to Muratori, type is an a priori synthesizing concept and an active organism associated with a specific time or historical period and place. Type is an internal structure that unites disparate elements and an energetic, dynamic link that reveals one element's relationship to another. A type is the creative basis of a process, remaining constant while the "shaping form" changes; it is collective formation and expression (Menghini, 2002).

Caniggia does not document the historical progression of the city's development, yet his work imparts the fundamental principles that form the city. Caniggia states that the human environment consists of interrelated *built objects* and is classified into four scales: the building, the group of buildings, the city, and the region. Each object, the living entity itself, is depicted as a complex, interconnected entity composed of elements, structures, systems, and organisms. These objects form the built environment, which is also an organism (Moudon, 1994).

Caniggia clarifies that cities are not a completed entity, but an evolving process formed by the gradual juxtaposition of many small elements. Analyzing the alteration of the type in time and space leads to an understanding of the formation and transformation of cities. According to Caniggia, the establishment of "procedural typologies" constitutes a basis for understanding the construction, design, and architecture of cities. Type is defined as the conceptual presence of an element in the form of cultural experience, apart from its physical or phenomenological existence. Its volumetric characteristics, position in relation to the street, and solar orientation determine a base type. This base type is later re-evaluated for transformations and adaptations over time. Therefore, type is described in terms of its formal concepts, correspondence with the scales above and below it, and its historical evolution (Moudon, 1994).

- **England: Urban Morphology and Conzenian Tradition**

M.R.G. Conzen, a prominent figure in the development of urban morphology in England, primarily focused his research on town plan reading. He defined this method in three stages (Moudon, 1994; Whitehand, 2001):

a. *"Town or ground plan:"* a two-dimensional cartographic depiction of the physical layout, including streets, parcels, and building plots.

DOI: 10.15320/ICONARP.2024.281

b. *''Building fabric:''* consisting of buildings and their related open spaces.

c. *''Pattern of land and building utilization:''* comprehensive analysis of land utilization.

The methodology of *''town plan analysis''* entails the identification of three primary elements of the town plan. These are the streets, the parcels, and the buildings. The parcel, which serves as the organizational structure for the urban form, is considered the primary unit of study in town plan analysis. Conzen clarifies the composite situation that arises from the amalgamation of different units, referred to as *"plan units,"* across various areas in the city. These are often observed in different variations of street, parcel, and building size and form, indicating disparities in the socio-economic origins of the settlements as well as buildings from different periods. These units have a role in the stratification of the townscape (Moudon, 1994).

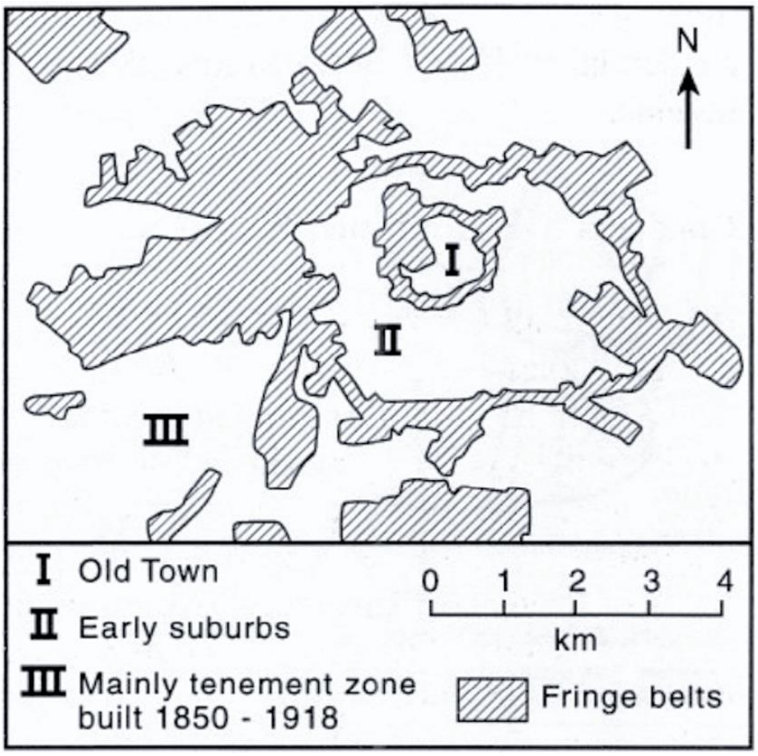


Figure 2. Inner Berlin fringe belt (H. Louis study) (Whitehand, 2001).

Conzen (1960) made significant contributions to the field of urban morphology by introducing two key concepts: the *"urban fringe belt"* and the *"burgage cycle." Urban fringe belts* (Figure 2) tend to emerge during periods when there are no built-up areas on the urban periphery or when they grow very slowly. Herbert Louis, a German geographer and one of Conzen's pioneers, observed the uneven growth of urban areas toward the periphery. In two of his earliest studies of the urban fringe belts in Berlin, he noted that the city walls, referred to as the *"fixation line"* by Conzen, were the primary impediment to the city's expansion. Urban fringe belts mostly consist of green open areas, encompassing parks, sports fields, and public buildings. Typically, these plans have relatively expansive plots, fewer hard surfaces, and minimal road crossings (Whitehand, 2007).

The burgage cycle involves the progressive occupation and subsequent removal of plots and backyards through the construction of buildings, referred to as the 'urban fallow' phase, followed by their re-entry into the development cycle (Figure 3; Figure 4). Increased construction activities within the city and evolving functional demands led to the expansion of buildings on the parcel. However, various factors, such as economic crises, new zoning regulations, natural disasters, and wars, cause the number of buildings to decrease (Whitehand, 2007).

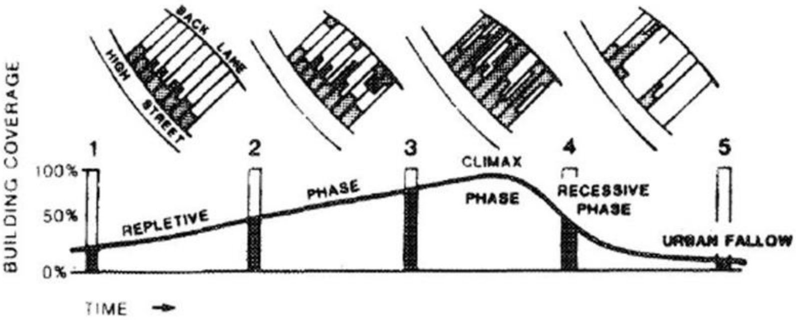


Figure 3. Burgage cycle phases (Larkham & Jones, 1991).

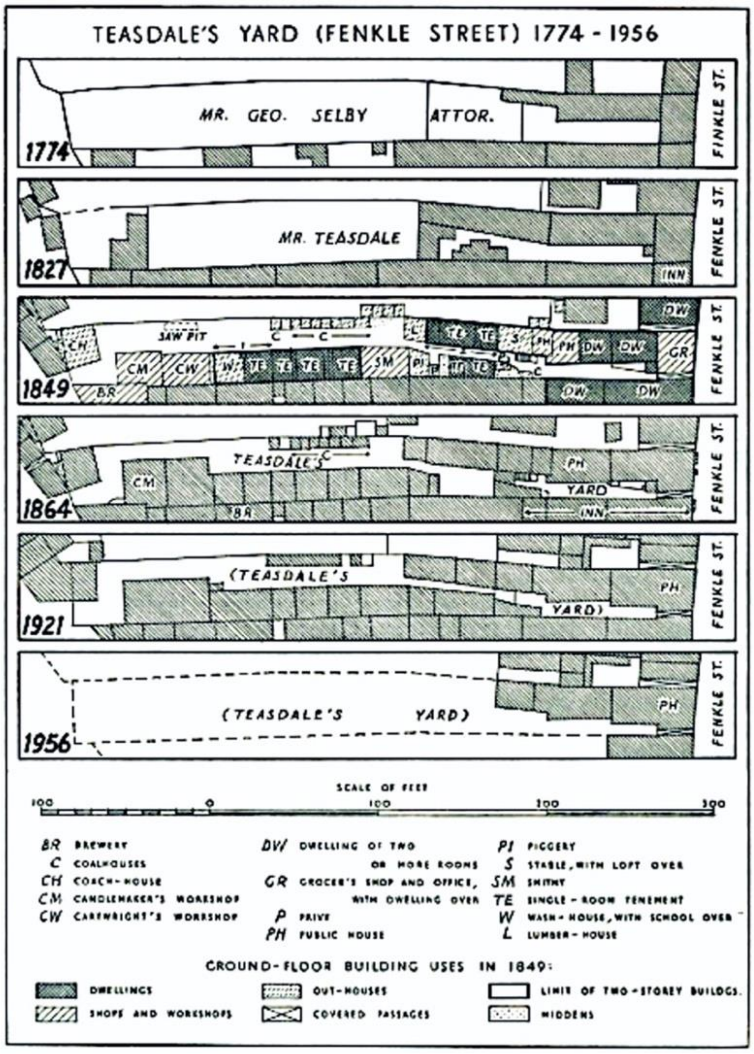


Figure 4. Conzen's Alnwick Town Fenkle Street Teasdale Garden burgage cycle study (Conzen, 1960).

DOI: 10.15320/ICONARP.2024.281

- **France: Versailles School of Architecture**

The Versailles School of Architecture was established following the institutional reform resulting from the student and worker rebellions in 1968. Aligned with Muratori's philosophical perspective, the school asserts that the modernist movement has caused a break with the past and argues that the roots of architecture should be sought in traditions. In Italy and the UK, the debate is between architects and geographers, but in France, a collaborative effort is being undertaken by sociologists, historians, geographers, and planners in conjunction with architects to cultivate a more sophisticated understanding of the city (Moudon, 1994).

Panerai, an outstanding member of the Versailles School, authored analytical works in which he expounded upon his perspectives on the examination of the city and its surroundings. His approach was like those of the English and Italian schools, and he advocated for expressing detailed observations beyond the main topics (Gürer, 2016). In his urban analyses, Panerai identifies four main categories, including *the typology of elements*, *urban growth*, *the articulation of urban space*, and *triangulation and legibility*. *The typology of elements* mentions the terms "type" and "typology" and examines the four-stage typological method for determining the typology. These are the categories of *typology of buildings* and *typology of unstructured spaces and other arrangements*. Cities, as living organisms, are constantly changing and progressing, resulting in *urban growth*. Panerai examined this category by segmenting it into three subheadings: *types of growth*, *limits of growth,* and *crossing the limit*. It is significant to understand the urban form within the context of its constituent elements and their interrelationship in unity. Panerai developed two sub-categories for the *articulation of urban space*. The *hierarchy*, consisting of private, daily, and urban levels, determines the organization of the elements that make up the city, while the *overlay* determines the relationship between these levels through various elements in cases where the organization's interpretation is unclear. Under the heading of *triangulation and legibility*, the author initially referred to Kevin Lynch's book *The Image of the City* (2012), stressing the significance of examining the urban landscape as a whole and along a route identifying visually perceived urban images. Panerai defined monuments as discrete elements, drawing attention from Aldo Rossi in *The Architecture of the City* (2006), and stated that they should be interpreted in terms of their relationship with the entire city and urban fabric (Panerai & Castex, 1970).

INTEGRATION OF TYPOMORPHOLOGY INTO ARCHITECTURAL AND URBAN DESIGN EDUCATION

In architectural design education, it is significant to combine typomorphological knowledge with the experience of design practice. Scientific research investigates the methods of integrating this knowledge into architectural and urban design education, identifying

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

the sequence of subjects to be taught to students and the most effective teaching approaches (Oliveira, 2018b). In this context, the studies of Kropf (2018), Oliveira (2018a), Hayward and Samuels (2018), and Maretto (2018) were examined.

Karl Kropf: ''The Design for Conservation''

In his lecture *"Design for Conservation,"* Kropf (2018) discussed the integration of urban morphology knowledge into education and the role of these principles in the design process.

This course examines the process of adapting new developments in historic environments to the site and protecting particular areas within the settlement, rather than individual buildings or artifacts. Within this framework, the course attempts to clarify to students the distinction between "looking" and "making," i.e., between describing the historical process and physical form of the built environment and creating new developments. The primary objective is to impart knowledge on urban morphology using design and objectify its abstract principles rather than solely teaching design. The course consists of four modules, namely *introduction*, *analysis*, *design guidance and critique* and *design proposal* (Figure 5). At the beginning of the semester, the course content is introduced to the students to facilitate their comprehension of the subject matter. Students concurrently carry out their individual work alongside the presentations and training sessions. In the midterm, students are required to provide a brief presentation, followed by the submission of their work in their final report at the end (Kropf, 2018).

In the first and second weeks, the *introduction* section encompasses a design activity, the presentation of case studies, information about the basic concepts (*natural environment*, *built form*, *use*, *control*, *intention*, *construction*, *perception*, *development and evolution*, and *flows of materials and resources*), and an organization of field visits to local settlements (Kropf, 2018).

From weeks three to six, in the *analysis*, the instructor explains fundamental morphological concepts and provides information about the analysis methods through presentations, including graphic visuals. Throughout this process, students analyze the environment and give interim presentations. In the lectures, *''historical development and map sequencing, route structure analysis, urban tissue analysis, land use analysis, and townscape analysis''* are explained verbally and with visual examples as the basic techniques of desktop analysis. According to him, the field trip is the initial and most substantial part of the analysis. With predetermined walking routes and systematic recordings, the place can be better perceived through the senses, its characteristics and elements can be identified, and the desktop analysis made in the same process can be checked and improved. Following the completion of their desktop analysis, students present their conclusions and findings to the class at the midterm (Kropf, 2018).

DOI: 10.15320/ICONARP.2024.281

Subsections	Contents and delivery of the lessons
	The module runs for 12 weeks and focuses on the design of new development in the historic environment and the principles of area-based historic conservation
1. Introduction (weeks 1–2)	Delivery: Short initial design exercise; illustrated lectures focusing on general principles and ways of thinking about design and conservation; coursework project brief introduced, example coursework made available (learning by example); walking tour of local settlement
2. Analysis (weeks 3–6)	Delivery: Illustrated lectures on basic morphological concepts and analytical methods: including demonstrations of graphic methods Student coursework: information gathering, mapping, desktop analysis and field surveys; interim presentation of results
3. Design guidance and critique (weeks 7–10)	Delivery: Illustrated guest lecture given by working Conservation Officer focusing on issues raised in practice on current projects; illustrated lectures on writing and presenting design guidance. Open discussion of examples of new development in historic environments. One-to-one tutorial sessions and parallel open studio for peer-to-peer learning Student coursework: formulate guidance, focusing on exercising judgement to select the elements and features that are most important to the character and identity of the place while allowing for growth and change in response to changing needs; illustrate guidance with maps, images, text, dimensions and diagrams; undertake design critique with reference to analysis and guidance
4. Design proposal (weeks 11–12)	Delivery: Illustrated guest lecture given by working property developer focusing on issues raised in getting consent for building in a conservation area; illustrated lectures focusing on the historical context for current principles of urban design and compositional principles of architecture and the central principle of abstraction; Open discussion of designs selected and introduced by students Student coursework: generate and present a design project (ideally of the site subject to the critique); compile coursework into a project document using a range of methods including text, images, maps, tables, diagrams

Figure 5. The program for the *Design for Conservation* course (Kropf, 2018).

During weeks seven and ten, *Design Guidance and Critique* includes a presentation by a conservation specialist about contemporary concerns, information on writing and presenting design guidance, and discussions on recent developments in the historic environment. The lectures, field trips, and presentations aim to enable students to develop an idea of what they feel and think about the built environment and to gain the ability to communicate their design with their "why." The purpose of the design guide is to provide a holistic expression of the existing positive characteristics of the area, particularly its historical character and the qualities that sustain activity and vitality. Students critique the consequences of change and transformation that result from the removal of some elements and the introduction of new designs within the existing identity (Kropf, 2018).

In the *Design Proposal* (weeks 11 and 12), the developer presents the issues that arise in the process of seeking permission for a building in a conservation area. Visuals support the lectures, which focus on the historical context of current urban design principles, the compositional principles of architecture, and the main principles of abstraction. Additionally, students hold discussions on the designs they have prepared. Students develop and present a new design project that aims to make modifications and transformations based on the design guide and critique they have formulated and concurrently produce a project document incorporating various visual elements such as text, visuals, maps, tables, and diagrams (Kropf, 2018).

Vitor Oliveira: ''Urban Morphology''

Oliveira (2018a) conducts *''Urban Morphology''*-titled trainings as a lecture or workshop at multiple universities in Portugal, Brazil, China, and Spain. The course consists of seven chapters titled *Introduction and the Elements of Urban Form, The Agents and Processes of Urban Transformation, Cities in History, Contemporary Cities, The Study of Urban Form: Different Approaches, From Theory to Practice,* and *Relationships with Other Fields of Knowledge* (Figure 6).

	Contents
Introduction and The elements of urban form	**Lesson 1** 1.1. Introduction 1.2. The Elements of urban form: the urban tissue, the natural context, the street system, the plot system, the building's system
	Lesson 2 1.2. The elements of urban form
The agents and processes of urban transformation	**Lesson 3** 3.1. Agents of change: developers, architects, builders, local authority planning officers, local politicians
	Lesson 4 Processes of urban transformation: plans in the nineteenth century, plans in the first half of the twentieth century, plans in the second half of the twentieth century; plan implementation and development control
Cities in history	**Lesson 5** The early cities: Sumerian, Chinese The Greek cities The Roman cities
	Lesson 6 The Islamic cities The Medieval cities The Renaissance cities The nineteenth century cities
Contemporary cities	**Lesson 7** Contemporary cities in Africa, america, Asia, Europe and Ocenia
	Lesson 8 One contemporary city
The study of urban form: different approaches	**Lesson 9** Classics in urban morphology and in urban studies
	Ders 10 Historico-geographical approach Process-typological approach
	Lesson 11 Space syntax Spatial analysis
From Theory to practice	**Lesson 12** Urban morphology and planning
	Lesson 13 Urban morphology, building typology and architecture
Relationships with other fields of knowledge	**Lesson 14** Urban morphology and society (Public health, social justice) Urban morphology and economy (heritage tourism) Urban morphology and environment (climate change, energy)
Conclusion	**Lesson 15** Conclusion and students feedback

Figure 6. Syllabus of *urban morphology* (Oliveira, 2018a).

The lectures are delivered through the utilization of visual slides, enriched with interactive questions and discussions, and supported by supplementary resources such as books, articles, applications, films, and websites. The initial part of the course focuses on the *city's object*, extending until the ninth lesson, then on the *researcher's identification and explanation*, and also on the ability to articulate the physical form of cities. Oliveira outlined the objectives of the Urban Morphology course in four points:

- Understanding urban morphology as a method for examining the city's physical form requires the recognition of the agents and their processes operative in shaping that form.

DOI: 10.15320/ICONARP.2024.281

- Recognizing and evaluating the diversity of urban form in fabrics from different time periods and regions.
- Introducing students to the concepts and techniques used in the analysis of urban form.
- Understanding the physical dimension of the cities (Oliveira, 2018a).

The first lecture, *"Introduction and the Elements of Urban Form,"* provided a definition of the fundamental components of urban form, namely the natural environment, public space, plot, and buildings, encompassing streets and squares, using examples from diverse urban fabrics found in various cities. The second lecture involves carrying out an exercise[1] created by Oliveira and Perdicoulis, which is designed as a computer-based application. In the exercise, a study area is given to the students. At first, the students only receive topography as data, while in the second stage, topography and the road system are provided. The initial student offers a new urban element to the field using these data. Following this, every student adds an urban element, taking into account the addition of the preceding student. This exercise seeks to balance and alter the emphasis on the building element in architectural education, underscore the importance of the street element in the city-building process, and demonstrate that the city is the result of collective work (Oliveira, 2018a)**.**

[1] Oliveira describes it as a "game". In the article, it is translated as "exercise".

The third lecture in the *''Actors and Processes of Urban Transformation''* explains how each agent, including architects, civil engineers, planners, and elected politicians, who effectively transform the urban fabric, particularly the built environment, participates in the process, how they fulfill their own goals, why they set these goals, and how they interact with each other. In the context of understanding urban transformation processes, the fourth lecture provides information on how residents should act collectively to create a balance between the planned and spontaneously built appearance of the city. The presentation of planning approaches analyzes three different periods: the 19th century, the first half of the 20th century, and the second half of the 20th century (Oliveira, 2018a).

The fifth and sixth lectures, entitled *''Cities in History,''* describe the development of cities across seven different historical periods. The objective of these two lectures is to get an understanding of the main characteristics of the urban form elements in the new period, the manner in which these elements come together to form various urban structures in different urban fabrics, and the elements that have undergone transformation and preservation over an extended period (Oliveira, 2018a).

''Contemporary Cities,'' the seventh and eighth lectures, focus on forthcoming trends, explore diversity, and caution against the homogenization and globalization of urban environments. The seventh lecture examines the physical structure of cities, with a particular emphasis on emerging urban forms. It explores the agents and processes that shape these forms, how the newly developed types of

urban form harmonize with the existing urban fabrics, which urban fabrics are being displaced by new formations, and the main differences in urban form in the diverse fabrics. In the eighth course, students present information about street typology, building blocks, plot structure, building typology, plot/building relationships, and street/building relationships of a place where they have resided, studied, worked, or experienced, that is, the main morphological characteristics (Oliveira, 2018a).

"The Study of Urban Form: Different Approaches," lectures nine, ten, and eleven, cover various approaches to studying urban fabric. The ninth lecture provides an introduction to classical works in the field of urban morphology and studies, while the tenth lecture discusses historico-geographical and process-typological approaches. The former provides Conzen's analysis of the urban landscape, town plan, building typology, land, and building utilization. The works of Whitehand are also examined. The process-typological approach discusses Muratori's type, urban tissue, organism and operative history, and the research and applications of Caniggia. Additionally, the 11th lecture introduces the syntax of space and the analysis of space (Oliveira, 2018a).

"From Theory to Practice," the 12th lecture, aims to provide an understanding of the potential contribution of urban morphology to planning practice. The lecture examines numerous examples within this theoretical framework. Lecture 13 explains the relationship between urban morphology, building typology, and architecture through the examples of the ENPAS building in Bologna, which focuses on form, structure, and tectonic perception in the context of a typological approach, and the Tate Britain building in London, which focuses on space in the context of spatial syntax (Oliveira, 2018a).

Lecture 14, titled *"Relationships with Other Fields of Knowledge,"* comprises three distinct subparts that offer insights into the social, economic, and environmental aspects of urban morphology. The social dimension explains strategies for enhancing the relationship between urban morphology, public health, and social justice. The economic dimension focuses on heritage tourism. The environmental dimension emphasizes issues related to climate change and energy (Oliveira, 2018a).

At the end of the course, Oliveira summarizes the main points covered in the lectures and presents them as a conclusion. Finally, he obtains feedback from the students via an anonymous questionnaire and uses this data to improve the course content in subsequent processes (Oliveira, 2018a).

Richard Hayward and Ivor Samuels: JCUD

Hayward and Samuels (2018) outlined how urban morphology concepts are used as a design tool in urban tissue in lectures examining the analysis and design proposals for large-scale housing projects as part of master's courses at various universities. According to them,

DOI: 10.15320/ICONARP.2024.281

having students from diverse educational backgrounds contributed positively to the course content but created difficulties in the residential layout design.

They emphasized that architecture students should concentrate on building groups related to public and private spaces rather than individual buildings. It is crucial to consider physical environmental data, topography, infrastructure layout, and socio-economic context when designing residential areas to achieve more appropriate outcomes (Hayward & Samuels, 2018).

The course consists of 10 lectures, each lasting three hours (Figure 7). These ten lectures can be completed within a week, with two lectures every day over a period of five weeks or one lecture per week over a span of ten weeks. The *urban tissue* concept, as defined by Conzen as the *''plan unit''* including street, plot, and building elements and by Caniggia and Maffei as the *''tessuto urbano''* encompassing streets, pertinent strips, lots, buildings, rooms, structures, and materials (Kropf, 2014), is used as a design tool throughout the course. They defined tissue as the essence of past schemes and their application to new contexts (Hayward & Samuels, 2018).

Module 1	An introduction to tissues and types and the qualities of diverse examples, and the manner in which they may be used to establish the development capacity of a site utilising the inherent qualities of the tissue
Module 2	A field visit to a suitable urban area focussing on varied tissues used in relative proximity, concluding with a discussion and recording of observations from the student cohort and the tutor
Module 3	A first tissue workshop in groups of 3 or 5, progressing to the preparation and presentation of the first two stages of the process, recording the observations of the cohort and tutor
Module 4	In this module, the students are required to complete the final stage of applying the tissue and to measure and record all aspects of the 'design' achieved, including density, mix, and key design and site characteristics
Module 5	In this module, the students are disbursed to urban study areas in groups to review further examples of tissue, identified from a teaching list, or from personal knowledge and recorded photographically and infield drawings
Module 6	Groups agree their findings from the self-guided field work in Module 5 and apply one tissue to one site provided by the tutor to the final stage, recording outcomes as they previously have done so in Module 4
Module 7	Students are introduced to the process of using simple software to judge the financial viability of tissue-based development proposals; each group runs the software for one of the tissue studies that they have completed
Module 8	The students are offered a range of related topics from which to choose to make a 5-minute presentation for Module 9 (depending on the number of groups, these presentations may be done in sub-groups, with a plenary at the end)
Module 9	Following on from the group topic presentations set at the end of Module 8, and a plenary discussion the tutor will draw together themes from the work of the 9 Modules
Module 10	The tutor will make a presentation on developments in the use of tissues and the value of the process as a means of applying morphological study to design. The module and course will conclude with a review discussion of the learning outcomes and manner in which the programme may be further developed to maximise learning from exemplary types and tissues

Figure 7. The content of the course (Hayward & Samuels, 2018).

The workshop emphasizes the importance of analyzing the relationship between the tissue and the site rather than quickly introducing a new design process. During the first stage, it is expected from the student groups to map the connections, actual or potential routes existing at the site and to document the observed outcomes and corresponding discussions in written form on the plans. During the second stage, students propose and debate minor modifications to create a more practical plan that remains compatible with the existing tissue. During the final step, students summarize their previous work on-site requirements and development and discuss the feasibility of the proposed plan, suggesting modifications to the tissue to achieve a transformation and design that aligns most effectively with the group's objectives for the study area. Five points summarize the criteria critical at each stage of the process (Hayward & Samuels, 2018):

- Determining the characteristics of the tissue and site as a group and adding the acquired data to the drawings,
- Changing the fabric as little as possible and documenting the rationale behind each modification while consistently remembering that the fabrics serve as identifiers for the strengths, weaknesses, opportunities, and threats posed by the different tissues in the sites.
- Allocating an adequate amount of time for the tissue study and then utilizing the majority of the tissue in the design phase,
- When proposing modifications to the tissue, document the specific changes made and the underlying reasons for them, and
- Rather than focusing on the known and unknown aspects of the selected tissues, the characteristics they reveal are understood and conveyed by the students' groups.

According to Hayward and Samuels (2018), the evolution of design possibilities realized by the tissues contributes to the following points:

- To highlight the importance of comprehending the built form within tissues across various contexts,
- Encouraging students to become ''reflective practitioners'',
- The information acquired through individual field trips yields more accurate outcomes compared to accessible hand drawings or computer-generated data related to the study area.

Marco Maretto: Urban Morphology Education in the Framework of Sustainability

Maretto (2018) discusses the urban morphology approach from a sustainability perspective. He stated that technology and energy performance are the subject of sustainability in architecture, but not the architectural culture, and in this regard, he mentioned the concept of ''*authenticity*'' as an essential aspect of sustainability. He pointed out that a structure needs to be built according to environmental data (climate, materials, etc.) and should be ''*authentic*[2]'' by meeting the social and cultural needs of the community in which it is built.

Maretto (2018) stated that urban morphology can be used as a method in the design process with a sustainable perspective, citing the following reasons:

- The morphological analysis of the urban fabric provides an authentic understanding of the physical structure of the environment, the reasons for the transformations taking place, and the interventions to be undertaken in these transformations.

[2] The *"authenticity"* of a structure depends on the fact that it is recognized by the society that builds it, that the culture of that society forms an identity with it, and that the technology of that culture can reproduce and develop it (Maretto, 2018).

DOI: 10.15320/ICONARP.2024.281

- As a tool, urban morphology can combine sustainability approaches with cultural, social, urban, and formal aspects of urban design and architecture.
- Between the macro and micro levels of urbanization, urban morphology can offer the *''social-building neighborhood''*, including physical (from building to neighborhood scale) and social (from family to community) elements, as a basic approach for sustainable urban planning. The social-building neighborhood is considered to have a substantial role in sustainable urban planning due to its ability to bring together the plurality of elements specific to the urban fabric and the desire for unity specific to living spaces in contemporary cities with many co-features of residential activities such as kindergartens, work areas, sports facilities, etc.

Workshops in Architecture and Urban Morphology (W.A.M.), held in many different cities since 2013, teach concepts and tools while student groups create designs at a realistic case site. The workshop consists of three phases (Figure 8):
1. In the methodological part, students learn the basic concepts of urban morphology (polarity, route, fabric, hierarchy, nodality, and social-building neighborhood)[3] and integrate them into the structural reading of the study area.
2. They confirm their structural reading through field studies and form the main framework of the design project.
3. The final stage concentrates on the environment's design and the urban design project's development (Maretto, 2018).

[3] Guiseppa Strappa's (1998) article, "The concept of enclosure in the creation of distinctive building types" provides additional insight into these principles.

Stages	Weeks, lessons, contents, products
1. Methodological	It is held in 12 weeks It is devoted to the learning of the basic morphological tools and the main software for the environmental analysis/design It is organized in theoretical lessons and practise laboratories At the end of the stage, MSc students will provide a basic morphological map, a first nodality survey and the environmental analysis of the design context First evaluation step
2. In-the-field workshop	It is held in one week MSc students verify the analyses previously developed and prepare a basic morphological master plan Together with the hosting institution, it is structured in a number of lessons and a continuative (24 h) laboratory activity At the end, students will present their work to a jury that will examine and evaluate their tasks Second evaluation step
3. Environmental design and urban project	It is held in 16 weeks It is entirely dedicated to the urban and environmental design MSc students provide a detailed master plan (accompanied by a complete morphological map, a nodality survey and the environmental analysis) They will have to deliver a number of accurate panels and an overall model Final evaluation step

Figure 8. The content of W.A.M. (Maretto, 2018).

In the workshop, students prepare a context morphological map, which serves as a base for entering the beneficial functional data of the physical context, and then conduct a nodality analysis. Using the context morphological map as a base, the next step involves creating a context functional map. These two maps make it possible to prepare a morphological master plan, which contains the initial morphological and functional elements and forms the basis of the urban design project. The context morphological map supports the morphological master plan throughout the process to evaluate the morphological consistency of the new interventions. By carrying out environmental analysis on the prepared morphological master plan, the data is transformed into an urban master plan. As a result, a morphological, functional, architectural, and environmentally aware urban master plan is revealed as a design product capable of supporting the complexities of the contemporary city and preserving the "place-making" feature (Maretto, 2018).

CONCLUSIONS AND RECOMMENDATIONS

It is crucial to integrate typomorphology approaches into education in the fields of urban design, planning, architecture, and conservation, which have interrelated practical applications (Barke, 2018). In Italy (Maretto, 2015), Spain (Ruiz-Apilánez et al., 2015), the United States, and probably elsewhere in the world (McClure, 2014), few schools of architecture consider typomorphological research as a scientific instrument for architectural and urban design and integrate it into the educational system.

Two different conclusions were drawn from the four studies analyzed in the section ‘‘Integration of Typomorphology into Architectural and Urban Design Education’’. The former are the concepts and issues related to the different dimensions of urban form taught to students in typomorphology education and analyzed in the design process. The latter is the contribution of the course to the students and their architectural design process.

Currently, there are uncertainties regarding the content of basic theories, concepts, and techniques and how to teach them to students in design education based on a typomorphological approach (Oliveira, 2018a). After analyzing the four studies, *Table 1* was created to present the initial findings. It lists a comparison of different concepts, issues, and analysis techniques addressed in the variously shaped education models, with the researcher responsible for each marked. Researchers commonly include the following items in their courses: identity/character, type, typology, hierarchy, natural environment data, urban fabric, street, building block, parcel, building, use and movement, perception of the environment, and historical development and transformation of the city. The provided table can be used as an example for transferring content to students and for analysis when introducing the typomorphological approach in a course construct.

DOI: 10.15320/ICONARP.2024.281

Table 1. The concepts, issues, and analysis techniques related to different dimensions of urban form in urban morphology and typomorphology courses.

	Concepts/Subjects	Karl Kropf	Vitor Oliveira	Richard Hayward & Ivor Samuels	MarcoMaretto
	Identity/Character	x	x	x	x
	Type	x	x	x	x
	Typology	x	x	x	x
	Hierarchy	x	x	x	x
	Sustainability				x
	Authentic-authenticity				x
	Pole-polarity				x
	Node-nodality				x
	Social-building neighborhood				x
	Natural environment*	x	x	x	x
	Topography		x		
	Climate				x
Built Environment	Urban fabric	x	x	x	x
	Streets/Routes	x	x	x	x
	Plot series/Blocks	x		x	x
	Plots	x	x	x	x
	Buildings	x	x	x	x
	Rooms	x		x	
	Structures	x		x	
	Materials	x		x	x
Human-form relations	Use/movement	x	x	x	x
	Control	x			
	Intention	x			
	Construction	x			
	Perception	x	x	x	
	Urban historical development and evolution	x	x	x	x
	Flows of materials and resources	x			
	The agents of urban transformation		x		
	Cities in history & contemporary cities		x		
	Classics in urban morphology/urban studies		x		
Different approaches	Historico-geographical approach		x		
	Process-typological approach		x		
	Space syntax		x		
	Spatial analysis		x		
	Urban morphology and society (public health, social justice)		x		
	Urban morphology and economy (heritage tourism)		x		
	Urban morphology and environment (climate change, energy)		x		
	Context morphological map				x
	Context functional map				x
	Urban master plan				x

*In the articles explaining the information transferred to the students within the scope of typomorphology education, they mentioned only the natural environment. The concepts specifically mentioned under the term natural environment have been added under the title of natural environment.
1) Kropf (2018) stated in his article that natural environmental data are mentioned in education. Kropf (2017) mentioned geology, minerals and soils, topography, water resources (including groundwater), plant and animal communities, and climate within the scope of natural environmental data in his book "The Handbook of Urban Morphology".
2) Oliveira (2018a) mentioned in his article that he explained natural environment data within the scope of education. Oliveira (2016) stated that in his book "The Elements of Urban Form", land reliefs, soil and subsoil quality and suitability, climate, wind and solar effects, and topography are analyzed as natural environmental data.
3) Maretto (2018) evaluated as part of the environmental analysis: Distribution analysis of luminous contributions and albedo values using solar axonometry and three-dimensional block diagrams, climate, and microclimate analysis (average temperature and wind profiles), irradiance profile analysis, and solar axonometry.
Within the microclimate analysis: thermal comfort, radiation components, wind components, and visual comfort.
Analysis of wind components: Outdoor space dimensions, wind speed at two meters height, height of adjacent buildings, wind.

As a second outcome, this text lists the contributions that the integration of typomorphological knowledge into architectural design education is believed to make to students and their architectural design education. The envisaged contributions to students are as follows:

- Comprehend typomorphology as an alternative approach within contextual analysis methods.
- Understand that analyzing the context is just as important as creating a new design.
- Understand and interpret the basic concepts of urban fabric conveniently because of the information learned in the design process.
- Strengthen their theoretical and literary bases.

- Gain awareness by reading and understanding the urban fabric (characteristic features, historical character, potentials, problems, etc.).
- Recognize the significance of groups of buildings and their connection to public spaces in the design process, rather than focusing on individual buildings.
- Be more conscious and systematic in the analysis process.
- Observe more consciously during field trips, see what they look at, evaluate what they see, and develop their ability to transfer these evaluations into design proposals.
- Develop the ability to justify the solutions they present in their design proposals and explain them to the other participants.
- Understand the place's identity, local culture, and values, which support Maretto's (2018) "authenticity" approach in the context of cultural sustainability, to provide more applicable proposals for interventions in the built environment.
- Produce designs quickly, consistent with the urban fabric, with less guidance in deciding new design proposals.

ACKNOWLEDGEMENTS/NOTES

This article is based on an unpublished PhD dissertation entitled *The Effects of Typomorphology on Design Process in Architectural Design Education* by Seda Saylan and continues under the supervision of Assoc. Prof. Dr. Tan Kâmil Gürer at Yıldız Technical University, Department of Architecture.

REFERENCES

Barke, M. (2018). The importance of urban form as an object of study. In V. Oliveira (Ed.), *Teaching urban morphology* (pp. 11–30). Springer International Publishing. https://doi.org/10.1007/978-3-319-76126-8_2

Conzen, M. R. G. (1960). *Alnwick, Northumberland a study in town-plan analysis*. George Philip & Son. https://archive.org/details/alnwicknorthumbe00conz/page/n7/mode/2up

Cross, N. (2021). *Engineering design methods* (5th ed.). Wiley.

Dutton, T. A. (1987). Design and studio pedagogy. *Journal of Architectural Education (1984-)*, *41*(1), 16–25. https://doi.org/10.2307/1424904

Farrelly, L. (2007). *The fundamentals of architecture*. AVA Publishing SA.

Gürer, T. K. (2016). Tipomorfoloji: Kentsel mekânın yapısını anlamak. *İdealKent Kent Araştırmaları Dergisi (Journal of Urban Studies)*, *7*(18), 8–21.

Gygax, F. (2007). The morphological basis of urban design: Experiments in Giudecca, Venice. *Urban Morphology*, *11*(2), 111–125. https://doi.org/10.51347/jum.v11i2.3936

Hayward, R., & Samuels, I. (2018). Moving urban morphology from the academy to the studio: The use of urban tissues in teaching and continuing professional development. In V. Oliveira (Ed.), *Teaching urban morphology* (pp. 281–296). Springer International Publishing. https://doi.org/10.1007/978-3-319-76126-8_16

Kropf, K. (1998). Typological zoning. In A. Petruccioli (Ed.), *Typological process and design theory* (pp. 127–140). Aga Khan Program for Islamic Architecture.

DOI: 10.15320/ICONARP.2024.281

Kropf, K. (2014). Ambiguity in the definition of built form. *Urban Morphology*, *18*(1), 41–57. https://doi.org/10.51347/jum.v18i1.3995

Kropf, K. (2017). *The handbook of urban morphology*. Wiley. https://doi.org/10.1002/9781118747711

Kropf, K. (2018). Interdisciplinarity and design: Tools for teaching urban morphology. In V. Oliveira (Ed.), *Teaching urban morphology* (pp. 297–315). Springer International Publishing. https://doi.org/10.1007/978-3-319-76126-8_17

Larkham, P. J., & Jones, A. N. (1991). *A glossary of urban form*. Urban Morphology Research Group, School of Geography, University of Birmingham.

Leupen, B., Christoph, G., Körnig, N., Lampe, M., & De Zeeuw, P. (1997). *Design and analysis*. 010 Publishers.

Lynch, K. (2012). *Kent imgesi*. Türkiye İş Bankası Kültür Yayınları.

Maretto, M. (2015). Teaching urban morphology in Italy: Balances and prospects. *Revista de Morfologia Urbana*, *3*(1), 66–67.

Maretto, M. (2018). Teaching urban morphology in a sustainable perspective. In V. Oliveira (Ed.), *Teaching urban morphology* (pp. 243–264). Springer International Publishing. https://doi.org/10.1007/978-3-319-76126-8_14

Marzot, N. (2002). The study of urban form in Italy. *Urban Morphology*, *6*(2), 59–73. https://doi.org/10.51347/jum.v6i2.3901

McClure, W. (2014). Interlacing urban morphology and design studio education: The time is ripe. *Urban Morphology*, *18*(2), 168–170. https://doi.org/10.51347/jum.v18i2.4581

Menghini, A. B. (2002). The city as form and structure: The urban project in Italy from the 1920s to the 1980s. *Urban Morphology*, *6*(2), 75–86. https://doi.org/10.51347/jum.v6i2.3902

Moudon, A. V. (1994). Getting to know the built landscape: Typomorphology. In K. A. Franck & L. H. Schneekloth (Eds.), *Ordering space: Types in architecture and design* (pp. 289–311). Van Nostrand Reinhold.

Oliveira, V. (2016). The Elements of Urban Form. In *Urban morphology an introduction to the study of physical form of cities* (pp. 7–30). Springer. https://doi.org/10.1007/978-3-319-32083-0_2

Oliveira, V. (2018a). A course in urban morphology. In V. Oliveira (Ed.), *Teaching urban morphology* (pp. 317–334). Springer International Publishing. https://doi.org/10.1007/978-3-319-76126-8_18

Oliveira, V. (2018b). Introduction. In V. Oliveira (Ed.), *Teaching urban morphology* (pp. 1–8). Springer International Publishing. https://doi.org/10.1007/978-3-319-76126-8_1

Oxman, R. (1990). Prior knowledge in design: A dynamic knowledge-based model of design and creativity. *Design Studies*, *11*(1), 17–28. https://doi.org/10.1016/0142-694X(90)90011-Z

Panerai, P. (1979). Beaubourgh, tipin ölümü ya da dirilişi. *Çevre Mimarlık ve Görsel Sanatlar Dergisi*, *3*, 71–79.

Panerai, P., & Castex, J. (1970). Notes sur la structure de l' espace urbain. *L'Architecture d'Aujourd'hui*, *153*, 30–33. In A. Köksal, A. Arel, E. Gürsel, S. Özkan (Eds.), *Selçuk Batur için mimarlık yazıları*. Mimarlar Odası Yayınları.

Rossi, A. (2006). *Şehrin mimarisi* (1st ed.). Kanat Kitap.

Ruiz-Apilánez, B., Solís, E., & Ureña, J. M. de. (2015). Urban morphological curricula in Spanish schools of architecture. *Urban Morphology*, *19*(2), 146–156. https://doi.org/10.51347/jum.v19i2.4028

Salama, A. M. (2008). A theory for integrating knowledge in architectural design education. *Archnet-IJAR, International Journal of Architectural Research*, *2*(1), 100–128.

Schön, D. A. (1984). The architectural studio as an exemplar of education for reflection-in-action. *Journal of Architectural Education (1984-)*, *38*(1), 2–9. https://doi.org/10.2307/1424770

Schön, D. A. (1987). *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions*. Jossey-Bass.

Schön, D. A. (1988). Toward a marriage of artistry & applied science in the architectual design studio. *Journal of Architectural Education (1984-)*, *41*(4), 4–10. https://doi.org/10.2307/1425007

Strappa, G. (1998). The notion of enclosure in the formation of special building type. In A. Petruccioli (Ed.), *Typological process and design theory* (pp. 91–113). Aga Khan Program for Islamic Architecture.

Uluoğlu, B. (1990). *Mimari tasarım eğitimi tasarım bilgisi bağlamında stüdyo eleştirileri* [Doktora Tezi]. İstanbul Teknik Üniversitesi.

Whitehand, J. W. R. (2001). British urban morphology: The Conzenian tradition. *Urban Morphology*, *5*(2), 103–109. https://doi.org/10.51347/jum.v5i2.3896

Whitehand, J. W. R. (2007). Conzenian urban morphology and urban landscapes. *Proceedings of the 6th International Space Syntax Symposium*, ii01–ii09.

Yücel, A. (1979). Mekân okuma aracı olarak tipolojik çözümleme. In M. Pultar (Ed.), *Çevre, Yapı ve Tasarım*. Çevre ve Mimarlık Bilimleri Derneği.

Resume

Seda SAYLAN graduated from the Department of Architecture at Yeditepe University in 2012. She completed her master's thesis at Yıldız Technical University and began her PhD education at the same institution in 2016. Since 2014, she has been working as a research assistant at Medeniyet University. Her research interests include urban morphology, architectural context, and architectural design education.

Tan Kâmil GÜRER; after completing his undergraduate education at YTÜ, Department of Architecture, in 1991, he completed his master's and doctorate degrees at Istanbul Technical University in 2004. After starting his academic career at YTÜ, Department of Architecture, in 1993, he has been working at ITU, Department of Architecture, since 2017. Although he mainly works in the field of architectural design, he also focuses on urban morphology and the design of sports facilities.

DOI: 10.15320/ICONARP.2024.281

ICONARP
International Journal of Architecture and Planning
Received: 17.03.2023 Accepted: 29.11.2023
Volume 12, Issue 1/ Published: 30.06.2024
Research Article *DOI: 10.15320/ICONARP.2024.282 E- ISSN:2147-9380*

ICONARP

Optimizing Passive Strategies for Energy Demand Reduction in Cold Climate Residential Buildings: A Case Study in Tabriz, Iran

Mahya Ghouchani *
Horreh Todeh Kharman**

Abstract

The fast growth of the population is leading to an ever-increasing trend in energy consumption these days. In this regard, the construction industry is among the biggest consumers. Considering that most buildings are residential, energy optimization is essential, especially during the initial design phase. A practical way of building design with less energy demand is passive design methods. The importance of this issue is more visible in residential buildings in cold climates, which have the greatest temperature fluctuations. This study aims to investigate the energy demand of different passive strategies applied to a residential building in the cold climate of Tabriz, Iran and to select the most efficient design factor. The methodology is a combination of qualitative and quantitative methods. As the first step, considering the theoretical framework of the research, passive systems and the factors affecting building envelope thermal performance are determined. In the next step, EnergyPlus is used to analyze the application of the passive systems in the baseline model. All states are simulated separately in terms of the amount of heating and cooling energy demand and the results are presented in compareable graphs. In the third step, the strategy that has the greatest impact on reducing energy demand in cold-climate buildings is identified, and the most efficient alternative is presented through the analysis of different scenarios compared to the baseline model. This research reveals that heat loss through the envelope accounts for most of the energy demand, and thermal insulation plays an important role in reducing that loss. Also, different scenarios (materials, thickness and location) of thermal insulation were investigated. It shows that the optimal mode of thermal insulation in residential buildings in cold climates is to use polyurethane insulation with a thickness of 7 cm in the outer part of the building wall.

Keywords:
Cold climates, Energy demand, EnergyPlus, Passive strategy, Thermal insulation

*Department of Architecture and Urban Planning, Technical and Vocational University (TVU), Tehran, Iran.

E-mail: m.ghouchani.arch@gmail.com

**Department of Architecture, Faculty of Architecture, College of Fine Arts, University of Tehran, Tehran, Iran. (*Corresponding author*)

E-mail: Toodekharman@ut.ac.ir

To cite this article: Ghouchani, M., & Todeh Kharman, H. (2024). Optimizing Passive Strategies for Energy Demand Reduction in Cold Climate Residential Buildings: A Case Study in Tabriz, Iran. *ICONARP International Journal of Architecture and Planning,* 12 (1), 211-233. DOI: 10.15320/ICONARP.2024.282

INTRODUCTION

Energy is one of the main production elements among all economic sectors, significantly affecting the economy (Ghanbari et al., 2018). Global research indicates that energy consumption is a major factor in countries' rapid economic and industrial development. Moreover, energy has the largest share in global activities and trades. Choosing the energy type depends on the country's policies. For example, France produces most of its energy (about 75%) from nuclear power plants, while countries like China and the United States of America depend on coal and oil to meet most of their energy demand, 65.2% and 37%, respectively (Abbasi Godarzi & Maleki, 2017). Due to the adoption of strict environmental laws and energy crises, developing renewable energy in developed industrial countries is important. Renewable energies are environmentally friendly and economically more affordable than fossil fuels. Wind, solar, hydroelectric, and geothermal energy are the most important renewable energies, and they have an ever-increasing usage speed (Sarleki & Hasan-Beigi, 2018).

Until recently, fossil fuels were one of the most popular energy resources worldwide and were preferred to other energy resources. However, the disadvantages of excessive use of these fuels have led people to look for other energy resources and ways to reduce energy consumption. Fossil resource limitations, environmental concerns, and political and economic crises have made energy management a priority. (Maftouni and Motaghedi, 2020). Population growth has increased energy demand in the building sector, which is expected to continue. According to statistics published by various organizations on energy consumption in different sectors, including the International Energy Agency (IEA), about 30% of global energy is consumed in the residential and commercial sectors. Heating and cooling in buildings consume a large portion of this amount (Bravo Dias et al., 2020).

Also, investigating the effect of climate change on energy consumption is becoming a special issue for economists and policy makers. Many believe that climate change is affected by human activities and energy consumption, especially fossil fuels (Ansell & Cayzer, 2018). Meanwhile, the effect of energy consumption on climate change is interpreted with concepts such as the effect of greenhouse gas (GHG) emission (Taherifard Hanjani & Mirhashemi Dehnavi, 2021). In addition to the air temperature rise, GHG emissions are increasing, making it more important to use less energy and be more energy efficient. (Wesseh Jr & Lin, 2018).

Passive systems use renewable energy and natural resources in various climates, using the building elements as design solutions (Zhang et al., 2019). As the problems of rapid urbanization increase, sustainable approaches have become a priority in the policies of developed countries. Developing countries like Iran are now following these policies to solve various cultural, social, and environmental problems while considering their economic consequences (Fakhar Asfarizi and Gandoomakar, 2020). By designing passive buildings, energy savings can be achieved by

DOI: 10.15320/ICONARP.2024.282

adjusting the form and orientation, the layout, the selection of the best envelope for climate conditions, fenestration sizes according to solar heat gain and loss, glazing types, and implementing appropriate methods to replace fossil fuels with renewable energy (Jomehzadeh et al., 2020). Despite their differences, each of the above reduces the building energy consumption to some extent. The factors discussed in the design process should be evaluated and prioritized according to their effect on energy consumption.

Iran consumes approximately 9% of the world's petroleum products while having only 1% of the world's population (Akbari Paydar et al., 2019). Over the last few years, the global energy consumption has increased by approximately 1-2 % annually, while Iran's consumption has increased by approximately 5%-8% per year (Mansouri and Heidari, 2021). In other words, energy consumption growth in Iran has risen more than five times the global average and annual energy subsidies of $1-$3 billion are paid. Studies indicate that if the trend continues, by 2030, Iran will become a petroleum importer (Fathalian and Kargarsharif, 2020). According to Iran Energy Balance data, in 2012, the share of the building sector (residential, industrial, and commercial) in the total final energy consumption in the country was 36%, which shows the importance of this sector in total energy consumption (Fayyaz et al., 2021).

As living standards have improved, the desire for comfort has also increased. People want to feel comfortable wherever they are. Thermal comfort conditions vary from person to person and from region to region. Such regional differences have a significant effect on energy consumption. If the indoor temperature of buildings in hot areas is supposed to be 25 degrees Celsius in winter, 20 degrees is enough in cold areas (Balilan Asl et al., 2021). Every one degree change in heating and cooling systems reduces about 7% of energy demand in the building (Shabanian et al., 2021). In the temporal analysis of thermal comfort for the cold climate of Tabriz city, based on Ashrae standard 2004-55, summer has the highest seasonal comfort 64% of the time (Qavidel Rahimi & Ahmadi, 2013). In Tabriz, during November to April, in addition to passive measures, active heating measures are also necessary. In the hot months of July and August, thermal comfort can be achieved by passive systems. In other months (September, October, May and June) the weather conditions of Tabriz are within the comfort range (Sabouri & Rahimi, 2017). So, a large amount of energy consumed by residential buildings in Tabriz is used for heating, and reducing the energy consumption in this climate depends on reducing the heating load.

Considering the importance of the subject, i.e. providing comfortable user condition in the cold climate, the aim of this research is to investigate the energy demand of residential buildings in different design conditions in cold climate of Tabriz. Reducing heating load is prioritized in cold climates for economic, energy security, and environmental reasons. Therefore, an effort has been made to calculate the amount of energy saved in each stage by measuring different strategies, and by changing these factors, the most optimal mode is selected. In this regard, by using simulations and quantitive analysis, the current study seeks to answer the following questions:

Which type of passive system has the most impact on energy demand?

What is the optimal state of this system?

RESEARCH BACKGROUND

Determining the range of thermal comfort in different climates with different models, including the "Olgyay" model and the "Terjong" model, relying on the influencing factors: temperature, radiant temperature, Humidity, air flow, activity rate, and clothing rate have been the subject of research by many researchers (Rezazadeh, R., & Aghajan Beiglou, 2012). Also, some critics have researched passive systems such as Trombe wall, solar space, and roof pond and their role in creating suitable thermal conditions in architecture (Abol-Hasani et al., 2022). The thermal performance of a building can be evaluated on three scales: micro-scale, medium-scale and macro-scale. Many studies are conducted on all three scales, yet they focus on the micro-scale and rarely consider the thermal performance of a building on a medium or macro-scale (Woo and Cho, 2018).

Mortezai et al. (2017) observe a strong correlation between primary energy consumption and plan layout, building location and form, building height, and open space area. They also observe a moderate correlation between primary energy consumption and building ratios. Haghani et al. (2017) investigated the effect of blinds on energy savings and discovered that blinds positively impact the total building loads. Ansarimanesh et al. (2019) used Design Builder simulator software to determine the optimal direction of an office building in Kermanshah. For this purpose, a frequently repeated type of office building in this city was simulated in the desired software with characteristics close to reality, and then the initial energy required for the building was calculated in different directions. The results of this research showed that considering the energy consumption index, the west-east stretch is the best orientation in the office buildings of Kermanshah.

Nourivand et al. (2021) studied the building energy performance simulation and optimization tools in the three main evolutionary stages of building energy performance: "design stage", "construction stage" and "operation stage". Reducing the energy consumption of an office building in the cold climate of Tabriz. In the article by Abdul Khaleqi et al. (2021), the effects of different criteria of solar greenhouse on the amount of energy intake and reduction of energy waste are presented. To achieve the desired goals, models of a residential unit with a solar greenhouse were examined with changes between the models. Ebrahimzadeh and Nilfroshan (2023) while calculating the angle of solar radiation in summer and winter and the degree of its rotation in the plan and section of tall residential buildings in Ardabil (cold climates), obtained the optimal form in such a way that the maximum area faces the sun in winter

DOI: 10.15320/ICONARP.2024.282

and have the least area facing the sun in summer. The results of this research state that by knowing the indicators of architectural form that are effective on energy consumption and efficiency in high-rise residential buildings in cold climates, it is possible to determine the level of energy efficiency from the perspective of physical and environmental indicators.

Ghadiri Moghadam et al.'s (2019) research, during laboratory and field studies, measured the amount of energy supply in five different modes from the combination of the Trump wall and the greenhouse phenomenon with the desired chamber in the first and second six months of the year in the cold climate of Ardabil city. The results of this research showed that among the different options of using the Trumpet wall and the greenhouse effect, installing the Trumpet wall and shade along with suitable windows on the south wall of the building with a score of 25.83 has the best performance in energy supply.

The purpose of this study is to evaluate the effect of several passive strategies step by step to determine which one has the most impact on the energy loads of a residential building in the cold climate of Iran. These include changing the glazing and window frame, shading, insulation, greenhouse, and orientations.

THEORETICAL FUNDAMENTALS

Passive systems are designed to meet buildings' heating, cooling, and lighting needs in a sustainable, climate-adaptive way while minimizing the use of HVAC equipment (Ghiabkloo, 2019).

Passive systems use architectural elements as design solutions for climate change. The passive system is nothing but the building itself. These building components will be effective in heating and cooling (Mashhor, 2019). Therefore, the use of passive systems requires careful design and decisions. Passive system elements are in full connection with the initial and basic architect design decisions, and after that, they are influential in the second stage of designing and organizing the form and shape of the building.

It should be noted that without observing the basic principles of climate design, applying these elements will not result in favorable performance. Using passive systems in a building may result in less energy consumption and lower costs of heating, cooling and lighting of the building. Furthermore, passive systems could create attractive and beautiful spaces, depending on the architect's ability (Vakilinejad et al., 2013).

These systems can be divided into passive heating and cooling systems. Passive heating is based on using solar thermal energy, and passive cooling is based on using different heat reducers (Vakilinejad et al., 2013). Considering the emphasis on the use of solar energy and reducing the consumption of fossil fuels, as well as reducing the costs of heating and cooling equipment and their repair, the role of these systems is important in achieving sustainable architecture.

Using passive systems for heating and cooling buildings is not a new technique, and it has been used for centuries. Direct sunlight through a typical south-facing window is the simplest type of this system. Using solar heating in Europe did not begin until the 1920s (Safar Alipour and Shahgoli, 2013). During the late 1950s and the early 1970s, passive systems were believed to have the greatest potential for receiving solar energy. However, passive systems received more attention with the developments and the APEC oil embargo in 1973. Passive systems have a lower initial cost than active systems (Ghadiri Moghadam et al., 2019). They also require less maintenance and are more reliable.

A passive thermal system is a system in which the main elements of the building collect, store and redistribute solar energy. Passive heating is based on the use of solar thermal energy and passive cooling is based on the use of various heat reducers (Abdul Khaleqi et al., 2021). In a general classification, the types of passive solar systems can be classified as follows (Vakilinejad et al., 2013):

- Passive heating: direct absorption, thermal storage wall (Trump wall and blue wall), solar space (greenhouse and atrium), air transfer cycle (stone bed and double wall system)

- Passive cooling: cooling through ventilation (ventilation with wind power and chimney effect and night ventilation and wind ventilation cap and double-walled roof), evaporative cooling (direct and indirect), radiation cooling (direct and indirect), cooling through mass effect (direct and indirect connection), cooling through dehumidification

The use of passive systems in architecture has a long history. To create comfort in traditional houses, traditional architects have invented and used elements that are similar to the concepts of today's passive systems (Torabi, 2019). The use of passive systems in the architecture of traditional houses, while achieving stable thermal comfort in the house, has also provided reasons for moving in the direction of sustainable development and saving resources (Nazarboland et al., 2021). Passive heating is based on the use of solar thermal energy and static cooling is based on the use of air displacement and different heat reducers (Valizadeh Oqani and Movahedi, 2019). The native architecture of different regions has been formed in line with the climate of the region and in order to take advantage of the free energy of nature such as sun and wind, and they have tried to provide comfortable conditions for the residents of these buildings in the best possible way. The native architecture of the cold and mountainous regions of Iran is not exempt from this rule. In such a way that it is formed with the proper orientation and the way it is placed in relation to the sun, the ground and other factors, and on the other hand, by creating small openings and thick walls, we try to maintain comfort conditions inside the building and prevent the entry of factors that disrupt comfort, such as cold. have entered (Zarnashani Assal et al., 2019).

The traditional houses of Tabriz are used for the natural heating and cooling of the house by applying local climatic patterns and using clean

DOI: 10.15320/ICONARP.2024.282

energy such as solar energy and natural ventilation, and as a result, in addition to creating a balanced climatic environment, it has limited the consumption of fossil fuels. In a cold climate, reducing the heating load is prioritized in terms of economic and energy supply security and environmental pollution reduction (Ghoddosifar and Faramarzi Asl, 2022). In this regard, in order to achieve optimal thermal comfort in some cold months of the year, active measures are used to heat the architectural space (Ghafarigilandeh et al., 2019). Therefore, in order to facilitate heating in cold areas, large spaces are avoided, and different architectural solutions and patterns are used to heat the spaces in order to utilize natural energy. In the case of high heating needs, they use fireplaces (Zarnashani Assal et al., 2019). Considering that in a cold climate, most of the energy of residential buildings is used for heating, reducing the energy consumption of buildings in this climate depends on reducing the heating load of spaces (Ebrahimzadeh and Nilfroshan, 2023). Therefore, in the following, the solutions considered by the residents and traditional architects of Tabriz in order to take advantage of the static heating systems and deal with the climatic factors in line with the comfort and peace of the residents are presented:

Building orientation: The proper building orientation is one of the essential principles for the efficient use of natural resources and energy (Galal, 2019). The optimal orientation and placement of a building protects occupants from the cold winters and the hot summers and prevent entering unpleasant winds. In Tabriz, buildings are typically oriented to the south, with deviations to the east and west based on sunlight (Figure 1). In addition, cubic volumes, compacted design, and the use of shared walls reduce the external surface of the building and thus reduce the heat loss through the envelope. Meanwhile, the southern facade of the building faces the courtyard and receives sunlight without any obstruction (Xia and Li, 2019).

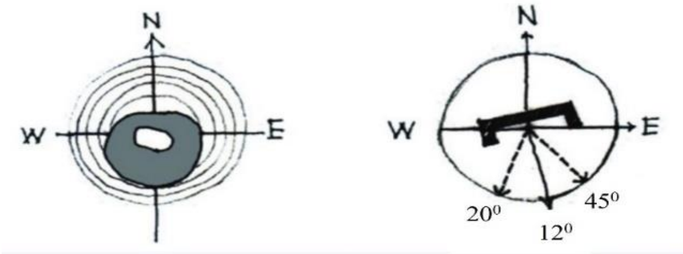


Figure 1. Diagram of Building orientation in cold climates (Ansarimanesh et al., 2019)

Earth coupling: Direct contact of parts of the building with the earth is one of the ways to reduce heat flow through the envelope; temperature is more stable underground than on the ground (Wang et al., 2020). Underground construction provides more thermal comfort in cold climates. Due to the high delay in the ground heat transfer, the ground's temperature is higher than the air temperature in winter and lower in summer, and the temperature fluctuations of the underground spaces are small (Yang and Jeon, 2020). Using basements and underground areas is one of the climatic strategies in Iranian architecture, which is also apparent in the traditional houses of Tabriz (Xia and Li, 2019) (Figure 2).

Figure 2. Placement of parts of the building in the soil in the house of Mojtahedi in Tabriz (Valizadeh Oqani and Movahedi, 2019)

Insulation: As a link between inside and outside, insulation in a building envelope is essential for reducing cooling and heating loads, improving thermal comfort, and saving energy (Liu et al., 2020). Insulation works as a shield between the inside thermal mass and the outdoors, which, in the winter, keeps solar heat inside the thermal mass during the day and returns it to the indoors at night. It also prevents sudden temperature rise during the summer. This function provides thermal comfort and reduces energy consumption, especially in winter.

Windows: Windows are one of the main elements of indoor space's cooling, heating and ventilation. Therefore, the key factors are window type, size, shape, configuration, and orientation (Fasi and Budaiwi, 2015). Traditional houses of Tabriz usually have south-facing windows, which provide more daylight and solar radiation. Also, the window height in the south is higher to increase sun access (Xia and Li, 2019). Skylights are another way to take advantage of daylight and natural ventilation in the houses of Tabriz (Haji Ghanbari et al., 2016).

Greenhouse: In cold climates and on the south side of buildings, sections with 100% glazing are designed to use solar energy. Sun rays enter through the windows and absorb into the walls and floors, which are typically dark (Han et al., 2021). The waves reflected from these surfaces have shorter lengths than the original, so glass blocks them. Thus, the sun's rays are trapped in the sunspace and gradually absorbed by different surfaces. The process heats the enclosed glass area and the surrounding spaces in cold climates (Esmaeli, R., Roshandel et al., 2020).

Natural ventilation: Creating airflow in the building for ventilation can be achieved artificially with devices like fan coils or naturally (Ghiyaee et al., 2013). Natural ventilation is a passive method of cooling and ventilating buildings that relies on natural forces, such as wind and buoyancy, to move air through indoor and outdoor spaces. By using this method, comfortable indoor conditions can be maintained without mechanical means in some periods of hot months.

RESEARCH METHOD

The present study aims to examine passive strategies based on a case study to reduce building energy demand with a qualitative and quantitative approach. Descriptive, analytical, and simulation methods are used throughout the research process. The case study enables us to

DOI: 10.15320/ICONARP.2024.282

conduct a comparative analysis of different passive strategies, allowing us to identify which strategies are more effective in specific contexts. This contributes to a nuanced understanding of the optimization potential. In this case, most of the simulations are on a single base room and there are some limitations to generalise them for larger areas with different layouts. However, it's crucial to emphasize that the selected building represents a complex typical case within a specific category (residential) in the selected region and as a result can be generalised for simillar places and buildings.

First, passive systems and factors affecting the thermal performance of external walls in a single-detached house are identified by studying the theoretical framework. The data collection consists of library studies, including thesis, articles, and searching about building materials in Tabriz.

Following that, simulations are conducted based on the findings and standard assumptions. Furthermore, simulations follow a clear pathway which is shown in flowchart below (Figure 3). It should be noted that scenarios are created at monthly intervals and the comparison is based on total annual result.

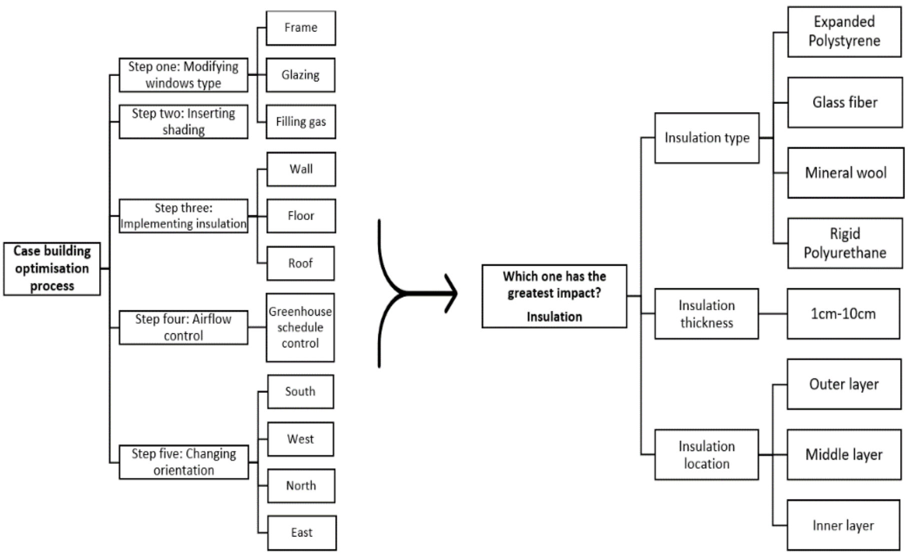


Figure 3. Case building optimization process flowchart

SketchUp is used to model the case building because of its specific features and user-friendly interface. Moreover, OpenStudio is used to determine the thermal zones of the building, fenestration, Window-to-Wall Ratio, and adjacency. Energy simulation is conducted by EnergyPlus (v. 9.2), which is a whole building energy simulation program that engineers, architects, and researchers use to estimate energy loads of heating, cooling, ventilation, lighting and water use in buildings (Bakhtyari, R., Fayaz, 2019). This software has been validated for energy building modeling in many studies before. For example, a practical way of validation is to collect real-world data in an experimental field work and collect simulation data based on realistic simulation and correct

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

assumptions, and compare both results. This method has been shown in detail in some studies (Pereira et al., 2014).

Finally, the passive systems discussed previously are investigated, and the system with the highest impact on reducing energy consumption is proposed.

Region:

The studied city in the process of energy simulation is Tabriz, which is in northwestern part of Iran, and is located 38°5′ north and 46°16′ east. Its climate is classified as BSk by Köppen and Geiger, with harsh winters and hot, dry summers (Ouria, 2019). The ratio of comfortable hours to uncomfortable hours in Tabriz is about 7%, and creating comfortable conditions for human physiology requires energy (Ghobadian, 2021). Iran National Building Code considers Tabriz buildings high energy consumers and the cooling-dominant regions (Rouhizadeh, M. Farrokhzad, 2020). Dry bulb temperature and psychometric chart of the city are present, using the LadyBug plugin in Rhino in Figure 4, respectively.

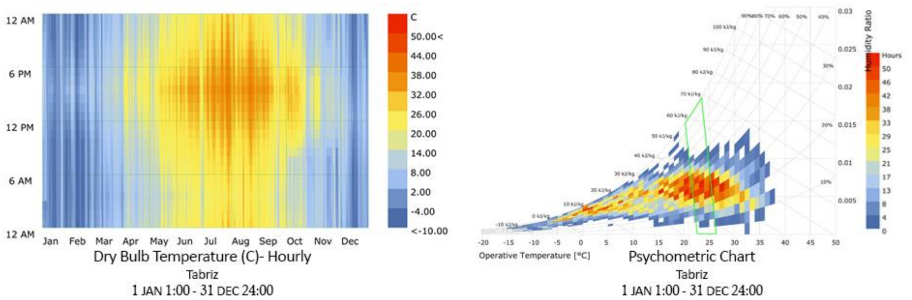


Figure 4. Left: Hourly dry bulb temperature, right: range of comfort conditions

The left side graph shows that the main heating period of the city is from November to March. However, on the other side, a small proportion (green line) of the whole year can be considered as a comfort zone and people do not need a heating or cooling system to feel comfortable.

Case building description:

The calculations were carried out on a simplified model of a two-floor building, including different parts which are shown in Figure 5.

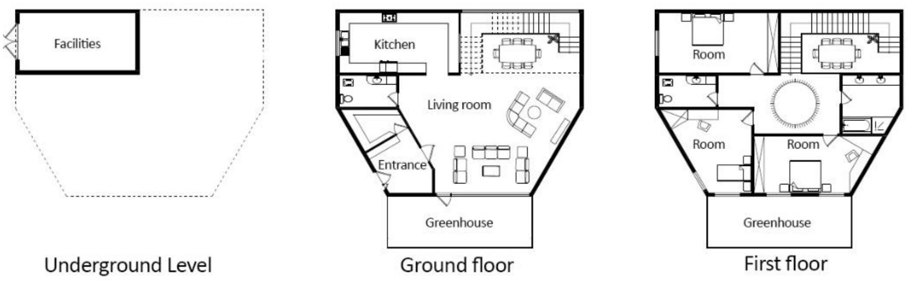


Figure 5. Layout design of the building

The total roof and ground slab surface is 140 m2, and the total area is 280 m2. In addition, the facility and greenhouse areas are 27 m2 and 25

DOI: 10.15320/ICONARP.2024.282

m2, respectively. In the southern part of the building, the walls are chamfered and do not follow a cube shape to get the maximum solar heat gain through the building envelope. Specifically, the building is south-oriented, with passive layout design principles. The living room, greenhouse and main bedrooms are in the south, corridors, stairs and kitchen in the north and other spaces in the east and west.

As a result of the sloped site, parts of the building, including the north and east walls on the ground level and portions of the first floor, are adjacent to the ground. Other outside surfaces have outdoor boundary conditions, and they define sun-exposed and wind-exposed surfaces. Other simulation assumptions on the case-building are provided in Table 1 and 2.

Table 1. Basic information about the case-building model

Title	Value
Total gross floor area	332 m^2
Number of floors	2
Floor-to-floor height	3 m
Building orientation	South-oriented
Terrain	Suburbs
Time steps per hour	6
WWR	S:40% N:20% W:30% E:0%
Glazing type	Single-pane clear with wooden frame
HVAC template	Ideal load air system

Table 2. Cross-section and physical properties of the construction of the case building

Construction Assembly	Elements from outside to inside	Thickness (m)	Thermal conductivity (W/m-K)	Thermal Resistance (m^2-K/W)	U-value (W/m^2-K)
Exterior wall cross-section	Cement board	0.03	0.58	0.052	4.103
	Cement plaster	-	-	0.026	
	Concrete 1600 (kg/m^3)	0.2	2	0.1	
	Gypsum plaster	-	-	0.066	
Interior wall cross-section	Gypsum plaster	-	-	0.066	2.592
	Brick	0.102	0.402	0.254	
	Gypsum plaster	-	-	0.066	
Roof cross-section	Asphalt	0.0032	0.04	0.08	2.627
	Cement plaster	-	-	0.026	
	Lightweight concrete	0.05	0.46	0.109	
	Concrete 1600 (kg/m^3)	0.2	2	0.1	
	Gypsum plaster	-	-	0.066	
	Cement	-	-	0.026	
Floor cross-section	Concrete 1600 (kg/m^3)	0.2	2	0.1	3.438
	Cement plaster	-	-	0.026	
	Laminated paperboard	0.01	0.072	0.139	

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

RESULTS

The approach of this study is to investigate the impact of various passive factors on the amount of cooling and heating energy demands in the building. It should be noted that while defining the case study may be simple as a strategy, its implementation is complex. In the process of using a case study, the reliability and validity of the process and the results achieved must also be analyzed. Moreover, the first stage assumptions should be based on past experimental measurements and field studies.

The case building: By defining thermal thermostats for the thermal zones and based on the primary properties of the building, the cooling and heating sensible energy was calculated monthly. It was observed that the highest energy demand is for the coldest month, and the lowest is in the two transition periods (after winter and after summer). Additionally, as the climate is cooling-dominated, the primary energy demand is heating (Figure 6).

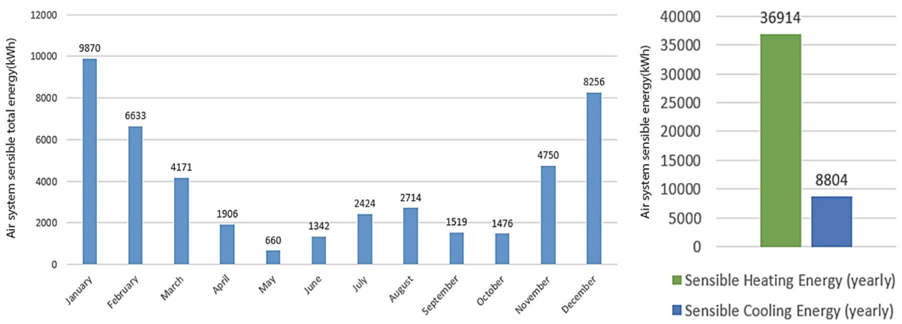


Figure 6. From right to left: Total monthly air system sensible energy, Total heating and cooling sensible energy

Therefore, according to the graphs and climate related properties which are discussed before, the main approach of the scenarios should be based on heat loss reduction during cold months. However, some passive actions, such as using shadings in hot months can reduce sensible cooling energy which is not enough.

Due to low solar heat gain, the highest sensible energy was for the stairs in the cold seasons and the western bedroom. In addition, the lowest sensible energy was for kitchen cooling due to lateral adjacency to the ground, vertical adjacency to the facility part, and limited solar heat gain in the west. Another reason for the high heating demand in the stair zone is its height and large window in the north. In cold climate regions, using large windows is not recommended because they could cause a lot of heat loss. Furthermore, in terms of visual comfort, large, unprotected windows increase the chance of glare in residential buildings. During summer, the southeast bedroom will consume the most cooling energy (Figure 7).

DOI: 10.15320/ICONARP.2024.282

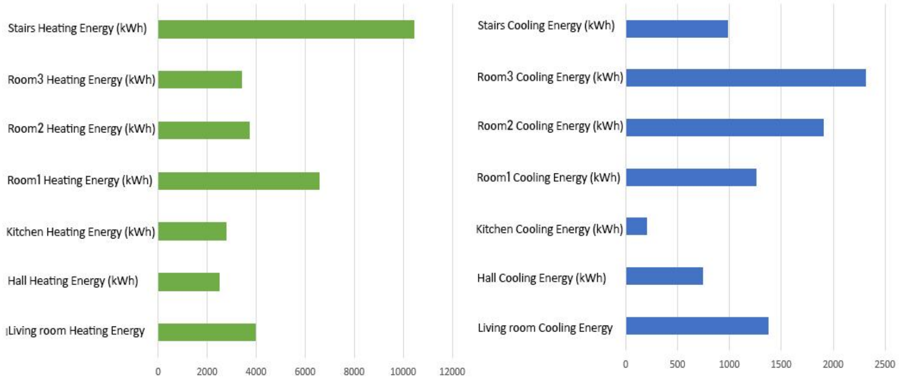
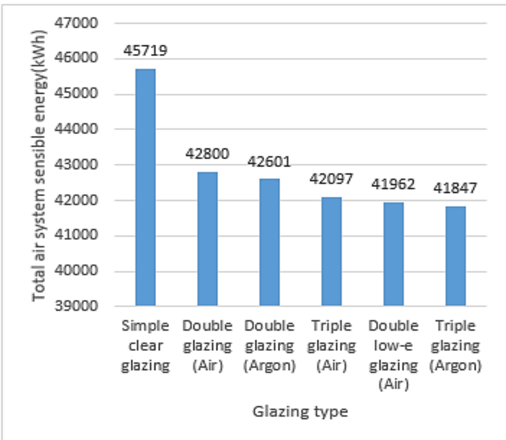


Figure 7. From right to left: Heating sensible energy (kWh) and cooling sensible energy (kWh) for each zone

Window: Compared to single-glazed windows, double and triple-glazed windows incorporate multiple layers of glass surrounded by insulating air pockets or gas pockets. This reduces heat transfer and improves energy efficiency. The temperature difference between the interior and exterior surfaces of single-glazed windows is also more likely to cause condensation. This may lead to issues like mold and mildew, affecting indoor air quality and potentially causing damage to the window frame. Regarding wooden frames, wood itself has some insulating properties, but it is not as effective as other materials used in modern window frames, such as vinyl, fiberglass, or aluminum with thermal breaks. Accordingly, the windows change from traditional single-pane (6mm, Solar transmittance 0.77) with wooden frames to double-pane (6mm and 4mm, Solar transmittance 0.77 and 0.84) with PVC frames and an air-filled cavity. The results show a 6.4% reduction in cooling and heating energy demand. The highest solar heat gain is from the greenhouse, which is desirable in the cold periods and will lead to higher energy consumption on hot days. Following that, the impact of four glazing types on energy demand was investigated. The results show that Argon-filled triple glazing has the best performance, and then double glazing with low emission (Low-E solar transmittance 0.6) coating on the inside reduces the energy by 8.4% and 8.2%, respectively. Also, Low-E double glazing has better performance than triple glazing (Figure 8).



Window type	Elements from outside to inside
Simple glazing + wooden frame	Clear 6mm
Double glazing + PVC frame (Air)	Clear 6mm
	Air 13mm
	Clear 4mm
Double glazing + PVC frame (Argon)	Clear 6mm
	Argon 6mm
	Clear 4mm
Triple glazing + PVC frame (Air)	Clear 6mm
	Air 13mm
	Clear 4mm
	Air 6mm
	Clear 4mm
Double low-e glazing + PVC frame (Air)	Clear 6mm
	Air 13mm
	Low-e clear 4mm
Triple glazing + PVC frame (Argon)	Clear 6mm
	Argon 13mm
	Clear 4mm
	Argon 6mm
	Clear 4mm

Figure 8. Total air system sensible energy for various window types

Shading: Shading evaluations were conducted using 40 cm horizontal shadings on the south and west and 30 cm vertical shadings on the west. The vertical shading blocks direct sunlight when the sun is lower. According to the results, the fixed shadings did not cause a noticeable change in annual cooling and heating sensible energy in this climate since they prevented solar gains on cold days and reduced cooling on hot days. In addition, if the shadings are controllable or have a greater depth, less cooling energy will be consumed in hot months, and by closing the shading in cold months, more energy will be saved (Figure 9).

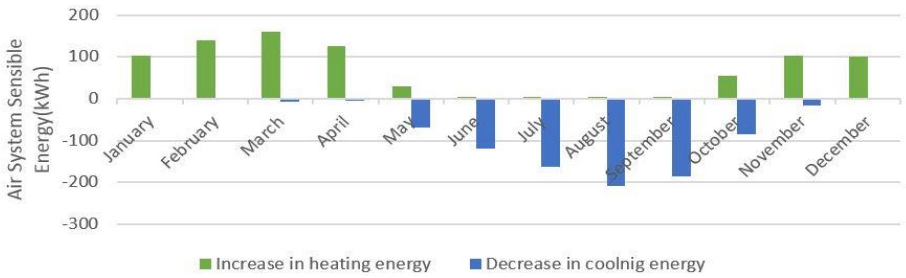


Figure 9. The difference between the heating and cooling sensible energy of the building with fixed shadings compared to the case without shadings

Insulation: Insulation materials reduce the rate of heat transfer through the building envelope. In addition to keeping the indoor temperature stable, insulated walls, roofs, and floors minimize the need for mechanical systems to compensate for heat loss or gain. This, in turn, leads to lower energy consumption and reduced utility bills. On a larger scale, it can reduce environmental effects and fuel poverty. In this regard, five centimeters of fiberglass insulation with 0.04 (W/mk) thermal conductivity was added to the floor and roof construction of the building. Thermal conductivity is a measure of how well a material allows heat to pass through it when there is a temperature difference across the material and it can be affected by various factors (Hung Anh & Pásztory, 2021). The added layer reduced the building's cooling and heating energy demand by 20.7%. A similar thickness of insulation was added to the structure of the walls and caused a 42.5% energy reduction compared to the base case. As a result, wall insulation alone reduced sensible energy by 21.8%. Finally, the insulation thickness within the floor, ceiling, and walls increased to 10 cm and 48.7% compared to the uninsulated state and 10.8% compared to the 5 cm insulation state energy reduction was observed (Figure 10).

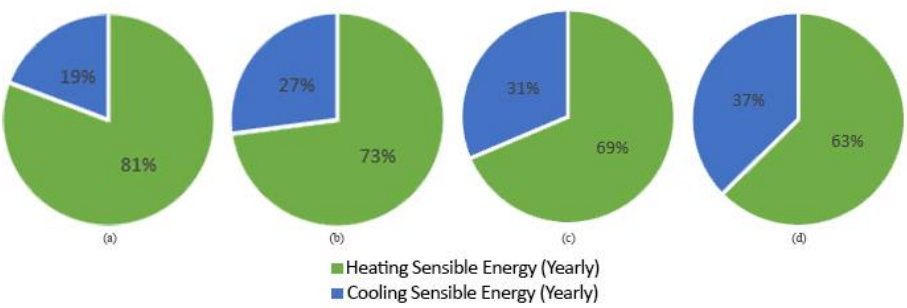


Figure 10. The contribution of cooling and heating sensible energy (a)without insulation (b) with 5cm roof and floor insulation (c) with 5cm wall, roof and floor insulation (d) with 10 cm wall, roof and floor insulation

DOI: 10.15320/ICONARP.2024.282

According to the results, building fabric insulation has a great impact on building energy demand compared to other scenarios, and the main impact of insulation is on the heating load of the building. Therefore, it can be considered as the answer to the research question and can be investigated in more detail to achieve higher energy efficiency.

Natural ventilation: Natural ventilation as a passive solution reduces the reliance on mechanical ventilation systems, leading to lower energy consumption. It also helps in removing indoor pollutants and ensuring a fresh supply of outdoor air. However, the best option is that make it as a part of a hybrid system that combines both passive and mechanical methods for optimal performance. In this regard, the greenhouse schedule was changed, so during the cold days, the openings between the living room and greenhouse would be open, while at night or on hot days, they would be closed. Also, airflow between the greenhouse, the living room, and the stairs was set, which increased the total heating energy and decreased the total cooling energy, which resulted in a 3.3% reduction in total sensible energy. Covering the upper surface of the greenhouse on hot days is also one of the strategies that causes a 14.5% reduction in cooling energy (Figure 11).

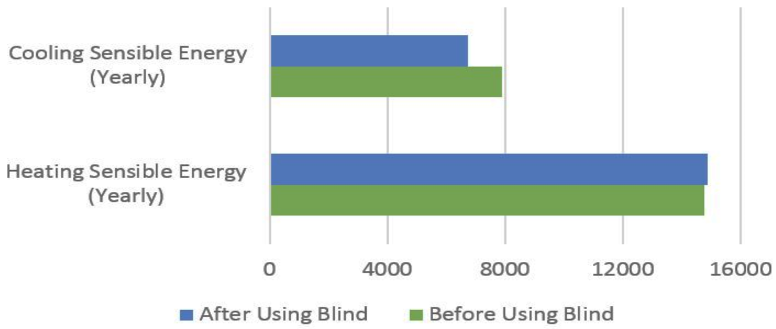


Figure 11. The effect of using blinds on top of the greenhouse

Greenhouses also can play a multi-functional role in buildings as a passive element. For example, to prevent overheating on hot days by increasing the greenhouse infiltration rate, it is assumed that the greenhouse has a flexible structure that folds on hot days and extends on cold days. Thus, it reduces cooling sensible energy by 1.6%.

Orientation: Another influential factor associated with energy demand is the proper orientation of the building according to climate, layout, and function. If the building is not properly oriented to take advantage of natural ventilation and solar gain, there may be a higher reliance on mechanical heating, ventilation, and air conditioning (HVAC) systems. This can increase operational costs and environmental impact. A comparison of the four main orientations found that the highest energy demand is in the western case, and the lowest cooling sensible energy is in the northern case. Simulation results indicate that an optimal layout and orientation can reduce energy demand by 12.3% (Figure 12).

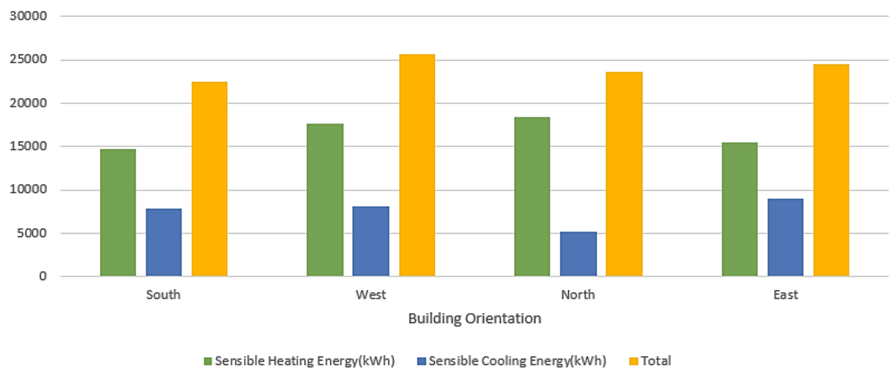


Figure 12. The effect of building orientation on sensible energy

After applying all the changes, the total cooling and heating energy decreased by 50.8% compared to the base case. Considering that heating energy decreased by 22217 kWh, the focus of building optimization should be on heating energy efficiency and improving the results by considering the optimum options in the early design stages (Figure 13).

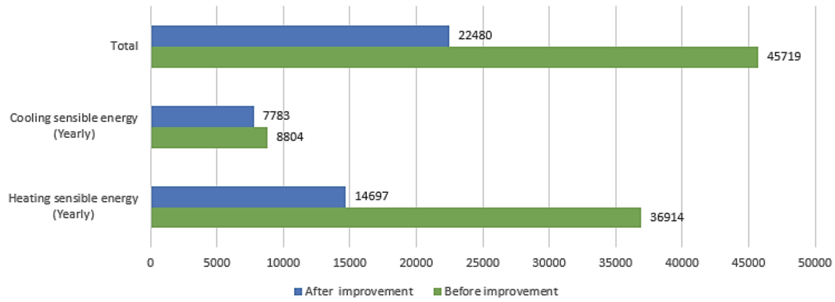


Figure 13. Heating and cooling sensible energy alteration

According to the findings, there is no doubt that passive approaches are a practical way of controlling energy demand in cold climate residential buildings. It can lead to various positive outcomes, such as less environmental impacts, lower utility costs, stable indoor temperature, and more energy security. However, if there is no possibility of using all passive design methods, they can be prioritize based on the energy outputs. For example, using insulation in building fabric would be the most practical way of energy demand reduction in similar buildings.

The results are based on modeling in EnergyPlus. The outputs of this software have relative errors, but it has a lower error rate than other energy analysis software and has been validated many times (Queiroz et al., 2020). On the other hand, in this study, a comparative analysis of passive systems in a case building is considered, and the difference is compared to the baseline model.

DISCUSSION

According to the results of the previous steps, insulation has the greatest impact on reducing sensible energy for buildings in cold climates. The following three questions can be discussed when installing thermal insulation inside building envelopes: (1) What is the most effective insulation material for cold climates? (2) What is the optimum

DOI: 10.15320/ICONARP.2024.282

insulation thickness for the building's envelope? (3) Where is the most effective placement of insulation inside the building's envelope?

According to the research method, further analysis is also conducted step by step to determine the optimal passive option. Equations of thermal resistance and thermal conductivity are used for detailed analysis to answer these questions.

Material: Based on factors such as price, transportation, and implementation cost, glass fiber, expanded polystyrene, mineral wool, and rigid polyurethane are the most common insulation materials in Iran. Different insulation materials with the same thickness of 5 cm were applied in the outer layer of the walls, as shown in Table 3.

Table 3. Comparison of different insulation materials

		Elements From Outside to Inside	Thickness (m)	Thermal Conductivity (W/m-K)	Thermal Resistance (m2-K/W)	U-value (W/m2-K)
Exterior Wall Cross Section		outside air film			0.04	
		Cement board	0.03	0.58	0.052	
		Cement plaster	-	-	0.026	
	Insulation Layer Options	a) Expanded Polystyrene	0.05	0.029	1.724	0.47
		b) Glass Fiber	0.05	0.04	1.25	0.605
		c) Mineral Wool	0.05	0.035	1.429	0.546
		d) Rigid Polyurethane	0.05	0.023	2.174	0.388
		Concrete 1600 (kg/m3)	0.2	2	0.1	
		Gypsum plaster	-	-	0.066	
		Inside air film			0.12	

The U-value of the entire wall will be 2.477 (W/m2-K), which, by using insulation and according to the results of Table 4, the best performance in reducing heat loss belongs to rigid polyurethane, which is 0.388 (W/m2-K).

Thickness: Insulation thicknesses from one to ten centimeters are checked. Findings show that, as insulation thickness increases, the rate of effectiveness decreases. The process aims to achieve the optimal thickness, so unconventional thicknesses are avoided (Table 4).

When the difference between a case thermal improvement and the thermal improvement in the previous case is not remarkable, it will be selected as the optimal thickness.

The equation is: $D = \frac{B-A}{B}$

Where (D) is the percentage of improvement, (A) is the U-value of the wall with the previous thickness, and (B) is the U-value of the wall with the chosen insulation thickness. Based on the results, a thickness of 7 cm of rigid polyurethane is recommended.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Table 4. Comparison of different thicknesses of polyurethane insulation

	Elements from outside to inside	Thickness (m)	Thermal conductivity (W/m-K)	Thermal Resistance (m2-K/W)	U-value (W/m2-K)
Exterior Wall Cross Section	outside air film			0.04	
	Cement board	0.03	0.58	0.052	
	Cement plaster	-	-	0.026	
	Rigid Polyurethane	0.1	0.023	4.348	0.21
		0.09	0.023	3.913	0.232
		0.08	0.023	3.478	0.258
		0.07	0.023	3.043	0.29
		0.06	0.023	2.609	0.332
		0.05	0.023	2.174	0.388
		0.04	0.023	1.739	0.467
		0.03	0.023	1.304	0.585
		0.02	0.023	0.870	0.785
		0.01	0.23	0.0435	1.193
	Concrete 1600 (kg/m3)	0.2	2	0.1	
	Gypsum plaster	-	-	0.066	
	Inside air film			0.12	

Placement: Another step in optimizing insulation is to indicate the location of the insulation inside the wall, which results in the maximum reduction in thermal loads. Thermal insulation can be applied to the inner side, outer side, and middle of the wall. As shown in Table 5, installing insulation in the outer part results in less total heating and cooling energy compared to other options. Therefore, based on previous findings about insulation, including material and thickness the best option is 7 cm rigid polyurethane insulation in the outer part of the wall (Table 5).

Table 5. Comparison of polyurethane insulation location

Insolation location	Air System Sensible Heating Energy [kWh]	Air System Sensible Cooling Energy [kWh]	Total Air System Sensible Energy [kWh]
Status 1: Outer layer	15991	5448	21439
Status 2: middle layer	16024	5462	21486
Status 3: Inner layer	16166	5645	21811

It is important to note that the location of different insulations changes in hot and cold climates. Also, the efficiency of different types of insulation varies depending on the material and location. In conclusion, although fabric insulation was selected as the most effective passive scenario, it is still necessary to analyze insulation in detail to find the optimal state of the system based on the research questions. Further simulation outputs showed that using rigid polyurethane with 7cm thickness in the outer part of the walls is recommended based on the evaluation of different thermal insulation scenarios. However, the cost of retrofitting or construction of passive buildings are not considered in this research that can have a huge effect on user preferences. As a result, a pay back period analysis is recommended during the process of passive design. There are also some new insulation materials and technologies which are not

DOI: 10.15320/ICONARP.2024.282

available in some countries but can be used to achieve better energy efficiency in buildings.

CONCLUSION

Nowadays, much energy is consumed to provide comfort in buildings. Assessing energy demand and providing appropriate strategies to increase energy savings is necessary. A useful method of determining energy demand is using simulation software, such as EnergyPlus. In this study, a simple building model is selected, and building air loads in different passive design conditions in a cold climate are simulated and compared.

Different passive methods are investigated, including natural ventilation, orientation, shading, window type and fabric insulation. Each stage has a range of reductions on energy load, but some have more impact in the selected climate. Results in response to the first-mentioned research question show that heat loss through the building envelope is a major energy drain, and installing thermal insulation in the envelope layers plays the most important role in preventing it. The findings are like the conclusions of Asghari et al. (2018), who, by comparing two passive strategies (shading and insulation), concluded that thermal insulation is more efficient than shadings. Regardless of increasing the shading depth, there will still be no significant reduction in energy demand.

Following the first part, by selecting thermal insulation as the most effective option, it is still necessary to investigate this factor in more detail. It can result in less energy demand and more user comfort. Therefore, in response to the second-mentioned research question, according to the study of different insulation materials, thicknesses, and location, the optimal condition is using rigid polyurethane insulation with 7 cm thickness in the outer layers of the building envelope. After comparing different insulations with the same thickness, Kazemi Pouran Badr et al. (2020) concluded that polyurethane insulation has better efficiency than other insulation materials. Although, these results differ from a published study by Eskandari et al. (2017). They claim that most insulation types, except Polyurethane and fiberglass used in roof layers, are effective in cold climates. Also, the best insulation is expanded polystyrene.

The results suggest that based on the climate, the envelope material and thickness, and insulation material, insulation thickness should be determined first, then its location inside the envelope should be evaluated to achieve the best result. Using proper passive design method can lead to less energy consumption in the building sector and consequently less following negative impacts, such as GHG emissions, less user comfort, and high energy bills. It should be noted that the present study was conducted on permanently used buildings. In buildings frequently used (such as office buildings), estimating energy demand based on detailed schedules is necessary to decide on proper insulation methods. Also, further work may consider other climates and simple case

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

study model, as this study was conducted in a cold climate. It may result in different passive methods and different technologies and materials.

REFERENCES

Abbasi Godarzi, A., Maleki, A. (2017). Renewable Energy Policy in I.R.Iran. *Strategic Studies of Public Policy*, *7*(23): 159-174.

Abdul Khaleqi, N., Mghouchi, Y. E., Hamdaoui, S., Asri, N. E., & Mouqallid, M. (2021). Multi-objective optimization of passive energy efficiency measures for net-zero energy building in Morocco. *Building and environment*, *204*, 108141.

Abol-Hasani, N., Mohammad Kari, B., & Fayyaz, R. (2022). Thermal Optimization of Existing Buildings in the Cold Climates of Iran Using Trombe-Wall Characteristics. *Journal of Iranian Architecture Studies*, *4*(8): 107-118.

Akbari Paydar, M., Mohammad Kari, B., Maerefat, M., Abravesh, M. (2019). Optimum Insulation Thickness Based on Energy Carriers Different Tariffs in Climatic Condition of Tehran. *Modares Mechanical Engineering*, 19 (6):1447-1456.

Ansarimanesh, M., Nasrollahi, N., & Mahdavinejad, M. J. (2019). Determination of the Optimal Orientation in the Cold Climate Administrative Buildings; Case Study: Kermanshah. *Armanshahr Architecture & Urban Development*, *12*(27), 1-9.

Ansell, T., Cayzer, S. (2018). Limits to growth redux: a system dynamics model for assessing energy and climate change constraints to global growth. Energy Policy, 120, 514–525.

Asghari, M., Polaei Mozirji, Z., Yazdani, H. (2018). Energy analysis of building cooling load using canopies and thermal insulation in three warm, temperate and cold climates of Iran. *Scientific Mechanical Engineering*, 27 (6): 14-22.

Bakhtyari, V., Fayaz, R. (2019). Capabilities and Limitations of Energy Optimization Tools in Architectural Design Phase. *Iranian Journal of Energy*, 22 (1):127-150.

Bravo Dias, J., Soares, P.M.M. and Carrilho da Graça, G. (2020), The shape of days to come: Effects of climate change on low energy buildings. *Building and Environment*, 181: 107125.

Ebrahimzadeh, A., & Nilfroshan, M. R. (2023). "Explaining the effect of architectural form on energy efficiency of high-rise residential buildings in cold and dry climates (Case study: Ardabil)". *Islamic Art Studies*, *19*(48), 7-24.

Eskandari, H., Maddahi, M.H., Khosrozad, B. (2017). Impacts of Building Insulation on Energy Consumption in Different Climates of Iran: A Cost Analysis. *Iranian Journal of Energy*, 20 (3): 5-18.

Esmaeli, H., Roshandel, R. (2020). Optimal design for solar greenhouses based on climate conditions. *Renewable Energy*, 145: 1255-1265.

Fakhar Asfarizi, M., Gandoomakar, A. (2020). The role of sustainable energy in urban design and construction (Case study: Khomeini Shahr). *Geographical Sciences (Applied Geography)*, 16 (33): 75-84.

Fasi, M.A., Budaiwi, I.M. (2015). Energy performance of windows in office buildings considering daylight integration and visual comfort in hot climates. *Energy and Buildings*, 108: 307-316.

Fathalian, A., Kargarsharif, H. (2020). Investigating the Effect of Different Energy Saving Strategies on Energy Rating of Building by Design Builder Software (Case Study: Office Building). *Journal of Environmental Science and Technology*, 22(7): 199-214.

DOI: 10.15320/ICONARP.2024.282

Fayyaz, R., Abolhasani, N., Fakhari, M. (2021). A Review on Building Energy Studies in Iran. *Andišnāme-ye Me'māri*, 1(1): 63-87.

Galal, K.S. (2019). The impact of classroom orientation on daylight and heat-gain performance in the Lebanese Coastal zone. *Alexandria Engineering Journal*, 58(3): 827-839.

Ghadiri Moghadam, M., Vaziri, V., Sanayeayan, H., Rashid Kolvir, H. (2019). Performance Evaluation of the Passive Energy System (Trombe Wall and Conservatory) in Cold Climate for Energy Saving. *Journal of Iranian Architecture & Urbanism(JIAU)*, 10(1): 25-36.

Ghafarigilandeh, A., Sobhani, B., Mikaili, K., & Ghavidel, F. (2019). Supply of energy in Tabriz city with regard to climate change based on ANP model. *Geographic Thought*, *11*(21), 139-160.

Ghanbari, A., Vaezi, M., Amjadi, Z. (2018). An Analysis of the Energy Consumption Status in the Framework of Future Study Case Study: Tabriz City. *Future study Management*, *29*(114): 53-73.

Ghiabkloo, Z. (2019). *Founder of Building Physics 2 (Environmental Regulation)*, Fourteenth Edition, Tehran: University Jihad (Amirkabir University of Technology).

Ghiyaee, M., Mahdavi Niya, M., Tahbaz, M., Mofidi shemirani, M. (2013). A Methodology for Selecting Applied Energy Simulation Tools in the Field of Architecture. *Hoviatshahr*, 7(13): 45-55.

Ghobadian, V. (2021). *Climatic study of traditional Iranian buildings*, tenth edition, Tehran: University of Tehran Press.

Ghoddosifar, S. M., & Faramarzi Asl, M. (2022). Analyzing the double skin facade moving in the efficiency of energy consumption in residential buildings sustainability in Tabriz city. *Sustainability, Development & Environment*, *3*(4), 21-41.

Haghani, M., Mohammad Kari, B., Fayaz, R. (2017). The Assessment of Window Blinds Effect on Conserving Energy Consumption of Office Building in Tehran. *Modares Mechanical Engineering*, 17 (4): 17-28.

Haji Ghanbari, A., Samaei, F., Karamniya, M. (2016). Combination of ecological architecture and new technologies in reducing energy consumption in mountainous areas (study sample of Tabriz metropolis). *Shabak*, 2(2): 13-21.

Han, F., Chen, Ch., Hu, Q., He, Y., Wei, Sh., Li, C. (2021), Modeling method of an active–passive ventilation wall with latent heat storage for evaluating its thermal properties in the solar greenhouse. *Energy and Buildings*, 238: 110840.

Hung Anh, L. D., & Pásztory, Z. (2021). An overview of factors influencing thermal conductivity of building insulation materials. *Journal of Building Engineering*, *44*, 102604.

Jomehzadeh, F., Hussen, H.M., Calautit, J.K., Nejat, P., Ferwati, M.S. (2020). Natural ventilation by windcatcher (Badgir): A review on the impacts of geometry, microclimate and macroclimate. *Energy and Buildings*, 226: 110396.

Kazemi Pouran Badr, S., Daneshjoo, F., Maasoumy Haghighi, A., Shayanfar, M. (2020). Impact of insulation and building management systems on reducing energy consumption and Energy analysis of residential buildings. *Journal of Structural and Construction Engineering*, 7(2): 5-23.

Liu, Sh., Kwok, Y.T., Ka-LunLau, K., Ouyang, W., Ng, E. (2020). Effectiveness of passive design strategies in responding to future climate change for residential buildings in hot and humid Hong Kong. *Energy and Buildings*, 228: 110469.

Maftouni, N. and Motaghedi, K. (2020). Optimization of Cooling and Heating Loads in a Residential Building in a Hot and Dry Climate. *Journal of Mechanical Engineering*, 50(3): 215-224.

Mansouri, H., Heidari, S. (2021). Energy-Oriented Approaches in Architecture from Embodied Energy Perspective. *Journal of Architecture in Hot and Dry Climates*, 9(13): 137-154.

Mashhor, Z. (2019), Investigating ways to optimize static heating systems to achieve sustainable architecture, *Green Architecture Journal*, 6(21): 35-44.

Mortezai, G., Mohammadi, M., Nasrollahi, F., Ghalenoei, M. (2017). Typo-morphological evaluation of new residential urban texture in order to optimize primary energy consumption case study: Sepahanshahr. *Motaleate Shahri*, 6(24): 41-54.

Nazarboland, N., Ghiyaei, M. M., & Mafi, M. (2021). Reduction of Energy Consumption Through Optimal Shutters in High-Rise Residential Buildings in Accordance with the Skylights of Traditional Buildings in Shiraz. *Islamic Art Studies*, *18*(42), 394-408.

Nourivand, S., Balilan Asl, L., Sattarzadeh, D., & Asefi, M. (2021). Simulation-Based Design in Experimental Researches of Building Performance: A Case Study of an Office Building in Tabriz. *Armanshahr Architecture & Urban Development*, *14*(36), 113-131.

Ouria, M. (2019). Solar energy potential according to climatic and geometrical parameters of cities and buildings: A case-study from Tabriz City- Iran. *Urban Climate*, 28: 100469.

Pereira, W., Bögl, A., & Natschläger, T. (2014). Sensitivity Analysis and Validation of an EnergyPlus Model of a House in Upper Austria. *Energy Procedia*, *62*, 472–481.

Qavidel Rahimi, Y., & Ahmadi, M. (2013). Time estimation and analysis of climatic comfort of Tabriz city. Journal of Geography and Development, 11(33), 173-182.

Queiroz, N., Westphal, F.S., Ruttkay Pereira, F.O. (2020). A performance-based design validation study on EnergyPlus for daylighting analysis. *Building and Environment*, 183: 107088.

Rezazadeh, R., & Aghajan Beiglou, E. (2012). A New Massing Pattern for Row Housing: A Comparison Between Two Massing Types of Residential Blocks Through Thermal Comfort. *Journal of Architecture and Urban Planning*, *4*(7): 165-184.

Rouhizadeh, A.R., Farrokhzad, M. (2020). *Regulation of environmental conditions*, seventh edition, Tehran: Asr Kankash Publications.

Sabouri, S. & Rahimi, L. (2017). Using Climatic Thermal Comfort for Energy Conservation: Case of Tehran, Tabriz, Isfahan, Shiraz, Yazd and Bandar Abbas. Quarterly Journal of Energy Policy and Planning Research, 3(1), 7-35.

Safar Alipour, Y., Shahgoli, A. (2013). The advantage of combining solar greenhouse system and wall thrombus in climate design of today's Isfahan housing, *International Conference on Civil Engineering, Architecture and Sustainable Urban Development*, Tabriz.

Sarleki, E., Hasan-Beigi, S.R. (2018), Production potentials and technical obstacles to the development and exploitation of renewable energies in Iran, *Renewable and New Energy Quarterly*, 6(1): 14 - 25.

Shabanian, M., Kabuli, M.H, Dehghan Benadaki, A., & Zare, L. (2021). Measuring the effect of using polystyrene in reducing the energy consumption of cold

DOI: 10.15320/ICONARP.2024.282

climate residential buildings. *Scientific Journal of Architectural Andisheh*, 5(9), 311-323.

Taherifard Hanjani, A., & Mirhashemi Dehnavi, S. M. (2021). The future study of energy consumption affected by climate change in Iran and its economic and security consequences for the Islamic Republic of Iran. *Defense Economics*, *6*(21), 89-113.

Torabi, F. (2019). Investigating the climatic elements of Iranian architecture based on static solar architectural elements in order to use it to reduce energy consumption in residential houses. Architecture, 6, 99-104.

Vakilinejad, R., Mehdizadeh Siraj, F., & Mofidi Shemirani, S.M. (2012). Principles of static cooling systems in traditional Iranian architectural elements. *Architecture and Urban Planning of Iran*, 4(1): 147-159.

Valizadeh Oqani, M.B., Movahedi, N. (2019). Using Passive Solar Systems for Making Thermal Comfort in Architectural Designs of Traditional Houses of Tabriz. *Journal of Renewable and New Energy*, 6(1): 26-37.

Wang, R., Lu, S., Feng, W. (2020). Impact of adjustment strategies on building design process in different climates oriented by multiple performance. *Applied Energy*, 266: 114822.

Wesseh Jr, P. K., & Lin, B. (2018). Energy consumption, fuel substitution, technical change, and economic growth: Implications for CO2 mitigation in Egypt. *Energy Policy*, *117*, 340-347.

Woo, Y.E., Cho G.H. (2018), Impact of the Surrounding Built Environment on Energy Consumption in Mixed-Use Building. *Sustainability*, 10(3): 832.

Xia, B., Li, X. (2019). Analysis and comparison on the potential of low-carbon architectural design strategies. *Sustainable Computing: Informatics and Systems*, 21: 204-211.

Yang, W., Jeon, J.Y. (2020). Design strategies and elements of building envelope for urban acoustic environment. *Building and Environment*, 182: 107121.

Zarnashani Assal, T., Valizadeh, N .& Satari Sarbangoli, H. (2019). Evaluation of physical components in traditional and modern houses with sustainable development approach (case study of Tabriz city). Scientific and Research Quarterly of New Approaches in Human Geography, 13(1), 172-192.

Zhang, F., de Dear, R. and Hancock, P. (2019), Effects of moderate thermal environments on cognitive performance: A multidisciplinary review. *Applied Energy*, 236: 760-777.

Resume

Mahya GHOUCHANI is an architect engineering, researcher, inventor, and university lecturer. She is inventor and passionate about creativity and innovation. Moreover, she is an INV member of the International Federation of Inventors' Associations – IFIA. In 2013, she received her master's degree in architectural engineering from Shahrood University, Iran, and since then has been working as an architectural designer and supervisor. In addition, she has written two books entitled "Principles of mosque design" and "Introduction to Architectural Design" in Persian.

Horreh TODEH KHARMAN is a PhD candidate in Loughborough University in the UK. She studied Architecture at Tehran University for her bachelor's and master's degrees. She pursued higher education due to her interest in building physics and thermal preferences.

ICONARP
International Journal of Architecture and Planning
Received: 27.01.2023 Accepted: 21.12.2023
Volume 12, Issue 1/ Published: 30.06.2024
Research Article *DOI: 10.15320/ICONARP.2024.283 E- ISSN:2147-9380*
ICONARP

A Conceptual Approach to Abandoned Industrial Sites within the Scope of Brownfield in the Context of Regenerative Design

Hande Apak*
Gökçe Tuna Taygun**

Abstract

Built environments and technologies produced to provide for people's requirements can also create environmental problems. The approaches used in the management of these problems are generally technology-based, focusing on reducing the damage to the environment, considering human beings independent from nature. As a critical view of these approaches, regenerative design has been placed in the literature. In contrast to environmental approaches that focus on the problem in design, regenerative design focuses on "turning the problem into potential". In this article, abandoned industrial areas (AIA) within the brownfield (BF) context of the degraded environment are discussed as one of the examples of the concept of turning the problem into potential in the built environment. These areas are problematic with intertwined ecological, sociological, economic, etc. degraded environments at different scales. However, they are built environments that can produce ecological, cultural heritage, social, etc. values as a result of their regeneration within the framework of their potentials.In this article, although not defined in the context of regenerative design and renewal, the projects implemented on AIA within the scope of BF, which can be evaluated in the context of transforming the problem into potential, are selected and analyzed. These projects are cases that have been successfully managed in the design, implementation and life processes, where the community and professionals have participated in a coordinated partnership, have been recognized globally with national and international awards. The lack of a systematic approach based on the different site-specific degradations in the BF in the regeneration of the analyzed projects has been seen as a gap in the literature. The aim of the article is to present an approach that can integrate different disciplines in a joint cross-section with a holistic approach to the area and to address the issue within the scope of the regenerative design process.

Keywords:
Regenerative design, Brownfield, Abandoned industrial area

* Department of Fine Arts, Istanbul Gelisim University, Istanbul, Turkey (*Corresponding author*)
Email: hapak@gelisim.edu.tr

**Department of Architecture, Yıldız Technical University, Istanbul, Turkey.
Email: tuna@yildiz.edu.tr

To cite this article: Apak, H., & Tuna Taygun, G. (2024). A Conceptual Approach to Abandoned Industrial Sites within the Scope of Brownfield in the Context of Regenerative Design. *ICONARP International Journal of Architecture and Planning,* 12 (1), 234-254. DOI: 10.15320/ICONARP.2024.283

INTRODUCTION

Built environments produced by humans cause different levels of negative impacts on natural environmental systems depending on their production, use and destruction. As a result of these negative impacts, approaches such as sustainable, green, ecological architecture have emerged that focus on reducing and/or eliminating environmental damage. Approaches are generally based on technological innovations to meet conditions such as energy efficiency, comfort and health. In this context, it has led to the development of a perspective that the building is considered on a single building scale without considering its relationship with other environments (APAK, 2022). As a response to critical approaches, the necessity of a perspective that redefines the relationship between human and natural environment within the scope of integration has come to the fore. In this context, the concept of regeneration, which aims the development and improvement of human and other environmental systems within the framework of an equal symbiosis by providing mutual benefit, has developed (REED,2007). In this framework, regenerative design, which is reflected in architecture, has been included in the literature. Regenerative design encompasses all environmentalist movements as an umbrella concept.

Instead of a problem-focused approach, regenerative design has a "turning the problem into potential" approach that focuses on the potential of the place (Miller, 2012). Focusing on the existing potentials of the place provides a different context for addressing the problem in the design process. In this article, abandoned industrial sites within the brownfields, which contain degraded environments at different scales, are discussed as examples of the concept of turning the problem into potential.

Abandoned industrial areas are considered as environmentally problematic areas because they contain degraded environments (ecological, sociological, economic, etc.) intertwined with each other at different scales (Pahlen & Franz, 2005). On the other hand, they are built environments that can produce values by providing equal symbiosis in ecological, spatial, cultural, etc. environments with their regeneration within the framework of their potentials in the context of regenerative design (Apak & Tuna Taygun, 2020). The coexistence of different degraded environments in the area may cause the subject to be taken with an interdisciplinary approach. The integration of ecological, sociological, economic and built environment regeneration with each other should be handled in a way that feeds each other. It is thought that addressing the issue with a single aspect in turning the problem into potential will create obstacles in producing values for related environments at different scales.

In the article; projects implemented on abandoned industrial areas within the scope of brownfields are selected and analyzed. Although the projects analyzed are not defined in the context of regenerative design

DOI: 10.15320/ICONARP.2024.283

and renewal, they can be evaluated in the context of transforming the problem into potential. Because these projects are examples of successful management in the processes of preliminary research, design, implementation and life/use of the area, and participatory living with the equal partnership of the community and experts. In addition, the selected projects have been recognized nationally and internationally with awards such as the European Culture Erasmus Award and Unesco as World Heritage.

The gap in the literature is the lack of a systematic approach in the regeneration projects selected within the scope of the article. In addition, the site-specific ecological, sociological, economic, psychological and built environment degradations at different scales in brownfields are integrated with each other. For this reason, it is thought that addressing the area from a single dimension will be insufficient in revealing its potential values within the scope of regenerative design. In this framework, the common dimensions that stand out in the methods of addressing the issue in the projects examined were analyzed. By making inferences from the perspective of regenerative design, it is considered to read the steps of a conceptual approach to address abandoned industrial areas with regenerative design through selected projects.

For this reason, the aim of the article is to present an approach that can integrate different disciplines in a collaborate cross-section with a holistic approach and ensure that the issue is addressed within the scope of the regenerative design process. The regeneration of the area from this perspective is thought to be important in terms of raising awareness about the sustainability of its development and the values it can produce.

REGENERATIVE DESIGN

In the regenerative design approach, it is argued that it is possible to regenerate lost environmental systems in the built environment. The subject is defined as "self-regeneration" (Reed, 2007). In this context, Miller defines regenerative design as "the effort to create favorable conditions for the regenerative capacity of the place itself". In Cole's work, the concept is considered as "the development and improvement of human and natural systems through a design approach based on the potential of the place, contributing to each other, within a framework of a mutual symbiosis" (Reed, 2007).

Regenerative design can be thought of as the ability to understand different environments that are unique to "place" and to use this as a tool and catalyst in architectural practice (Tillman, 1996). In Mang and Reed's studies, it is emphasized that with regenerative design, the building should be understood within the environmental systems with which it is related and in this context, a similar feature can be created in the built environment.

In the literature review, different principles (Tillman Lyne, 1996 & Mang, 2016 & Cole, 2012) were observed within the scope of regenerative design. In the **holistic systems approach**, the relationship and interaction of environmental systems with each other is comprehended. In the **co-evolutionary development approach**, the creation of a process in which the natural, social and economic environment can be related through the built environment and can develop together within the framework of co-evolutionary symbiosis. **Place-based design approach** involves investigating and comprehending all environmental features, both the larger and smaller environmental systems, and determining relationships in the area to be designed. In the **collaborative integrated design approach**, the comprehension of environmental systems requires different professionals, as well as changing and differentiating conditions depending on time. In this context, it is emphasized that the designer, owner/investor, producer and user should cooperate for adaptation, thus ensuring the continuity of the regenerative process. The understanding of **turning the problem into potential**; it is emphasized that the design problem should be handled within the framework of the potentials provided by the place.

In this context, the principle by which regenerative design differs from environmental movements that focus on the problem is "turning the problem into potential". The concept of turning the problem into potential is quite crucial in terms of revealing the inherent values of the place and making a positive contribution to the environmental systems with which it is associated (Reed, 2012). Assessing the potentials of place provides a different context for how problems are addressed. In order to realize these currently intangible potentials, it is necessary to **understand site-specific environmental systems**, **to establish mutually beneficial relationships with the built environment within the framework of an equal symbiosis, and to ensure development and regeneration** in this context. This approach constitutes the essence of regenerative design. The process of turning a problem into a potential and in this context the process of value generation of the built and related environmental system is given in Figure 1.

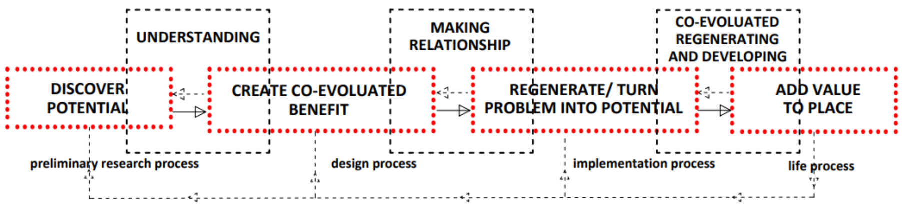


Figure 1. Evaluation of the concepts/principles covered within the scope of regenerative design through the architectural design process (model created by the author Apak, 2022)

In order to discover potentials in the **preliminary research process**, it starts with understanding the place in the context of different scales and inter-scale relationships, and in this context, it starts with providing interdisciplinary work. In the **design process**, the relationship between the construction and the related environmental systems that will count

DOI: 10.15320/ICONARP.2024.283

as a partnership/benefit at the same level is constructed. With the **implementation process** of the design within the framework of the established relationships, it is expected that the potentials determined by the start of short and long term regeneration in the implementation process will be realized. The capacity of the site to generate value through common development and improvement in different environments related to the **living/using process of the site is monitored**.

When considered with the values that it can produce according to the potential of the place, abandoned industrial areas within the scope of brownfields can be defined as environmentally degraded problematic areas that have the potential to be reintegrated into the 'place' where it is located and to contribute sociologically, ecologically and economically (Alker et al., 2020). In this context, abandoned industrial areas may contain ecological, environmental, spatial, sociological, psychological, cultural, technological and economic values depending on their characteristics. (Apak & Tuna Taygun, 2020).

In terms of the values of place, these are the areas where the phenomenon of turning problems into potentials in the regenerative design approach can best be observed. It is also important that these degraded areas are addressed with creative methods to ensure that they can add value to the urban area, as opposed to traditional 'cleaning methods'.

ABONDONED INDUSTRIAL AREAS WITHIN THE SCOPE OF THE BROWNFIELD

It is known that the socioeconomic and technological developments brought about by the phenomenon of urbanization, which started with the industrialization process, have had a great impact on the cities to take their current forms (Koksal & Ahunbay, 2006). Industrial areas located in urban core areas have been shifted to the peripheries of the city where land prices are more attractive for investors due to developments in technology and transportation industries, proximity to raw material resources, and cheap labor (Dixon et al., 2008). In 1970, with the emergence of the oil crisis, economic growth began to decline and as large-scale production slowed down, factories and industrial areas lost their importance, leading to a rapid increase in vacant and abandoned areas in large cities and the formation of isolated areas within the city (Cengizkan, 2006). All abandoned port and heavy industrial buildings/structure groups and their surrounding areas have become economically disadvantaged as well as socially problematic, abandoned and ecologically degraded.

Although the first use of the term "brownfield", which is generally used within the scope of abandoned industrial areas, started in the 1990s, its conceptualization has developed differently since the 1970s, especially in countries with a history of industry. Figure 2 presents the historical sequence of definitions that have influenced the conceptualization of brownfields.

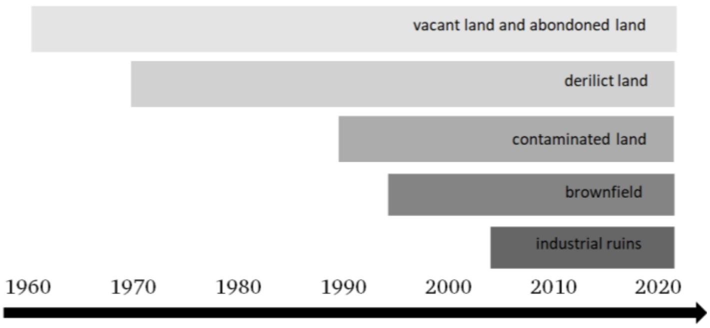


Figure 2. The historical sequence of definitions affecting the conceptual formation of the brownfield (model created by the author Apak, 2022)

Brownfields are defined as areas that contain industrial structural assets, where environmental and physical deterioration is perceived due to abandonment and functional use, and where there is existing or potential contamination (Apak, 2022).Although there are definitional differences, in general, the concept can be defined as a previously developed and contaminated area with environmental deterioration in ecological, sociological and economic contexts (Concerted Action on Brownfield and Economic Regeneration Network, 2006) (Figure 3).

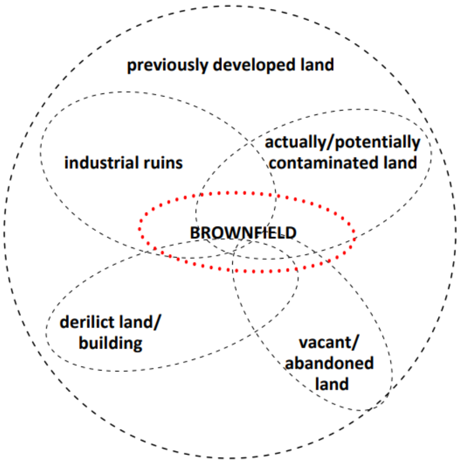


Figure 3. Conceptual framework of brownfield (Adaptation of the model created by CABERNET by the author Apak, 2022)

Projects are carried out at international, national and local scales in order to provide financing within the framework of regulations that develop depending on the definitional differentiation in countries. In the literature research, it has been observed that there are two different approaches to brownfield regeneration in the national legislation of countries (Adams et al, 2010, Vanheusden, 2003, Heberle & Wernstedt, 2006). The first of these approaches is the emphasis on reclamation in countries such as the USA and Canada, which only aims to clean up the environment and remove contaminated soil without considering future/potential uses. In countries such as the UK, Germany and the Netherlands, on the other hand, there are efforts to make the area suitable for reuse upon necessity, taking into account future use. However, brownfield regeneration requires an integrated approach

DOI: 10.15320/ICONARP.2024.283

between planning, reuse and cleanup legislation (Vanheusden, 2003). In this context, the literature highlights the need for more specific regulations to meet environmental, economic and social requirements.

AN EVALUATION OF PROJECTS FOR THE REGENERATION OF ABANDONED INDUSTRIAL AREAS WITHIN THE SCOPE OF BROWNFIELDS IN THE CONTEXT OF REGENERATIVE DESIGN

In this article, projects implemented on abandoned industrial sites within the scope of brownfields are discussed. These projects are not defined as renewal within the scope of regenerative design. However, the fact that the area is managed in the context of the transformation of the problem into potential in the preliminary research, design, implementation and life/use processes overlaps with the processes of regenerative design (Figure 1).

The criteria for the selection of the projects analyzed in this article are that **the projects have large groups of participants, have registered successes in national or international platforms, and have a large number of tools produced** at the same time. The projects selected in this context are given in Table 1.

Cooperation networks such as REVIT (Revitalizing Industrial Sites), CABERNET (Concerted Action on Brownfield and Economic Regeneration Network) and projects have been developed in different countries with various funds and support systems at national or international scale for the regeneration of abandoned industrial areas. In these projects, stakeholders participating in the regeneration of abandoned industrial areas were identified and different road maps were created for the process.

APA (American Planning Association) emphasized that the regeneration process will be shaped by the unique characteristics of the brownfield site, such as its physical characteristics, industrial history, community dynamics, location, potential/existing pollutants, ownership status and financing (government or private sector initiative) (APA, 2010). In this context, the community-based brownfield redevelopment model developed by APA is presented in Figure 4.

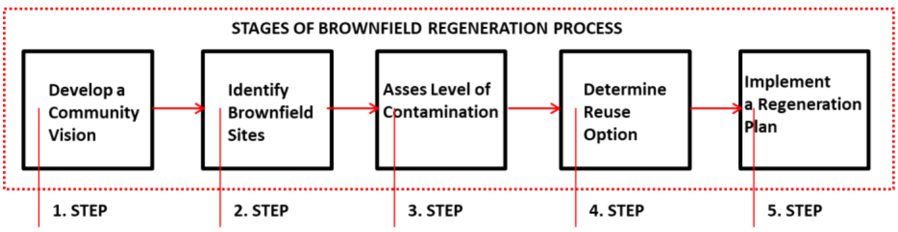


Figure 4. Implementation steps of the brownfield regeneration in the planning dimension (Adaptation of the model created by APA by the author Apak, 2022)

The first step is the process of developing community vision that will allow bringing together public, private and community interests and build collaboration and consensus. This involves developing ideas on

Table 1. Examined projects and administrative networks for the regeneration of abandoned industrial areas within the scope of brownfields (table created by the author Apak, 2022)

EXAMPLES OF PROJECTS SUPPORTED FOR THE REGENERATION OF ABANDONED INDUSTRIAL AREAS			
PROJECT-SPECIFIC FEATURES		**STUDIES/OUTPUTS CARRIED OUT WITHIN THE SCOPE OF THE PROJECT**	
PROJECT NAME / TIMELINE	**PARTICIPATING COUNTRIES IN THE PROJECT**	**LOCATION AND TYPE OF REGENERATION PROJECTS**	**TOOLS PRODUCED (design guide, database, etc.)**
Brownfield European Regeneration Initiative (BERI) 2004-2007	*Belfast Gas Works,uk *Bristol City Council,uk *Affaires économiques et Internationales,Fransa; *Linnaplaneerimise Amet, Estonya; * Stockholms stadsbyggnads kontor, İsveç; *Hansestadt Rostock, Almanya	*Belfast Gasworks North Foreshore, Bristol Harbourside Temple, uk * Lyon Vaise Le Carré de Soie / La Vallée de la Chemie, fransa *Stockholm Hammarby, Sjöstad Hjorthagen Värtan, İsveç *Tallinn Ilmarine Quarter Harbour Area,Estonya	–
Revitalising Industrial Sites (REVIT) 2003-2007	*City of Stuttgart, Thomas Zügel,Almanya; * University of Twente, Netherlands	* an old railway yard in Stuttgart, Germany * dockyards Nantes, France * abandoned textile works in Tilburg, Hart van Zuid in Hengelo , The Netherlands * dockyards Medway, United Kingdom * old coalmines Torfaen, United Kingdom	*stakeholder Engagement Tollkit (REVIT) *brownfields START-UP Tool
Concerted Action on Brownfield and Economic Regeneration Network (CABERNET) 2002-2008	*University of Nottingham, UK	*Berryhill Fields, Stoke on Trent *Havnestad, Copenhagen *Holgate Development, York *The Lowry, Manchester *Urbis, Manchester *Gasometers, Vienna, Austria	*Sustainable Brownfield Regeneration: CABERNET Network Report * Brownfield standards and tools Product
Regeneration of European Sites In Cities and Urban Environments (RESCUE) 2002-2015	*Montan-Grundstuckgesellschraft mbH, France, Germany, England	*Radbod, Ruhr and Espenhain, South of Leipzig, Germany *Dolomites Sports Valley, Bytom and Sosnowiec Coal Mine, Sosnowiec, Poland *Markham Vale, Derbyshire and Gateshead Quays, Tyne and Wear, UK *Loisinord and Les Tertiales Nord Pas de Calais, France	* Best Practice Guidance for Sustainable Brownfield Regeneration * Brownfield Sustainability Assessment Tool
Tailored Improvement of Brownfield Regeneration in Europe (TIMBRE) 2011-continue)	*Center for Applied Geosciences at the University of Tübingen, Germany * Academy of Sciences of the Czech Republic *University Ca' Foscari of Venice, Italy *Technical University of Denmark *The National Environmental Protection Agency	*C-Mine,Park Spoor Noord Antwerp, Pieper Site,Belgium * Babylon Liberec, Fabrika Svitavy, Galant Mikulov, Kukla Complex Oslavany, Technical Muzeum Brno, Çekya * Bernburg,Bitterfeld-Wolfen,Eckolstädt, Freight Station Sonneberg,Gehlberg Geraberg, Germany	* Information system for brownfield regeneration handbok *Site Assessment and Re-use Planning Tool (SAT) *The Prioritization Tool
Promoting Sustainable Inner Urban Development (PROSIDE) 2003-2006	*UW Umweltwirtschaft GmbH Stuttgart, Universität Karlsruhe, Germany * Municipality of Milan, Italy * Budapest Urban Planning Ltd, Hungary * Municipality of Lodz, Polonya	*Bad Cannstatt, Stuttgart *Bovisa, Milan *Mester Business Park, Budapeszt	*Internet Based Information System for Investors *Integral Investigation Cost Prognosis Tool
Holistic Management of Brownfield (HOMBRE) 2010-continue	*University of Nottingham, UK; *Geo-Logik, Poland; *Wageningen University, Netherlands; *AGH-University of Science and *Technology/Cracow, Poland; *University of Rome, Italy; *Environmental Technology Ltd, UK; Stadt+, *Germany; Acciona, gmbh	*Gelsenkirchen former coal mining area, Germany *Solec Kujawski, urban and post-industrial area, Poland *Turceni /Jiu mining and rural area, Romania *Terni industrial area, Genoa industrial and urban area, Italy *Markham Valemining and urban area, UK	*a roadmap for the zero brownfields perspective *The Brownfield Navigator (BFN) *technology train concept *Brownfield soft re-use matrix

DOI: 10.15320/ICONARP.2024.283

how to clean up and redevelop brownfield land based on the needs of the community. The brownfield to be redeveloped is then defined (legal limitations, ownership status, etc.) and environmental site assessments are conducted to determine the contamination status of the area. The results of these assessments are instrumental in determining the suitability of the project to proceed in the selected area. The regeneration option is determined through a participatory process and implemented in line with the planning in the last step.

In the general framework developed in the TIMBRE (Tailored Improvement of Brownfield Regeneration in Europe) project, steps are given within the framework of socio-economic values, including decision-making processes based on communication focus within the scope of effective participation of stakeholders (Figure 5).

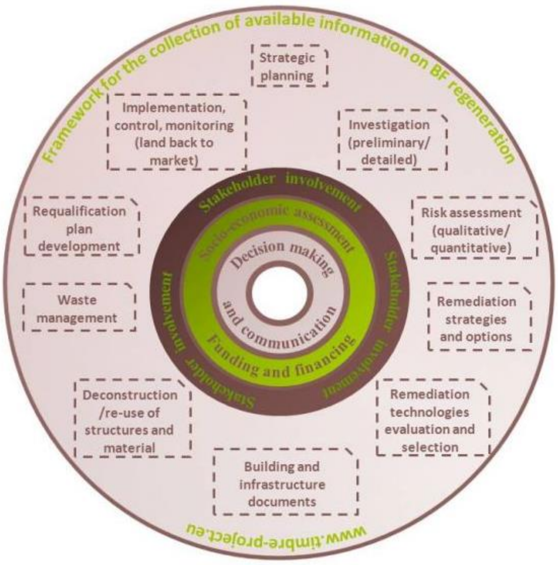


Figure 5. Framework for the collective of available information of brownfield regeneration (TIMBRE, http://www.timbre-project.eu/)

One of the common issues emphasized in the examples in terms of the healthy spatial development of the area and the continuity of regeneration is the inclusion of **different participant groups (local administrations, universities, experts, NGOs, etc.) from the beginning of the regeneration process** due to the different deterioration of the area. The need for **collaborative decision-making processes** between participating groups and the need for the **creation of permanent monitoring groups** are other common points emphasized.

Within the collective objectives of the projects, the elimination of environmental deterioration (REVIT, RESCUE, etc.) is prioritized. Among other objectives, revitalization of regions and cities is also prioritized. In order to create a certain data infrastructure, there are also studies such as the classification of relevant existing information, creating accessible literature in this context, collecting and evaluating data (TIMBRE, HOMBRE, etc.). The selected projects were evaluated in terms of environmental-ecological, project management, economic, technical, social, marketing and cultural heritage dimensions. **While the environmental, project management and economic dimensions are evaluated as common to all cases, the technical, social and cultural heritage dimensions differ depending on the specific characteristics of the cases.**

The environmental dimension considers the use of new techniques such as biological remediation based on natural processes, protection of habitats and legally protected species, mitigation of adverse environmental impacts on the site and its vicinity, including human health risks, and characterization, monitoring and remediation of subsurface pollution (Figure 6).

In this context, the RESCUE network, which is discussed within the scope of this article, has implemented practices in line with the goals set by the Ruhr master plan project that started in 2010. The objectives of the project were to preserve unused and abandoned landscapes in the area, to consider fragmented areas in the landscape as a whole, to re-zone the areas separated from the whole under the heading of park areas, to provide benefits on both local and regional scales by producing long-term designs, and to protect open green spaces within the regional park system (Pahlen & Franz, 2005).

Figure 6. The transformation of Emscher valley in line with the master plan (https://fgvprojetos.fgv.br/sites/fgvprojetos.fgv.br/files/arquivos/mario_sommerhauser.pdf)

IBA planners considered **that environmental improvement was seen as a prerequisite for economic regeneration**, on the basis that business was becoming increasingly sensitive to environmental factors. These include sewage treatment and biological treatment, maintenance of waterways, natural remodeling of open sewage channels, flood protection, water flow regulation and biodiversity enhancement, groundwater and stormwater management. Figure 7 shows the implementation and impact of the C-Mine, Park Spoor Noord Antwerp project, which resulted in the abandonment of 24 hectares of land by the National Railway Company of Belgium (NMBS) in Belgium, where TIMBRE is involved.

Figure 7. C-Mine,Park Spoor Noord Antwerp regeneration (https://oppla.eu/casestudy/19438)

Within the scope of the **project management dimension**, it was investigated to develop a management plan and then support it with

DOI: 10.15320/ICONARP.2024.283

monitoring, review and supervision plans. The primary objective was to identify the responsibilities of all actors to avoid incompatibilities between different public institutions during the project phases. **Creating interdisciplinary teams that integrate social, economic and environmental aspects, and ensuring the integration of teams for the successful completion of the project** were addressed. Within the scope of the examples analyzed, it is seen in Figure 8 that the planning group (IBA) established sub-working groups for collective decisions for each pilot project within the scope of the implementation in the Ruhr region. In each project, management was ensured through the appointment of the planning group and the organization of the members of the planning group (architect, urban planner, urban designer, landscape architect, etc.) in relation with other disciplines.

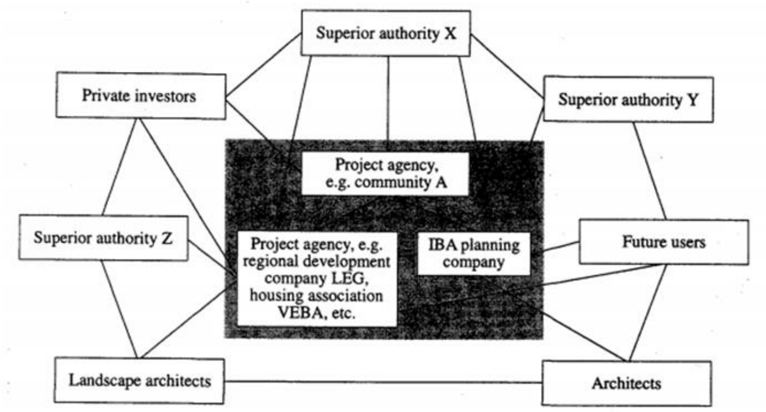


Figure 8. The Emscher park International building Exhibition Project planning groups (Kilper & Wood, 1995)

Within the scope of the **economic dimension**; creating potential for tourism businesses that will provide economic vitality, using existing facilities and infrastructure, modernizing and improving the urban fabric. Urban neighborhoods to generate economic growth, increasing public and private income, improving the perception of the area and increasing the value of the area, and providing employment. Consideration of potential economic benefit and inclusion from the beginning of the assessment, innovative financing, partnership and dividend provision, and research for funding and incentives. Among the projects examined in this context, the Belfast Gasworks regeneration project in the UK, realized within the scope of the BERI network, changed the perception of the area and increased commercial vitality and tourism (Figure 9).

Figure 9. Belfast Gasworks Regeneration (https://sticerd.lse.ac.uk/dps/case/cr/casereport54.pdf)

The **technical dimension** includes establishing **advanced monitoring and field investigation technology approaches**, selecting soil cleanup techniques based on the site, its vicinity and future use, using screening methods to characterize brownfields, and identifying infrastructure networks (water supply connections, sewerage, electricity, etc.). In this context, the decision to isolate contaminated soil from topsoil and groundwater by using a protection layer to prevent further contaminants from entering the groundwater was used as an implementation decision in the Ruhr region (Figure 10). Due to the risk of the horizontal spread of pollution from production, the Landschaftpark GMBH permanent group regularly monitors pollution levels and distribution in the industrial park at 3-year intervals and continues to take action accordingly.

Figure 10. Site-specific cleanup operations in the Ruhr region (https://www.ruhrcleanup.org/en)

Within the scope of the **social dimension**; community participation in the regeneration process, increasing the permeability of brownfields, changing the image of brownfields to prevent negative impacts on the neighborhood and the region have been observed. In this context, it has been determined that efforts have been organized for the re-adoption of the public. Within the scope of social needs, the development of regeneration plans, making functionalization analyzes in accordance with the population density, and providing opportunities to improve education based on the education level of the region were discussed. Figure 11 shows the tours of the abandoned textile works Hart van Zuid in Hengelo for the program organized for local people to visit the abandoned textile works Hart van Zuid in Hengelo before regeneration. Various activities were organized in order to maintain the vitality of the site and to ensure that the site could be functionalized according to the needs of the region.

Figure 11. Excursions for the program organized for local people to visit the Abandoned textile works Hart van Zuid in Hengelo before its regeneration (REVIT, 2003)

Within the **marketing dimension**, networks, events, competitions and promotions, strengthening a positive image for renewal and the efficient use of communication channels for this purpose are discussed. In the projects researched on this topic, promotional initiatives for tourism

DOI: 10.15320/ICONARP.2024.283

purposes were prominent. The organization of various events was used as a tool to promote the place. In the Loisinord and Les Tertiales project, the old mine was transformed into a ski area and brought to the forefront of tourism activities, and the festivals in the Ruhr region brought economic and social vitality to the region and improved the quality of life as a result of highlighting the tourism marketing dimension of the area (Figure 12a-12b).

Figure 12a. Prominent events within the scope of the marketing dimension
Loisinord and Les Tertiales regeneration (https://bassinminier-patrimoinemondial.org/la-reconversion/terril-n42-piste-de-ski-de-loisinord-et-plan-deau-**noeux-les-mines/)**

Figure 12b. Prominent events within the scope of the marketing dimension
Zollverein food festival (https://www.waz.de/staedte/essen/zechenfest-auf-zollverein-das-sind-die-schoensten-fotos-id239647779.html)

Within the **cultural heritage dimension**, the process begins with an assessment of the industrial heritage potential of the brownfields by creating an inventory prior to the development of the master plan.
The use of this assessment for future actions without compromising the integrity of the site and its cultural past, the use of industrial heritage as a driving force for regeneration and investment, and the restoration and re-functioning of buildings with historical and technological value were discussed. Protecting cultural heritage, especially in the Ruhr region, is one of the core concepts of the IBA. In addition, the industrial history and cultural heritage of all assets of historical and cultural value have been given brand new definitions and have led the local people to be proud of their culture and history, strengthening their sense of belonging. It played an active role in the regeneration of the area (Figure 13).

Figure 13. Preserving industrial heritage and using industrial heritage as a driver for regeneration and investment in the Ruhr Project (https://www.archdaily.com/970632/adaptive-reuse-as-a-strategy-for-sustainable-urban-development-and-regeneration)

When the projects supported for the regeneration of abandoned industrial areas are analyzed, it is inferred that the regeneration process requires an integrated approach. When evaluated in terms of dimensions, it is seen that they are not considered separately but are interrelated. For example, it describes the post-industrial transformation of industrial areas, including the evolution of the natural landscape in the Ruhr region over time. In addition, the industrial heritage and industrial landscape of Emscher Landscape Park is unique to the Ruhr region (Figure 14).

Figure 14. Use cases of industrial landscapes in the Ruhr area (https://bioclearearth.com/techniques/industrial-nature)

Throughout the projects, the interactions between the environmental and industrial heritage dimensions, and the economic and sociological vitality as a result of these dimensions, have not been considered separately in the regeneration of the area. **They are place and time specific and intertwined, influencing and being influenced by each other.** In the design and planning process, ecological and cultural regeneration was recognized as an important prerequisite for future economic development.

EVALUATION OF ABANDONED INDUSTRIAL AREAS WITHIN THE SCOPE OF THE BROWNFIELD IN THE CONTEXT OF REGENERATIVE DESIGN

It is obvious that the dynamics in the regeneration process of abandoned industrial areas involve different dimensions (environmental, social, economic, etc.) and therefore the process is inevitably complex. **Collaboration with experts from different disciplines** is a collective requirement in all the projects examined in order to systematically understand and relate abandonment and different potentials in the context of regeneration. In this context, it may be necessary to establish relationships between the systems (ecological, sociological, economic, etc.) that make up the dimensions and to plan **collaborative partnerships and collective decision-making processes** to ensure benefits. In addition, depending on the diversity and intensity of deterioration, the regeneration process is considered as long-term (gradual adaptation). The creation of **permanent groups/associations to ensure the developmental continuity/sustainability of the area**, to generate regenerative values and to be adopted by the occupants, and to explore new potentials that may emerge is very important in terms of monitoring and feedback.

DOI: 10.15320/ICONARP.2024.283

All these characteristics overlap with the conceptual and theoretical framework of the regenerative design approach. In this framework, in the process of addressing the area, which includes different dimensions, in a regenerative context**, it is necessary to first determine the potentials on the individual site basis through an interdisciplinary study. In this context, it is important to understand the built environment and related dimensions, to establish relationships in this context, and to make and implement collective decisions for mutual benefit between dimensions. Monitoring the development and improvement of the area in the process of living/using, and evaluating it jointly with all its dimensions on an area based approach is a necessary process for the sustainability of regeneration.**

The regeneration of the area requires sharing and collective decision-making processes. In this context, one of the conclusions of the study is that a **multi-participatory process model should be applied depending on the needs of the are**a. Depending on the scope of the projects evaluated collective study grup has been created based on the needs of the area, where the project manager and experts and organizations from different disciplines will come together.

In order for the regeneration to be long term and to ensure its continuity depending on the dynamic feature of the area, it has been determined that an approach that is coordinated between the working groups and that involves collective decision-making processes where they cooperate at different steps is necessary**. In the context of establishing a common approach in an area that requires different specializations, collective decision-making processes were found to be important.**

The systematic interdisciplinary relationship network that can be created for regeneration at different scales (ecological, sociological, etc.) depending on the needs of the area is presented in Figure 15**. The relationship network presented is defined in the form of working groups with the inferences within the framework of the dimensions addressed in the projects analyzed.** In the working group, which may require different specializations (sociologist, land developers, ecologist, etc.), the members of the built environment working group may include urban design, restoration, landscape, building, etc. within the discipline of architecture. The regenerative design process, which starts with the identification of potentials, constitutes the first collective step for the correct discovery of all regenerative values that can be produced. Other working groups may differ in the approach and methods they take, the steps they follow and their scope. However, it is important that the decision, monitoring and evaluation steps are shared for the maintenance and continuity of the healthy co-evolutionary development and improvement in the life/using process of the area. In this context, based on the potentials of the place, the capacity of the area to produce regenerative value is ensured through understanding, establishing relationships and the co-evolutionary process that constitutes the regenerative process.

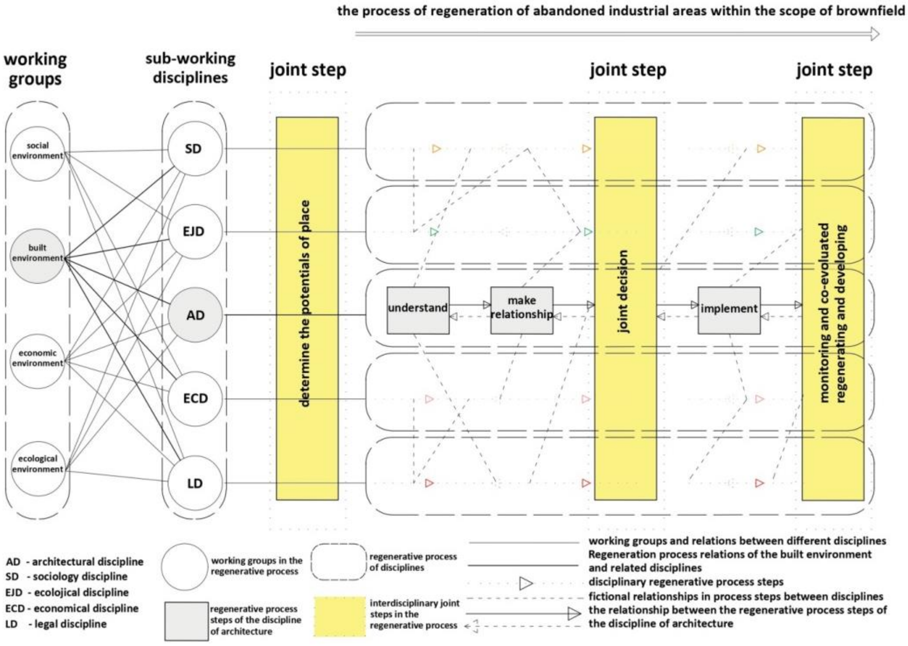


Figure 15. Dynamic relationship network between architectural discipline and related working groups that can play a role in brownfields (model created by the author Apak, 2022)

In the process where the problem can be turned into potential, it is thought that working groups from different disciplines will contribute to the emergence of regenerative values. Thus, how to establish a relationship with systems at different scales, how to benefit from these systems and how to benefit these systems can be determined through collective decision-making processes. The action prescriptions that can be generated have the possibility of affecting the applications of different disciplines such as the use of the building/area, legal regulations, spatial hierarchy, functional distribution or restoration. Therefore, they should be developed within the scope of a collective decision-making process.

The role of the architect, as part of the built environment working group, has an interactive role in addressing the issue in the context of regenerative design. It may be necessary to consider the environmental system created by the built environment (structural assets) existing in the area and its related environment in different dimensions (ecological, economic, sociological, etc.) as a whole. This will contribute to the collective development/improvement of the environmental system and transform the built enviroment into an entity capable of generating positive value for its related environment. In this context, there is a necessity to **create a systematic approach to understand and associate the area with all its dimensions, and to improve and develop it synchronously between all dimensions.** In the context of the analyzed projects, the article proposes an approach that abandoned industrial areas can be handled within the framework of regenerative design (Figure 16).

DOI: 10.15320/ICONARP.2024.283

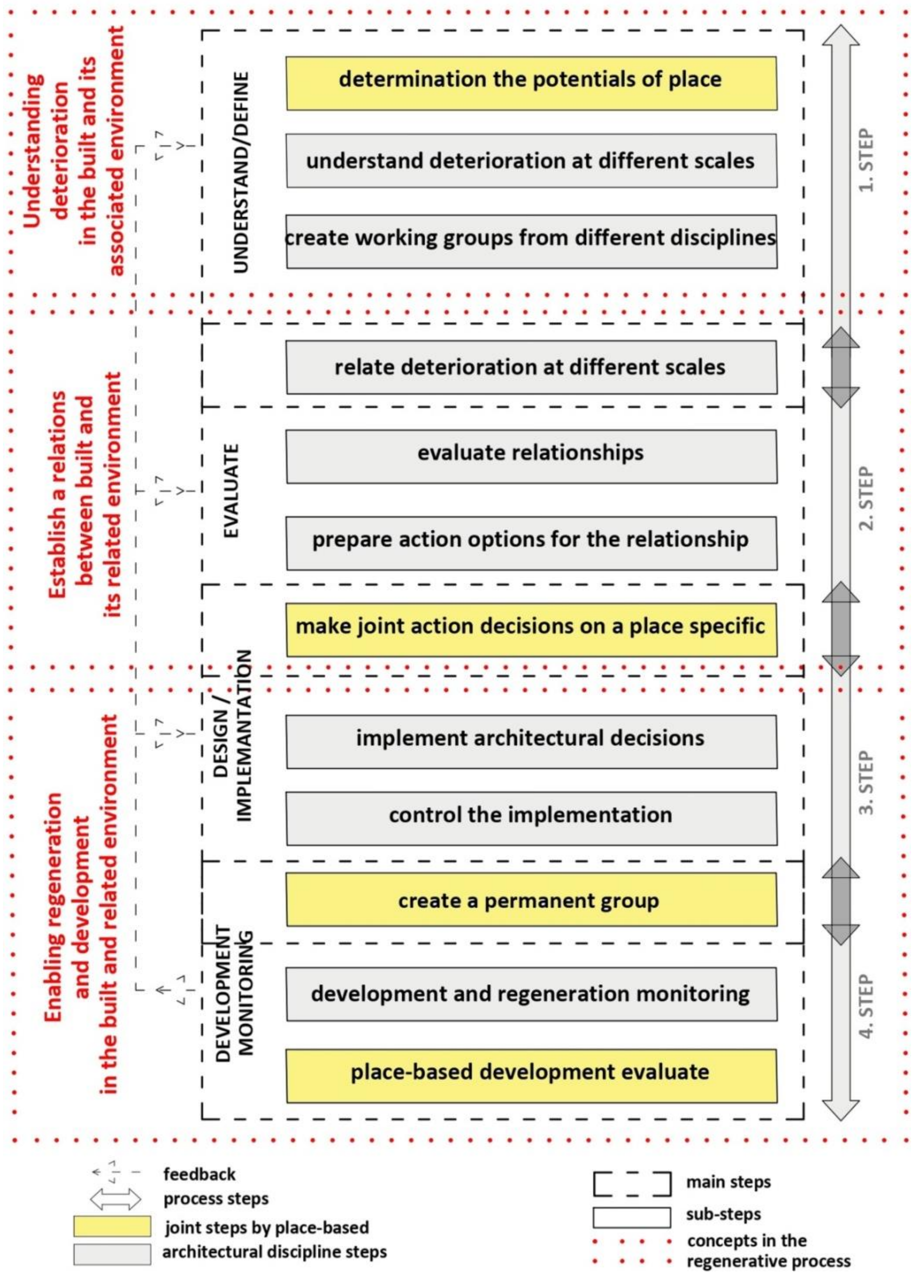


Figure 16. An approach that can be considered from a regenerative design framework in the context of deterioration in the built and associated environmental system of abandoned industrial areas (model created by the author Apak, 2022)

The steps in the approach begin with the process of **defining the area within the framework of its dimensions.** Potentials (ecological, sociological, economic, cultural, technological, etc.) should be identified by different disciplines. In this context, working groups are formed within the scope of the dimensions addressed depending on the needs of the place.

In the evaluation step; the defined dimensions are considered from an integrated framework and the relationships between the dimensions are established and evaluated. In this context, action options specific to the needs of the place are prepared.

In the design and implementation step; collective decisions are taken for action options that affect each other created by different disciplines.

In the implementation process, the relevant decisions are implemented and monitored.

In the development monitoring step; the regeneration process is monitored in terms of its long-term development and continuity. A permanent monitoring group is formed to play a role in the life/using process of the area in order to discover new potentials that may arise, to maintain the dynamic structure and vitality of the area, and to evaluate the actions implemented.

CONCLUSION

In this article, an approach to the application of regenerative design in architectural practice is presented through abandoned industrial areas. With the approach proposed in the article, the reuse of abandoned industrial areas is considered to provide equivalent improvements in different environments. It is considered that healthy spatial conditions for different environments will be created within the scope of this approach. In addition, it is thought that the approach will contribute to the following issues and raise awareness on the subject.

- In the process that starts with the understanding/defining step, establishing the proper relationships between different environments and selecting the appropriate mutual solution methods, and in this way, ensuring process gain in the implementation phase,
- The formation of working groups from the beginning of the process in understanding, defining, designing and evaluating relationships, and the use of a mutual approach in the communication and transfer of information in the steps and the formation of proper decision-making processes in this context,
- Increasing awareness on the issue, which is also on the agenda in Turkey and has a large number of application areas, will help the development of the issue by lighting the way for policy and law makers in Turkey through the evaluation and analysis of policies, programs and legislation in different countries,
- Raising awareness with a new approach in the context of the potentials of these areas, which are considered as "problematic" areas,
- Highlighting the relationship between the building to be regenerated or newly produced and the existing environmental systems. Making conscious decisions by including this issue in design, renovation and utilization criteria. Ensuring the sustainability of the improvement and development of the area by monitoring the implementation and life cycle of the area.

ACKNOWLEDGEMENTS

The manuscript produced from a doctoral dissertation;
Hande Apak (2022). Kahverengi Alanlardaki Yapıların Kirlenmişlik ve Bozulmuşluk Bağlamında Yenilenmesine Yönelik Çevresel Risk Tabanlı Yaklaşım Önerisi, yayınlanmamış doktora tezi, Yıldız Teknik Üniversitesi Fen Bilimleri Enstitüsü, 2022, İstanbul.

DOI: 10.15320/ICONARP.2024.283

REFERENCES

Adams, D., De Sousa, C., and Tiesdell, S., (2010). Brownfield Development: A Comparison of North American and British Approaches, Urban Studies, vol. 47(1), pp. 75-104.

Alker, S., Joy, V., Roberts, P., and Smith, N., (2020). The Definition of Brownfield. Journal of Environmental Planning and Management, vol. 43, pp 43-69.

APA, (2010). REUSE Creating Community-based Brownfiel Redevelopment Strategies. Environmental Protection Agency Press, USA.

Apak, H., & Tuna Taygun, G., (2020). Rejeneratif Tasarım: Sorunu Potansiyele Çevirme, Kahverengi Alanlardan Yaşam Merkezi Kentsel Yeşil Alanlara: Fudidora Parkı, MUSEO DEL ACERO HORNO 3 Müzesi, Meksika. Yapı Dergisi, vol. 457, pp.20-25.

Apak, H. (2022). Kahverengi Alanlardaki Yapıların Kirlenmişlik ve Bozulmuşluk Bağlamında Yenilenmesine Yönelik Çevresel Risk Tabanlı Yaklaşım Önerisi. Yayınlanmamış doktora tezi, yıldız teknik üniversitesi fen bilimleri enstitüsü, İstanbul.

Baskaya, T., (2010). Ways to Sustainable Brownfield Regeneration in Istanbul, ITU journal A/Z, vol. 7(2), pp. 74-88.

BERI, Brownfield European Regeneration Initiative, https://keep.eu/projects/14940/Brownfield-s-Europe-Regener-EN/, 09.09. 2020

CABERNET, (2006). Sustainable Brownfield Regeneration: CABERNET Network Report. Land Quality Management Group (LQMG), University of Nottingham Press, United Kingdom.

Cengizkan, M., (2006). Endüstri Yapılarında Yeniden İşlevlendirme: 'İş'i Biten Endüstri Yapıları Ne 'İş'e Yarar?, Mimarlar Odası Ankara Şubesi Bülten, vol. 45(3), pp. 9-13.

Cole, R., J., (2012). Regenerative design and development: current theory and practice. Building Research & Information, vol.40, pp. 1-6.

Cole, R., J., (2012). Transitioning from green to regenerative design. Building Research & Information, vol.40, pp. 39-53.

Du Plessis, C. (2012). Towards a regenerative paradigm for the built environment. Building Research & Information, vol. 40, pp.7-22.

Dixon, T., Raco, M., Catney, P., and Lerner, D., N., (2008). Sustainable Brownfield Regeneration: Liveable Places from Problem Spaces. John Wiley & Sons, New York.

Environmental Protection Agency (EPA), (1999). A Sustainable Brownfields Model Framework. EPA Press, Washington.

Ergen, M., (2013). A New Methodology Proposal For Urban Regeneration of Brownfield Areas; Case Study Of Zonguldak City Turkey, Unpublished Ph.D. Dissertation, Faculty of Spatial Planning of Dortmund University of Technology, Germany.

Gorman, H., S., (2003). Brownfields in Historical Context, Environmental Practice, vol.5(1), pp. 21-24.

Heberle, L., & Wernstedt, K. (2006). Understanding Brownfields Regeneration in the US, Local Environment, vol. 11(5), pp. 479-497.

HOMBRE, (2013). Holistic Management of Brownfield Regeneration, EU Seventh Framework Programme, Land Quality Press.

Ispalar, A., Cahantemur, R., Beceren, Ö. and Öztürk, A., C., (2010). Securing Land for Urban Transformation Through Sustainable Brownfield Regeneration –

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

the Case of Eskisehir, Turkey, Environment and Urbanization, vol. 22(1), pp. 241–258.
Köksal, G., & Ahunbay, Z., (2006). İstanbul'daki Endüstri Mirası İçin Koruma ve Yeniden Kullanım Önerileri, İtu dergisi/a, vol:5 (2), pp. 125-136.
Kılınç, G. (2016). Brownfield Redevelopment in Turkey, as a Tool for Sustainable Urbanization. Sustainable Urbanization, Intech Press.
Mang P. & Reed, B. (2007). Shifting from 'sustainability' to regeneration. Building Research & Information, vol.35, pp. 674-680.
Mang, P., & Haggard, B., (2016). Regenerative development and design: a framework for evolving sustainability. John Wiley & Sons, Hoboken, New York.
Mang P. & Reed, B. (2020). Regenerative development and design, sustainable built environment. Regenesis Group & Regenesis Institute for Regenerative Practice
Miller, D. (2012). Regenerative design: an exploration of process, practice, and the role of planners. The University of British Columbia Publisher.
Pahlen, G., & Franz, M., (2005). Sustainable Regeneration of European Brownfield
Sites: Criteria for Future Funding Decisions. Land Quality Press, England.
PROSIDE, https://keep.eu/projects/219/Promoting-sustainable-inner-u-EN/, 11.10.2020.
Reed, B., (2007). Shifting from 'sustainability' to regeneration. Building Research &
Information, vol.35, pp. 674-680.
RESCUE, (2004). Sustainability Assessment Tool for Brownfield Regeneration projects, Land Quality Press,.
REVIT, (2006). Revitalising Industrial Sites. University of Twente Netherlands Press.
TIMBRE, http://www.timbre-project.eu/, 15.10.2020.
Tillman Lyle, J. (1996). Regenerative design for sustainable development. John Wiley &Sons,
Vanheusden B., (2003). Towards a Legal Framework in the EU for Brownfield Redevelopment, European Energy and Environmental Law Review, vol. 12(6), pp. 178-186.
Kilper H., wood G. (1995). The Rise of the Rustbelt, Routledge, UK.

Resume

Hande APAK graduated from Faculty of Architecture, Department of Architecture at ITU. In 2022, she completed her doctorate at YTU. She has been involved in academic activities such as papers in national and international congresses and articles in journals. She continues her academic studies as a guest lecturer in undergraduate and graduate courses at Ytu and Gtü. Her research areas are sustainability in architecture, environmental risk management, life cycle assessment, indoor air quality.

Gökçe TUNA TAYGUN has been working at Yildiz Technical University, Faculty of Architecture, Department of Architecture since 1996. She gives lectures in undergraduate and graduate education, manages master's and doctoral theses, takes part in academic and administrative commissions and juries. She has academic studies such as national and international articles, papers and research projects on green building, green building products and materials, life cycle

DOI: 10.15320/ICONARP.2024.283

assessment of building products and materials, environmental impact assessment and building biology.

Research Article

ICONARP
International Journal of Architecture and Planning
Received: 02.01.2023 Accepted: 22.03.2024
Volume 12, Issue 1/ Published: 30.06.2024
DOI: 10.15320/ICONARP.2024.284 E- ISSN:2147-9380

ICONARP

A Comparative Analysis of the Change of Kula Traditional Turkish Housing Architecture in The Last 50 Years

Gizem Özer Baş*
İpek Demir**

Abstract

Kula is a district rich in cultural values. There are many historical and traditional residences in this region. These historical structures have undergone great and different changes over time. It is aimed to determine the transformations related to facade, structural element, and interior use in traditional houses. In addition, by looking at the obtained data, namely the architectural changes, it was determined as a secondary purpose to make suggestions about conservation. The study consists of a combination of two basic methods: literature research and field research. After determining the subject of the study, written sources related to the subject were searched and the research was supported by field studies. The method of the study is the comparison of the data obtained from the sources and the evidence in the field study. Findings were obtained by analyzing the detected differences. In the study, which was carried out with the comparative analysis method, the historical process was examined, and information, architectural drawings and photographs were obtained about the conditions of the buildings 50 years ago. For this reason, scope of the study consists of both the data obtained and the houses that provide both conditions depending on the availability of these data today. In this context, the study is limited to 14 traditional Turkish residences in the Kula site, from which both historical data and locations can be accessed. In the studies carried out in the field of architectural restoration and conservation, the current situations are examined in the studies on conservation. However, in this study, not only the current situation of the buildings, but also the conditions of the previous years and even the comparison of the data was obtained. Although this study was carried out within the scope of Kula district, it gives an idea about the change and usage of interiors of the residences.

Keywords:
Kula, Traditional Turkish house, Vernacular architecture, Architectural heritage.

*Department of Interior Design, Manisa Celal Bayar University, Manisa, Turkey. (*Corresponding author*)
Email: gizemozergizem@gmail.com

**Department Urban and Regional Planning, Manisa Celal Bayar University, Manisa, Turkey.
Email: ipekdemir0@gmail.com

To cite this article: Özer Baş, G., & Demir, İ. (2024). A Comparative Analysis of the Change of Kula Traditional Turkish Housing Architecture in The Last 50 Years. *ICONARP International Journal of Architecture and Planning,* 12 (1), 255-286. DOI: 10.15320/ICONARP.2024.284

INTRODUCTION

As stated in the ICOMOS Traditional Architectural Heritage Charter, traditional architecture, has a special place for people and and also source of pride, is a document of the past reflecting the characteristics of societies (ICOMOS, 1999). Although our country is very rich in terms of traditional architecture, some of these heritages are left to their fate. Due to the lack of repair or restoration work in many of the architectural heritage structures or the uncontrolled erroneous interventions, these structures lose their feature of being documents of the past. For this reason, these structures fade into history over time. At this point, the concept of conservation emerges.

Conservation refers to ensuring the continuity of all tangible and intangible elements according to changing cultural and environmental conditions in order to preserve the document quality and transfer them to future generations. Cultural heritage must be preserved in order to transfer it to future generations and to prevent the destruction of structures. As stated in 'Article 4 of the Venice Charter', the protection must be permanent and its continuity must be ensured. In 1979, the Turkish Ministry of Culture, Antiquities and Monuments High Council, with its decision dated 10.11.1979 and numbered A 1986, carried out detection studies in Kula.

In this study, 31 religious and cultural buildings and 368 houses were identified and registered for protection. Thus, the borders of the conservation area in Kula were determined. However, in 1986, the 'High Institute of Immovable Cultural and Natural Heritage', which was restructured and renamed, had a new determination and registration work done in Kula. With the decision dated 29.08.1986 and numbered 2640, the number of religious and cultural buildings was registered as 21 and residences as 286 (Altınel, 2021, 109). This number is higher than many regions and conservation area. For this reason, these precious structures need to be documented and protected.

The examples of Kula civil architecture are in danger of extinction day by day. For this reason, within the scope of this study, it is aimed to reveal the changes in the examples of civil architecture in the Kula urban protected area in 50 years with facade examinations and to propose solutions to the conservation problems.

In this study, a multi-faceted study was carried out for the protection of cultural heritage. Within the scope of the study, literature review, location determination of the structures, examination and documentation of the structures carried through. Then, a comparative analysis was made with previous literature information and photographs. Documentation of these structures is important for a region like Kula, which is especially rich in traditional Turkish housing. In this context, first of all, it would be appropriate to examine methodology, the Kula region and its architectural texture.

DOI: 10.15320/ICONARP.2024.284

METHODOLOGY

This study, which was prepared with a comparative analysis of the traditional houses of Kula in the historical process, was formed in three phases (Figure 1).

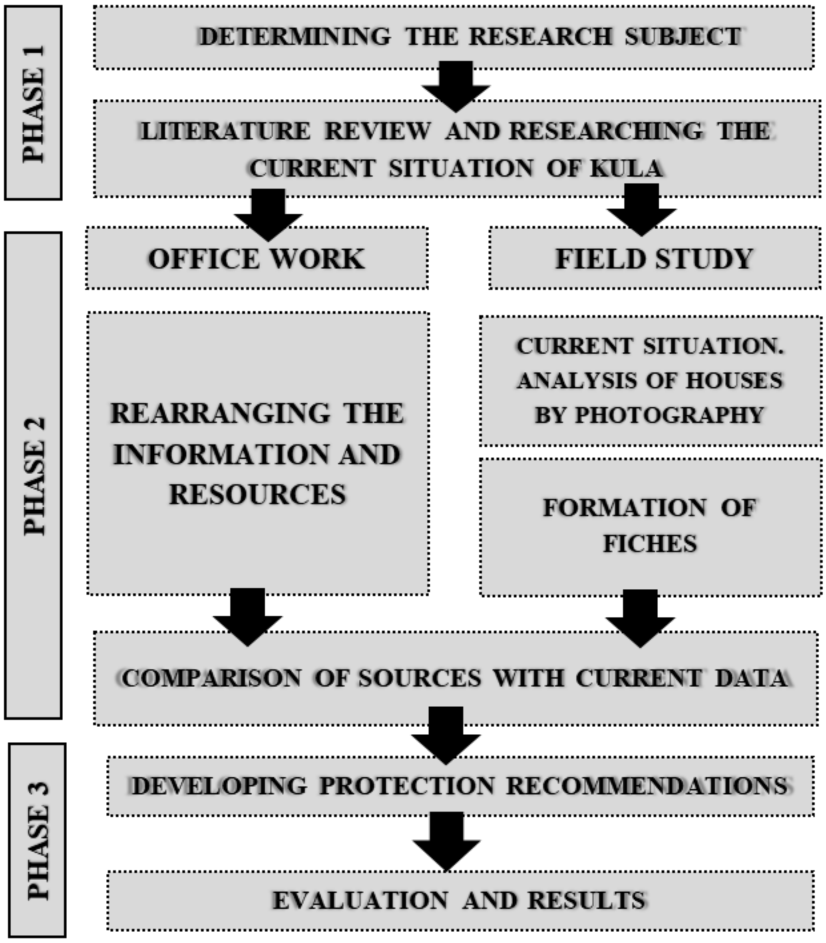


Figure 1. Methodology of the research

In the first phase, the research topic is determined. Within the scope of the determined research topic, the town of Kula and literature research were carried out. The research subject is based on the change and preservation status of historical traditional buildings from past to present.

In order to determine the historical change of traditional Turkish houses, documents and information about houses were obtained. Although there are many buildings with a historical texture in the centre of Kula, the retrospective information of only 14 Turkish House could have been reached. In order to carry out the comparative analysis that constitutes the main structure of the second phase, the houses whose historical data can be accessed were included in the scope of the study. This phase was carried out with two different methods. These are office work and field work. With office work, data were analysed, and historical processes, plans, existing maps and information were synthesized. Within the scope of the fieldwork, the identity cards (fiches) created for the buildings were determined and filled in place (working area). In this phase, the information obtained in both studies (office and field) was brought together and the data were compared.

In the last phase, the obtained data was converted into fishes. This information obtained has been evaluated within the scope of architecture. Then, within the scope of the data, conservation proposals were made that increase the feature of the study and its contribution to the literature.

KULA

Kula district is located in the province of Manisa. Kula is surrounded by Eşme and Gediz in the east, Salihli, Gördes in the west, Simav, Demirci in the north and Alaşehir in the south (Tosun, 1969, 12).

The distance of the district to the city center of Manisa is 118 km, and the distance to the province of İzmir, which is export port to the Aegean Sea, is 147 km. The vitality of the Izmir port has had a positive impact on the surrounding cities by providing economic growth throughout history. Kula is one of these cities (Altınel, 2021, 98). Beside, since it is located on the road to two metropolitan cities, İzmir and Ankara, it has a central district location (Figure 2).

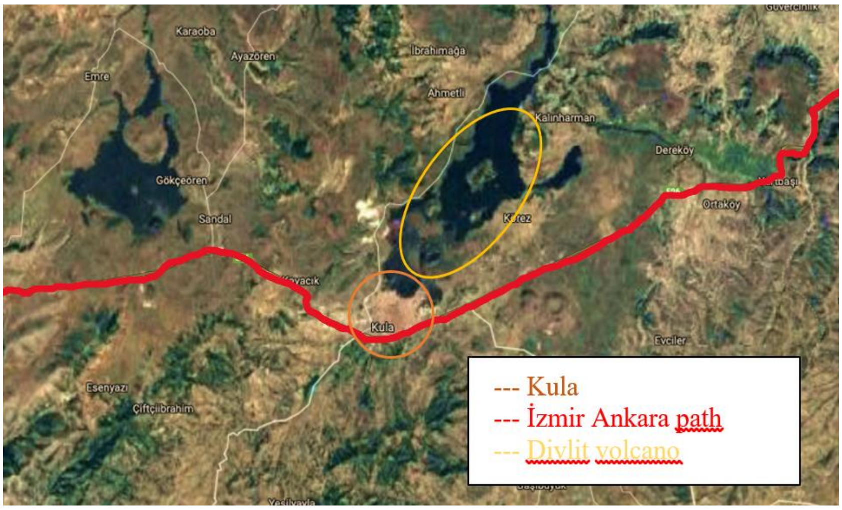


Figure 2. Location of Kula district (Author archive)

Kula, it was founded on the lands where the volcanoes of the Aegean Region were active in the Neozoic Period. It is located on the second degree seismic belt and its north-eastern side is completely surrounded by volcanic lands (Altınel, 2021, 98). It is a town with an altitude of 720, built on the volcanic valley extending to the south of the 800-meter high Karadivlit volcano (Tosun, 1969, 12). The area of Kula district is 960 square kilometers. This area, which is approximately 30-35 km long and 10-15 km wide, is a region where the youngest volcanoes of Turkey are densely populated (Figure 3). The region is a transition area between mediterranean climate and continental climate.

DOI: 10.15320/ICONARP.2024.284

Figure 3. View of the city of Kula (URL-1)

Kula is surrounded by ancient settlements. One of the most important of these settlements is the historical Sardis ruins on the borders of Salihli. The first information we have about the region is given by the philosopher and traveler Strabo from Amasya, who is also known for his first geography book that has survived to the present day (Altınel, 2021, 99).

Strabo describes the region as Kattakekaumene (Burnt Lands), meaning completely burned. A reference to this region, known as Mysia, is made in the Pozzolana chapter of the second book of De Architectura, the work of the famous architect Vitruvius, who lived in the first century at the end of the Roman Republic Period. According to Vitruvius, pumice (köfeke) can be obtained from places other than the vicinity of Etna volcano, the region called Katakekaumene by the Greeks, and similar places (Altınel, 2021, 99).

In the archaeological excavations, the remains of 56 B.C. show that Kula and its surroundings are residential areas. Kula, which was in the Byzantines until 1071, changed between the Turks and the Byzantines for a short time, but later it was again taken by the Turks. With the available information, it is thought that Kula was established with the settlement of the Turks who settled in the region, and it is considered to be an important settlement in the lands under the possession of the Kütahya-centered Germiyanoğlu Principality, which ruled between 1299-1499 (Altınel, 2021, 99).Until 1852, Kula was connected to the province of Kütahya, after which it was connected to the province of Manisa. The population of the district is 43421 according to 2021 TUIK data and population statistics (TUİK, 2022).

When the cultural history of Kula is examined, it has been a city of peace, tolerance, and respect since the day it was founded When the Turks came here, they adopted to live together with the Greeks (Roman-Helen) who are the people of the region. This common life continued until 1920. For this reason, Kula's historical culture, cuisine, music, handcrafts, lifestyle can be described as a colorful mosaic (Ataş, 2017, 78).

TRADITIONAL KULA TURKISH HOUSES

Traditional Kula Architecture

The pavements of the streets in Kula, which are built with a mound in the middle and sloping sides, and built with small black stones, are paved with slate stones. The Greeks, who applied the Roman technique in the Eastern Roman period, initially established neighbourhoods consisting of separate streets. A part of the city consists of kefere districts (non-Muslims) and a part consists of Turkish districts (Ataş ,2017, 177). Although the communities were formed in the form of neighbourhoods because they gathered around religious buildings, dividing walls did not exist in the Ottoman Empire. This situation is not suitable for the demographic structure and philosophy of the Ottoman empire (Altınel, 2021, 108).

Because the city is located at the bottom of an extinct volcano, the abundance of stone material has led to the use of stone in houses and streets (Bozer, 1988, 42). The streets are paved with basalt stone. The houses with wooden protruding masonry are adjacent to each other (Ataş ,2017, 177).

Turkish houses are at the bottom of the gardens and have a courtyard door. Greek houses are on the street and have 2,3 steps of marble stairs. Greek courtyards are at the back of the house. The roofs of the houses built (usually 2 and 3 floors) are very close to each other, so in the past, it was possible to reach the bazaar without getting wet when it rained. (Ataş, 2017, 177). The people of Kula named these eaves 'damla altı (under the drip)' (Altınel, 2021, 112). The streets are paved with basalt stone. The houses with wooden protruding masonry are adjacent to each other (Ataş ,2017, 177).

The altitude of the district is approximately 700 meters and its location; The climate makes it harsher than the coastal region. Climate affects architecture. However, besides the climate, there are many other factors that affect and diversify architecture, and each of them forms the basis of this variation. The possibilities of the region in terms of building materials (köfeke stone), cultural ties with the past, production activities, ethnic identity, religion and other factors that can be counted shape the architecture (Altınel, 2021, 104).

Characteristics of Traditional Kula Turkish Houses

All traditional Kula Turkish houses have a courtyard, albeit a small one. The courtyard floor is usually paved with slate. The courtyard is surrounded by a wall at least three meters high. In the examples of the 18th century and the first half of the 19th century, the entrance to the house is mostly provided by a double-wing wooden door in the courtyard (Bozer, 1988, 40) (Figure 4).

DOI: 10.15320/ICONARP.2024.284

Figure 4. Traditional Kula House Example Zeytinli House

Traditional Kula Turkish houses usually have two floors. On the ground floor, there are places such as barn, cellar and kitchen. The toilet and sometimes the oven are mostly in a corner of the courtyard. In houses with interior sofas, the toilet is included in the house (Bozer, 1988, 40).

Although the bathing is usually done in the rooms, some houses also have a hammam. In some examples, basements were built below the ground level, which are places where the food is preserved. In some houses, there is a mezzanine floor between the ground floor and the first floor (Bozerler, Beyoğlu examples). These rooms, which are flat and unadorned, are used in winter days. On the upper floor, there are sitting areas where daily life takes place. In houses with open sofas, one side of the upper floor faces the street and the other side faces the courtyard. The street-facing facade of the life is covered with wooden latticed or barred windows. While the side facing the courtyard was open in the early examples, it was covered with glass in the late period houses (Bozer, 1988, 40) (Figure 5).

Figure 5. Traditional Kula House Example Bekir Beyler House

There is usually a pavilion(köşk) at one end of the iwan (eyvan). The pavilion is an open, scenic and airy place to sit, especially in summer. One or two of the rooms on the upper floors are the main rooms (başoda). These are more elaborately decorated and located on the street side (Bozer, 1988, 40).

Rooms arranged for various purposes are not encountered in Turkish houses; each room accommodates daily actions such as eating, sleeping, sitting and so on. In the Kula houses, the rooms receive sunlight with windows opening to the iwan and windows opening to the street. Generally, three windows are made in each room in the direction of the iwan. The windows on the upper floors are arranged in double rows. In the lower row, vertical rectangular windows with wooden railings or lattice wooden shutters are arranged in double rows. Vertical rectangular windows with wooden bars or lattices and wooden shutters in the lower row, skylights in the upper row (Bozer, 1988, 42).

The rooms contain the characteristics of traditional Turkish house rooms. The 'plan type with outer sofa' is mostly used in Kula houses. Besides, there are examples with 'inner sofa' and 'middle sofa' in Kula (Bozer, 1988, 42). Kula houses are very rich in ornaments. Ceilings, room doors, cabinet doors, pores, cupboards, hoods, window rails, stair headboards and eaves cornices are the main ornamental elements (Bozer, 1988, 53).

Traditional Kula Turkish Houses

It is known that there are 1050 registered residences in the Kula Urban Protected Area (Altınel, 2021, 109). This study was carried out with 14 traditional Kula Turkish houses, the surveys of which are also included in the book of Tosun (1969). Due to the fact that some of these buildings are in ruins that cannot be entered, the owners of some of them cannot be reached and the study includes old data, this number of residences could be realized.

Examined houses are; Hocacılar House, Sofular House, Çolaklar House, Kızıklar House, Haci Recep House, Bekir Beyler House, Haci Yusuflar House, Beyoğlu (Beyler) House, Bozerler House, Kacaklar House, Terzi Ahmet House, Külkömür House, Büyük Göldeliler House, Küçük Göldeliler House. Within the scope of the study, Bozer (1988)'s book "Kula Houses" was also used, especially in the examination of houses (Figure 6).

DOI: 10.15320/ICONARP.2024.284

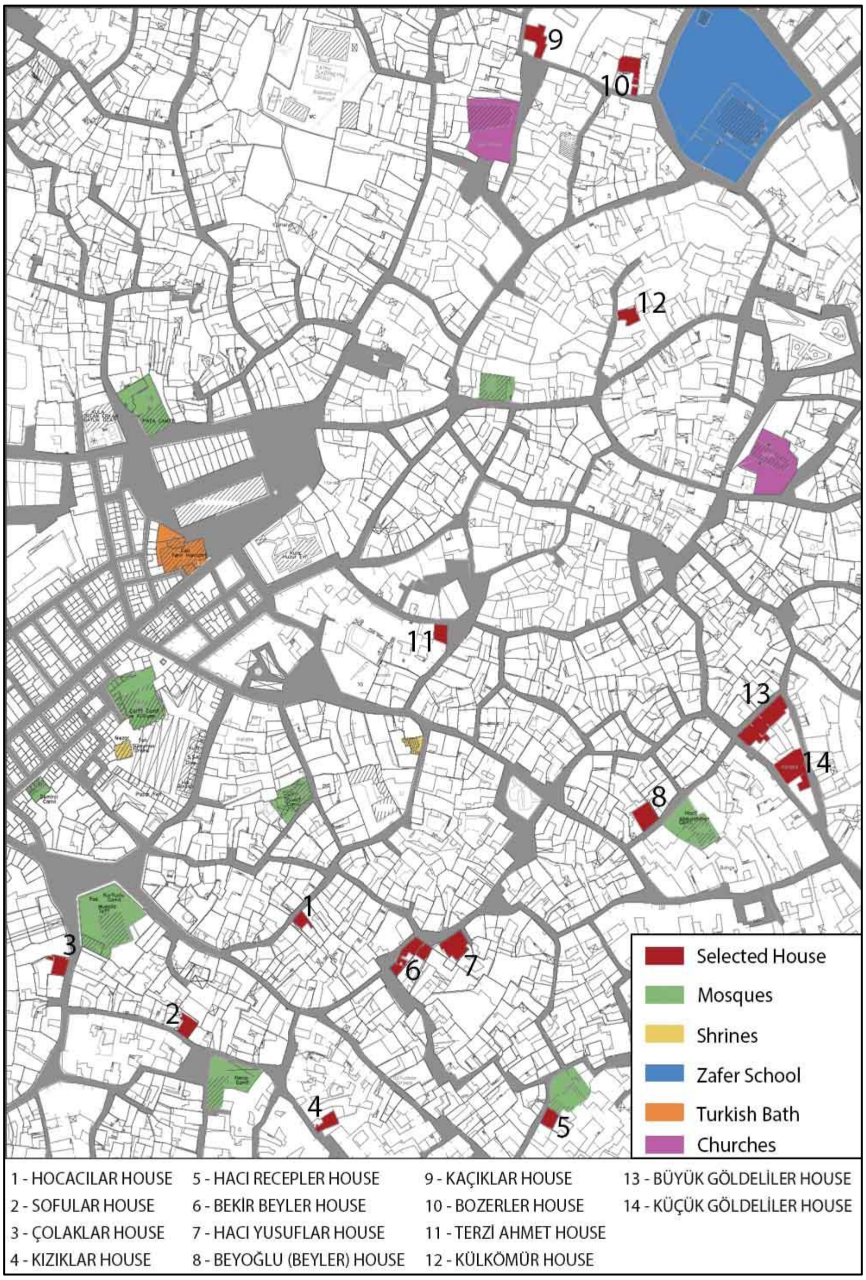


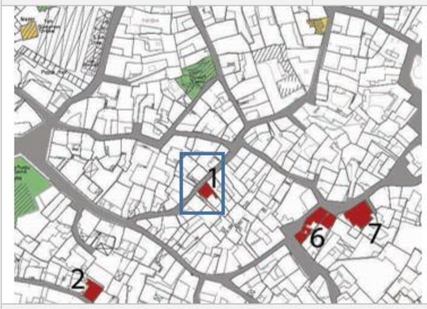
Figure 6. Map of the Examined Traditional Kula Turkish Houses

Hocacılar House

The 'Hocacılar House', which has a quadratic plan type with an outer sofa is a characteristic example for the traditional architecture of Kula. It has a plan that allows a passage from the ground floor in order to connect another adjacent residence with the street (Table 1).

On the ground floor, there is a kitchen and a toilet in the courtyard like other residences, as well as barn and storage spaces. The building, which has one room on the mezzanine floor, has two rows of rooms on the upper floor and an iwan to the east of the living room.On first floor; The oriel (cantilever) of the pavilion room is in the street direction.

Table 1. Identity Card of Hocacılar House

THE IDENTITY CARD (FICH)				
NAME(S)	HOCACILAR HOUSE (1)			
ADDRESS	Camicedit Neighbourhood 127. Street No:9		Legal registration	TKTVYK 29.08.1986/2642
CONSTRUCTION DATE	19th century			
NUMBER OF FLOORS	2 Floors + Mezzanine			
PLAN TYPE	Outer Sofa			
FUNCTION	Original	House		
	Present	Abandoned		
	Yes	No		
GARDEN/COURT	X			
				
SITE PLAN			Photograph of the situation in 1969	

The fireplace of the other room on this floor also forms an jump towards the street (Tosun, 1969, 42).

Sofular House

There are oven, kitchen, toilet, barn and storage spaces in the courtyard of the building, which has a plan type with an outer sofa. All the windows of the building on the street side are wooden latticed and shuttered (Table 2). The embellishments on the ceilings and cupboards in these rooms constitute the ornamentation of the building (Tosun, 1969, 47).

Table 2. Identity Card of Sofular House

THE IDENTITY CARD (FICH)				
NAME(S)	SOFULAR HOUSE (2)			
ADDRESS	Camicedit Neighbourhood 131. Street, No:13		Legal registration	TKTVYK 29.08.1986/2642
CONSTRUCTION DATE	18th century			
NUMBER OF FLOORS	2 Floors + Mezzanine			
PLAN TYPE	Outer Sofa			
FUNCTION	Original	House		
	Present	House		
	Yes	No		
GARDEN/COURT	X			
				
SITE PLAN			Photograph of the situation in 1969	

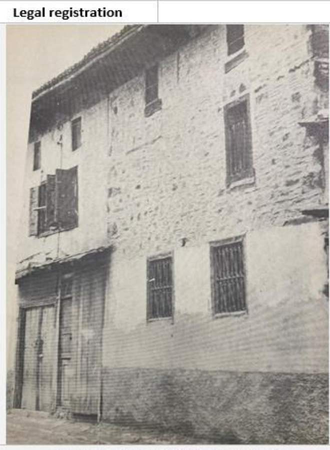
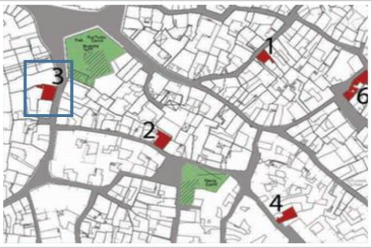
DOI: 10.15320/ICONARP.2024.284

Çolaklar House

The entrance to the building is provided by passing under the sofa to the courtyard. The building, which has the plan type with an outer sofa, is surrounded by thick walls on three sides.

There are two row rooms on the ground floor and a kitchen, a warehouse, a toilet in the courtyard. On the upper floor, there are two row rooms and a pavilion facing the street at the eastern end of the sofa (Table 3). In addition, while the baths and toilets in Kula houses are usually found in the courtyard, in this building, the upper floor is reached through a transition from sofa (Tosun, 1969, 50).

Table 3. Identity Card of Çolaklar House

THE IDENTITY CARD (FICH)				
NAME(S)	ÇOLAKLAR HOUSE (3)			
ADDRESS	130. Street, No:10-12		Legal registration	
CONSTRUCTION DATE	18th century			
NUMBER OF FLOORS	2 Floors			
PLAN TYPE	Outer Sofa			
FUNCTION	Original	House		
	Present	Store / Cafe		
	Yes	No		
GARDEN/COURT	X			
				
SITE PLAN			Photograph of the situation in 1969	

Kızıklar House

The building, which is a small house with one room, is in plan type of outer sofa. On the ground floor there is a toilet, a barn and a kitchen in the courtyard, and on the upper floor there is a sofa and a single room (Table 4).

Table 4. Identity Card of Kızıklar House

THE IDENTITY CARD (FICH)				
NAME(S)	KIZIKLAR HOUSE (4)			
ADDRESS	Camicedit Neighbourhood / 131. Street, No:35		Legal registration	TKTVYK 29.08.1986/2642
CONSTRUCTION DATE	18th century			
NUMBER OF FLOORS	2 Floors			
PLAN TYPE	Outer Sofa			
FUNCTION	Original	House		
	Present	House		
	Yes	No		
GARDEN/COURT	X			
				
SITE PLAN			Photograph of the situation in 1969	

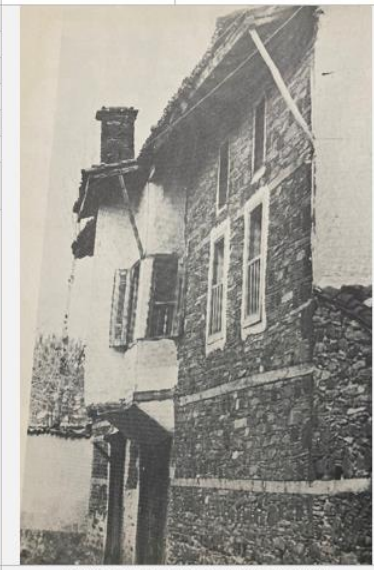
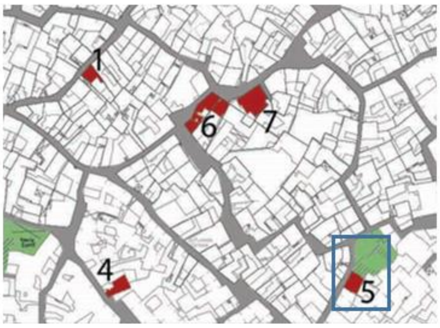
ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

The chimney of the furnace on the lower floor pierces the sofa of the upper floor and reaches the roof.The ceiling and door decorations in the building are partially colored (Tosun, 1969, 53).

Hacı Recepler House

The street façade of the ground floor of the building is a blank wall. The building has outer sofa plan type an and there is courtyard on the back part. Although the building is a single house, it was separated formerly by a partition and converted into two houses. On the upper floor, there is an iwan at both ends of the sofa. In addition, there are two rooms opening to the sofa and an iwan in the middle of this floor. The iwan was closed and turned into a room (Table 5).

Table 5. Identity Card of Hacı Recepler House

THE IDENTITY CARD (FICH)				
NAME(S)	HACI RECEPLER HOUSE (5)			
ADDRESS	Camicedit Neighbourhood / 119. Street, No: 1		Legal registration	KTVKK 09.04.1993/3248
CONSTRUCTION DATE	18th century			
NUMBER OF FLOORS	2 Floors			
PLAN TYPE	Outer Sofa			
FUNCTION	Original	House		
	Present	House		
	Yes	No		
GARDEN/COURT	X			
				
SITE PLAN			Photograph of the situation in 1969	

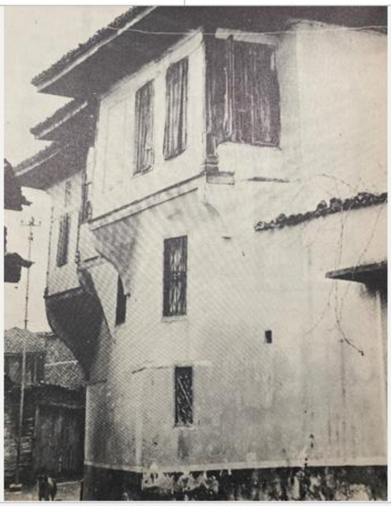
The iwan which is in the middle; protrudes from the street front. Unlike other traditional Kula houses, there are surfaces decorated by drawing plant patterns with madder (root paint). These paintings are seen on the main room door, the sofa ceiling, the main room ceiling, the main room closet, and the columns between the closet and the ceiling. The newel post was carved out of a single wood. There is no jointing on newel post (Bozer, 1988, 20-26; Erdem, 1983, 144; Tosun, 1969, 58-62).

Bekir Beyler House

'Bekir Beyler' house, which is an 18th century structure, was used as divided into three separate households. The building is an example of a plan typology of outer sofa. Door, cabinet and ceiling decorations in 'Bekir Beyler' house are valuable cultural heritages. It is one of the large-scale and multi-roomed examples of Kula traditional residences (Table 6) (Tosun, 1969, 63).

DOI: 10.15320/ICONARP.2024.284

Table 6. Identity Card of Bekir Beyler House

THE IDENTITY CARD (FICH)				
NAME(S)	BEKİR BEYLER HOUSE (6)			
ADDRESS	Camicedit Neighbourhood. / 117. Street, No:32A		Legal registration	TKTVYK 29.08.1986/2642
CONSTRUCTION DATE	18th century			
NUMBER OF FLOORS	2 Floors + Mezzanine			
PLAN TYPE	Outer Sofa			
FUNCTION	Original	House		
	Present	Abandoned		
	Yes	No		
GARDEN/COURT	X			
				
SITE PLAN			Photograph of the situation in 1969	

Hacı Yusuflar House

The house, which has a two-storey exterior sofa plan type, is one of the buildings where the concept of privacy is prioritized. The back and side walls are blank walls. While there are windows on the side faces of the oriel; the front side of oriel is blank wall with the possibility that it would be seen from the opposite house due to the narrowness of the street (Table 7). The concept of privacy seen in traditional Turkish house plans is also reflected in the facade applications (Tosun, 1969, 68).

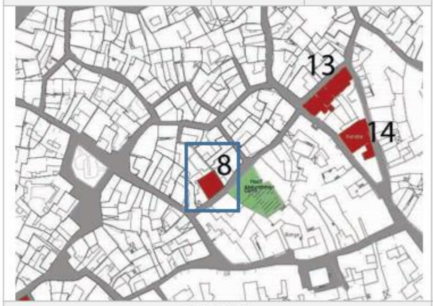
Table 7. Identity Card of Hacı Yusuflar House

THE IDENTITY CARD (FICH)				
NAME(S)	HACI YUSUFLAR HOUSE (7)			
ADDRESS	X		Legal registration	X
CONSTRUCTION DATE	18th century			
NUMBER OF FLOORS	2 Floors			
PLAN TYPE	Outer Sofa			
FUNCTION	Original	House		
	Present	New House		
	Yes	No		
GARDEN/COURT	X			
				
SITE PLAN			Photograph of the situation in 1969	

Beyoğlu (Beyler) House

The building, which is one of the characteristic examples of traditional Kula houses, is in plan type with an outer sofa. This building, which has a ground floor, a mezzanine level 150 cm above the ground, and an upper floor, was built in a rectangular shape (Table 8).

Table 8. Identity Card of Beyoğlu (Beyler) House

THE IDENTITY CARD (FICH)			
NAME(S)	**BEYOĞLU (BEYLER) HOUSE (8)**		
ADDRESS	Zaferiye Neighbourhood / 78. Street, no:5	**Legal registration**	KTVKK 09.04.1993/3248
CONSTRUCTION DATE	18th century		
NUMBER OF FLOORS	2 Floors + Mezzanine		
PLAN TYPE	Outer Sofa		
FUNCTION	**Original** / House		
	Present / Museum		
	Yes / **No**		
GARDEN/COURT	X /		
			
SITE PLAN		**Photograph of the situation in 1969**	

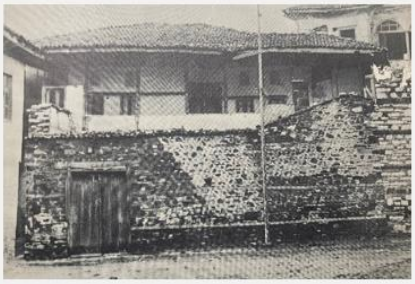
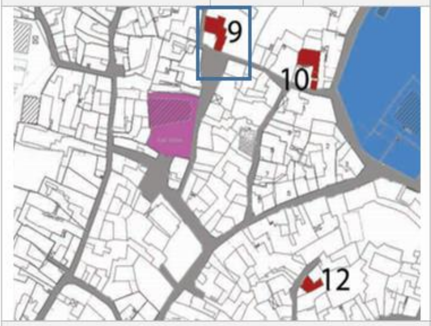
One façade is adjacent to the side structure. There are bay windows on the street side of the building. On the ground floor there are kitchens and warehouses, on the mezzanine floor there are two rooms, on the upper floor (according to the survey drawings) there are three rows of rooms and two mansion rooms. The hoods, newel post, doors, eaves cornice, cabinets, ceilings and column capitals, woodwork and ornaments in the building constitute the decoration of the building (Bozer, 1988, 12-19; Erdem, 1983, 153; Tosun, 1969, 72-77).

Kaçıklar House

Kaçıklar house is an 18th century structure with an outer sofa plan type (Table 9). There are root painted and mirrored interior doors in the building (Tosun, 1969, 87).

DOI: 10.15320/ICONARP.2024.284

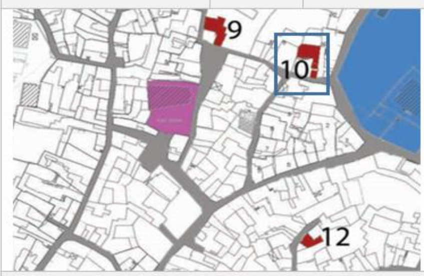
Table 9. Identity Card of Kaçıklar House

THE IDENTITY CARD (FICH)			
NAME(S)	KAÇIKLAR HOUSE (9)		
ADDRESS	48. Street No:1	Legal registration	TKTVYK 29.08.1986/ 2642
CONSTRUCTION DATE	18th century		
NUMBER OF FLOORS	2 Floors + Mezzanine		
PLAN TYPE	Outer Sofa		
FUNCTION	Original: House		
	Present: House		
	Yes / No		
GARDEN/COURT	X (Yes)		
			
SITE PLAN		Photograph of the situation in 1969	

Bozerler House

The building, which has a plan type with an outer sofa, has both a front and a back courtyard (Table 10). The barn, kitchen and warehouses are located on the ground floor and there are three rooms on the mezzanine floor. On the upper floor, there is an iwan at one end of the sofa and a mansion that leads out to the garden at the other. In addition, there are two more rooms that open to sofa and an iwan in the middle. This iwan makes corbelling to the back courtyard. Wooden doors, eaves cornices, cabinets and ceilings in the building constitute the decoration of the building (Bozer, 1988, 27-32; Erdem, 1983, 173-177; Tosun, 1969, 78-85).

Table 10. Identity Card of Bozerler House

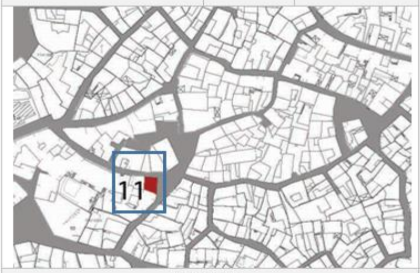
THE IDENTITY CARD (FICH)			
NAME(S)	BOZERLER HOUSE (10)		
ADDRESS	48. Street No:11	Legal registration	TKTVYK 29.08.1986/ 2642
CONSTRUCTION DATE	18th century		
NUMBER OF FLOORS	2 Floors + Mezzanine		
PLAN TYPE	Outer Sofa		
FUNCTION	Original: House		
	Present: House		
	Yes / No		
GARDEN/COURT	X (Yes)		
			
SITE PLAN		Photograph of the situation in 1969	

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Terzi Ahmet House

Terzi Ahmet house was built by the Şapçılar family in the 18th century. It is one of the richest examples of the buildings in the region in terms of comfort. It has a symmetrical plan as outer sofa plan type. The sofa is accessed by two different stairs (Table 11). This building has four rooms in a row, two more rooms in the middle are located behind (Tosun, 1969, 92).

Table 11. Identity Card of Terzi Ahmet House

THE IDENTITY CARD (FICH)				
NAME(S)	TERZİ AHMET HOUSE (11)			
ADDRESS	60. Street, No:4		Legal registration	TKTVYK 29.08.1986/2642
CONSTRUCTION DATE	18th century			
NUMBER OF FLOORS	2 Floors			
PLAN TYPE	Outer Sofa			
FUNCTION	Original	House		
	Present	House		
	Yes	No		
GARDEN/COURT	X			
				
SITE PLAN			Photograph of the situation in 1969	

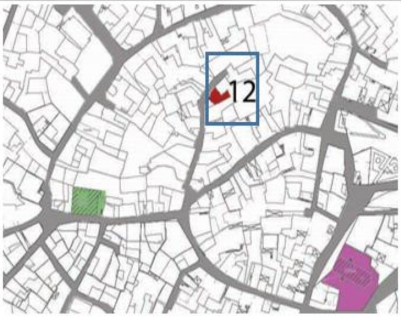
Külkömür House

Külkömür house has a rectangular plan (almost a square) and is of plan type with an outer sofa. The building, which was built as a ground and first floor, has two floors; the ground floor is alternate order of stone-brick, and the upper floor is wooden frame system. The ground floor flooring is slate, the upper floor flooring and ceiling flooring is wood. The upper cover is hipped roof and covered with alaturka tiles (Table 12). On the upper floor, there is a sofa, a mansion and two rooms in row. In these rooms, there are cupboards, ghuslhane and niches (Bozer, 1988, 10-11; Erdem, 1983, 160; Tosun, 1969, 94-105).

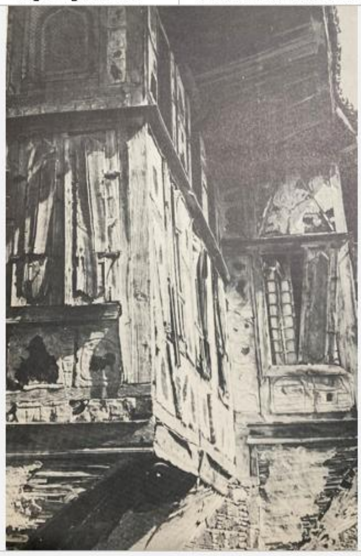
DOI: 10.15320/ICONARP.2024.284

Table 12. Identity Card of Külkömür House

THE IDENTITY CARD (FICH)			
NAME(S)	KÜLKÖMÜR HOUSE (12)		
ADDRESS	55.Sokak, No: 19	Legal registration	TKTVYK 29.08.1986/2642
CONSTRUCTION DATE	18th century		
NUMBER OF FLOORS	2 Floors		
PLAN TYPE	Outer Sofa		
FUNCTION	Original: House		
	Present: House		
	Yes	No	
GARDEN/COURT	X		
SITE PLAN		Photograph of the situation in 1969	



SITE PLAN



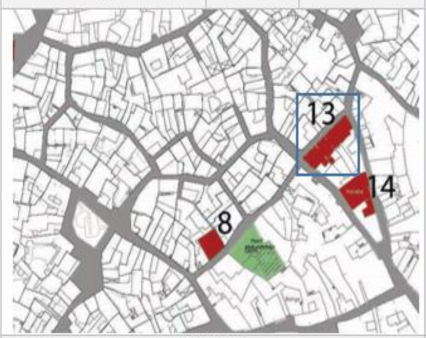
Photograph of the situation in 1969

Büyük Göldeliler House

The building, which was built as three floors by the Göldeliler family, was demolished for third floor in the 19th century and turned into two floors (Tosun, 1969, 106). The building, which has a symmetrical planning, has an iwan in the middle of the upper floor and three rooms on both sides of the iwan. The iwan in the middle has cantilever to the street (Table 13).

Table 13. Identity Card of Büyük Göldeliler House

THE IDENTITY CARD (FICH)			
NAME(S)	BÜYÜK GÖLDELİLER HOUSE (13)		
ADDRESS	X	Legal registration	TKTVYK 29.08.1986/2642
CONSTRUCTION DATE	18th century		
NUMBER OF FLOORS	2 Floors		
PLAN TYPE	Outer Sofa		
FUNCTION	Original: House		
	Present: New House		
	Yes	No	
GARDEN/COURT	X		
SITE PLAN		Photograph of the situation in 1969	



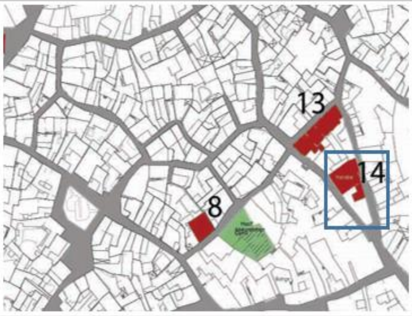
SITE PLAN

Photograph of the situation in 1969

Büyük Göldeliler House

There is a courtyard on both sides of the square planned, two-storey building with an inner sofa. The entrances of the four rooms on the upper floor are chamfered and the middle part of the sofa has been enlarged. The rooms have stoves, gusulhane (ablution place), niches, large closets and cupboards. Contrary to other traditional historical buildings, the decorations in this building do not attract attention. Although there are decorations on the ceiling of the main room, the pores and the upper cabinets, their workmanship is of poor quality compared to other examples (Table 14) (Bozer, 1988, 33-35; Erdem, 1983, 173-178; Tosun, 1969, 110-113).

Table 14. Identity Card of Küçük Göldeliler House

THE IDENTITY CARD (FICH)				
NAME(S)	KÜÇÜK GÖLDELİLER HOUSE (14)			
ADDRESS	Zaferiye Neighbourhood 79.Street No :5		Legal registration	TKTVYK 29.08.1986/2642
CONSTRUCTION DATE	18th century			
NUMBER OF FLOORS	2 Floors			
PLAN TYPE	Outer Sofa			
FUNCTION	Original	House		
	Present	Abandoned		
	Yes	No		
GARDEN/COURT	X			
				
SITE PLAN			Photograph of the situation in 1969	

COMPARATIVE ANALYSIS

Traditional Kula Turkish houses are documented and explained with their architectural details. The changes and transformations that these structures have undergone in the last 50 years are explained under this heading. First of all, the houses are explained one by one by making determinations with their differences from the past to the present. Descriptions are supported by photographs. Then, all the houses are examined together in two different comparative tables. 14 residences in the Kula site area, whose detailed information can be accessed in the literature and archives, and accordingly evaluated within the scope of the study; visual changes on the façades, use cases and structural element changes are discussed.

DOI: 10.15320/ICONARP.2024.284

Visual Changes on the Facades

Hocacılar House

Hocacılar house is one of the abandoned buildings in Kula district. Although the building is standing; It has suffered a lot of damage because it was abandoned and not maintained. Looking at the street façade, both material deterioration and material losses are seen. As a frontal change, it is seen that the bay window and chimney have been canceled. The bay window was closed, and a double wing window was opened.

A new window was opened in place of the chimney, and the windows on the right and left of the chimney were filled with filling material. A new window was opened on the ground floor. At the courtyard facade, the staircase parallel to the sofa was canceled and a new brick staircase with iron railing was added adjacent to the east wall and perpendicular to the sofa. In addition, the balustrades of the sofa have undergone changes locally (Table 15).

Table 15. Comparative Analysis of Hocacılar House

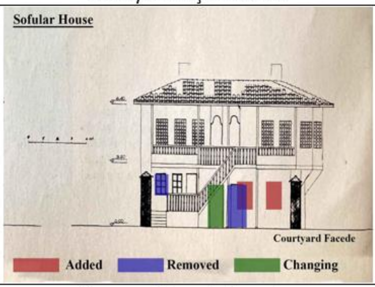
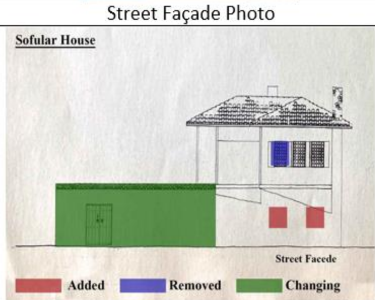
	
Courtyard Façade Photo	Street Façade Photo
	
Courtyard Façade Drawing	Street Façade Drawing

Sofular House

The 'Sofular' house is a building that has not changed to a great extent but has undergone some interventions in order to provide the comfort conditions of the time. It is a building used as a residence. Looking at the street facade, it is seen that the garden wall was raised and the garden gate was built with an arch. The leftmost one of the three windows on the upper floor bay window has been closed.

On the lower floor, two new windows were opened. On the courtyard front; while the upper floor preserved its originality, the lower floor was changed to a double-winged door of the two doors in the middle, while the door on the right was cancelled. Two windows were added to the surface of the canceled door. On the first landing of the staircase, there are two windows in the 1969 survey. Today, there is one original window. It is estimated that there was an accidental error in the 1969 survey (Table 16).

Table 16. Comparative Analysis of Sofular House

	
Courtyard Façade Photo	Street Façade Photo
	
Courtyard Façade Drawing	Street Façade Drawing

Çolaklar House

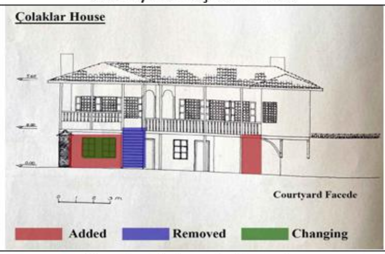
Today, the ground floors of this building are used as shops, while the upper floor has been abandoned. Although it mostly preserves its originality, collapse of the roof and neglect are observed due to its abandonment. The two windows of the room on the left side of the courtyard are turned into a single large window. In addition, a new space was obtained by closing the bottom of the sofa where the windows were opened. Although the exit to the upper floor is visible on the left side in the drawings, there is another staircase on the right in its current form. The staircase on the left has not reached the present day. The street façade has undergone many changes due to its use as a shop.In the 1969 photograph, the windows on the upper floor are visible, but in the survey drawings of the same year, the windows are not visible. These windows have survived to the present day. The windows on the ground floor were canceled and turned into a door and a showcase. The ground floor is used as two separate shops today. In addition, an awning made of ondulin sheet was added to the middle line of the structure (Table 17).

DOI: 10.15320/ICONARP.2024.284

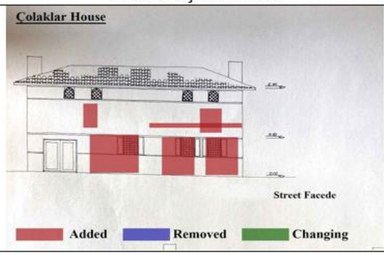
Table 17. Comparative Analysis of Çolaklar House

Courtyard Façade Photo

Street Façade Photo



Courtyard Façade Drawing



Street Façade Drawing

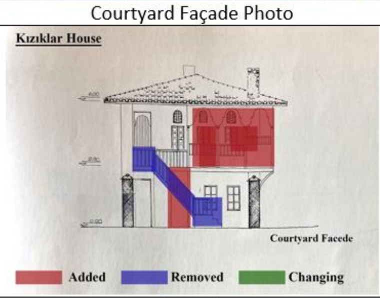
Kızıklar House

The building, which is used as a residence today, has lost its originality to a large extent. When the street facade was examined, it was determined that the sofa was closed and turned into a room. Due to this change, windows and doors were added to the newly built wall on the upper floor on the courtyard facade. The garden wall was raised with brick material. The sofa was left outside by building a brick wall on the street front. For this reason, the uprights and woodworks of the Sofa were exposed to external factors and material deteriorated to a large extent. Two window spaces on the stone wall located in the continuation of the hall are not seen in the 1969 survey drawings.

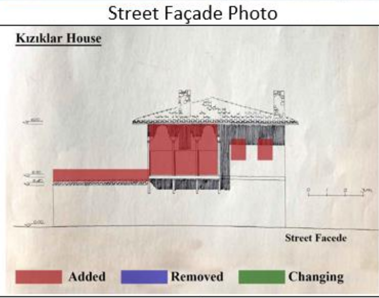
Table 18. Comparative Analysis of Kızıklar House

Courtyard Façade Photo

Street Façade Photo



Courtyard Façade Drawing



Street Façade Drawing

Due to the original lintels, two alternatives come to the fore. Either a mistake was made in the 1969 drawing, or the stone wall was rebuilt after 1969 by opening the window spaces again. Since the owners of the building could not be reached, the front of the lower floor courtyard could not be fully examined. However, it was found that the staircase was canceled and a new iron railing staircase was placed perpendicular to the structure (Table 18).

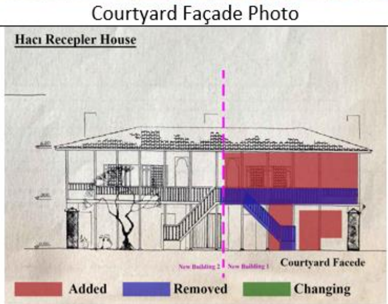
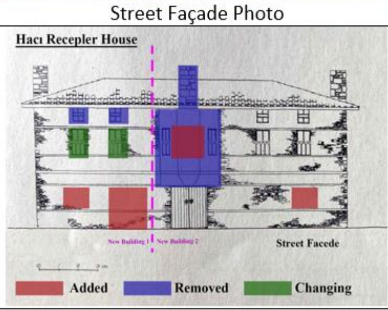
Hacı Recepler House

Hacı recepler house, which was originally a single building, is used as two separate buildings today. For this reason, another entrance door was added on the façade facing the street. To provide comfort conditions, one window has been added to the spaces on the ground floors.

The chimney, bay window and windows on the bay window in the middle of the building have been canceled. It was replaced by a single window. Two windows on the upper floor left side of the building (new building 1) were replaced with PVC windows. Also the skylights have been cancelled. On the right (new building 2), the original windows are repaired and continue to be used.

Since the owners of the new building 2 on the courtyard front could not be reached, only part of the new building 1 could be examined. Due to the conversion of the building into two new structures, there are major changes on the courtyard facade. The existing staircase was canceled and a new vertical staircase was added to the building. The upper floor is closed from the living level. Under life was closed and a new place was created. New windows and doors have been added to the closed surfaces. A porch has been added to protect from rain and sun (Table 19).

Table 19. Comparative Analysis of Hacı Recepler House

	
Courtyard Façade Photo	Street Façade Photo
	
Courtyard Façade Drawing	Street Façade Drawing

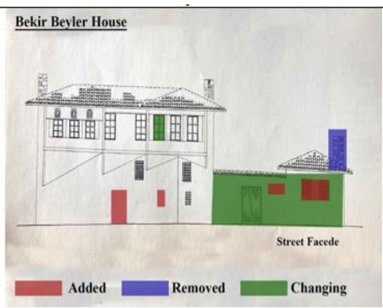
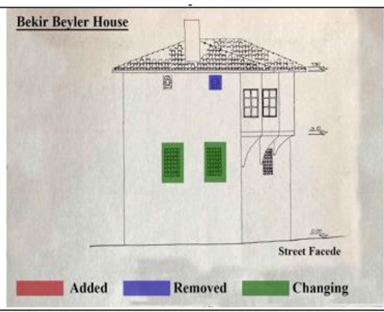
DOI: 10.15320/ICONARP.2024.284

Bekir Beyler House

Since this structure, which preserves its originality to a great extent, was not used, local deterioration began to occur. The garden wall of the building and the parts of the outbuilding on the right facing the street were demolished and rebuilt as a brick wall. In this new wall, a window was opened next to the door and a single larger window was opened in place of the two windows of the outbuilding. In addition, the chimney of the outbuilding was canceled. When we look at the street façade of the main building, the leftmost window of the overhang on the far right has been closed.

A doorway was opened at the lower level of the overhang in the middle on the ground floor. Another small window was found next to the opened doorway. The small windows on the floor are covered with wooden material. When we look at the second street façade, although the window locations in the old survey drawings and the current window locations and number are correct, when we look at the size and construction systems of the windows, it has been determined that they are not original. In addition, the upper right window was closed with stone filling (Table 20).

Table 20. Comparative Analysis of Bekir Beyler House

	
Street Façade Photo	Street Façade Photo
	
Street Façade Drawing	Street Façade Drawing

Hacı Yusuflar House

It was determined that the old two-storey house was demolished and a two-storey reinforced concrete building was built in its place (Table 21).

Table 21. Comparative Analysis of Hacı Yusuflar House

Photo in 1969 (Tosun, 1969, 71)

Photo in 2022

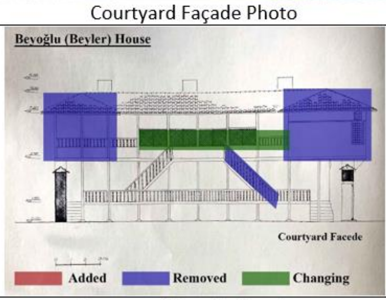
Beyoğlu (Beyler) House

This building, which was restored in 2016, serves as a culture house and cafe. When the survey drawings of Tosun (1969) are examined, it is seen that three layers of protrusions were made on the street façade. Although the leftmost pavilion is the room, in the photo in the same source, the pavilion room part is not visible. If we evaluate the street facade through the drawings, it is possible to say that the mansion room was removed at some time. Apart from this, there is no change in the façade. When we look at the front of the courtyard, it is determined that the two mansions and the window on the right hand side have been removed. In addition, the upper floor life railings were renewed during the restoration and replaced with a different model (Table 22).

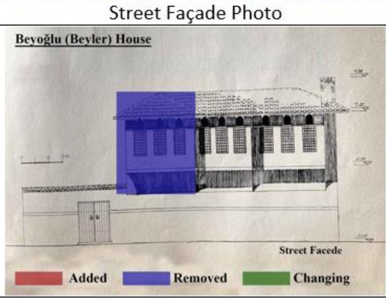
Table 22. Comparative Analysis of Beyoğlu (Beyler) House

Courtyard Façade Photo

Street Façade Photo



Courtyard Façade Drawing



Street Façade Drawing

Kaçıklar House

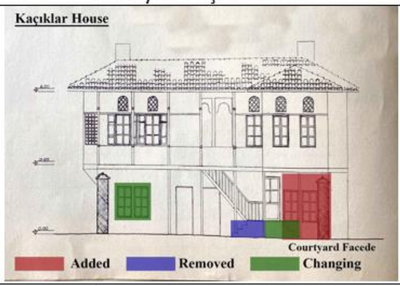
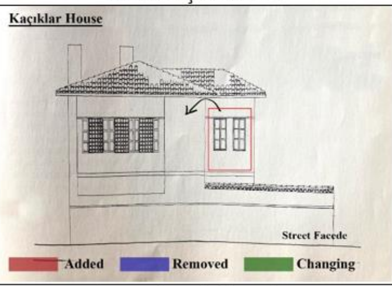
This residence, which is a classical traditional Turkish house, is not used today. One of the 2 staircases with 4 steps providing access to the main staircase on the courtyard facade of the house has been canceled and the direction of the other has been changed. Two windows on the left side of the ground floor were combined into a larger single window. In

DOI: 10.15320/ICONARP.2024.284

addition, an additional structure was created to include 2 windows on the right side of the building.

No changes were detected on the street façade. However, in the survey of the street façade dated 1969, it was determined that the locations of the existing windows were not drawn correctly (Table 23).

Table 23. Comparative Analysis of Kaçıklar House

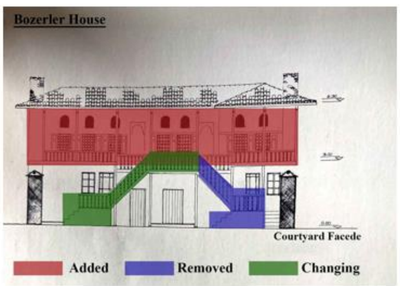
	
Courtyard Façade Photo	Street Façade Photo
	
Courtyard Façade Drawing	Street Façade Drawing

Bozerler House

Bozerler house is not in use. Within the scope of this study, both street and courtyard facades of the buildings were examined. However, due to the fact that this building was not used, its rear facade could not be reached and only the courtyard facade could be examined.

When looking at the courtyard of Bozerler house, it is seen that life and the mansion connected to life are closed with walls. In addition, the right arm of the wooden two-armed staircase was canceled and rebuilt in reinforced concrete in the same place (Table 24).

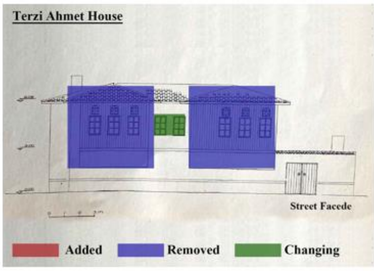
Table 24. Comparative Analysis of Bozerler House

	
Courtyard Façade Drawing	Courtyard Façade Photo

Terzi Ahmet House

The pavilion section and the bay window on the street front of the 'Terzi Ahmet' house have been removed. A straight wall was built instead of the bay window that was removed. A large window has been added to this wall. In addition, the windows on the surface next to the closed bay window were closed. The building is not used today and the inner courtyard could not be entered during the research. For this reason, the courtyard facade of the building could not be evaluated (Table 25).

Table 25. Comparative Analysis of Terzi Ahmet House

	
Street Façade Drawing	Street Façade Photo

Külkömür House

There are changes on the facades of the 'Külkömür House' compared to the original. There are two projections in the archive photos, but the projection wall on the right was canceled and pulled back and the two windows above it were turned into a single large window. The top window on the left-hand overhang and the right-most window have been cancelled. In addition, the other two windows were combined into a single window. On the ground floor, three windows were opened in order to provide today's comfort conditions.

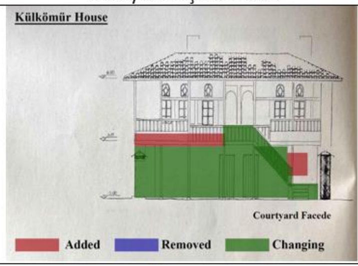
On the courtyard front, the ground floor wall has been completely renovated to provide comfort conditions, and windows and doors have been opened. The first four steps of the staircase leading to the upper floor were canceled and rebuilt as a single arm reinforced concrete. On the ground floor, a porch has been added to protect from the weather (Table 26).

DOI: 10.15320/ICONARP.2024.284

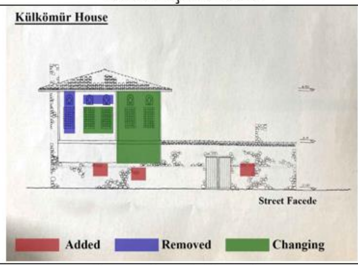
Table 26. Comparative Analysis of Külkömür House


Courtyard Façade Photo


Street Façade Photo



Courtyard Façade Drawing



Street Façade Drawing

Büyük Göldeliler House

It was determined that the old two-storey house was demolished and four separate new buildings were built in its place (Table 27).

Table 27. Comparative Analysis of Büyük Göldeliler House


Photo in 1969 (Tosun, 1969, 106).


Photo in 2022

Küçük Göldeliler House

The two-storey house was found in ruins. It was not included in the evaluation due to its ruins (Table 28).

Table 28. Comparative Analysis of Küçük Göldeliler House


Photo in 1969 (Tosun, 1969, 110)


Photo in 2022

Use Cases of Examined Houses

The 14 houses examined have been examined in terms of active use today. Five of these buildings are used with all their floors, only the ground floor of one is used as a shop, and one is used periodically. Four of them are abandoned, one is in ruins, two of them have been demolished and new structures have been built in their place (Table 29).

Table 29. Use Cases of Examined Houses

	Hocacılar House	Sofular House	Çolaklar House	Kızıklar House	Hacı Recepler House	Bekir Beyler House	Hacı Yusuflar House	Beyoğlu (Beyler) House	Kaıçıklar House	Bozerler House	Terzi Ahmet House	Külkömür House	Büyük Göldeliler House	Küçük Göldeliler House
Buildings in use		X		X	X			X				X		
Abandoned Buildings	X					X			X		X			
Periodically Used Buildings										X				
Buildings Using Only the Ground			X											
Buildings in Ruins														X
New Builds Built							X						X	

Structurel Element Changes of Examined Houses

The structural element changes that occur over time are actually the result of spatial use. For this reason, the use of interior space and spatial requirements affect the formation of the buildings. Examined structures are discussed in terms of material-element changes on the façade and interior usage (Table 30). It has been observed that Kızıklar House, one of the structures that continue to be used, has undergone radical changes that will damage the structure in order to adapt to today's comfort conditions. The 'Külkömür house', on the other hand, has undergone changes for comfort conditions, but it maintains its originality to a large extent, except for the interventions made on the upper floor street front protrusions. The Hacı Recepler House, on the other hand, was divided into two separate buildings, and as a result of this, additional spaces were added to the building and its originality was lost. Beyoğlu (Beyler) House, on the other hand, is the only one among the 14 buildings that has undergone detailed restoration. It has been determined that the Terzi Ahmet house, one of the abandoned buildings, has undergone great interventions.

Street and courtyard façades of eight of fourteen buildings, only courtyard façade of one, only street façade of one building and two street façades of one building could be examined. Due to the fact that one building was in ruins and a new building was built instead of two other buildings, it was not included in the examination.

When we look at the changes in the street facades of the ten buildings, it is observed that new windows have been added on the ground floors and some windows in the building have been changed in order to provide today's comfort conditions. It was observed that new doors were added in three of the buildings. When looking at the courtyard facades, the most important change is observed in the stairs. Changes in the stairs were detected in 8 of the 9 courtyard facades examined. It is possible to state that all these structural element and facade changes are due to the differentiation of the requirements for interior use.

DOI: 10.15320/ICONARP.2024.284

Table 30. Structurel Element Changes of Examined Houses

	Street Facade			Courtyard Facade / Street Facade 2		
	Added	Removed	Changing	Added	Removed	Changing
Hocacılar House	ground floor window	chimney, oriel and Windows	X	stairs	stairs	railing
Sofular House	window	window	garden wall	window	window - door	door
Çolaklar House	door, tent	windows	X	stairs	stairs, room	window
Kızıklar House	garden wall, window ve room	X	X	room, window, door ve stairs	stairs	X
Hacı Recepler House	windows, Entrance Door	Oriel, chimney, top window	window	divider wall, doors windows, stairs, lean-to roof	Stairs, railing	X
Bekir Beyler House	Door, window	chimney	Window, wall	X	Top window	window
Hacı Yusuflar House	The building was demolished and a new building was built in its place.					
Beyoğlu (Beyler) House	X	pavillion	X	X	Pavillion, stairs	railing
Kaçıklar House	X	X	X	additional structure	stairs	stairs window
Bozerler House	Not reviewed			wall	stairs	stairs
Terzi Ahmet House	window	pavillion, oriel, window	window	Not reviewed		
Külkömür House	window	Top window, window	window and Corbelling	window penthouse roof	X	lower floor Wall, stairs
Büyük Göldeliler House	The building was demolished and a new building was built in its place.					
Küçük Göldeliler House	The building is in ruins.					

Structural elements create changes, but apart from the table forming the list, a visual comparison has also been made (Table 31). The examined structures were compared with their photographic conditions in 1969 and their documented states in 2022. In order to make the comparison more understandable, the photographs from 1969 were used by coloring them.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Table 31. Visual Change of Examined Houses [1]

	The Year 1969	The Year 2022		The Year 1969	The Year 2022
Hocacılar House			Sofular House		
Çolaklar House			Kızıklar House		
Hacı Recepler House			Bekir Beyler House		
Hacı Yusuflar House			Beyoğlu (Beyler) House		
Bozerler House			Kaçıklar House		
Terzi Ahmet House			Külkömür House		
Büyük Göldeliler			Küçük Göldeliler		

[1] The photos dated 1969 were taken from the book named "Kula Houses in Our National Architecture" and colored on the website www.myheritage.com.tr.

RESULTS

It is possible to state that the structural element and facade changes determined in the data obtained are due to the differentiation of the requirements for indoor use. For example, the change in the family form and the decrease in the number of individuals living in the houses have caused the number of indoor spaces to be higher. For this reason, only the interior spaces on the lower floors are used in many residences in use. The lower floors, originally designed as a common area and with deaf walls; It was used as living spaces, so window openings were needed. Based on this and many similar examples, it is possible to state that the use of interior space has a great effect on the changes in both the structural elements and the facades. As can be seen in the structures

DOI: 10.15320/ICONARP.2024.284

examined, the traditional examples of civil architecture that make up our cultural values with the efforts to comply with today's comfort conditions are either abandoned and left to their fate because they cannot keep up with the comfort conditions, or they are exposed to some conscious or unconscious interventions in order to provide comfort conditions. This causes the historical value of the buildings to disappear.

Restoration is a compulsory intervention method for the survival of examples of civil architecture today. However, it is important to what extent this intervention will be carried out by whom and with which supervisory authorities. Because the slightest wrong intervention to the building can destroy the originality of the building and destroy its quality and value. For this reason, every intervention to be made must be done by taking into account the values of the building.

'Restoration' can ensure the transfer of a document regarding the social-economic, cultural, architectural and historical values of the past to future generations, while preserving the original qualities of a cultural property; this is a scientific study that predicts honest approaches to architectural documents and interventions that will not cause any errors in the future (Asatekin, 1995, 68). However, the examinations made in the area show that interventions that may cause misconceptions were made within 50 years or that these documents began to disappear by leaving the structures to their fate.

REFERENCES

Altınel, N. N. (2021). İzmir ve Kula'da Ortodoks Sivil Mimari Mirası, İzmir: Yakın Kitabevi.

Asatekin, G. (1995). Restorasyon Teriminin Yüklendiği Yeni Anlam, Mimarlık Dergisi, (261), 66-69.

Ataş, A. (2017). Tarih, Kültür ve Lakaplarıyla Kula Katakeumene (Yanık Diyar), İzmir: TC Kültür ve Turizm Bakanlığı Yayınları.

Bozer, R. (1988). Kula Evleri. Ankara: Kültür ve Turizm Bakanlığı.

Erdem, A. (1983). Kula Tarihsel Sit, Sivil Mimarlık Örnekleri ve Sorunları Üzerine Bir Araştırma. (Yayımlanmamış lisansüstü araştırma tezi). Yıldız Üniversitesi, İstanbul.

ICOMOS. (1999). Icomos Geleneksel Mimari Mİras Tüzüğü. http://www.icomos.org.tr/Dosyalar/ICOMOSTR_tr0464062001536913566.pdf

Sütgibi, S. (2006) Kula ve Çevresinde Arazi Kullanımı. Geçmişten Geleceğe Köprü Yanık Ülke Kula Sempozyumu, s. 167–176. Manisa

Tosun, İ. (1969). Milli Mimarimizde Kula Evleri. İzmir: Ticaret Matbaacılık T.A.Ş.

Tosun, İ. (1986) Tarihi Sosyal Kültürel ve Turizm Yönü İle Kula (2.Baskı), İzmir: Kula Belediyesi Yayınları.

TUİK. (2021). İlçe Nüfusu. https://www.tuik.gov.tr › duyuru › favori_raporlar adresinden edinilmiştir.

URL-1. https://manisa.ktb.gov.tr/TR-152074/kula.html

Resume

Gizem ÖZER BAŞ has been working as An Assistant Professor Doctor in Manisa Celal Bayar University Department of Design. She received her master's degree and

Ph.D. from Hacettepe University, Interior Architecture and Environmental Design Department. In 2022, she received his Associate Professor. Her areas of expertise are Interior Architecture and Environmental Design, Architectural Restoration, Elderly Design.

İpek DEMİR works in the Architectural Restoration program at Manisa Celal Bayar University. She completed her master's degree in Architectural Conservation at Anadolu University and undergraduate education in Architecture at Eskişehir Osmangazi University. She works in the field of conservation, restoration and architectural design.

DOI: 10.15320/ICONARP.2024.284

ICONARP
International Journal of Architecture and Planning
Received: 16.11.2022 Accepted: 26.01.2024
Volume 12, Issue 1/ Published: 30.06.2024
Research Article *DOI: 10.15320/ICONARP.2024.285 E- ISSN:2147-9380*
ICONARP

Utilizing Orthophoto Through Adaptive Re-Use Courses in Architecture Education

Sibel Özden Omuzlu*
Bülent Onur Turan **

Abstract

With the developing technologies, digital-based technologies and methods used in the field of architecture, as in every field, are increasing. This situation causes the methods used in architectural education to change. This study examines the use of terrestrial laser scanning technologies as a new method in adaptive re-use in the distance education process of architectural education. The aim of the study is to examine the use of Terrestrial Laser Scanning technologies in the adaptive re-use projects of architecture in the distance education process, by comparing it with the conventional method in face-to-face education process, to analyse whether it is an efficient method and to investigate its contributions, if any. In the experimental study, it was tried to find the answer to the question of whether the use of orthophoto produced from terrestrial laser scanning technologies as a method within the extent of re-use historical buildings is an efficient method compared to the conventional method. Orthophoto images obtained from Terrestrial Laser Scanning technologies will be used in the project of re-use a historical building, and the conduct of the course in distance education will be investigated. In this research the comparative analysis method was used in 25 student projects were evaluated. In the analyses made, the average success scores according to the parameters, the most positive and negative aspects of the projects, the general evaluation of the projects were compared and interpreted in the findings section. According to the analyses, firstly, whether the orthophoto method is efficient compared to the traditional method was examined and then the efficient aspects were determined. It is thought that being able to access measurable, comparable, and high-accuracy data without going to the place is an alternative and useful method in the emergency distance education period. However, the application of site study and learning methods by practice is important for the development of the student's mastery of the process and should not be ignored. In future studies, it is foreseen that the research will lead to new discussions on originality, creativity, and the use of different 2D, 3D, and hybrid techniques and presentation tools in presentation formats, since each project is designed on the supplied ready-made bases.

Keywords:
Adaptive re-use, Architectural education, Distance education, Terrestrial laser scanning technologies

*Department of Architectural Design Computing, Istanbul Technical University (ITU), Istanbul, Turkey. (Corresponding author)

E-mail: mim.sibelozden@gmail.com

**Department of Informatics, Mimar Sinan Fine Arts University (MSGSU), Istanbul, Turkey.

E-mail: bulent.onur.turan@msgsu.edu.tr

To cite this article: Özden Omuzlu, S., & Turan, B.O. (2024). Utilizing Orthophoto Through Adaptive Re-Use Courses in Architecture Education. *ICONARP International Journal of Architecture and Planning,* 12 (1), 287-315. DOI: 10.15320/ICONARP.2024.285

INTRODUCTION

Architecture is a discipline consisting of design and production processes, so it is a field that constantly renews and updates itself. With the developing technologies, the use of technology in architecture and architectural education is becoming more and more widespread. Two- and three-dimensional technologies are used in areas such as drawing, modeling, prototyping, 3D printers, and laser cutting during the design and production stages. In addition, terrestrial laser scanning technologies are used, especially in projects for the refunctioning and reuse of historical buildings. With this technology, the survey and architectural documentation stages, which require a long time and labor, can be prepared with high accuracy in a much shorter time. With the development of technology, the technologies used in the field of architecture have also participated in architectural education and the education has been updated.

The COVID-19 pandemic, which has had an impact all over the world, has made the transition to emergency distance education compulsory, considering the risk factors. Thus, as in every field, some disruptions and questions have emerged in architectural education. Although the Covid-19 pandemic, which brings along a series of questions about the difficulties encountered in architectural education and the future of the methods used in universities today, is characterized as a crisis, it has created an environment of opportunity that offers solutions to problems (Salama and Crosbie, 2020).

Design studios and applications which are considered the core of architectural education and one of the main topics of academic research have become a matter of distance education due to the pandemic. This necessity and urgent change situation necessitates adaptation to the distance education process. In the case where a course taught with conventional methods will be taught with distance education each of which needs (need for tools and equipment, student concentration, change of environment, technology usage skills, internet access, etc.) to be considered and planned separately.

In their study, Megahed and Hassan (2021) examine the blended education method of architectural education, remotely and face-to-face, during and after the COVID-19 pandemic. The pandemic and the conditions it brought with it have led to questions about the applicability of different methods as well as conventional methods. In the research, questions about what kind of technology-based models can be used in architectural education, whether distance education can be efficient, especially in design and studio-based approaches, and the effects of blended learning models on students are discussed. In the study, it was concluded that the blended learning strategy in architectural education will support the professional development of students in the post-pandemic period (Megahed & Hassan, 2021).

In their study, Ceylan et al. (2020) examined the perspectives of architecture students on online studio courses during the COVID-19

DOI: 10.15320/ICONARP.2024.285

pandemic. A questionnaire was used to get the opinions of the students on the selected sample. In the research, it was concluded that students benefit from using digital design tools, that necessary tools are provided in the distance education process, and that students can perform an effective study when they are given the chance to realize themselves. This study is important in terms of understanding the expectations of students from distance education and determining the issues that need to be emphasized for the next semester (Ceylan et al., 2020).

Based on these, it can be thought that it is expected to be implemented in the future as face-to-face and distance education in the curricula of architectural education, and accordingly, new methods will be developed and implemented. According to the research, in the technology-based distance education process, it is necessary to research and develop methods that will increase the interaction of digital-based design and tools with students.

The advancements in technology have led to significant innovations in techniques and methodologies used in fields such as topography, measurement, and construction. Substantial progress has been made in 3D data collection, representation, processing, and measurement. As a result, specialized documentation tools like 3D surface models, solid models, virtual models, textured surfaces, and animations have been developed. The progress in sensor technology and increased computing power has brought functionality and flexibility to spatial modeling through georeferenced technologies in contemporary times (Yılmaz and Yakar, 2006).

Architectural documentation has become a crucial tool for documenting, visualizing, and understanding structures, historical buildings, landscapes, and ruins. Such analytical studies are also essential for understanding cultural heritage. While realistic graphics and illustrations were predominantly used in the past, various data management techniques have been developed in recent years for the analysis of raw documentary data. In the architectural documentation process, laser scanning is widely used in areas such as urban studies, historical sites, archaeological sites, and significant structures or architectural remnants. Particularly, laser scanning is used alongside photogrammetric techniques for documenting large-scale areas like historic neighborhoods, archaeological sites, and monuments. In cases where traditional methods may not be sufficient and yield consistent results, laser scanning is necessary for documenting deformation, structural analysis, and material measurement (Korumaz et al., 2010).

In the study conducted at Akhan Caravanserai, laser scanning was employed in the preservation and documentation of cultural heritage to prepare a conservation project and take necessary measurements (Yakar et al., 2009). In Ağzıkara Han, terrestrial laser scanning technique was used for detailed digital documentation, resulting in a 3D point cloud (Kanun et al., 2021).

Ensuring the continuity and sustainability of cultural heritage requires the identification, documentation, and protection of the structure's material issues before its demolition. Laser scanning data were utilized to detect and document material deteriorations on the facades of Şanlıurfa Kışla Mosque, providing significant time and labor savings for analytical purposes (Karataş et al., 2022a). In the case of the historic Diyarbakır Sur Mansion, analytical research was conducted with sufficient detail in architectural documentation based on orthophoto images (Karataş et al., 2022b).

Laser scanning is also beneficial in detecting material damages. In their study, Karataş et al. (2022c) used this method to investigate and identify deteriorations on the stone materials that constitute the historic Burdur Railway Station Facilities structure (Karataş et al., 2022c).

Terrestrial laser scanning has become highly important as a measurement tool in the architectural and cultural heritage fields due to its speed and accuracy. Laser scanning is particularly effective for the analysis and visualization of complex surfaces. It facilitates data interaction across different disciplines and reduces costs when documents are formatted appropriately (Ulvi et al., 2014). However, laser scanning has some disadvantages. For instance, obtaining drawings may be challenging if the data is very dense and complex, and edges may not be well-defined. Additionally, processing large amounts of data can be time-consuming. In conclusion, laser scanning is an essential tool in the architectural documentation process and is continuously evolving as a technology (Korumaz et al., 2010).

This study focuses on the use of Terrestrial Laser Scanning (TLS) technologies, which is a technology used in adaptive re-use projects in the field of architecture, as a new method in the distance education process of architecture. In this research, the use of terrestrial laser scanning technologies used in the field of architecture education as a method in adaptive re-use projects is examined by comparing it with the traditional method and its contributions are investigated. In this framework, answers to the following questions are sought. The main question of the research is 'Is the use of orthophoto produced from terrestrial laser scanning technologies within the scope of adaptive re-use of historical buildings an efficient method compared to the traditional method?' The sub-questions of the research are as follows, 'In which aspects is the use of orthophoto method an efficient method compared to the traditional method within the scope of adaptive re-use of historical buildings in architecture education? Are there any differences between the outputs obtained by orthophoto method and traditional method? If so, what kind of differences are there?

Orthophoto images obtained from TLS technologies will be used in the project of adaptive re-use of a historical building, and the conduct of the course in distance education will be investigated. While conducting this research, the face-to-face process of the course will be handled and the outputs of the control group of the previous period and the outputs of the

DOI: 10.15320/ICONARP.2024.285

experimental group in the distance education process will be evaluated by comparative analysis method. The concept of adaptive re-use, the course's operation, outputs, and evaluation criteria will be emphasized, and the findings will be evaluated by referring to the expert opinion.

LASER SCANNING TECHNOLOGIES

Laser scanning technologies are basically a measurement method that provides 3D point cloud data of that area by sending beams to an area or surface with a laser scanning device. Using Terrestrial laser scanning technology has many advantages such as producing real-like 3D models from complex geometries with high accuracy of 99.9% (+,- 2mm) measurement, reducing cost and labor, and saving time. Also, these technologies provide transform it into the required form by obtaining detailed and comprehensive data at once, providing measurement opportunities in dangerous or inaccessible areas where measurement is difficult. (Reshetyuk, 2006). Laser scanning application is used in different disciplines with processes involving similar steps. Point cloud data is collected with laser scanning devices installed at station points, and data collected from different points are combined, made usable and converted to orthophoto images (Kurultay and Birer, 2016).

Orthophoto Images and Phases in Orthophoto Production

Orthophoto image is a photogrammetry application in which a vertical projection is obtained by removing the camera angle, lens, height, or slope features that may cause errors in the perspective image of a place (Lillesand and Kiefer, 1994). Orthophoto images obtained with terrestrial laser scanning technologies accelerate the project processes in the field of architecture, urban or engineering, facilitate interdisciplinary use, and make it advantageous. While detailed measurements can be made from long distances with orthophoto images, large areas can be scanned in a short time and data can be obtained at a realistic level of detail (Fröhlich and Mettenleiter, 2004). By transferring the point cloud data obtained by terrestrial laser scanning technologies to the computer, it is possible to create 3D models of the measured area and to obtain drawings in the CAD environment. In this context, the orthophoto method is efficient in terms of time and cost.

Application stages in TLS technology consist of a series of successive processes. First of all, point cloud data of the area to be scanned or the surface to be scanned is obtained by terrestrial laser scanning measurement process where scanning data is needed. The obtained point cloud data is colored and subjected to preliminary data processing. Then, the point cloud data is combined by scanning from different points with the independent model method. The created point cloud is cleaned from unnecessary points that may cause errors. Point cloud data is transferred to the software for obtaining orthophotos. By creating the projection surface, parameters such as resolution and increment value that affect the quality and accuracy of the orthophoto are determined. With the

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

settings made, orthophotos are created from the points determined in line with the needs. In the accuracy analysis phase, control points are selected over the orthophoto, analyze point cloud and coordinate system of the project. As a result, orthophoto images of the needed surfaces from the point cloud are obtained with high accuracy (Uzar and Öğütcü, 2016).

During laser scanning, the process steps are listed as follows:

• The device is placed at the station point determined according to the distances.

• The accuracy of the device levels is checked at the station point.

• Target points (CheckBorder) are placed on the surface to create a depth and height difference.

• An SD card is inserted into the device.

• Create New Project from Projects command is pressed, and the project is named.

• Parameters are entered. For example, one of the Indoor, Outdoor or Preview options is selected based on the distance. Resolution and quality values are entered according to the level of detail and sensitivity. The resolution and quality parameter settings screen is shown in Figure 1.

Figure 1. Resolution and quality parameter settings screen.

The precision of measurements and acceleration of project processes can be improved by eliminating errors caused by camera angles, lenses, and topographical features during the vertical projection process. TLS technology involves successive stages, from obtaining point cloud data through laser scanning to the creation of orthophotos, which require meticulous processes to generate detailed and accurate 3D models. This method is not only efficient in terms of time but also cost-effective. The use of TLS technology ensures precise calibration and positioning of the scanning device, resulting in high-quality orthophoto images with remarkable accuracy. Orthophoto images obtained from terrestrial laser

DOI: 10.15320/ICONARP.2024.285

scanning technologies offer a versatile and expedited solution for professionals in the architectural and engineering realms.

INVESTIGATION OF TERRESTRIAL LASER SCANNING TECHNOLOGIES VIA ADAPTIVE REUSE EXAMPLES IN ARCHITECTURAL EDUCATION

Conventional architectural education is a process that is carried out as theoretical and applied courses. Practical courses are usually design studios, technical drawing courses based on expression techniques, or construction courses for the implementation of the architectural product. Conventional design studios are design environments where educators and students can meet face-to face, providing shared reasoning, criticism, and discussion. The processes of transforming the abstract idea imagined by the students into a design product in a concrete way within the framework of a specific design problem and need are experienced in studio lessons.

In the curriculum of architectural education, re-functioning courses are included in order to ensure the sustainability of historical buildings by giving them a new function and to provide students with the ability to evaluate the existing building stock with a contemporary interpretation. Refunctioning courses are taught in parallel with the design studio.

Ensuring the continuity of the structures that were built to serve various purposes in different periods, with a new function, is a design process that architects will manage. To carry out this important process, there are courses within the framework of the concept of re-functioning in the curriculum of architecture departments. In the content of the courses, there are the concept of conservation, the methods to be used in the documentation and research of the current situation, survey restoration measurements and drawings, photography, image taking processes, spatial organization, requirement chart, scenario, concept, and function studies for the function to be determined, structural system design to eliminate structural deficiencies. Theoretical explanations and applications are made on topics that support the learning outcomes of the course, such as detail production, analysis and strengthening or redesign of the structure and construction system, and the production of sustainable solutions. At the end of the course, it aims to restore the existing building stock and to gain contemporary interpretation skills and awareness to meet today's needs.

The 'Adaptive Re-use of Existing Buildings' course is included in the elective course pool of architecture faculties providing undergraduate education, as a total of six hours, two hours of theory and four hours of practical. In their study, Balcı Yaşar and Yıldırım Gönül (2019) examined the courses in the undergraduate programs of 65 universities in Turkey and TRNC that provide education on Interior Architecture and Interior Architecture and Environmental Design and tried to determine the adequacy of undergraduate education in the formation of conservation awareness. According to the data, because of analyzing the courses within the scope of conservation with keywords, it was found that there were 12 courses within the scope of Adaptive Re-use (Balcı Yaşar & Yıldırım Gönül, 2019).

The process of the course, which is carried out with conventional methods, is carried out in parallel with the project courses and architectural studio approach. Students are expected to examine classical and contemporary structures with a holistic perspective and gain a sensitive and critical perspective.

The course usually focuses on an old building. First of all, comprehensive analyses of the historical building and its surroundings are made. The area and its surroundings are photographed in detail. To create the survey drawings of the current situation, the survey measurements are taken. The measured building and its immediate surroundings are transferred to the drawing. Damage assessment analysis is made from photographs and documents. Thus, the design process, which started with a sketch, can continue by making inferences about volumetric dimensions, space organization, and damage assessment, and the new function will be projected in a consistent manner. After the survey drawings, needs, deficiencies, and problems are determined. A new function is decided that will find a solution to all these and make the building reusable with a contemporary interpretation. After the function was determined, the scenario for the new function, spatial organization charts, and functional setup were made, and the design was started. Physical requirements such as structural system, acoustics, and lighting required by the design are evaluated by evaluating the current situation of the building and detailed with protection, repair, or additions.

The orthophoto method in architectural education can be used in the documentation of the current situation and in the design stages, especially in the courses where surveying, restoration, and adaptive re-use projects are the subject.

With the COVID-19 pandemic, emergency distance education has been introduced in education and education processes around the world. In this course, in which re-functionalization projects are designed, the use of terrestrial laser scanning technologies can be considered as an alternative to the creation of architectural documentation and survey drawings on orthophotos instead of fieldwork to eliminate the risk factor caused by pandemic diseases.

CASE STUDY

In this section, the experimental study carried out to investigate whether the use of orthophoto produced from Terrestrial Laser Scanning technologies is an efficient method compared to the conventional method is explained in detail within the scope of the refunctioning of historical buildings.

DOI: 10.15320/ICONARP.2024.285

Research Method

In this research, student project outputs obtained with the conventional and orthophoto methods were evaluated with a focus on the concept of re-use. Within the framework of the determined evaluation criteria, the use of terrestrial laser scanning technologies as a method in the distance education process and the conventional method used in the face-to-face education process were examined with the comparative analysis method. The general framework of the research is shown in Figure 2.

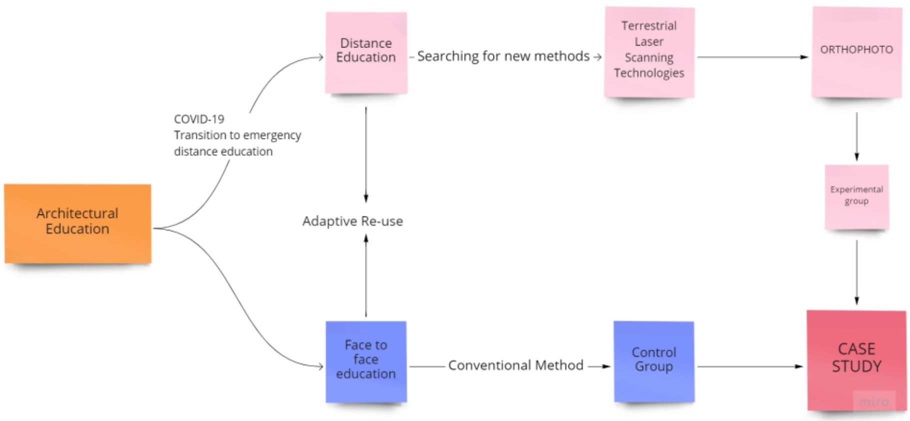


Figure 2. General Framework of the Research

Evaluations were made on 25 student projects. During the comparative analysis, opinions were taken from 3 experts on re-use, and the findings of the research were presented and interpreted.

In the experimental study, the answer to the question of whether the use of orthophoto, which is produced from TLS technologies, as a method within the scope of refunctioning historical buildings, was tried to be found that efficient method compared to the conventional method. Orthophoto images obtained from TLS technologies will be used in the project of re-use of a historical building, and the conduct of the course in distance education will be investigated. Orthophoto images, which are the outputs of the "Refunctioning of the Germiyan Church" project supported by the Istanbul Rumeli University Scientific Research Project, were used. It was thought that the use of orthophotos obtained by terrestrial laser scanning technologies in re-functional projects in architectural education could be an alternative method. In this context, plan, section, and view orthophotos documenting the current situation of the Germiyan Church, which is expected to serve as a basis for students, are shown in Figure 3.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

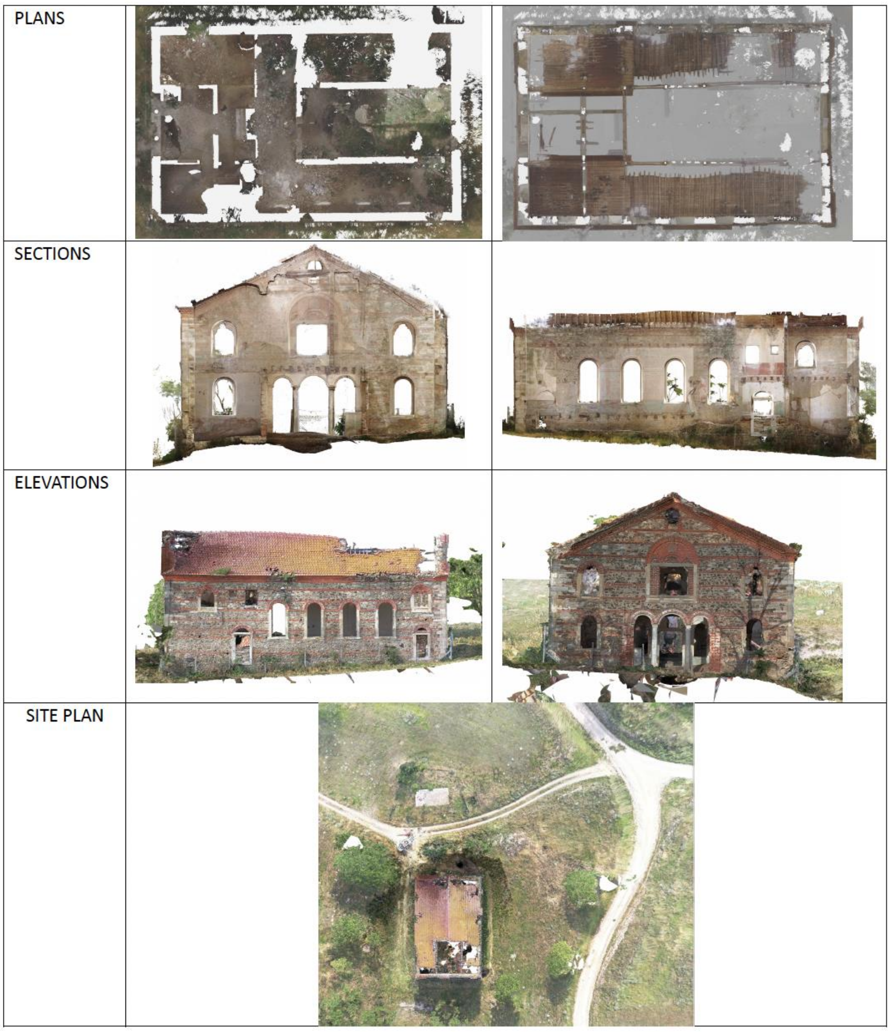


Figure 3. Germiyan Church Plans, Sections, Elevations, and Site Plan Orthophotos

The study is carried out within the scope of the Adaptive Re-use of Existing Buildings course at the Faculty of Engineering and Architecture of Istanbul Rumeli University. The final assignment of the course was carried out with 18 students in the distance education process and 7 students who took the course in the face-to-face education process in the Faculty of Architecture, completed the final assignment of the course. The course lasted a total of 14 weeks in both processes. Due to the COVID-19 pandemic, the participation of the TLS technology in the course in which the research was conducted and the process carried out with the orthophoto method as distance education and the process with the previous face-to-face conventional method were compared. Since a comparison will be made with the outcomes of the face-to-face education process in the period before the COVID-19 pandemic, the number of students taking research courses is limited. While making the comparison, the opinions of 3 experts with at least a master's degree in the field of surveying and restoration were consulted and evaluation criteria forms prepared by taking expert opinion were used. In the comparisons, the student outcomes obtained with the orthophoto method constitute the experimental group, and the student outcomes

DOI: 10.15320/ICONARP.2024.285

obtained with the conventional method constitute the control group. Evaluation points between 1 and 5 (1=Strongly Disagree, 2=Disagree, 3=Undecided, 4=Agree, 5=Strongly Agree) will be given with the Likert type survey measurement method. According to the scores, first of all, it will be examined whether the orthophoto method is efficient compared to the conventional method, and then it will be determined in which way they are efficient. While analyzing the data, the SPSS 28.0 program was used. To obtain the data to be used in the comparison, first of all, the normal distribution analysis of the groups was examined with the Shapiro Wilk (S-W) test (Bryman & Cramer, 2001). Afterward, Levene's test was performed to analyze the homogeneity of the variances of the groups. After the homogeneous distribution conditions were determined, to determine whether there was a difference between the normally distributed groups in terms of variables, the 'Independent Two-Sample t-Test' for the normally distributed variables and the 'Mann-Whitney U-Test' for the non-normally distributed variables were performed. While analyzing the data, the mean evaluation scores of each expression were also compared. Answers to open-ended questions directed to experts were used to interpret the findings. Finally, the general evaluation statement was included in the form, the success of the projects as a whole was evaluated between 1 and 5 in Likert type, and the results were given as average values. Selected outputs from both processes were brought together and categorized according to parameters and representations as orthophoto and conventional method processes, sample comparison tables were prepared and evaluated, interpreted according to the analysis results.

Findings

In this part of the study, the data obtained from the expert evaluation were statistically evaluated and student projects were analyzed comparatively. First of all, demographic information of the groups to be analyzed in the experimental study was included. The demographic information of the groups is shown in Table 1.

Table 1. Demographic information of the groups.

Variable		n	%
Gender Group	Woman	12	48
	Male	13	52
	Total	25	100
Education Group	Orthophoto Method	18	72
	Conventional Method	7	28
	Total	25	100

By analyzing the data obtained in the experimental study, the data obtained in the orthophoto method process, and the conventional method process were compared within the framework of the parameters. In the analysis, firstly, the normal distribution analysis of each variable was performed for the groups in the orthophoto and conventional method processes. The normal distribution analysis results for the groups are shown in Table 2.

Table 2. Normal distribution analysis results for education groups.

Variable	Group	n	Test Statistics	p
Design Features	Orthophoto Method	18	0,941	0,299
	Conventional Method	7	0,919	0,459
Three Dimensional and Space Perception	Orthophoto Method	18	0,961	0,613
	Conventional Method	7	0,887	0,259
Relationship with the Surroundings/Context	Orthophoto Method	18	0,926	0,167
	Conventional Method	7	0,829	0,079
Structural Features	Orthophoto Method	18	0,946	0,363
	Conventional Method	7	0,901	0,340
Analysis/Diagram Features	Orthophoto Method	18	0,892	0,041
	Conventional Method	7	0,933	0,579

Accordingly, the variables of Design Features, Three Dimensional and Space Perception, Relationship with the Surroundings/Context, and Structural Features showed normal distribution among the groups ($p>0.05$), while the Analysis/Diagram Features variable was not in normal distribution ($p<0.05$).

When comparing the orthophoto and conventional method processes, it was first checked whether the variances of the groups were homogeneous in the normally distributed variables to determine whether there was a significant difference between the groups. The analysis results for the variances of the groups are shown in Table 3.

DOI: 10.15320/ICONARP.2024.285

Table 3. Analysis results of the variances of the education groups.

Variable	F	p
Design Features	1,517	0,231
Three Dimensions and Space Perception	2,709	0,113
Relationship with the Surroundings/Context	3,658	0,068
Structural Features	5,807	0,024

Considering the average data of Design Features, Three Dimensional and Space Perception, Relationship with the Surroundings/Context, the variances of the groups for these variables are homogeneous (p>0.05), but not homogeneous for the Structural Features variable (p<0.05).

The comparison table of the differences between the education groups is shown in Table 4.

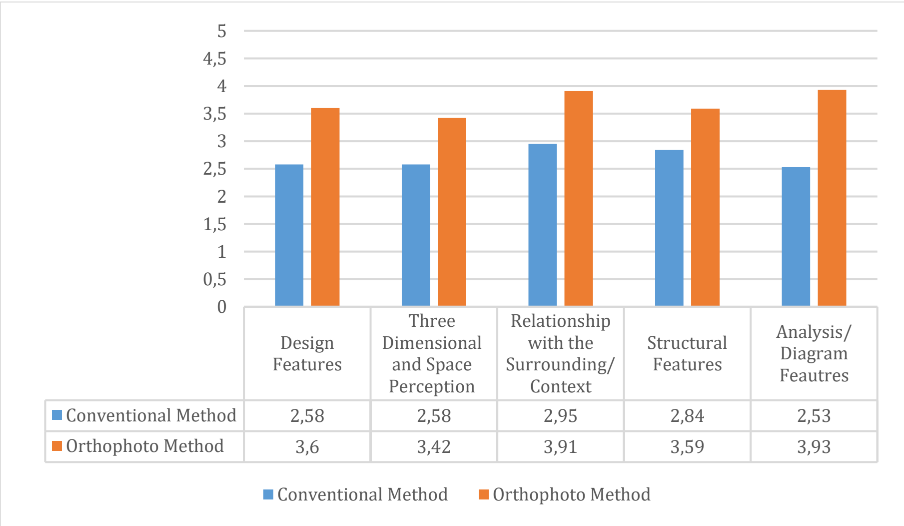
Table 4. Comparison of the differences between education groups.

Variable	Group	n	Mean ± S.D.	Test Statistics	
				t	p
Design Features	Orthophoto Method	18	3,60 ± 0,70	2,902	0,008
	Conventional Method	7	2,58 ± 1,00		
Three Dimensions and Space Perception	Orthophoto Method	18	3,42 ± 0,70	2,247	0,035
	Conventional Method	7	2,58 ± 1,15		
Relationship with the Surroundings/Context	Orthophoto Method	18	3,91 ± 0,63	2,756	0,011
	Conventional Method	7	2,95 ± 1,08		
Structural Features	Orthophoto Method	18	3,59 ± 0,77	1,433	0,191
	Conventional Method	7	2,84 ± 1,28		
Variable	**Group**	**n**	**Median (min.; max.)**	**Test Statistics**	
				z	p
Analysis/Diagram Features	Orthophoto Method	18	3,93 (3,00; 4,60)	-3,338	<0,001
	Conventional Method	7	2,53 (1,13; 3,20)		

According to the results of the analysis, there is a significant difference between the education groups for these variables when the average data of the variable's Design Features, Three Dimensional and Space Perception, Relationship with the Surroundings/Context and Analysis/Diagram Features are considered ($p<0.05$). There was no difference between the education groups for the Structural Features variable ($p>0.05$).

To compare the differences between the education groups, the average values of the evaluation scores given by the experts are shown in Table 5.

Table 5. Comparison of the average scores of the project outputs in the orthophoto method and conventional method processes according to the evaluation criteria.



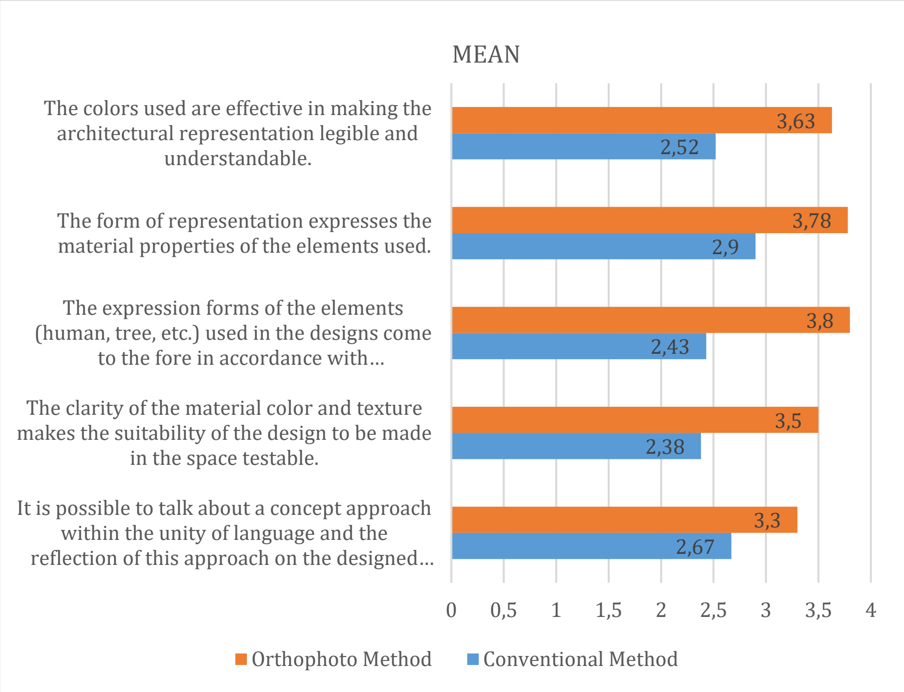
According to these data, it was seen that the average scores of the student projects in the process where the orthophoto method was used in all parameters were higher than the projects made in the conventional method process. It is seen that the biggest difference in the averages is in the title of Analysis/Diagram Features, then in the title of Design Features, Relationship with the Surroundings/Context, Three Dimensions, and Space Perception and Structural Features, respectively. Accordingly, it can be said that the orthophoto method makes a significant difference compared to the conventional method in defining the functions of the buildings, conveying the relations of the spaces, and expressing the design features schematically.

Design Features (Color, Texture, Material)

An evaluation form was directed to the experts and 5 different expressions supporting this title were evaluated under the title of Design Features. The average answers of the experts were compared for the education processes using the orthophoto and conventional methods and are shown in Table 6.

DOI: 10.15320/ICONARP.2024.285

Table 6. Averages of Design Features indicators in conventional and orthophoto method processes.



According to the expert opinions, the students who got the highest score in their group for this category, with an average of 4.73 points for the conventional method example and 3.69 points for the orthophoto method example. According to the expert answers given to the open-ended questions for the two projects, for which the sample comparison table is given, it was seen that the structure of the project was well expressed with three-dimensional expression in the column and dome details in the conventional method process, and the material and structural features were found positive in the modeling of the outdoor space. The most negative side is the lack of explanation about the design decisions, the lack of the site plan and the inability to resolve the building relations. In the process of the orthophoto method, the most positive feature is the ability to create a language unity in the design by using color and material correctly, while the most negative feature is the explanation of how the building relates to its site in three dimensions and that the other designed structures are not detailed.

As a sample comparison table within the scope of the Design Features criterion, the layout plan, floor plan, section and mode sheet of the projects prepared by the students, one sample from the conventional method process and one sample from the orthophoto method process, were examined and compared within the framework of the design features parameter, which is one of the evaluation criteria. The outputs of this comparison are shown side by side in Figure 4.

When the outputs in Figure 4 are compared, it has been seen that the road, building, green area, hard ground, and parking parts are separated by using different colors, thus making the plan more understandable and readable. In 1A, only the buildings were painted, and it is thought that the environmental data remained expressionless.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

In 2B, this time, not only color but also forms of expression that will enable materials to be recognized and show texture have been preferred, thus increasing the sense of reality.

The plan has been made readable, and it is seen that a representation style with a three-dimensional effect is used compared to 2A, even if it is on the plan plane.

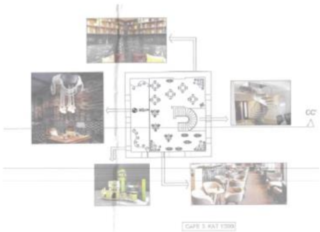
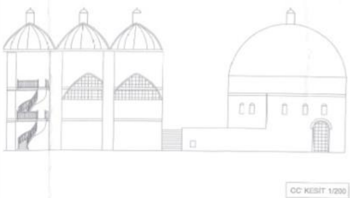
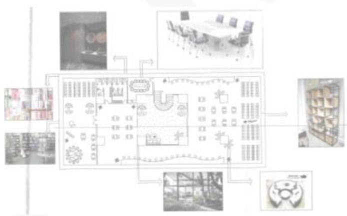
	1. Design Features (Color, Texture, Material)		
		A-Conventional Method	B-Orthophoto Method
1	Site Plan		
2	Plan		
3	Section		
4	Mod Sheet		

Figure 4. Design Features (Color, Texture, Material) sample comparison table

Although it is stated by the student that 3A is a sectional drawing, it cannot be clearly understood from the representation that it is a section or view. There is no data in the representation that makes the material understandable. Also, the connection points (the vertical junction of the dome) are considered to be inexpressive. In the elevation part of 3A, no material was identified on the facade. In 3B, first of all, it is possible to read that the drawing is a section, from which material the building is made and the color of the material. The clarity of the material color and texture makes the suitability of the design to be made in the space testable. It can be mentioned in a design approach within the unity of language in the space.

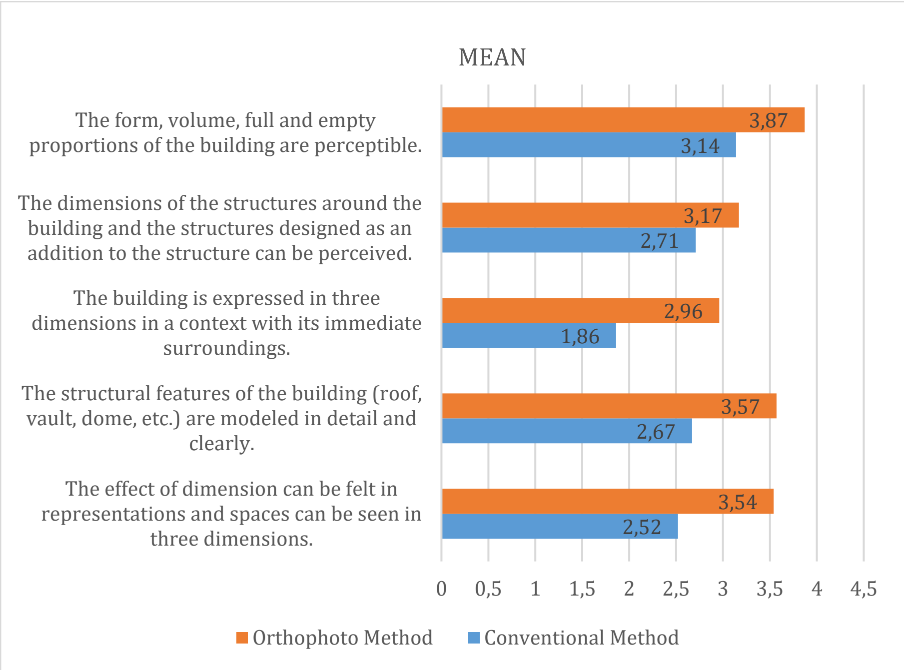
DOI: 10.15320/ICONARP.2024.285

There is no data on the material of the building is defined in 4A. Therefore, only the formal suitability of the selected furniture can be interpreted. It does not seem possible to evaluate in terms of color. In 4B, the data of the building and the furniture in it are understandable in terms of material. Therefore, the suitability or incompatibility of the selected furniture in terms of color can be examined.

Three Dimensional and Space Perception

An evaluation form was directed to the experts and 5 different expressions supporting this title were evaluated under the title of Three Dimensional and Space Perception. The average answers of the experts were compared for the orthophoto and conventional method processes and are shown in Table 7.

Table 7. The averages of the Three Dimensional and Space Perception indicators in the conventional method and orthophoto method processes.



In the project outputs of the students in the conventional and orthophoto method process, a comparison was made over perspective, facade, and sections, and evaluated in terms of three dimensions and space perception. Perspective, elevation, and section representations that can be compared from both sample groups are given in the sample comparison table. The data for the comparison made are shown in Figure 5.

According to Figure 5, the three-dimensional work done in 1A makes the shape, volume, full and empty proportions of the structure perceptible, but it is not clear from which material the structure is made. Details of the facade surfaces are not defined, so there is uncertainty between paint, exposed concrete or stone coating materials. The additional glass structure near the building can be understood at first

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

view, and the three-dimensional expression of the building with its surroundings was found positive in the opinions of the experts.

Although a dark atmosphere is preferred in 1B, the structure looks more realistic. This expression resembles a realistic photo frame rather than modeling. According to expert opinions, the most positive aspect of the project is the abstract processing of the data on the real appearance in an expressive way and the understanding of the interior perspectives.

In 2A, the structure is perceived as three-dimensional, but the structure-ground connection seems far from reality. Therefore, the building was designed as a stand-alone three-dimensional object detached from the context. It is not possible to form an idea about the surroundings of the building. In the evaluations, color, definitions, pedestrian, and vehicle roads were found to be missing in the site plan. The structural features of the building (vault, dome, etc.) are modeled in a detailed and understandable way.

The most positive aspect is that the column and dome details of the building are well expressed with a three-dimensional expression. In 2B, the structure analysis was positive. Although the wall texture can be partially understood, it is thought to look three-dimensional and realistic beyond the texture coating. The negative feature is that the building is not handled in three dimensions with its surroundings.

3A and 3B display a very similar façade character, both of which are stone walls. However, even if it is a facade drawing, the stone wall also has a dimension effect, and this dimension effect is thought to be caused by working with realistic orthophoto images and using abstractions such as humans and trees. With the orthophoto, the stone wall is almost at the level of detail that can be seen. In 3A, the stone wall drawing is far from reality and does not reflect the stone wall character.

DOI: 10.15320/ICONARP.2024.285

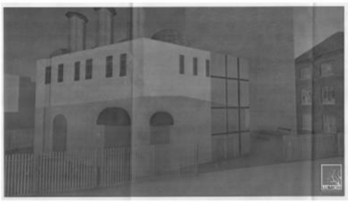
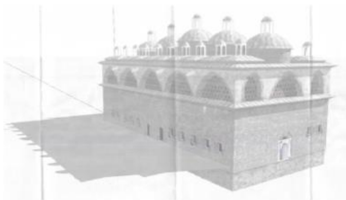
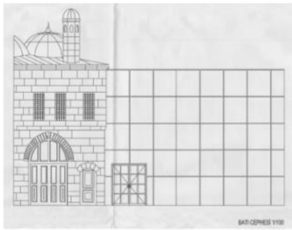
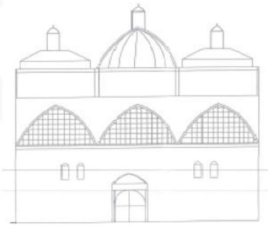
		2. Three Dimensional and Space Perception	
		A-Conventional Method	B-Orthophoto Method
1	Perspective		
2	Perspective		
3	Facade		
4	Section		 

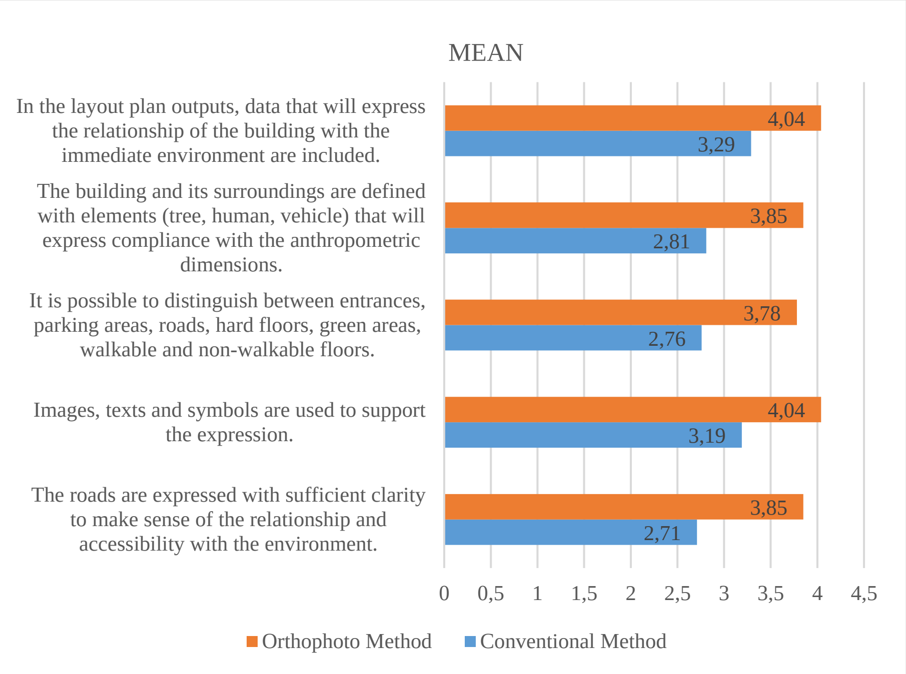
Figure 5. Three Dimensional and Space Perception sample comparison table

The most positive part of the project is that the immediate surroundings of the building are expressed in a context with three-dimensional expressions. The drawing expresses that the original facade can still be seen as the entrance is designed as glass, and the accuracy of this design idea can be evaluated. When the facade representations are considered in general, it is thought that the effect of technical drawing decreases in the outputs of the orthophoto method process. Since distance cannot be perceived in 4A, the perception of size is lost accordingly. In 4B, it is thought that the use of the real facade in the background directly affects the perception of size.

Relationship with the Surroundings / Context

An evaluation form was directed to the experts, and it was ensured that 5 different expressions supporting this title were evaluated under the title of Relationship with the Surroundings/Context. The average answers of the experts were compared for the orthophoto and conventional method processes and are shown in Table 8.

Table 8. Average of Relationship with the Surroundings/Context indicators in conventional method and orthophoto method processes.



A comparison was made on the project outputs of the students in the process of conventional and orthophoto method, over the site plans, and the relationship of the buildings with the surroundings and the context features were evaluated. The data for the comparison made are shown in Figure 6.

In the site plan outputs in the orthophoto method process, data that will express the relationship of the building with the surroundings are included. With the use of texture and color, roads, hard floors, green areas, walkable and non-walkable floors can be distinguished. Entrances and parking areas are defined. Visuals, texts, and symbols are used to support the expression.

On the other hand, it is seen that the use of limited colors is included in the layout plan outputs in the conventional method process. The roads are not expressed clearly enough to make sense of the relationship and accessibility with the environment. Floor coverings do not contain data on the distinction between hard and soft floors. Green areas are not clearly defined, only linear separation or tree furnishing is made, so there is uncertainty about the boundaries of green areas. The relationship between the building and the surrounding structures is weak. Vehicle and pedestrian roads are not defined, landscaping is generally not visible.

DOI: 10.15320/ICONARP.2024.285

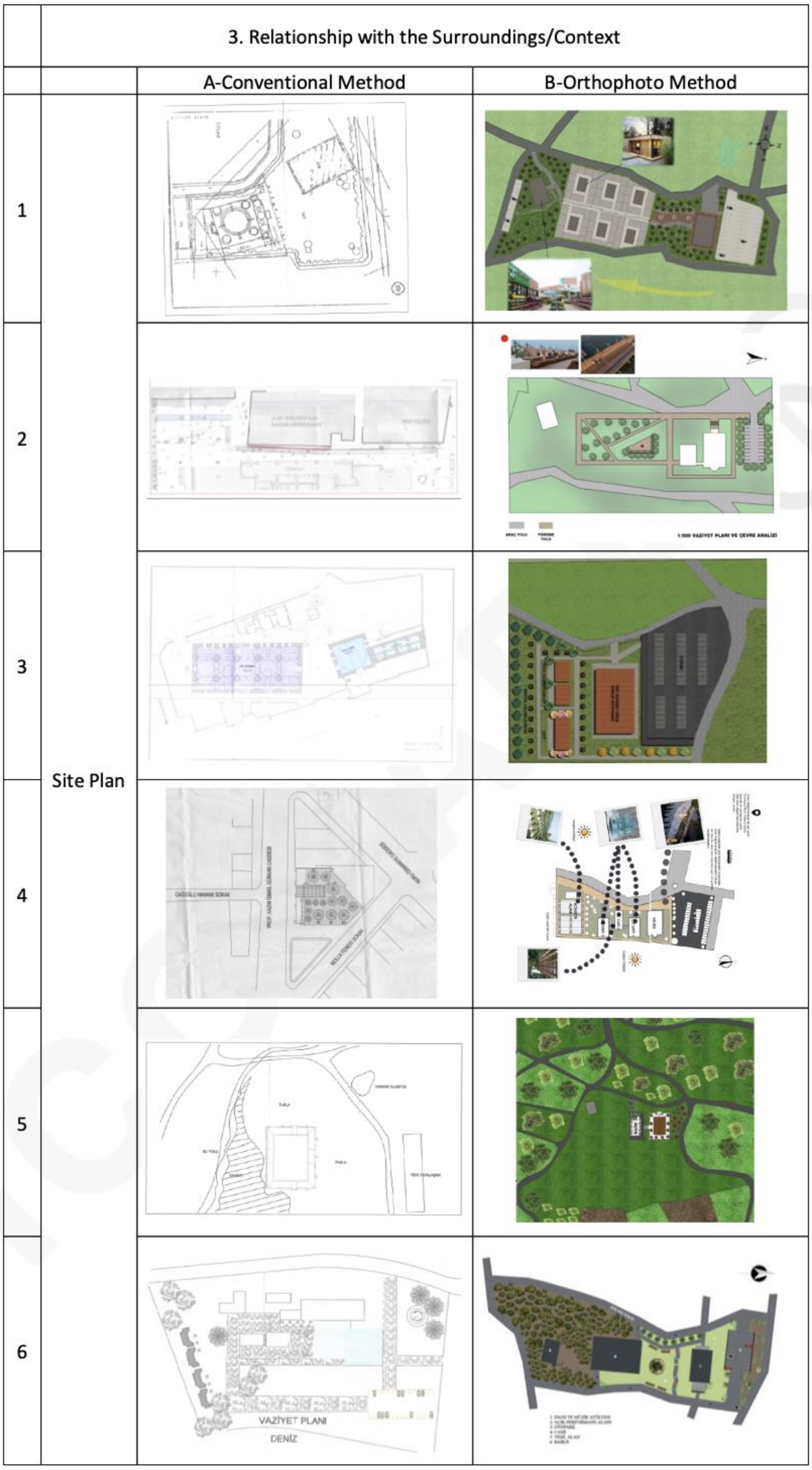


Figure 6. Relationship with the Surroundings/Context example comparison table

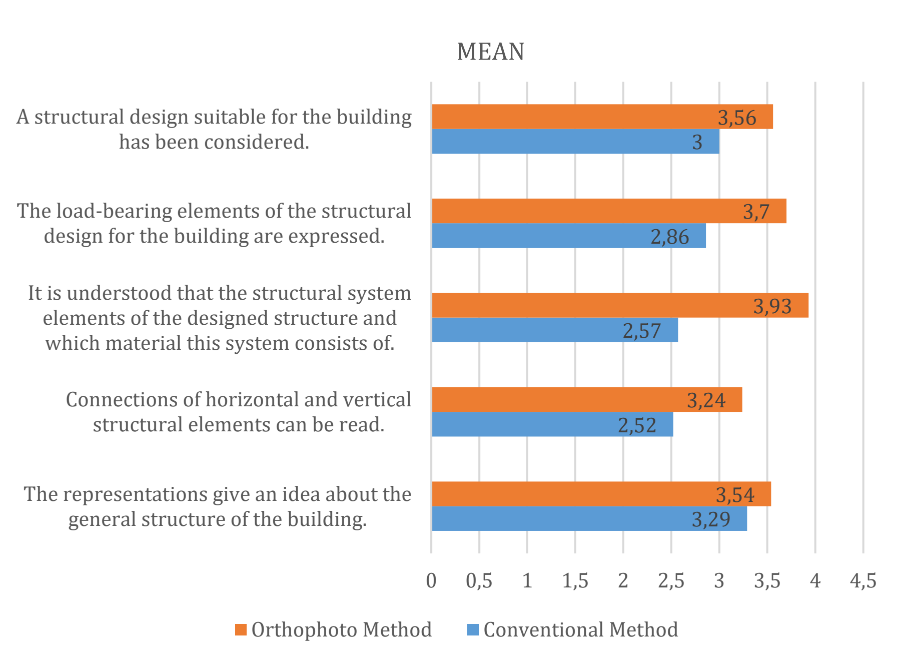
Structure Features

An evaluation form was directed to the experts and 5 different expressions supporting this title were evaluated under the title of Structural Features. The average answers of the experts were compared

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

for the orthophoto method and conventional method processes and are shown in Table 9.

Table 9. Averages of Structural Features indicators in conventional and orthophoto methods.



The structural features of the buildings were evaluated by making a comparison over the sections in the project outputs of the students in the conventional and orthophoto method process. The data for the comparison made are shown in Figure 7.

According to Figure 7, it was seen that the structure was not considered sufficiently in 1A and only the thickness of the top cover was expressed. There is no statement regarding the material of the top cover. In 1B, it is understood that the structural system and what material this system consists of. The most positive aspect of the project is that the roof and joint details are expressed in the structure system in an explanatory way and the roof structure is found to be suitable for the structure.

While 2A contains a more technical expression, 2B contains a more schematic explanation. The faint expression of the stone wall in the background, which appears in 2B, provided a simpler understanding of the section.

In 3A, it is seen that the structural features are not understood, and the horizontal and vertical element connections are uncertain. General structure and connection details are incompletely expressed. However, it is thought that the details of the dome of the building are well expressed in the three-dimensional expression, and it is positive in the opinion of the expert. Although structure details cannot be understood in 3B, the material of general structural elements can be understood. This has been the most positive aspect of the project.

In 4A, the structural system setup was found to be positive, but it is thought that the structure expressions can be given more clearly in the section. It is stated in 4B that the general structure of the building is

DOI: 10.15320/ICONARP.2024.285

understandable. The structural setup and three-dimensional expression in the space are among the most positive aspects of the project. The drawing has been brought closer to the technical drawing language with annotations.

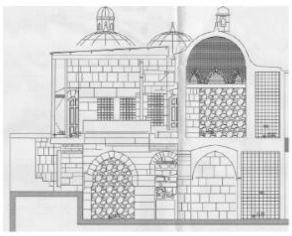
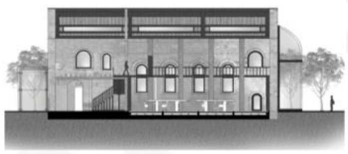
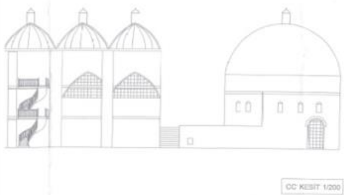
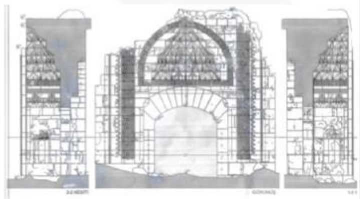
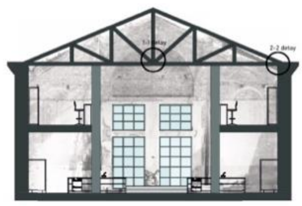
	4. Structural Features		
		A-Conventional Method	B-Orthophoto Method
1	Section		
2			
3			
4			

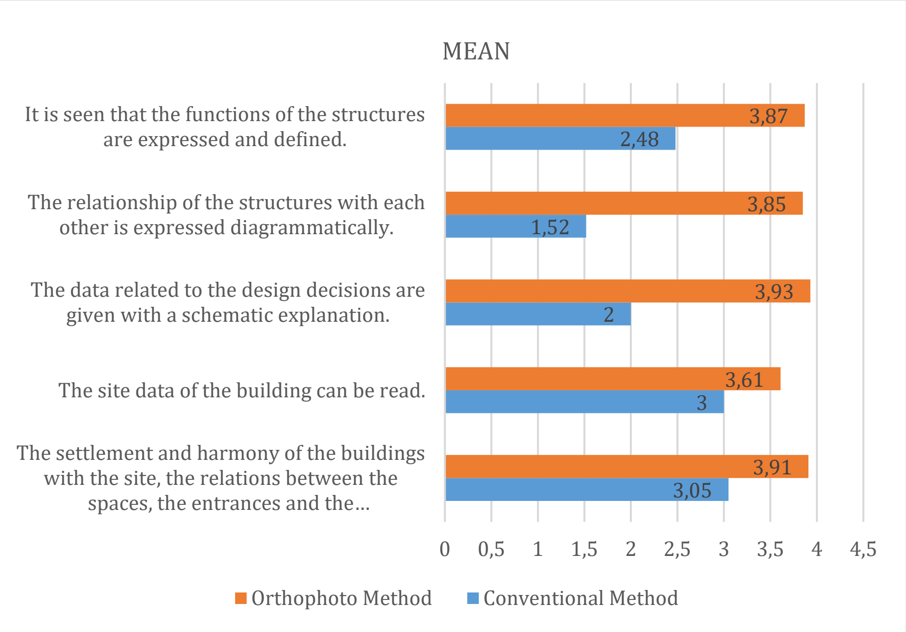
Figure 7. Structural Features sample comparison table

Analysis / Diagram Features

An evaluation form was directed to the experts, and it was supported that 5 different expressions supporting this title were evaluated under the heading Analysis/Diagram Features. The average answers of the experts were compared for the orthophoto and conventional method processes and are shown in Table 10.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Table 10. Averages of Analysis / Diagram Features indicators in conventional method and orthophoto method processes.



The analyzes and diagrammatic expressions of the projects prepared by the students during the conventional and orthophoto method were compared. The outputs of this comparison are shown side by side in Figure 8.

When the data in Figure 8 are compared, it is seen that the functions of the structures are expressed and defined in the outputs of the orthophoto method process. The relationship of the structures with each other is expressed diagrammatically. Data on design decisions are included. In 4B, the function chart that defines the spatial organization and needs program and the diagram that shows the new state of the old building after the functionalization are used. In the three-dimensional terrain model, which shows the approach in 3B, site data, roads, settlement, and harmony of structures with the site, relations between spaces, entrances, transportation axes to the structures are described. In expert opinions, one of the most positive aspects of the project was its analysis.

DOI: 10.15320/ICONARP.2024.285

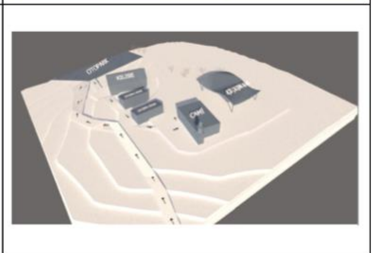
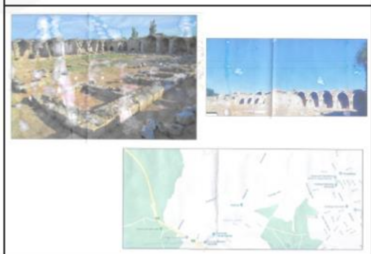
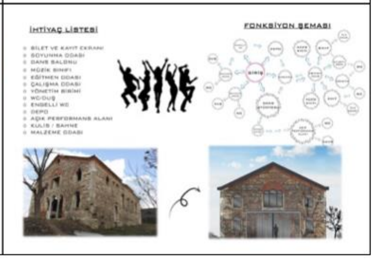
	5. Analysis/Diagram Features		
		A-Conventional Method	B-Orthophoto Method
1	Analysis Sheet		
2			
3			
4			

Figure 8. Analysis / Diagram Features sample comparison table

In both processes, it is seen that real photographs of the structures are used in the project outputs, and satellite images are preferred to show the location information.

CONCLUSION AND RECOMMENDATIONS

The use of digital technologies has become inevitable, especially during the pandemic. In this period, it has been difficult for students to move away from traditional methods, especially in applied fields such as architecture and design. In these experience-oriented fields, it is thought that technology should be integrated with traditional methods in distance education to achieve success.

In their study, Özgüven et al. (2020) examined in distance education at Maltepe University Faculty of Architecture and Design in the spring semester of 2019-2020, design studios were conducted online. However, students' methods of expressing their design projects differed from traditional approaches. The projects, which were expressed in a virtual environment using digital tools such as three-dimensional modelling and screen sharing instead of tangible materials, differed among students depending on their proficiency levels. This situation triggered the search for new methods and revealed thought processes related to time, space and method (Özgüven et al., 2020). In this context, in this study, the use of TLS technologies in the adaptive reuse projects of architecture in the distance education process was examined by comparing it with the traditional method in the face-to-face education process and its contributions were investigated.

Considering the mean data and distributions of the Design Features, Three Dimensional and Space Perception, Relationship with the Surroundings/Context, and Analysis/Diagram Features variables, it was seen that there was a difference between the education groups for these variables, and there was no difference between the education groups for the Structural Features variable. On the other hand, according to the comparison, it was determined that the success averages of the orthophoto method were higher than the averages of the conventional method in all criteria. In the orthophoto method, the harmony of the designs in the projects to the anthropometric dimensions, the three-dimensional expression of the new structure with the environment, the accessibility, the structural elements and materials, and the relational definitions of the structures were found to be quite productive compared to the conventional method process. The least differences between the groups on average were the creation of a concept in a linguistic unity, expressions about the dimensions of the structures, the site plan and its relationship with the immediate environment, information about the general structure setup, and the ability to read the field data. Accordingly, it can be said that while there is little difference in general expressions, the difference in details that will highlight and contribute to the project is large for the two method processes, and the orthophoto method stands out at these points.

When the evaluation of the project is analyzed in expert opinions, the average of the orthophoto method process is 3.39; the average of the conventional method process was determined as 2.71. This means that when the projects are evaluated as a whole, those in the orthophoto method process were found to be more successful than those in the conventional method process.

As a result, while it is thought that the orthophoto is detailed in terms of color and texture, it is thought to offer a closer reality to the experienced space, it is thought that students can not present realistic visuals because the technical drawing is far from the real image, because it cannot be visualized in 3D in their minds. It is seen that orthophoto image data provides a holistic perspective in design and allows students to test color, material, and texture harmony while designing. Students can try the harmony of orthophoto and building designs added later to the building and make inferences about the structural system. In addition, they can easily detect traces of old artifact with orthophotos, make period and damage analyses, and create protection, repair, and intervention decisions.

DOI: 10.15320/ICONARP.2024.285

During the orthophoto method process, Autocad for scaled and technical drawing, Sketchup for modeling and realistic images, and Photoshop for design, image correction, layout design, and presentation were used. However, the most important point to be mentioned here is that the Photoshop program is used directly during the design phase. Facade character, use of materials, colors, textures, and appropriate structural design were tested on real-scale photographs, and their suitability was evaluated. The students decided on their designs based on these experiments. For this reason, the fact that the orthophoto is scaled and real images documenting the current situation is considered positive in terms of its use in design. Since the representation will be made on real images, it would be appropriate to use realistic representations to ensure harmony. It is thought that the fact that the orthophoto is very close to reality enables the development of 3D thinking and perception. In the process where the orthophoto method was used, the drawing and presentation quality of the students increased compared to the conventional method. In addition, orthophoto because it contains more data such as damage detection, material analysis, structure, etc. has increased the knowledge to be used in design inputs according to existing CAD plans.

It is thought that being able to access measurable, comparable, and high-accuracy data without going to the place is an alternative and useful method in the emergency distance education period. In the use of TLS technologies, the time gained from the surveying process brought by the orthophoto is seen as an advantage. However, the application of site study and learning methods by practice is important for the development of the student's mastery of the process and should not be ignored.

In future studies, it is foreseen that the research will lead to new discussions on originality, creativity, and the use of different 2D, 3D, and hybrid techniques and presentation tools in presentation formats, since each project is designed on the supplied ready-made bases. Student outputs can be evaluated within the framework of design success, technology usage capacity, habit, and desire to use the internet and new media, and the method used can be associated with these parameters. The question of whether giving orthophoto data to students as a base affects design and creativity can be examined.

REFERENCES

Balcı Yaşar, S. and Yıldırım Gönül, B. (2019). Türkiye Ve KKTC'de İç Mimarlik Eğitiminde Koruma Bilinci Üzerine Güncel Bir Araştirma. Çukurova Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 28(2), 294-311. https://doi.org/10.35379/cusosbil.588291

Bryman, A. and Cramer, D. (2001). Quantitative data analysis with SPSS release 10 for windows: A guide for social scientists. London: Routledge.

Ceylan, S., Şahin, P., Seçmen, S., Somer, M. E. and Suher, K.H. (2020). "An evaluation of online architectural design studios during COVID-19 outbreak", Archnet-IJAR: International Journal of Architectural Research, 15(1), 203-218. doi: 10.1108/ARCH-10-2020-0230.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Fröhlich, C. and Mettenleiter, M. (2004). Terrestrial Laser Scanning – New Perspectives in 3D Surveying. International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences Vol. XXXVI- 8/W2:7

Kanun, E., Metin, A., and Yakar, M. (2021). Yersel Lazer Tarama Tekniği Kullanarak Ağzıkara Han'ın 3 Boyutlu Nokta Bulutunun Elde Edilmesi. Türkiye Lidar Dergisi, 3(2), 58-64.

Karataş, L., Alptekin, A., and Yakar, M. (2022a). Analytical Documentation of Stone Material Deteriorations on Facades with Terrestrial Laser Scanning and Photogrammetric Methods: Case Study of Şanlıurfa Kışla Mosque. Advanced LiDAR, 2(2), 36-47.

Karataş, L., Alptekin, A., and Yakar, M. (2022b). Creating Architectural Surveys of Traditional Buildings with the Help of Terrestrial Laser Scanning Method (TLS) and Orthophotos: Historical Diyarbakır Sur Mansion. Advanced LiDAR, 2(2), 54-63.

Karataş, L., Alptekin, A., and Yakar, M. (2022c). Determination of Stone Material Deteriorations on the Facades with the Combination of Terrestrial Laser Scanning and Photogrammetric Methods: Case Study of Historical Burdur Station Premises. Advanced Geomatics, 2(2), 65-72.

Korumaz, A. G., Korumaz, M., Dulgerlera, O. N., Karasaka, L., Yıldız, F., and Yakar, M. (2010). Evaluation of laser scanner performance in documentation of historical and architectural ruins, a case study in Konya. International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences, 38(5), 361-366.

Kurultay, A. and Birer, M. (2016). Transferring Terrestrial Laser Scanning Results to Architectural Technical Drawing Language in Documenting Historical Buildings. Conservation and Repair Seminar in Masonry Buildings Proceedings Book, 69-70.

Lillesand, T. and Kiefer, R. (1994). Remote Sensing and Image Interpretation, 3rd ed. New York: Wiley, 189.

Megahed, N. and Hassan, A. (2022). A blended learning strategy: reimagining the post-Covid-19 architectural education. Archnet-IJAR: International Journal of Architectural Research, 16(1), 184–202.

Özgüven, Y., Bayram A., K. and Cantürk, E. (2020). Mimari Tasarım Stüdyosunda Bir Tamir Deneyimi: COVID-19 ve Uzaktan Eğitim Süreci. Ege Mimarlık Dergisi, EgeMim, 2020-4 (108); 64-69.

Reshetyuk, Y. (2006). Investigation and calibration of pulsed time-of-flight terrestrial laser scanners (Doctoral dissertation, KTH).

Salama, A. M. and Crosbie, M. J. (2020), "Educating architects in a post-pandemic world", Common Edge, Vol. 14, October, p. 6.

Ulvi A., Yakar, M., Toprak, A. S., and Mutluoglu, O. (2014). Laser scanning and photogrammetric evaluation of Uzuncaburç Monumental Entrance. International Journal of Applied Mathematics Electronics and Computers, 3(1), 32-36.

Uzar, M. and Öğütçü, H. (2016). Measurement and Orthophoto Production of Tavra Creek Church Using Terrestrial Laser Scanner, 6th Remote Sensing-GIS Symposium (UZAL-CBS 2016), 5-7 October 2016, Adana.

Yakar, M., Alyılmaz, C., Telci, A., Baygul, E., Çolak, S., Aydın, M and Yılmaz, H. M. (2009). 3D laser scanning and photogrammmetric measurement of Akhan caravansaray. Scientific Research and Essay Vol. 4 (13), 1565-1568.

Yılmaz, H. M., and Yakar, M. (2006). Lidar (Light Detection and Ranging) Tarama Sistemi. Yapı Teknolojileri Elektronik Dergisi, 2(2), 23-33.

DOI: 10.15320/ICONARP.2024.285

Resume

Sibel ÖZDEN OMUZLU received her B.Arch. from Bahcesehir University in 2018. She worked on her M.A. at Mimar Sinan Fine Arts University in the Department of Computer Aided Art and Design. She continues her Ph.D. education at Istanbul Technical University Architectural Design Computing programme. Her research interests include, design methods, architectural education and computational design.

Bülent Onur TURAN graduated from Yildiz Technical University in 1999, completed his master's and Ph.D. degrees in the field of Architecture. He works as an academic at Mimar Sinan Fine Arts University since 2010. His research interests include, design methods, architectural education, digital design and fabrication and design informatics.

Research Article

ICONARP
International Journal of Architecture and Planning
Received: 13.09.2023 Accepted: 27.04.2024
Volume 12, Issue 1/ Published: 30.06.2024
DOI: 10.15320/ICONARP.2024.286 E- ISSN:2147-9380

ICONARP

Cultural Heritage Across Borders: A Comprehensive Examination of the Restoration of the St. Nicholas Memorial Museum (2021-2023)

Serap Sevgi*

Abstract

St. Nicholas Church is a remarkable Byzantine structure located in the Demre district of Antalya, in the southern region of Türkiye. The church and its accompanying tomb were built in the 5th century AD in memory of St. Nicholas after his death. It became a sacred cultural center and a pilgrimage site throughout the Middle Ages. Throughout history, the church underwent multiple reconstructions and substantial repairs necessitated by invasions, earthquakes, and other factors. During the Late Middle Ages, a flood of the river Myros submerged the church under approximately 6meters of alluvial deposits. The excavations, which began in 1862 and have continued intermittently to this day, have uncovered significant remains, which were subsequently restored in accordance with the conservation approach of their respective periods. However, certain ruins persist within privately owned areas. Although the church largely maintains its structural integrity, ongoing excavations within the Ministry of Culture and Tourism's designated areas in the monastery complex continually contribute new insights. This article aims to provide data on the restoration efforts undertaken on the church and its ruins, which now function as a Memorial Museum, preserving their original values during the restoration period of 2021-2023. The primary goal is to contribute valuable insights for future restoration initiatives. Furthermore, the article seeks to advocate for the inclusion of the monument in the World Heritage List, the establishment of Site Management, and the enhancement of its global recognition. By making the newly unearthed spaces accessible to visitors, particularly for Russian pilgrims for whom the church holds significant religious importance, it is envisioned that this will not only foster faith and cultural tourism but also enrich the perception and interpretation of this historic structure.

Keywords:
Demre St. Nicholas Church, Byzantine architecture, Architectural restoration, History of architecture, Cultural heritage

*Başak Cengiz Faculty of Architecture, Karabuk University, Karabuk, Turkey.
Email: serapsevgi@karabuk.edu.tr

To cite this article: Sevgi, S. (2024). *Cultural Heritage Across Borders: A Comprehensive Examination of the Restoration of the St. Nicholas Memorial Museum (2021-2023). ICONARP International Journal of Architecture and Planning,* 12 (1), 316-338. DOI: 10.15320/ICONARP.2024.286

INTRODUCTION

Situated in the Demre district of Antalya, Türkiye, St. Nicholas Church stands as a testament to the enduring legacy of St. Nicholas, the 4th-century bishop of Myra, who was born in Patara (Anrich, 1913: 51). While the precise date of the church's construction remains unknown, historical records indicate that a church and tomb were erected in the 5th century to commemorate St. Nicholas, who passed away in Myra, on December 6, 343. These structures evolved into significant pilgrimage sites for travelers who headed to Jerusalem in the 6th century (Ötüken, 1998: 85-86; Doğan, 2016: 238). Myra and the tomb, which was believed to be the resting place of St. Nicholas, were ruined by Arab Muslims in 808 (Breyer, 1964:147; Demiriz, 1966: 20). Later, in 1034, Myra was looted by the Zirids from Africa, and the church was destroyed during this plunder (Ötüken, 1998: 86). During the Crusades, merchants from Bari obtained some relics of St. Nicholas and brought them to Bari in 1087. These relics were initially preserved in St. Stephen Church until the Basilica of St. Nicholas was completed around 1105. The Venetians took the remaining relics and are currently preserved in San Nicolò al Lido in Venice (Doğan, 2018a: 44). As a result, St. Nicholas's recognition started to increase in the West (Demiriz, 1966: 20-21). In the 10th century under the reign of Vladimir the Great, not only did Christianity become the official religion of Russia, but also St. Nicholas became the patron of Russia. In the second half of the 13th century, the church was filled with approximately 6 meters of alluvial soil up to its gallery level due to the overflow of the river Myros in Demre, which was under the reign of the Turkish people at that time. In the 15th century, the bishopric moved to the island of Kastellorizo (Megisti), off the coast of Kaş (Rott, 1908: 295-297; Harrison, 1963: 122-124; Doğan, 2018b: 38; Fındık, 2015: 303-305). Following the population exchange between Greece and Türkiye in 1923, some Greeks left Demre and moved to Kastellorizo. St. Nicholas is renowned for various miracles as the protector of sailors and children (Işık, 1996: 460; Doğan et al., 2014: 19-23; Ebon, 1975: 11-13, 50-51; Miller, 1955: 15, 80-81) and has become a legend associated with Santa Claus (Figure 1).

Figure 1. St. Nicholas appearing to Emperor Constant St. Nicholas appearing to Emperor Constantine the Great in a dream (top right), A Sea Miracle (bottom right), Scenes of helping to childless families (left) (Çorağan, 2018: 247-252).

DOI: 10.15320/ICONARP.2024.286

In the contemporary context, the Church, now transformed into a Memorial Museum (henceforth MM), has a crucial role in preserving historical, cultural, and community values. Functioning as the custodian of tangible and intangible cultural heritage, the MM encapsulates Anatolian history from the medieval Byzantine period to the present day, providing visitors with a rich cultural experience and drawing attention as a hub for cultural and religious tourism.

Globally renowned as the church of Santa Claus, the MM holds a coveted spot on the World Heritage Tentative List, emphasizing the need to preserve its universal values, originality, and integrity. The restoration process requires a holistic, interdisciplinary conservation approach, considering beliefs, cultural practices, and social dynamics alongside its museum function.

The restoration plan encompasses several key components as listed below:

- Gathering data on the building's repair history by scrutinizing the resources and archives of the Ministry of Culture and Tourism (henceforth MoCT),
- A thorough analysis of the current environmental, ground, structural, and material condition of the church and its contextual ruins in a limited area,
- Enhancing the perception, interpretation, and presentation of newly unearthed places through archaeological excavations, integrating them into the museum visit route for public access

Given the ongoing nature of archaeological excavations and the necessity to incorporate the latest findings into the structural considerations, the restoration project is meticulously programmed. The guiding principle is one of minimum intervention, prioritizing the preservation of existing traces while avoiding unnecessary completion and integration unless dictated by structural concerns.

RESTORATION HISTORY OF THE CHURCH

Based on the architectural features of the church, we can date the capitals and the naos back to the late 5th century and early 6th century. However, various sections of the church suffered damage over time, likely due to invasions or earthquakes, leading to subsequent reconstruction in the form of a domed basilica. This reconstruction brought about substantial changes to the upper structure and roof (Pershlow, 1975: 347; Ötüken, 1996: 75-76; Demiriz, 1966: 19-20). The church endured further challenges during the Arab invasions between the 7th and 11th centuries (Ötüken, 1992: 294). An inscription found in Demre provides evidence that Emperor Constantine IX and Empress Zoe initiated the renovation of a structure in Myra. St. Nicholas Church is highly likely to be the structure mentioned in this inscription (Rott, 1908: 340). According to these restoration works, the opus sectile floor dates to the 11th century.

A new monastery was built around the church in the second half of the 11th century and enclosed by a wall made of Roman stone blocks. This monastery featured two gates, one facing the sea and the other toward the ancient harbor (Figure 2) (Lethaby, 1915: 17).

Figure 2. The depiction of the Monastery and St. Nicholas Church in the topographic plan of Myra (Lethaby, 1915: 17).

In the western courtyard of the church, an arcosolium dating back to August 6, 1118, showcases a mural depicting scenes from Mary's life, embellishing both the sarcophagus and the vault (Rott, 1908: 339-40; Doğan, 2018a: 44-45). The southern section of the church, augmented with additional structures in the 12th century, accommodates a burial chamber featuring arcosolia and sarcophagi. Over distinct historical periods, the church has been adorned with a diverse array of wall paintings, encompassing depictions of St. Nicholas's life, biblical figures, and festive scenes (Çorağan, 1998: 66-67). During the 12th to 13th centuries, a mural illustrating the 'Communion' was incorporated into the dome of the prosthesis located northeast of the church. Simultaneously, scenes portraying the 'Supplication' and the annunciation to Mary were integrated into the 3rd Southeast Chapel (Doğan, 2018a: 47). The catastrophic flooding of the river Myros resulted in the burial of St. Nicholas Church, along with the rock tombs and the hillside theater in Myra, under 6 meters of alluvial soil (Ötüken, 2006: 524). Enduring across centuries, the church's pulpit, believed to trace back to the 6th century, underwent reparations, persisting until the early 20th century (Doğan, 1998b: 323-324) (Figure 3-4).

Figure 3-4. The western facade of the church and the pulpit in front of the apse (Rott, 1908: 325, 331-335).

DOI: 10.15320/ICONARP.2024.286

An inscription from 1798, discovered during recent excavations, pertains to the restoration of a chapel atop the 3rd Southeast Chapel, which is now inaccessible (Rott, 1908: 326; Doğan, 2018a: 48). The Russian Archaeological Institute undertook the first archaeological excavations and subsequent restoration of the church during the reign of Tsar Nicholas I, from 1857 to 1862. These initiatives encompassed thorough cleaning and repairs to the church's interior and courtyard, accompanied by substantial alterations to the original architectural scheme (Ötüken et al., 2000: 224). Key modifications involved the addition of a four-domed outer narthex and the reconstruction of the vaulted roof in the naos section (Doğan, 2018b: 51; Ötüken, 1996: 76). While the dome of the 2nd Southeast Chapel underwent rebuilding, it remained unfinished. The keystone on the south arch of the outer narthex, dating to 1862-63, serves as a pivotal record of this restoration. In 1876, the Greek community facilitated repairs to the administrative building and water facility, along with the construction of a bell tower. Following the Greek community's departure from Demre in 1922, it is postulated that the templon in the naos and the south chapel fell into disrepair (Doğan, 2018b: 325) (Figure 5).

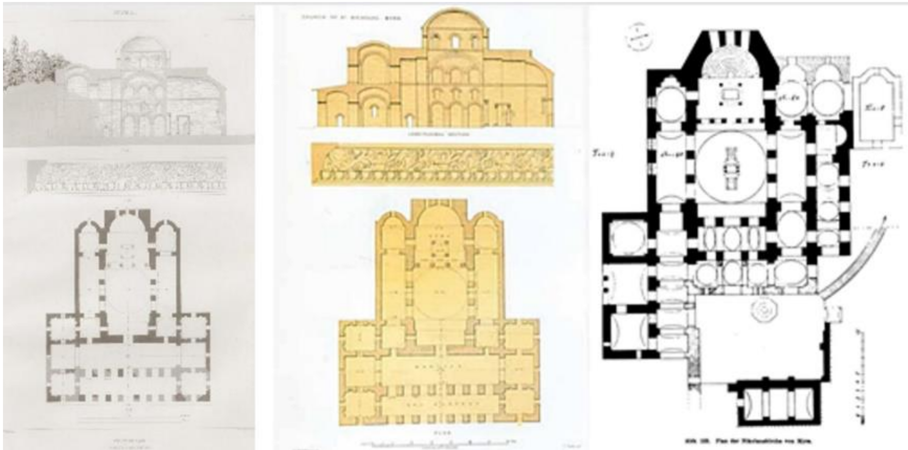


Figure 5. 1839-1849 (Textier), 1867 (Textier and Pulland), 1908 (Rott)

The Ministry of Culture and Tourism (MoCT), in collaboration with the Antalya Archaeological Museum, conducted extensive excavation efforts aimed at removing soil fillings from the southern and eastern sections of St. Nicholas Church during the years 1963-64 and 1966-67. Simultaneously, the German Archaeological Institute, as part of the Myra project, performed a comprehensive architectural assessment of the church in 1965 (Borchardt, 1975: 30; Peschlow, 1990). In 1968, recognizing the need for protective measures, a roof-tiled canopy was erected over the South Burial Chamber, 2nd and 3rd Southeast Chapels, initially safeguarding their murals. Subsequently, in the 1980s, this canopy transformed, evolving into a steel construction with a plastic-coated roof (Doğan, 2018a: 57) (Figure 6). Given its below-sea-level location, the church faced the detrimental effects of water exposure, especially during rainy periods when groundwater levels increased. Responding to this challenge, a pump discharge system was implemented in the 1980s to regulate groundwater levels and divert water away from the church. Between 1989 and 2009, subsequent excavations brought to light additional structures within the northern area, including the Episkopeion (bishopric structure), sites associated with the daily lives of monks, and various graves. Conservation efforts from 2000 to 2009 primarily concentrated on fortifying mural surfaces. Building on this foundation, ongoing work from 2013 to 2021 has encompassed a spectrum of activities, including excavation, preservation, and systematic exploration. The architectural evolution of St. Nicholas Church spans three significant construction phases dating back to the 6th, 8th, and 11th centuries. Remarkably, during the 18th and 19th centuries, the church underwent restoration and expansion with the incorporation of new elements. It retained its functional use until the early 20th century (Ötüken 1996: 76) (Figure 7).

Figure 6-7. Tile and metal protective roofs, Construction periods proposal (AMoCT-PR)

St. Nicholas Church's complex reflects multiple construction phases, prominently featuring a well-preserved domed basilica dating back to its second period. This architectural marvel not only exemplifies the influence of the Byzantine era but also draws from Mediterranean civilizations, as noted by Ötüken (1996: 75). The church stands out for its remarkable frescoes, representing the exclusive St. Nicholas cycle – a distinctive feature unparalleled on a global scale, as highlighted in the work by Ötüken (1998: 87). Recognizing the profound cultural significance of St. Nicholas Church, it was accorded legal protection as a first-degree Archaeological Site in 1993. Furthermore, its historical and architectural importance is underscored by its inclusion in the UNESCO World Heritage Tentative List in 2000.

SPATIAL LAYOUT AND ARCHITECTURAL FEATURES

The MM cafeteria, sales unit, and restrooms occupy the western section of its courtyard. Access to the Church's entrance from the courtyard is facilitated by a southern ramp. It is noteworthy, however, that the original entrance to the Church is situated on the western side. Unfortunately, due to the presence of privately owned parcels adjacent to

DOI: 10.15320/ICONARP.2024.286

this entrance (refer to Figure 8), its current use is not feasible. The architectural layout of the church encompasses a ground floor and a gallery floor (Figure 9).

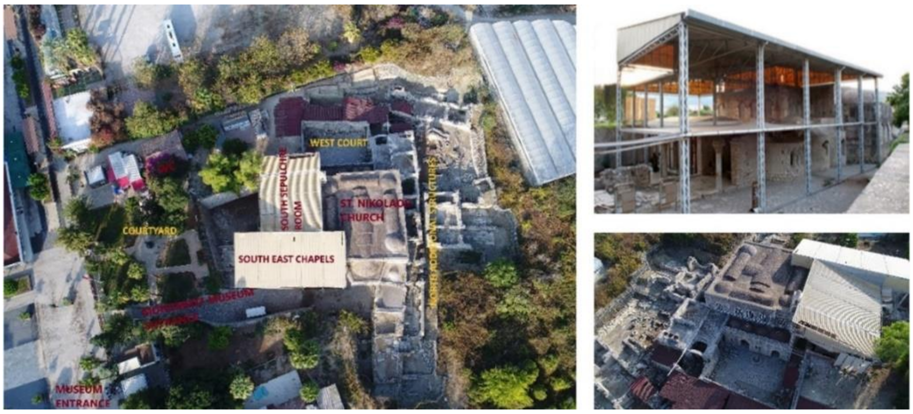


Figure 8-9. The church and its surrounding remains, the south and west facades (AMoCT-PR-4).

Three chapels, designated as Chapel III, Chapel II, and Chapel I, are intricately linked to the entrance hall in the southeast direction. Additionally, situated in the western direction is the South Burial Chamber (henceforth SBC). This architectural arrangement highlights the spatial configuration of the chapels to the entrance hall and the strategic placement of the South Burial Chamber (Figure 10).

Figure 10. Access to the southern entrance and SECIII (AMoCT-PR-4)

Access to the interior narthex is facilitated through the 2nd Southeast Chapel (henceforth SEC I). The southern hall boasts a sturdy stone pavement and is distinguished by the presence of three columns. The architectural layout of the 3rd Southeast Chapel (henceforth SEC III) adopts a cruciform plan aligned along the east-west axis (Figure 11). Despite the dome's complete state of ruin, a portion of its drum remains preserved. The apse, adorned with three arched windows, is notable for its intricate murals. Access to SEC II is facilitated through a north-side arched opening in SEC III, while an opening on the south side allows passage from SEC I to the naos. The chapel's dome underwent renovation in the 19th century; however, its top was left uncovered (Figure 12).

Figure 11. The apse of SEC I and its connection to the SBC from the west (AMoCT-PR-4).

Figure 12. SEC II, the arcosolium in SEC II, and its dome (AMoCT-PR-4)

The entry point for the SBC is a gate situated in the western arm of the cross, characterized by a rectangular plan segmented by north-south arches. The intact northern and southern walls, extending to the commencement of the vault, are covered in canvas. Entry to the western courtyard is granted through a doorway in the western wall. Marked by embellished arched niches, the northern and southern walls also feature two facing arcosolia containing sarcophagi in the western segment (Figure 13). Notably, the transition to the vault cover hosts 12th-century murals depicting scenes from the life of Saint.

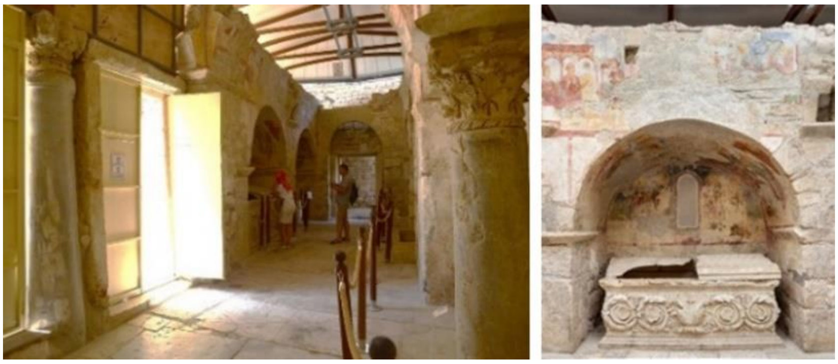


Figure 13. SBC and the sarcophagus (AMoCT-PR-4)

The naos, characterized by a rectangular plan and east-west orientation, features an apse with a semi-circular interior plan, adorned with three windows boasting semicircular arches. Within the apse niche, a synthronon with accompanying steps graces the interior, its lower section forming a passageway. Centrally positioned on the highest step of the synthronon is a cathedra, serving as the bishop's seat, supported by a pedestal. The bema, distinguished by its elevated rectangular plan and stylobate, showcases two columns with capitals erected on pedestals. At the heart of the bema rests a pedestal bearing an altar table. Notably, recent restoration efforts have introduced four ciborium columns surrounding this central pedestal (Figure 14).

DOI: 10.15320/ICONARP.2024.286

Figure 14. The apse of the naos, the ciborium, the altar, the bema, and the cathedra (AMoCT-PR-4).

The naos is partitioned by two primary pillars into northern and southern side naves. Access to the northern side is facilitated by way of two arches, while the southern side is entered through three arches. Semicircular arched windows illuminate the side naves. Within the northern nave, a sarcophagus is positioned on the top of a Roman theater seat, strategically situated between the two main pillars (Figure 15).

Figure 15. The openings of Naos (AMoCT-PR-4).

The original dome of the naos, likely destroyed by an earthquake, along with the half-dome of the apse and the barrel vault of the bema, underwent replacement with a cross-vaulted roof during the 19th-century Russian renovations. This comprehensive restoration extended to the vaults and domes of the gallery level, commencing from the arches. On the western side of the naos, three door openings—of which the central one is wider—grant access to the inner narthex. Simultaneously, three arched openings on the west side of the gallery floor establish a connection with the naos, offering both access and natural illumination. The decorative murals adorning the barrel vaults and arches within the inner narthex exemplify the meticulous attention to detail during the renewal. Additionally, the flooring of the naos is adorned with an array of square limestone tiles (Figure 16).

Figure 16. Western inner narthex, murals, and view toward the naos (AMoCT-PR-4).

Accessing the western courtyard from the inner narthex involves passing through the outer narthex, which is divided into four sections by arches (Figure 17). The Phiale (Fountain), initially positioned at the courtyard's center, has been relocated in front of the structure to accommodate the extension of the outer narthex in the complex. The courtyard is encircled by burial chambers, and remnants of the monastery are interspersed throughout the surrounding area.

Figure 17. The western outer narthex, Phiale in the courtyard (AMoCT-PR-4).

The northern section of the nave within the naos exhibits a rectangular layout, encompassed by an east-west barrel vault. Three windows adorn the northern wall, while the flooring is paved with limestone tiles of varying dimensions. Adjacent to this region, towards the east, lies a rectangular space identified as the Prothesis, fulfilling a dual role as both an independent area and a passage from the bema. The Prothesis is capped by a dome supported by pendentives, featuring an evocative "Communion" scene (Figure 18).

The northern side nave of the structure is linked to the west corridor through an arched passage, segmented into four sections in the north-south direction. The central portion of the west corridor, defined by three primary pillars, is demarcated by the subsequently added western wall of the outer narthex. Originally featuring a barrel vault, the roof of the

DOI: 10.15320/ICONARP.2024.286

western section suffered a collapse during 19th-century repairs (Figure 19), leading to damage in specific areas of the floor in that region.

Figure 18. The northern nave and the dome painting (Prothesis) (AMoCT-PR-4).

Figure 19. The outer narthex that closes off the western corridor arch and its collapsed vault (AMoCT-PR-4)

The southern outer nave, covered by a barrel vault, is characterized by a quadrilateral plan divided into four sections by arches. Within the eastern section's southern wall, a remarkable feature is the Late Roman sarcophagus positioned within an arcosolium niche. The barrel vault ceiling above is adorned with motifs of floral patterns and crosses, serving as symbolic representations associated with the concept of the afterlife (Figure 20).

Figure 20. The southern outer nave, its vault, and the sarcophagus (AMoCT-PR-4).

The church features twenty in-situ panels created using the opus sectile technique. Among these, nine panels adorn the naos, while an additional five panels are strategically positioned in the bema (Figure 21).

Figure 21. Examples of opus sectile floor from SEC I and the naos (AMoCT-PR-4)

The gallery floor of the church, which envelops the naos in a U-shaped configuration and is positioned above the northern side nave, inner narthex, and southern side nave, is accessed from the north via exterior stone steps. Originally, the burial of the naos under soil rendered it nonfunctional, prompting 19th-century Russian excavations that led to the transformation of the western windows of the southern gallery into doors. Simultaneously, stone steps were strategically added in front of these windows to enhance access to the gallery (Figure 22).

Figure 22. The western side of the gallery and view to Naos (AMoCT-PR-4).

In the 19th century, a bell tower was added to the southwestern section of the church. This tower, characterized by a two-story rectangular prism shape, features arch openings on each floor and is capped with a small dome atop a drum. Adjacent to the narthex, towards the north of the naos, remnants of a priest's dwelling and the monastery are accessible.

PROBLEMS OF ST. NICHOLAS CHURCH AND ITS SURROUNDING REMAINS

St. Nicholas Church and its surroundings are situated at a lower level than the current settlement, enclosed by privately owned parcels used for greenhouse cultivation. The drainage system around the church, which lost its efficiency over time, has resulted in elevated groundwater levels and increased water infiltration during heavy rainfall, leading to occasional floods within the church. The interventions undertaken to address these issues have caused major changes and damages to its original components. The roof of the church was renovated by the

DOI: 10.15320/ICONARP.2024.286

Russians in 1862 and covered with a thick protective layer. Due to inadequate slopes in certain areas of the protective layer, the cracks in the vaults caused moisture to infiltrate, resulting in salt efflorescence. Subsequently, a steel-framed and plastic-covered protective roof was erected over the church's south wall, supported by concrete pillars (1986-1989). However, these pillars impeded the drainage of roof water, resulting in the closure of gargoyles (Figure 23).

Figure 23. Mortar of the protective roof (AMoCT-PR-4)

The utilization of cement-based materials across different restoration periods has accelerated the deterioration of materials due to moisture-related issues. Climatic factors have induced a repetitive wetting-drying cycle, contributing to the partial deterioration of arches and lintels within door and window openings constructed with bricks. Moreover, lintels crafted from stones have suffered from fractures and cracks.

A series of fundamental physical tests, including assessments of hardness, unit volume weight, and porosity, were executed on samples extracted from diverse components such as stone/stone tessera, soil, brick, mortar, plaster, and pigments sourced from St. Nicholas Church. Additionally, comprehensive archaeometric investigations were carried out, encompassing analyses to establish the aggregate/binder ratio, aggregate particle distribution (aggregate granulometry), weight loss through heating, fine-section optical microscope examinations, and PED-XRF analysis (Figure 24).

The structural components of the church are composed of limestone exhibiting a highly carbonated and saline nature, as determined by previous studies. Over time, the physical properties of these stones undergo changes influenced by both intrinsic factors and environmental conditions. Stone samples from SBC display the lowest unit volume weight of 2.15 g/cm3 and the highest porosity of 13%, attributes associated with the prevalent high humidity in the region. The varying salt content (0.41%-2.47%) within identical rock types signifies distinct stages of deterioration. We observe repairs with cement-based mortar in sections with high salt content, including the central nave. (AMoCT-PR-1).

Figure 24. Microbiological formations on the internal walls (AMoCT-PR-4)

In-depth analysis of mural pigments and plasters involved documenting samples and employing advanced analytical techniques, including Raman Spectroscopy, XRD, and FTIR. Petrographic analysis characterized small-sized plaster samples, while calcination analysis and acid/sieve tests identified binder and aggregate tones, as well as sieve distribution. Results indicate the activation of salts and sulfates from alluvial soils in humid environments (AMoCT-PR-2). Additional concerns encompass the removal of supporting plaster layers, surface dust accumulation, and abrasions on salt-painted surfaces. The church showcases both opus sectile and cosmatesque techniques, with notable deteriorations such as variations in the ground settlement, partial loss of opus sectile panels, microcracks, fractures, stone loss, surface accumulations, microbiological formations, burn marks, missing joints, and bedding mortars, and past repairs with incompatible mortars in various colors and textures (yellow, gray, white, and pink).

Geophysical studies indicate the presence of silty clay, gravelly, and silty sand transported by the Demre Stream from the neighboring area. Given the church's location in a region with moderate seismic risk (M: 6.8) and an elevation in groundwater levels during rainy seasons, the likelihood of soil liquefaction in the area is notably high (AmoCT-PR-3).

On the other hand, the MM, situated in the center of Demre, attracts considerable attention from both local and international tourists. Throughout the tourist season and particularly during ceremonies commemorating the death anniversary of St. Nicholas on December 6, the influx of visitors places immense pressure on the building, hastening its physical wear and tear. Challenges arise from spatial constraints at the museum's entrance security point, prolonged sun exposure during ticket queues, insufficient rest areas in the courtyard, and unhygienic conditions in the toilets, all of which detrimentally impact the quality of services provided. The MM is often incorporated into tour packages

DOI: 10.15320/ICONARP.2024.286

offered by operators, bundled with visits to the ancient cities of Myra and Simena, as well as boat tours. However, due to the rapid group visits guided by tour operators, local shopkeepers struggle to fully capitalize on the economic advantages of tourism in Demre.

RESTORATION INTERVENTIONS AT ST. NICHOLAS CHURCH AND ITS SURROUNDING REMAINS[1]

In the UNESCO World Heritage Convention Implementation Guide, operating under the framework of the Convention concerning the Protection of the World Cultural and Natural Heritage (1972), it is explicitly stated that the nominee's outstanding universal values form the central focus and constitute the primary element of evaluation. Guided by the principles outlined in the Nara Document on Authenticity (1994), the assessment of authenticity extends to considerations such as form, design, material, usage, construction technique, and other facets related to the asset. Integral to this assessment is the concept of integrity, a metric evaluating the extent to which unique qualities endure (Articles 79–80), thereby serving as a measure of the completeness of the heritage (OG 87–95). The 2005 revision of The Operational Guidelines for the Implementation of the World Heritage Convention (Articles 96-118) introduced more comprehensive provisions for the management systems of assets boasting outstanding universal value. This revision emphasized the imperative of formulating a meticulous management plan for cultural assets. St. Nicholas Church stands as an exemplary representative of medieval Byzantine architecture, strategically positioned at the convergence of east-west trade routes and diverse cultures. Its pivotal role in Myra's evolution into a focal point for the development of Christianity underscores its exceptional universal values. The preservation of the church's ruins, both in structure and context, maintains their originality and integrity within contemporary borders (Criteria iii-iv) (UNESCO, 2000).

The restoration works on the church adhered to both national legislation and international agreements. Insights gleaned from recent excavations informed subsequent restoration work. Guided by principles of minimum intervention, reversibility, and the capacity to distinguish from the original structure, in alignment with the museum's function, the restoration aimed to preserve past repairs as period additions. Additionally, the restoration work included reinforcing the perception of the church's architectural value and optimizing service spaces to align with its current function as a museum.

Consolidation Implementations

These consolidation implementations aimed to ensure the stability of the walls by preventing the widening of structural cracks by employing hydraulic lime-based mortar and grout compatible with the original mortar content in terms of color, texture, and quality. The masonry materials in the deteriorated sections of the roofs, particularly in SEC II, were cleaned and replaced with materials resembling the original ones. This approach effectively contributed to stabilizing the walls that had begun to degrade. Throughout the process, great care was taken to preserve the integrity of the original intact joints. In instances where joint

[1] As the Director of Antalya Surveying and Monuments for the Ministry of Culture and Tourism of the Republic of Turkiye, the author managed the restoration of St. Nicholas Church in 2021-2023.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

deterioration occurred, the restoration strategy considered various repair periods in the structure's history. Material consistent with the original content, as determined through material analysis results, was applied. To maintain authenticity, smaller dimension stones were introduced during the restoration (Figure 25).

Figure 25. Southern Nave and the Naos after implementation (AMoCT-PR-4)

For protection against external weather conditions, a stone and lime-based capping was applied to the remains uncovered during the excavation process. As part of the 19th-century Russian restoration, a lime-based protective mortar layer containing brick fragments was preserved on the dome and vaults of the church. To treat the cracks in the mortar layer, hydraulic lime-based material was used by applying the microinjection technique. In addition, a protective coating with vapor permeability and water-repellent properties was applied to fortify against the deterioration process. The deteriorated joints within the domes and vaults were filled utilizing original materials. Furthermore, slopes were arranged in necessary areas to allow effective drainage of accumulated rainwater on the upper structure. The enclosed gargoyles were restored to functionality, and the addition of titanium-zinc rainwater pipes at the gutter ends enabled the water to be directed to the drainage wells to prevent water flow onto lower-level spaces (Figure 26).

Figure 26-27. After the application of the cleaning, conservation, and capping of the remains (AMoCT-PR-4)

The collapsed floors in the western courtyard were systematically numbered, dismantled, and reinstated to their original positions following the correction of the underlying layer. In instances of extensive fracture in the stone pavement, particularly evident in the southern

DOI: 10.15320/ICONARP.2024.286

entrance hall and front of the southern chapel, in-situ improvement procedures were undertaken without removing the stones (Figure 27).

The unskilled implementations on the opus sectile floors of the church underwent a thorough cleaning process, with particular attention to the examination of the rudus (coarse mortar) and nucleus (fine mortar) layers in regions affected by ground subsidence. In addition, the bedding mortar layers and gaps between the opus sectile elements were completed. Chemical cleaning methods were applied to heavily soiled surfaces exhibiting calcification, while mechanical cleaning procedures were employed to address microbiological formations and surface accumulations. To address structural issues, broken pieces within the opus sectile unit elements were reinforced. Fragments obtained from excavations, with identifiable positions in areas exhibiting losses, were carefully placed on panels. In cases where positions were indeterminable, mortar filling was utilized to complete the restoration (Figure 28). Concerning murals, reinforcement of gaps between the plaster and the support layer was executed using the injection method following the removal of dust accumulations and salts. Borders were strategically applied to the edges of the plaster to prevent separation between the plaster and the support layer. It is noteworthy that previous repairs had involved the application of Paraloid B72 to the painting surfaces, creating a film layer that posed a potential risk to the paint layer during removal. Consequently, no intervention was undertaken in this regard (Figure 29).

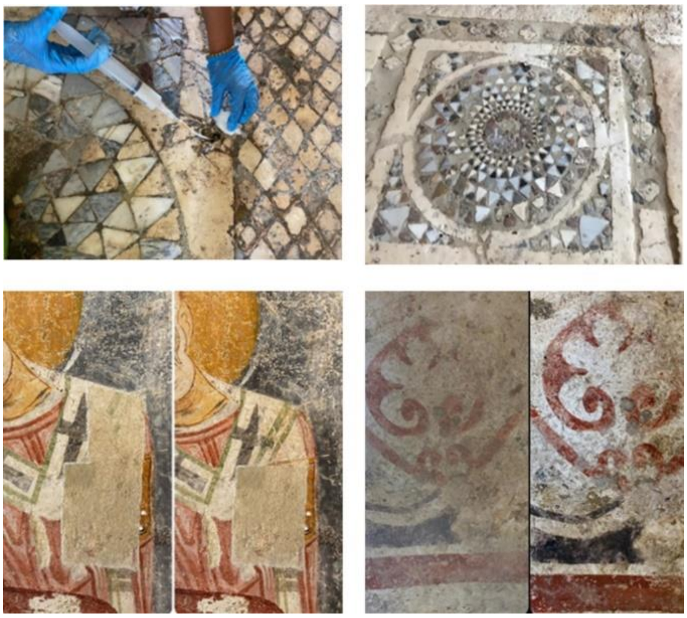


Figure 28-29. Conservation applications on opus sectile panels and wall paintings (AMoCT-PR-4)

Reintegration Implementations

The restoration initiative included the reintegration of a segment of the missing western corridor vault, employing stone materials and hydraulic lime mortar. This approach aimed to ensure compatibility with the original materials, thereby reinstating the architectural integrity of the structure in terms of its original form, materials, and intricate details.

Section losses resulting from masonry deterioration and voids on the walls were addressed by completing those by using smaller-sized stone materials that were compatible with the original composition. Furthermore, efforts were directed towards the consolidation of columns, integration of broken floors, and the comprehensive repair and leveling of damages to the infrastructure (Figure 30).

Figure 30. Reinforcement of SEC I dome drum and completion of columns (AMoCT-PR-4)

Liberation Implementations

Previous unskilled applications made with cement-based mortar were cleaned utilizing non-damaging mechanical methods to preserve the integrity of the original materials. Interventions were carried out based on the original material content, details, and application style. Unskilled repairs at the pulpit location within the naos, opus sectile panels, and natural stone paved floors were dismantled. Archaeological excavation was methodically conducted on the floor, with the acquired information informing subsequent restoration efforts. The excavation site within the naos, serving both worship and museum functions, was conscientiously resealed, preserving the historical traces of the pulpit's original location, and a new floor was laid using contemporary stone materials (Figure 31).

Figure 31. Floor and the traces of the pulpit in the naos (AMoCT-PR-4)

DOI: 10.15320/ICONARP.2024.286

The protective roofs over the church and visitor platforms, as well as security-oriented metal doors and window frames, were systematically removed during these restoration efforts. Subsequently, they were reconfigured with designs that harmoniously blend with the architectural aesthetics, ensuring a complementary integration with the overall structure.

Cleaning Implementations

The extensive growth of Deep-rooted vegetation on the church walls was removed using herbicide-type pesticides. To preserve the integrity of the outer stone patina, a series of trials involving water, mechanical, steam, and chemical cleaning methods were conducted (Figure 32). However, surface cleaning of exhibited archaeological remains was not carried out in this restoration process.

Figure 32. Liturgical materials before and after cleaning (AMoCT-PR-4)

Usage-related Applications

Due to its high number of visitors, the church spaces were closed off in stages to visitors for the implementation of the works. During the removal of the roofs, temporary access was provided to the upper-level courtyard from the east of the church, through a metal construction bridge leading to the northwest podium, ensuring visitor safety. The new protective roof of the church, designed not to impose any additional load on the structure, was applied as a steel construction with titanium zinc coating, with its carriers placed outside the building. Still, it covers SBC and southeast chapels, providing natural ventilation while preventing rainwater from entering through its eaves located at appropriate distances. Wooden shingle roofs, previously used in various periods in the excavation areas, have been replaced with metal coverings to ensure visual consistency in the excavation site. After the completion of repairs, the entrance was restored from the southern direction, and the northern arcades were included in the visitor's route (Figure 33).

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Figure 33. Temporary visitor entrance (AMoCT-PR-4).

In regions characterized by elevated ground levels surrounding the parcel, drainage systems were systematically established along the contour lines and enclosed by rubble stone walls. Enhancements were made to the pre-existing water drainage wells and pumps adjacent to the church, both in terms of quantity and functionality. Furthermore, the restoration efforts incorporated the revival of the authentic Byzantine water channel located to the north of the church, seamlessly integrating it into the expanded drainage system (Figure 34).

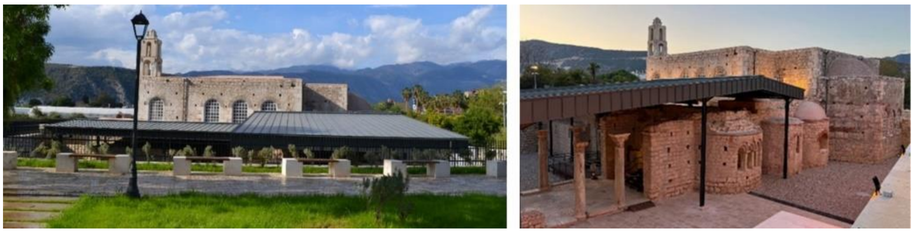


Figure 34. View of after the implementation (AMoCT-PR-4).

CONCLUSION

St. Nicholas Church, resilient through time with multiple reconstructions and the addition of new spaces, stands today amidst an ongoing archaeological excavation, revealing insights into its intricate history and the surrounding monastery complex. This excavation has provided valuable information about both the church and its surrounding complex. Therefore, a comprehensive conservation approach has been adopted, considering both the principles of monument conservation and archaeological site preservation during these excavation processes. This holistic conservation approach focuses on preserving the church's original values historical traces and related structures, employing archaeometry and engineering assessments during structural repairs. The overarching objective is to counteract past unskilled interventions, ensure harmony with original materials in restorations, and halt ongoing deterioration, all aimed at preserving these structures for posterity. Throughout the implementation, the guiding principle has been minimal intervention, prioritizing the preservation of original materials, details, and forms within the structure. Moreover, the completions were applied in faithful adherence to the original, mainly in unadorned sections with reliable historical information. In its role as a memorial museum, meticulous design considerations were given to productions,

DOI: 10.15320/ICONARP.2024.286

emphasizing contrast to illuminate architectural, historical, and aesthetic values without burdening the structure. These new materials in contrast with the original architectural style, materials, and details ensure they can be removed or replaced. The presentation of visitor routes has been organized to enhance public comprehension of the church and its surroundings.

Areas previously inaccessible, including the gallery floor, the ruins of the northern extension, remnants of the eastern temple, and the original western entrance, have been opened to the public for the first time. The unveiling of limestone-coated murals adds a new dimension to the cultural offering, which is shared with both the scientific community and visitors.

Between 2021 and 2023, the MM's restoration process was essential to preserve the economic benefits derived from local and national cultural tourism while acknowledging the museum’s international religious significance. Therefore, the spaces of the MM were partially closed and implemented according to the restoration program. Meanwhile, necessary security measures were taken, and tourists were able to visit the MM without interruption.

Within the framework of sustainable conservation and management, in the Short Term, ensuring the MM’s integrity requires limiting and regulating visitor numbers and duration to prevent physical damage. This measured approach can also contribute to the local economy by providing waiting visitors with the opportunity to explore local products. In the Medium Term, site management should be established to ensure sustainable preservation for the MM, which has been a world heritage nominate since 2000.

Site management should determine conservation and promotional strategies along with encouraging the participation of local people. The boundaries of the monument's management area and the buffer zone, regulating privately owned lands, and supporting archaeological excavations must be determined within the management plan. Archaeological excavations should be supported to reveal the cultural heritage of the region accurately. Establishing a cultural route plan, connecting key locations associated with the life of St. Nicholas, can heighten the region's appeal and cultural experiences for visitors. A cultural route plan should be established within the framework of religious tourism by creating tourist routes connecting significant points such as Patara, Myra, and Demre, which are the key locations associated with the life of St. Nicholas. These initiatives can increase visitors' interest in the region and enhance their cultural experiences. The establishment of a site management plan is of paramount importance to the MM, as it is a prerequisite for being included on the World Heritage List. Such an inclusion would not only increase the international recognition of the MM but also strengthen the region's tourist appeal.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

ACKNOWLEDGEMENTS/NOTES

Special thanks are also extended to the technical team of the Antalya Directorate of Surveying and Monuments, the members of the St. Nicholas Scientific Committee, the Directorate of the St. Nicholas Excavation, the project contractor Cumhur Gürel and his team, and the implementation contractor UCA Construction and their team for their collaborative efforts in this work.

The restoration interventions of the St. Nicholas Church for the year 2021-2023 were carried out by the Ministry of Culture and Tourism of the Republic of Türkiye, Antalya Directorate of Surveying and Monuments.

REFERENCES

Archive of the Ministry of Culture and Tourism of the Republic of Türkiye. (AMoCT), Drawing Measure, Restitution, Restoration Project (RP), and Project Reports (PR) 2018, Cumhur Gürel),

(PR-1) Antalya, Demre St. Nicholas Church Building Material Analysis Report) (Ali Akın Akyol, 2018),

(PR-2) Murals Archaeometric Analysis) (İsmet, Ok, 2018),

(PR-3) Antalya Province, Demre District St Nicholas Church Geotechnical Survey Report (Atakan Yüklü 2018)

(PR-4) Figures of restoration period (2021-2023)

Anrich, G. (1913-1917). Hagios Nikolaos. Der hl. Nikolaos in der geriechischen Kirche. Texte und Untersuchungen, I-II, Leipzig-Berlien.

Breyer, L. (1964) Bilderstreit utıd Arabersturum in Byzanz (Byzantinische Geschichtschreiber VI.) Graz-WienKöln,

Borchardt. J.(1975).Myra. Eine lykische Metropole in antiker und byzantinischer Zeit Plan. IstForsch 30.

Cockerell, C., R. (1903). Travels in Southern Europe and the Levant 1810-1817, The Journal of C. R. Cockerell.

Çorağan, N. (2018). "Duvar Resimleri", Aziz Nikolaos Kilisesi Kazıları 1989- (ed. Sema Doğan ve Ebru Fatma Fındık), Homer Kitabevi, İstanbul, pp. 226-264.

Demirci, K. (2016). "Myra (Demre) Piskoposu Pataralı Aziz Nikolas" (ed. Havva İşkan), Yapı Kredi Yayınları, İstanbul.

Demiriz, Y. (1966). "Demre'deki Aziz Nigolas Kilisesi", Türk Arkeoloji Dergisi, Sayı XV-I, Milli Eğitim Bakanlığı, Eski Eserler ve Müzeler Genel Müdürlüğü, Türk Tarih Kurumu Basımevi, Ankara, 1968, pp.13-34.

Doğan, S. (2016). "Likya'da Bir Hac Merkezi: Myra Aziz Nikolaos Kilisesi", (ed. Havva İşkan- Erkan Dündar), Yapı Kredi Yayınları, İstanbul.

Doğan, S., Çorağan, N., Bulgurlu V. (2014). "Demre-Myra Aziz Nikolaos Kilisesi" Arkeoloji ve Sanat Yayınları, İstanbul.

Doğan, S. (2018a). "Kaynaklar Eşliğinde Aziz Nikolaos Kilisesi'nin Tarihi", Aziz Nikolaos Kilisesi Kazıları 1989-2009, (ed. Sema Doğan ve Ebru Fatma Fındık), Homer Kitabevi, İstanbul, pp. 35-62.

Doğan, S. (2018b). "Mimari Plastik Buluntular: Liturjik Kuruluşlar ve Liturjik Mekânlar ile İlişkisi", Aziz Nikolaos Kilisesi Kazıları 1989-2009 (ed. Sema Doğan ve Ebru Fatma Fındık), Homer Kitabevi, İstanbul, pp. 301-328.

Ebon, M. (1975). St. Nicholas Life and Legend, Harper&Row, New York.

Fındık, E., (2015). Myra/Demre, Aziz Nikolaos Kilisesi Rum Mezarlığından Boucla ve Gouna Örnekleri, Adalya. (No. XVIII/2015. The Annual of the

DOI: 10.15320/ICONARP.2024.286

Suna&İnan Kıraç Research Institute on Mediterranean Civilizations), pp.303-324.

Fellows, C. (1840). An Account of Discoveries in Lycia: a journal kept a second excursion in Asia Minor.

Foss, C. (1993). "The Settlement at Dereağzı and other Material remains in its Vicinity from Antiquity to the Middle Ages", Lycia in History, J. Morganstern (ed.), IstFor 40, Berlin, 5-25.

Harrison, R., M. (1963). "Churches and Chapels of Central Lycia", Anatolian Studies, Vol. 13 (1963), pp. 117-151 (47 pages), https://doi.org/10.2307/3642492

Işık, H. (1996). "Dini Köken Açısından Noel ve Yılbaşı, Selçuk Üniversitesi İlahiyat Fakültesi Fak. Dergisi, C.7, S.459

Lethaby, W., R. (1915). Myra and Lycian Sculpture, Antiquities of Ionia, V, London.

Miller, R. (1955). In Search of Santa Claus, Published by The Turkish Press, Broadcasting and Tourist Department.

Ötüken, Y. (1992). "1990 yılında Antalya'nın Demre ilçesindeki Aziz Nikolaos Kilisesinde yapılan çalışmalar", XIII, Kazı sonuçları toplantısı II, 1992, pp. 291-303.

Ötüken, Y. (1996). "Likya Ortaçağ Çalışmaları ve Aziz Nikolaos Kilisesi Kazısı", Adalya, pp. 73-86.

Ötüken, Y. (1998). "Demre Aziz Nikolaos Kilisesi Kazılarının Ortaçağ Araştırmalarına Katkıları", Sanat Tarihi Dergisi, 9 (9), pp.85-102.

Ötüken, Y., Alpaslan, D., Acara, M. (2000). "Demre-Myra Aziz Nikolaos Kilisesi Kuzey Ek Yapısının Yeni Bir Değerlendirmesi", Adalya, No. IV/1999-2000, The Annual of the Suna&İnan Kıraç Research Institute on Mediterranean Civilizations), pp.221-242.

Ötüken, Y. (2018). "Aziz Nikolaos Kilisesi Kazı Çalışmaları 1989-2009", (ed. Sema Doğan ve Ebru Fatma Fındık), Homer Kitabevi, İstanbul, pp. 63-138.

Peschlow, U. (1975). "Die Architectur der Nikolaos Kirche in Myra", J. Borchhardt (ed.), Myra. Eine Lykische Metropole in Antiker und Byzantinischer Zeit,301-357.

Peschlow, U. (1990). "Materialien zur Kirche des H. Nikolaos in Myra im Mittelalter, in: Istanbuler Mitteilungen 40", 207-258.

Rott, H. (1908). Kleinasiatische Denkmaeler aus Pisidien Pamphylien Kappadokien.

Textier, C. (1849). "Description de L'asie Mineure, Armenie, la Perse et la Mesapotamie III, Paris, 205-238.

Texier, C.-Pullan, R. (1867) Byzantine architecture illustrated by examples of edifices erected in the East during the earliest ages of Christianity, London.

UNESCO, (2000). Tentative List. St. Nicholas Church.https://whc.unesco.org/en/tentativelists/1399/

Resume

Serap SEVGİ. After graduating from Selçuk University in 1996, Serap Sevgi completed her master's degrees in building science (1999) and restoration (2012), followed by a PhD in Cultural Heritage Preservation from Gazi University in 2020. She worked at the General Directorate of Foundations and the General Directorate of Cultural Heritage and Museums until 2023, managing restoration projects for heritage sites and engaging national and international cultural heritage preservation. Since 2023, she has focused on academic research in historical environments and architectural restoration.

ICONARP
International Journal of Architecture and Planning
Received: 26.10.2023 Accepted: 28.05.2024
Volume 12, Issue 1/ Published: 30.06.2024
Research Article DOI: 10.15320/ICONARP.2024.287 E- ISSN:2147-9380

ICONARP

Evaluation of Urban Renewal Projects in the Historical Texture Within the Framework of Passive Design Strategies; A Case of Diyarbakır-Suriçi Alipaşa-Lalebey Neighborhood

Sevilay Akalp*
İdil Ayçam **

Abstract

In the 21st century, contemporary architectural designs have often overlooked the interaction between constructed structures and their natural environment, neglecting to consider climatic variables as essential design inputs. This oversight, coupled with the rising threats of climate change and extreme weather conditions, has compromised the comfort and well-being of occupants within these spaces. A shift towards different design paradigms has become imperative to address these challenges and build a sustainable future. Diyarbakır traditional urban fabric has conserved its authenticity in social, cultural, and environmental contexts up to the present day. However, the migratory movement's social and cultural developments have disrupted the original fabric, resulting in deteriorating areas over time. This study focuses on the traditional settlement pattern within the historical Suriçi and Alipaşa-Lalebey Neighborhood, where the Urban Transformation Project was completed, was chosen as the case area. To analyze the changes in building patterns, spatial relationships, parcel configurations, and transformations in courtyard-street structures, Geographic Information System (GIS.)-based ArcMap software is employed. Digitized data, on-site observations, and photographic documentation are used to compare urban and neighborhood units in terms of climate-responsive design strategies and passive cooling systems. This study underscores the importance of incorporating climate-responsive design approaches from the past while utilizing contemporary technological advancements, emphasizing the significance of technologies such as Geographic Information Systems (GIS), which contribute to energy conservation and time efficiency during the reconstruction processes. The findings of this study demonstrate that alterations in building patterns, shifts in solid-empty relationships, and changes in street patterns not only lead to the loss of cultural heritage but also hinder the transmission of numerous geographically specific design approaches to future generations.

Keywords:
Climate-responsive design, Geographic Information System (GIS), Passive cooling strategy, Traditional Suriçi urban fabric.

*Graduate School of Natural and Applied Sciences, Gazi University, Ankara, Turkey.
(Corresponding author)
E-mail: sevilay.akalp@gazi.edu.tr

**Faculty of Architecture, Gazi University, Ankara, Turkey.
E-mail: iaycam@gazi.edu.tr

To cite this article: Akalp, S., & Ayçam, İ. (2024). *Evaluation of Urban Renewal Projects in the Historical Texture Within the Framework of Passive Design Strategies; A Case of Diyarbakır-Suriçi Alipaşa-Lalebey Neighborhood. *ICONARP International Journal of Architecture and Planning,* 12 (1), 339-367. DOI: 10.15320/ICONARP.2024.287

INTRODUCTION

Global warming and climate change have emerged as significant challenges of the Anthropocene era. According to the World Resource Institute, 64.5% of global anthropogenic greenhouse gas emissions originate from the energy sector (World Resource Institute, 2014). Population growth, efforts to meet modern living standards, and changing consumption habits have begun to impact the energy consumption dynamics of buildings within urban environments. According to the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report, if greenhouse gas emissions remain at current levels, global temperature increase could exceed the target value of +1.5°C set by the Paris Climate Agreement, reaching over +3°C (Masson-Delmotte, 2021). Given these future scenarios, it is imperative to develop design approaches focusing on existing cities and architecture (Groot et al., 2015; Van Hooff et al., 2015). The increase in outdoor temperatures is expected to lead to a differentiation in heating-cooling demands in the construction sector, accelerating energy consumption (IPCC, 2014). Extreme weather events are anticipated to affect human activities, daily life, thermal comfort, building production patterns, and the construction industry. In other words, global climate change and temperature increases are expected to impact thermal comfort perception and human health (Baharun et al., 2020).

This framework considers initiating climate change mitigation strategies from the construction sector a rational approach. Sustainable architectural approaches that effectively utilize energy and reference renewable energy sources have become necessary for optimizing the natural environment (Semahi, 2019). Climate-responsive design, an approach used in local and traditional architectural examples, significantly reduces energy demand in buildings without compromising modern living standards (Bodach et al., 2015). Traditional architecture has incorporated traces of climate-responsive design strategies since ancient times (Vatan Kaplan, 2019). The fundamental principle of climate-responsive design is optimizing building environmental performance by evaluating climatic parameters (Piquer, 2003; Topfer, 2009; Zare & Ghanberi, 2022). The environmental comfort of users experiencing the building depends on their adaptation to climatic factors such as wind and sun (Motealleh et al., 2016). Traditional architecture can be considered significant built environment resources that carry traces of climate-responsive design strategies. Considering local climatic data, design parameters and outputs at both the neighborhood unit and single-building scales have been created. Therefore, traditional architecture is crucial in sustainable and climate-responsive architecture (Zare&Ghanbari, 2022).

Traditionally developed architectures have been formed through living and experiencing building techniques and features. Local architecture brings different solutions and approaches to climatic constraints (Rakoto-Joseph et al., 2009; Soleymanpour et al., 2015). In

DOI: 10.15320/ICONARP.2024.287

this context, Historical Diyarbakır City, Suriçi known as the city's first settlement, contains climate-responsive design components such as compact urban form, mixed land use, pedestrian-focused transportation solutions, and specific structural characteristics. Over time, migrations to the region and uncontrolled illegal constructions have disrupted the traditional urban fabric. This study focuses on the traditional urban fabric of Diyarbakır's Sur Neighborhood. It selects the Alipaşa-Lalebey Neighborhood, where an Urban Renewal Project was initiated in 2015, as the study area. The reconstruction process initiated in the Alipaşa-Lalebey Neighborhood aims to design new living spaces compatible with the historic environment. To ensure the sustainability of the original characteristics in new housing structures, the Conservation Development Plan was revised in 2016, and urban renewal projects were aimed to be designed in line with this plan. In this study, the ArcMap program was selected to digitize and compare the fabric losses in urban blocks, solid-void relationships, and changes in block-parcel-street patterns. Digitized data was combined with on-site observation, photography, to compare urban and neighborhood units regarding climate-responsive design strategies and passive cooling systems.

This study aims to emphasize the importance of using technologies such as the Geographic Information System (GIS), which takes into account climate-responsive design approaches from past to present while using energy-saving and sustainable design strategies in the reconstruction processes of historical patterns and also contributes to time-saving by following current technological developments in this process. In the first step of the study, using the ArcMap program, the sizes of the urban blocks in five regions in Alipaşa-Lalebey Neighborhood, where the Urban Renewal Project was completed, were compared with the conservation development plan.

As a result of the digitization, the second region, where the relationship between parcel-urban blocks was altered by dividing it with road axes, was selected. The fabric losses in the urban block of the second region and their effects on building-parcel-block relationships, solid-void ratios, and urban block-parcel-street configurations were digitized using the ArcMap program and compared with the Conservation Development Plan. Within the framework of all numerical data, the impact of changes in urban block rates, solid-empty percentages, and urban block-parcel-street pattern on passive cooling strategies was examined due to urban transformation.

The study revealed that the narrow streets, characteristic features of the historic fabric, were widened as part of the urban renewal project. These changes will reduce shadow effects between buildings, leading to the warming of facade surfaces and a decrease in internal thermal comfort. Additionally, this change in street widths was considered to harm pedestrians experiencing the street in their daily life practices, decreasing outdoor thermal comfort. The increase in the solid surface is expected to lead to an increase in the urban heat island effect due to the

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

lack of application of another passive cooling design strategy. Urban form, functions of urban blocks, mixed land use, dead-end streets, and other climate-responsive design components have remained unchanged, adhering to the original fabric within passive cooling strategies.

This study demonstrated that if passive cooling strategies such as shading, wind, and landscape are not sufficiently utilized, thermal comfort in both indoor and outdoor spaces may decrease. In this context, it was emphasized that a design approach incorporating climate-friendly and passive systems that consider current needs and conditions should be adopted in renovating a historic fabric.

This study has proven that the loss of urban blocks in the traditional pattern, the change in solid- void relationship, and the differentiation of street patterns will lead to the loss of cultural heritage and cause many characteristic design approaches specific to the geography not to be transferred to future generations. The unique value of this study is that it is the only study that examines in detail the large-scale reconstruction process of a historical pattern in the 21st century and examines it on the scale of passive design strategies using quantitative and qualitative research techniques.

This study shows how the use of computer-based technologies, such as Geographic Information Systems, can be integrated into rapidly digitizing and mapping spatial transformations and changes to guide the management of similar projects in the future. In addition, the necessity of passive design strategies for the adoption of energy-saving, sustainable, and integrated design approaches in the reconstruction processes of the historical fabric is also emphasized in this study. In addition, choosing the GIS-based ArcMap program within the scope of the study shows that time can be saved using technological methods and can contribute more effectively to the conservation and reconstruction processes of future historical patterns. This study has shown that it is possible to create energy-efficient urban blocks and street pattern by integrating today's advanced technologies into climate-responsive design approaches.

LITERATURE REVIEW

Climatic events such as sun, wind, and rain are essential parameters that direct the design of the built environment from the past to the present. There are different approaches in which natural environmental parameters are included in the design by developing different design approaches within the framework of climatic variables. In his study published in 1989, Hasting expressed the way a building interacts with external environmental climatic conditions as climate-insensitive, climate-combative design, and climate-responsive design approaches (Figure 1).

DOI: 10.15320/ICONARP.2024.287

With Climate-Insensitive Design there is no interaction with the environment at all. The building operates indifferent from the climate it is set in. With such buildings most of the interior spaces have no direct contact with the outdoors and building services are provided mechanically.

With Climate-Combative Design the building 'fights' the outdoor environment, mainly through super-insulation. The building design does take local climate into account while it sets for the initial amount of insulation needed.

With Climate-Responsive Design the building acts as an environmental filter. A balance is found between the exclusion of unwanted forces and the admittance of the beneficial ones.

Figure 1. Building interacts with environment in three different ways

Although the climate-responsive design approach was included in the literature in the 20th century, it has survived from ancient times to the present day with different examples on an urban and architectural scale (Panarelli et al., 2016; Vatan Kaplan, 2019). The comfort of the user who experiences the building depends on its adaptation to climatic factors such as wind, sun, and rain. In this context, climate-responsive design helps the building user provide maximum comfort by aiming to reduce the consumption of energy resources to a minimum level (Motealleh et al., 2018). Parameters such as the location of the building, its orientation, the positions and distances of the buildings relative to each other, the building form, shell, and thermophysical properties are among the essential parameters affecting energy conservation and indoor thermal comfort at the building scale (Manioğlu & Yılmaz, 2007; Saraydar; 2015; Sami, 2021).

Climate-responsive design is based on the principle of creating the built environment by considering the environmental dynamics of the region. In other words, climate-responsive design strategies aim to save energy in the summer and winter periods by providing solutions that will increase solar radiation in the winter period and design strategies that will reduce solar radiation in the summer (Olgyay, 1963; Pour, 2011; Almatarneh, 2013; Yang, 2022). Turkey has a rich cultural heritage based on traditional architecture and has five different climate zones. The adverse effects of the climate, especially in hot-dry regions, have been tried to be eliminated with traditional construction methods and experiences. As a result, unique local architectural patterns have been formed in cities. The southeastern Anatolia Region has a desert climate with a high-temperature difference between day and night. Traditional buildings built in this region, where the highest solar radiation is observed, provide passive thermal comfort in the interior by controlling the climatic conditions (Erdemil et al., 2016; Manioğlu & Koçlar Oral, 2012; Manioğlu & Yılmaz, Z, 2007).

The climate-responsive design approach includes different construction techniques according to climatic effects. Climate-responsive design approaches according to hot-dry climate regions on an urban scale are shown in Table 1. Human and natural parameters such as narrow streets, neighborhood units, urban form, open-semi-open areas, topography, and urban heat island, which include urban design and its sub-parameters, are used as climate-responsive design parameters (Abanomi & Jones, 2005; Saraydar; 2015; Peker, 2016; Forouzandeh, 2018; Han et al., Kaihoul et al., 2021; 2023; Salameh et al., 2023).

Table 1. Climate-Responsive Design approaches in hot-dry climate regions at urban scale (Abanomi ve Jones, 2005; Saraydar; 2015; Peker, 2016; Forouzandeh, 2018; Han vd., Kaihoul vd., 2021; 2023; Salameh vd., 2023)

Climate Responsive Design Approaches at the Urban Scale Urban Form	
Urban Form	• Narrow streets • Compact urban form • Shaded volumes can be created with columns, arcades, overhangs, and cantilevered building components. • Membranes and small closed courtyards are traditional solutions in climate-sensitive design approaches.
Open-Semi Open Areas	• Small or medium-sized green open areas should be created. • Walking distance to public areas should be minimal. • Access to public areas should be provided from shadow areas. • Green areas or recreational areas should be created in areas where streets meet.
Topography	• Shaded areas can be provided with natural topography (Tercing). • High altitudes and places with the possibility of evaporation are advantageous for urban settlements.
Heat Sinking Surfaces Urban Heat Islands	• Heat sinks such as seas, lakes, and forests will create more excellent areas on a city scale. • Fountains and ponds are among the effective air conditioning systems at more minor scales. • To reduce the urban heat island effect, It is necessary to reduce the use of hard ground such as concrete and asphalt.

Passive design strategies provide requirements such as heating, ventilation, air conditioning (HVAC), hot water production, and lighting without using energy systems (Foster, 2021). In other words, they are systems that optimize indoor comfort conditions without the need for artificial forces such as mechanics or electricity. Passive design strategies vary depending on the region's climatic conditions (Almatarneh, 2013). In hot, dry climate regions where the hot period lasts longer than the cold period, urban design approaches must be considered together with the physical environmental context. Urban design configurations in hot, dry climate regions directly impact energy use. Street pattern, green areas, and vegetation, landscape elements shape the microclimatic characteristics of the region (Fahmy & Sharples, 2009a; Mirzaei & Haghighat, 2010; Galal et al., 2020; Mahmoud et al., 2021; Fahmy et al., 2022).

Neighborhood unit and street pattern, which are among the urban design sub-components, significantly impact outdoor climatic comfort. When realizing passive design solutions in the context of neighborhood units in hot, dry climate regions, it is possible to provide thermal comfort by using the shadow effect, orientation and width of street canyons, urban density, and form, afforestation, and green infrastructure, and horizontal and vertical solar control elements (Figure 2).

DOI: 10.15320/ICONARP.2024.287

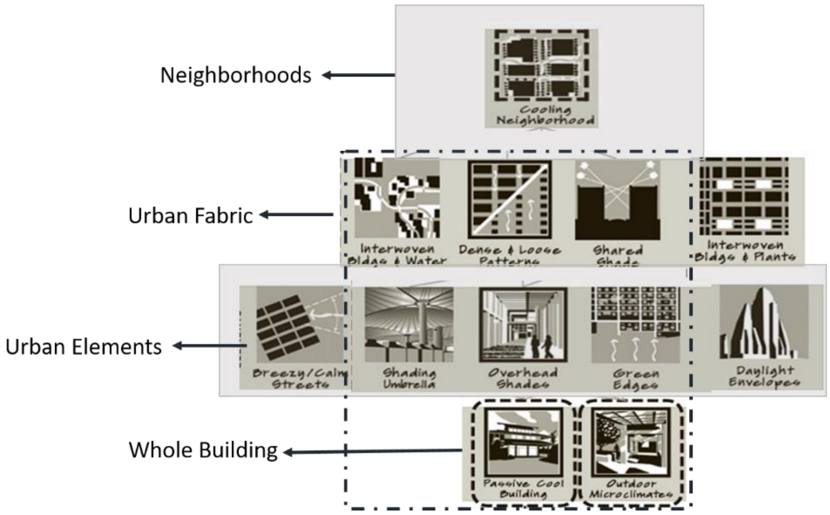


Figure 2. Passive cooling system in the context of neighborhood unit (Dekay & Brown, 2014)

Many studies in the literature address passive cooling system parameters at different scales. In this context, studies addressing the effect of passive design strategies on thermal comfort on an urban scale are one of them.As a result of the study carried out in Egypt to examine the effect of open space design and urban configuration on façade temperature proved that the urban configuration that effectively reduces solar radiation has a clustered city form (Bahgat et al., 2020). Additionally, the effect of residential courtyards in the city of New Assiut in Egypt on outdoor thermal comfort was examined, and it was proven that the P.E.T. value could be reduced up to 17°C in the scenario where the appropriate tree species and shading element were used together (Abdallah & Mahmoud, 2022). Another study on an urban scale was to investigate the effect of shadow effect on thermal loads in high-density urban areas in hot-dry climate regions. As a result of this study, it was determined that thermal loads decreased by 16-18% due to the shadow effect (Lima et al., 2019). Another study on urban form, conducted in a hot-dry climate region, proved that the compact urban form increases thermal comfort by reducing solar radiation falling on pedestrian paths (Alznafer, 2014). In hot-dry climate regions, courtyards provide thermal comfort due to the shade effect.

In this context, as a result of the study carried out on the courtyard building form, which helps to reduce annual energy consumption with passive cooling techniques in the hot-dry climate region, it was concluded that annual energy savings can be achieved if the courtyard form is integrated into today's housing sector (Ayçam et al., 2020; Hatipoğlu&Mohammad; 2021). Another study on courtyard form and layout determined that annual energy loads would decrease when a shadow effect was created by creating appropriate form and building density (Ayçam & Varshabi, 2016). In studies on street pattern and orientation of passive cooling strategies in hot-dry climate regions, it has been determined that North-South (N-S), NE-SE, and NW-SE directions are optimal, and these directions have a positive effect on providing thermal comfort (Jamei & Rajagopalan, 2019). The effective use of the shadow effect, which is a passive cooling criterion on an urban scale, in the context of the neighborhood unit and street pattern, also varies depending on the type and thermal properties of the floor coverings used in the streets and avenues in urban areas. In this context, in the study conducted to examine the effect of flooring materials on thermal comfort, it was determined that surface temperatures reached up to 60 ◦ C if coating materials such as cement, concrete, and high asphalt mixtures were used as flooring (Santamouris et al., 2001; Xu et al., 2019).

To summarize, creating a shadow effect by increasing height/width (H/W) ratios in hot, dry climate regions (Fahmy, 2022; Muniz-Gaal et al., 2020; Yıldırım, 2020), developing green areas and infrastructure systems (Kenawy et al., 2010; Bekleyen ve Melikoğlu, 2021). ; Lowe, 2016; Dwiputra, 2021; Al-Kubaisy, 2022; Najah, 2023), using urban surfaces and water elements with different thermal properties (Peng et al., 2019; Ferrari et al., 2020), orientation of canyons and streets in the north-south direction, use of courtyards, compact city form (Ahmadi et al., 2022; Zhang et al., 2023; Sözen et al., 2019; Ridha, 2017; Abaas, 2020; Abaas & Khalid, 2023).

When all studies were examined, it was determined that many studies were carried out on the shadow effect, which is among the passive cooling criteria. It has been proven that indoor and outdoor thermal comfort can be achieved through the shadow effect, without relying on mechanical or electrical systems, if the street pattern and orientation, courtyard form, and appropriate landscaping elements are used. Another critical issue on which studies have been carried out is the thermophysical properties of the building materials due to the heat island effect. These studies have shown that it is possible to provide thermal comfort both indoors and outdoors if passive design strategies on an urban scale are considered together with appropriate climatic features specific to the location. No study has been found in the literature that addresses the urban renewal process in a historical pattern with passive cooling strategies. In this context, no comprehensive study currently examines the impact of urban transformation in the Diyarbakır Suriçi region on passive design systems. No scientific source digitizes this transformation in the traditional urban pattern on the scale of urban block, solid- void percentage, and building-parcel-street pattern and compares it with the old urban pattern. In this context, the Suriçi region was taken as the study area on the UNESCO Cultural Heritage list and stood out with its cosmopolitan structure throughout history .

As a result of this study, it has been shown that the loss of urban blocks in the traditional pattern, the change in solid-void relationships, and the differentiation of the street pattern will both lead to the loss of cultural heritage and cause many characteristic design approaches specific to the geography not to be transferred to future generations. The unique value of this study is that it is the only study that examines in detail the large-scale reconstruction process of a historical pattern that

DOI: 10.15320/ICONARP.2024.287

took place in the 21st century and addresses it at the passive design strategy scale using quantitative and qualitative research techniques. This study shows how the use of computer-based technologies, such as Geographic Information Systems, can be integrated into rapidly digitizing and mapping spatial transformations and changes to guide the management of similar projects in the future. The study underlines the requirements and importance of passive design strategies for adopting energy-saving, sustainable, and integrated design approaches in the reconstruction processes of the historic fabric.

RESEARCH MATERIAL AND METHOD

Geographic Information Systems (GIS) based ArcMap program was used as study material. This software program combines storing, analyzing, and collecting data (Jin et al., 2023). The acceleration of the urbanization rate in the 21st century is reflected in spatial analysis technologies. Recent studies on public spaces have used GIS based spatial analysis methods and quantitative methods that include numerical data. (Jiang 2010; Chen, 2021). The main class of GIS data is coordinate data, which contains geometric data and reflects spatial dimension. Large amounts of data are used to create facts. GIS may differ depending on the intended use. GIS supports resource and land management, urban design, transportation, risk analysis, and other spatial features (Haydarovich et al., 2023). With the help of Arcgis, analyses such as spatial analysis, digitization, mapping, and remote sensing can be performed.

GIS evaluates information from a broad perspective, such as transportation networks, land use, and demographic data in urban design, and evaluates this information spatially. In this context, the GIS-based ArcMap program, which realizes potential problems not noticed by traditional data analysis methods in a shorter time, was determined as the study material. This program was used to digitize and map the spatial change in the urban fabric of Suriçi. Using GIS-based ArcMap, the Conservation Development Plan (2016) and Urban Renewal Projects of the Suriçi urban fabric were mapped using ArcMap 10.8. In the first step of mapping, the program introduced the coordinate and projection systems of the Diyarbakır Suriçi region. The layers on the map were converted to GIS-based extensions and digitized.

Table 2. The climate-responsive design parameters evaluated within the scope of the study

Climate Responsive Strategies
Urban Fabric Scale
Compact Urban Form
Density Urban Form
Street Pattern Scale
Narrow Streets
Connected building
Arrangement of buildings according to the sun and wind direction
Courtyard-Street Relationship
Courtyard Design (Solid-Void Relationship, orientation)

The changes that occurred with the urban renewal project in the Suriçi city fabric, in other words, the boundaries, sizes, forms, and street characteristics of the urban block in the original pattern, were examined within the framework of the climate-responsive design approach. At the urban scale, a compact urban form and urban density were evaluated. At the street scale, climate-sensitive design strategies were employed, including narrow streets, courtyard solid-void relationships, and the placement of buildings based on sun and shadow effects (Table 2).

The method of the study is shown in Figure 3.

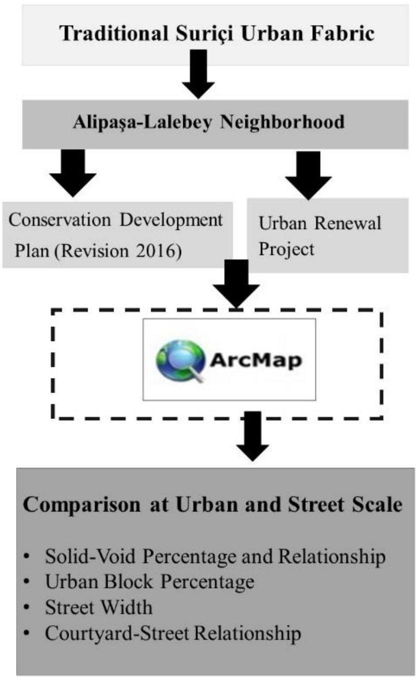


Figure 3. General Framework and Methodology of the Study

General Characteristics of the Traditional Suriçi Urban Fabric

Diyarbakır is located in the southeastern region of Turkey, on a broad plateau between Karacadağ and the Tigris River. The traditional Diyarbakır settlement pattern is located in the central part of Southeastern Anatolia, between Karacadağ Mountain and the Tigris River (38° 51' N, 40° 21'E), on the eastern slope of a basalt plateau (Darçın, 2020; Demir, 2021). Although the beginnings of the city's history are not sure, it is suggested that it is the period of the Hittites and Hurrians (3500 BC) (Beysanoğlu, 2003). Diyarbakır Historical Suriçi Region is surrounded by walls that are 5 km long and 6-8 m high (Baran et al., 2011). The Suriçi Region comprises 15 neighborhoods with north-south settlement patterns (Figure 4).

DOI: 10.15320/ICONARP.2024.287

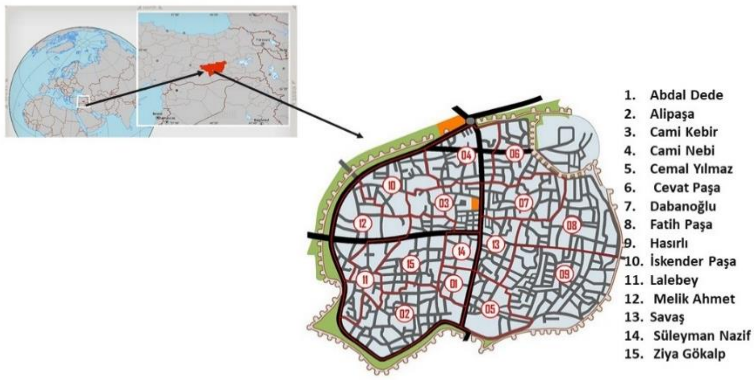


Figure 4. Suriçi Region location and neighborhood illustrations (Maphill, 2024)

According to the Köppen climate classification, the city of Diyarbakır has a dry summer Mediterranean climate (Csa) with hot and dry summers and rainy winters (Yılmaz & Çiçek, 2018). According to long-term data from the weather observation station in the city center, the annual average temperature was determined as 15.9 °C and the highest and lowest temperatures were 46.2 (July) and -24.2 (January). The annual sunshine duration is 7.5 (Table 3).

Table 3. Climatic Data for Diyarbakır City (Turkish State Meteorological Service, 2022)

Climate Period (1991-2020)													
	January	February	March	April	May	June	July	August	September	October	November	December	Anuel
Average Temperature (OC)	1.8	3.8	8.3	13.8	19.3	26.1	31.0	30.5	25.1	17.6	9.7	4.1	15.9
Average Highest Temperature (ºC)	6.7	9.2	14.5	20.5	26.6	33.6	38.4	38.3	33.4	25.4	16.3	9.2	22.7
Average Lowest Temperature (ºC)	-2.2	-1.0	2.5	7.0	11.3	16.6	21.7	21.1	16.0	10.1	4.2	-0.2	8.9
Average Sunshine Duration (hour)	3.9	4.9	5.6	7.2	9.6	12.2	12.4	11.7	10.0	7.5	5.5	3.9	7.9
Average Rainy Days	12.33	11.34	11.83	11.22	8.74	2.66	0.47	0.32	1.07	5.71	8.17	11.50	85.4
Measuring Period (1929-2020)													
The highest temperature (ºC)	16.9	21.8	28.3	35.3	39.8	42.0	46.2	45.9	42.2	35.7	28.4	22.5	46.2
The lowest temperature (ºC)	-24.2	-21.0	-14.0	-6.1	0.8	1.8	9.9	11.4	0.0	-1.8	-12.9	-23.4	-24.2

Case Area: Alipaşa-Lalebey Neighborhood

In 2008, an urban design project was prepared to end slum development within the scope of the "Diyarbakır Alipaşa and Lalebey Neighborhood Urban Renewal (Slum of Transformation) Project." The demolition process was stopped because most of the neighborhood's population did not accept the transformation. In the negotiations that started again in 2009, it was stated that Conservation Development Plan would be adhered to within the scope of urban renewal, and a conditional protocol was signed within this framework (Korkma, 2016). In 2010, within the scope of the İçkale Urban Transformation project, a protocol was signed with the Mass Housing Administration, and the transformation process started, albeit partially. In 2012, the urban transformation works were suspended after those residing in the Alipaşa-Lalebey Neighborhood did not leave their homes. In 2015, when the conflict process began, the Urgent Expropriation and Suriçi Urban renewal project started, based on the Disaster Risk Area Decision taken in 2012 (Yakut & Ceylan, 2019). Alipaşa-Lalebey Neighborhood is the first settlement where the urban renewal project started. After the expropriation decision in the areas to be demolished, demolition work started (İpek, 2020).

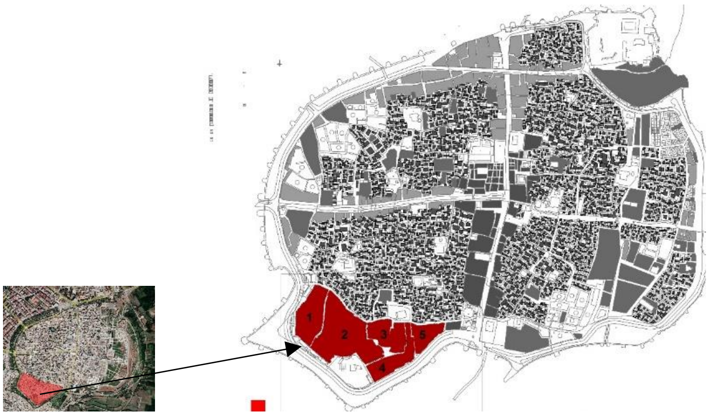


Figure 5. Diyarbakır Alipaşa and Lalebey Neighborhood Urban Renewal (Slum Transformation) Project (The map was recreated by the author using the city plan base taken from the Ministry of Environment, Urbanization and Climate Change)

In aerial photographs, changes in the original pattern are stated chronologically. Aerial photographs of urban transformation and before in Alipaşa-Lalebey Neighborhood are shown Figure 6. The reconstruction phase started in the southwestern part of the region (İpek, 2020).

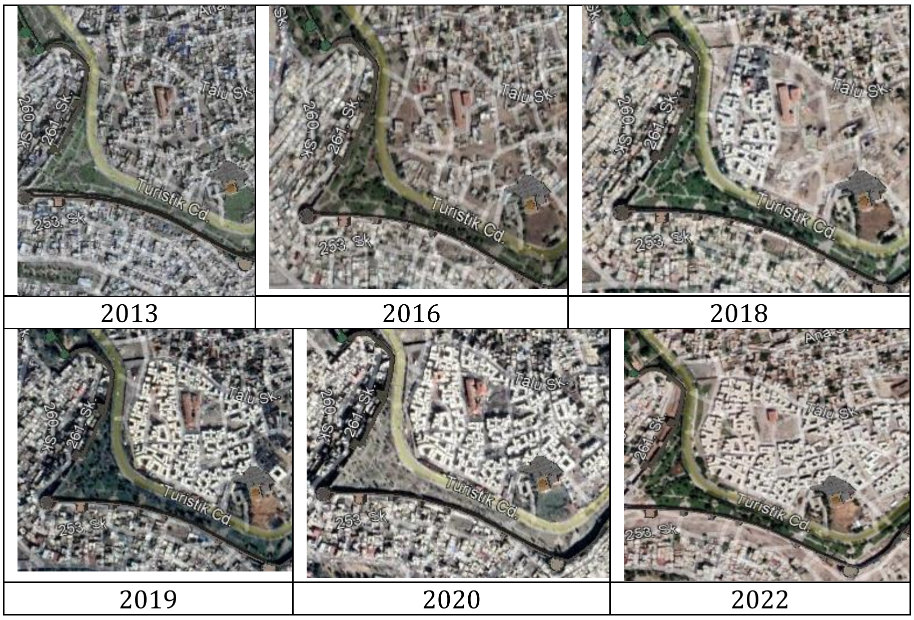


Figure 6. Change of Alipaşa-Lalebey Neighborhoods over the years (Aerial Image/Google Earth)

Alipaşa-Lalebey Neighborhood Urban Renewal Project was initiated by the Ministry of Environment and Urbanization. The housing construction projects in the Alipaşa and Lalebey neighborhoods, divided into five regions, were undertaken by five different contractors, as shown in Figure 5 and Figure 7 (Aslan & Dündar, 2022).

DOI: 10.15320/ICONARP.2024.287

	
Diyarbakır Alipaşa and Lalebey Neighborhood Urban Renewal (Slum Transformation) Project (Ministry of Environment, Urbanization and Climate Change, 2018)	Conservation Development Plan (2016 Revision)

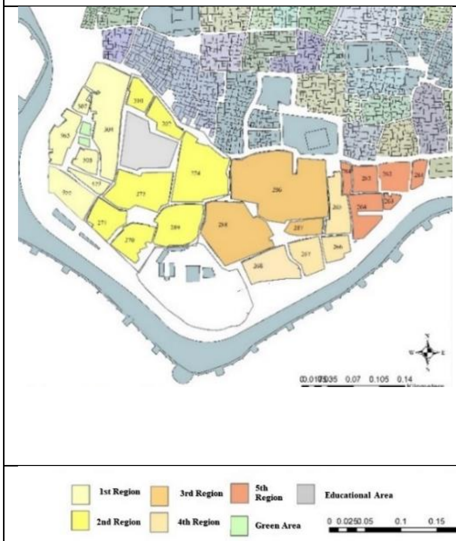
Figure 7. Comparison of Diyarbakır Alipaşa and Lalebey Neighborhood Urban Renewal Project and Conservation Development Plan (Ministry of Environment, Urbanization and Climate Change, 2019)

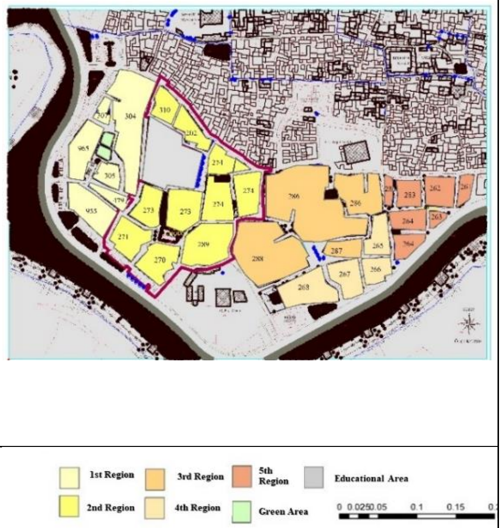
EVALUATION AND DISCUSSION OF RESULTS

Alipaşa-Lalebey Neighborhood Urban Renewal Project and Conservation Development Plan (2016) were compared on the urban block size scale, and the changes in unit square meters were calculated using the Arcmap program. As a result of the digitizations carried out in the first region, 3-10% of pattern loss occurred in the square meters of the urban block. The most significant change in urban block size and boundaries occurred in urban block number 479. Increasing the road width to 7 meters to provide access to every point from urban block number 305 in the center caused an 8% pattern loss in this urban block. The change in urban block sizes within the scope of the urban renewal project in the second region is shown in Figure 9. Roads have been opened to ensure the continuity of transportation axes within the urban block. The urban block number 273, previously designed as a single-building urban block, was divided into two regions with 7-meter wide roads to ensure the continuity of the transportation axis and for emergency crossings, resulting in an 11% decrease in the square meter of the urban block (Figure 8).

The urban block number 274 is divided into three zones by 5-meter-wide roads passing through its center. There was a 10% decrease in the size of the urban block due to the increase in street width. The change in the urban blocks that occurred within the scope of the urban renewal project in the third region is shown. In the third region, street widths were increased from 3 meters to 5 meters in some areas. This change in the street pattern has caused a decrease in the size of the urban blocks by 3-13%. When the change in the borders of the urban blocks in the fourth region is examined, the road width in the urban block Number 267 has been increased to 7 meters in order to ensure the continuity of the transportation axis, which is located in the south and designed as a ring road in the Suriçi city fabric. The same situation applies to the urban block 266. Street widths, which varied between 2-3 meters in the Conservation Development Plan and the old traditional pattern, were increased to 5 meters within the scope of the urban renewal project (Figure 8).

Alipaşa-Lalebey Neighborhood	
Urban Conservation Plans (2016 Revision)	Urban Renewal Project





Region No	Urban Block No	The Scale of Urban Blocks According to Urban Conservation Plans (m^2)	The Scale of Urban Blocks According to Urban Renewal Project (m^2)	Urban Block Dimensions Decrease Percentages
1	955	2295	2227	3
	965	1830	1800	2
	479	706	640	10
	304	5376	5100	5
	305	857	787	8
	307	488	455	7
2	302	1262	1180	7
	270	1830	1757	4
	271	1736	1650	5
	273	3687	3263 (1346+1917)	11
	274	4861	4417 (1150+1353+1914)	10
	316	1019	967	5
3	286	980	957	3
	287	972	850	13
	288	613	568	7
4	265	2011	2001	1
	266	1097	1004	8
	267	1687	1501	11
	268	2601	2430	7
5	261	625	598	4
	262	1440	1364	5
	263	354	306	13
	264	2141	1936	9
	283	1169	990	14
	284	528	348	35

Figure 8. Mapping of the Conservation Development Plan and Urban Renewal Project with the Arcmap Program

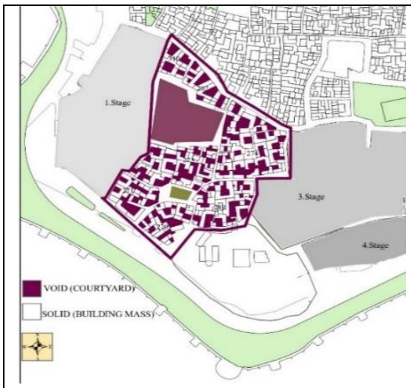
When the changes in block sizes in the fifth region are examined, area losses were higher (35%) because the block number 284 intersects on the road axis in 4 directions.

On the road between the urban block Number 264, parcel number 10 was evacuated and connected to the axis in the southwest direction. Changes in street and road widths in all regions have led to pattern losses in the size of urban blocks. However, this change brought about tissue losses and caused some areas previously shown as a single urban block in Conservation Development Plan to be separated by roads. In order to ensure continuity of transportation, especially in the urban blocks numbered 273 and 274 in the second region, the roads were changed in the range of 5-7 meters, and this caused the urban blocks to be divided.

DOI: 10.15320/ICONARP.2024.287

In this context, as a result of the analyses carried out with the Arcmap program, it was determined that there were pattern losses in all regions. However, in addition to the pattern losses in the urban blocks in the second region, the urban block-parcel relationships also changed. In other words, it has been determined that the areas previously designed as a single urban block in the traditional Suriçi urban fabric were divided into 2 or 3 parts to provide road crossings within the scope of the urban renewal project. In this context, instead of searching for the effect of the transformation experienced within the scope of the urban renewal project on passive cooling criteria in 5 regions, the second region, which experienced characteristic differences, was chosen as the study area.

Table 4. Comparison of solid-void percentage of urban blocks within the scope of Conservation Development Plan and Urban Renewal Project (Alipaşa-Lalebey Neighborhood 2nd region)



Urban Conservation Plans (2016 Revision)

Urban Renewal Project

Urban Block No	The Scale of Urban Blocks (m^2)	Void Volumes (Court)	Urban Density Ratio	The Scale of Urban Blocks (m^2)	Void Volumes (Court)	Urban Density Ratio
316	1019	345	34	967	284	29
302	1262	476	38	1180	404	34
289	3069	997	32	2740	772	28
274	4861	1565	32	4417	1241	28
273	3687	1306	35	3263	668	20
271	1736	652	38	1650	574	35
270	1830	608	33	1757	663	38

As a result of the analyses carried out through the ArcMap program, the urban block pattern losses due to the change in street widths in the second region led to a change in the solid-void percentages. While the percentage of courtyards in the urban blocks located in the second region varies between 32-38% according to the Conservation Development Plan, it has been determined that this rate is between 20-38% within the scope of the urban renewal project. Except for the urban block number 270, the solid-void percentages decreased in all other urban blocks. In other words, within the scope of urban transformation, the courtyard rates and percentages that dominated the traditional Suriçi urban fabric decreased with the urban renewal project. According to the Conservation Plan, the most change was observed in this area due to the division of the urban block by roads to ensure continuity of transportation in the urban block number 273, which was previously a single urban block. In other words, a 15% decrease in solid-void rates was detected in comparing Conservation Development Plan and urban renewal projects.

Due to the urban renewal project, there was an increase in the solid and void percentages in urban block number 270, leading to a conclusion that it has a different solid-void relationship than other urban blocks in the region. Furthermore, the presence of parcels not recommended for mass use to provide transit (urban block number 274) has caused the solid-void relations in the multi-layered traditional urban fabric and the urban density to change (Table 4).

Pattern losses in the urban block have led to changes in the courtyards and parcel layouts in the traditional Suriçi urban fabric and a decrease in the solid-void ratios. Increasing street widths in the traditional urban fabric has caused artificial gaps to be created by retreating urban blocks in the historically protected area. In other words, within the scope of the urban renewal project, front gardens were created, and the traditional street pattern-courtyard-building relationships were changed. As a consequence of the analyses conducted using the ArcMap program, the widening of streets resulted in ineffective utilization of passive cooling strategies due to shadow effects. Furthermore, the disruption of urban block-parcel-courtyard relationships will induce a heat island effect in the street canyon, leading to thermal comfort degradation in indoor and outdoor spaces. In this context, the upcoming section will discuss and compare the positive and negative attributes of the alterations in the traditional urban fabric concerning passive cooling within the framework of the urban renewal project. This discussion will encompass evaluations at both the street and urban scales.

DISCUSSION

As a result of the analyses carried out through the Arcmap program, the changes and transformations experienced in the Alipaşa-Lalebey Neighborhood Urban Renewal Project were compared with the old city pattern on the scale of climate-responsive design strategies. The urban transformation experienced in the Alipaşa-Lalebey Neighborhood was evaluated within the framework of street pattern, solid-void relationships, and urban block-parcel relations and evaluated on the scale of passive cooling criteria (Table 5). Within the scope of the urban renewal project, the compact urban form, mixed land use, hierarchy of open-semi-open and closed spaces, urban amenities, and green areas have been preserved. This has resulted in the continuation of passive cooling design strategies that dominate traditional urban fabric configurations. However, the creation of front yards and side yards, which were not previously present in the traditional fabric, has led to an increase in street widths, thereby reducing the passive design shadow effect within the traditional fabric.

DOI: 10.15320/ICONARP.2024.287

Table 5. Evaluation within the Framework of Climate-Responsive and Passive Cooling Design Strategies (Urban Scale)

Evaluation in the Context of Climate-Responsive Design Strategies		**Evaluation of the Alipaşa-Lalebey Neighborhood Urban Transformation Project within the Framework of Passive Cooling System**
Traditional Settlement Area	Urban Renewal Project in Alipaşa-Lalebey Neighborhood	Advantage and Disadvantage
Evaluation On an Urban Scale		
• Compact City Form (Erdemir, 2014; Özdemir, 2016). • Neighborhood unit design based on cultural, religious, and local dynamics. 	• The urban forms included in the Conservation Development Plan have been preserved. • Commercial, religious, and educational functions included in the Conservation Development Plan have been preserved. 	• The compact city form provides energy efficiency due to mixed land use. In the traditional Suriçi urban texture settlement configuration, the compact city form was created in line with microclimatic components such as the sun and wind. These microclimatic elements positively affect passive cooling systems in the hot-dry climate zone.
• Settlement Layout topography harmony • Orientation in all four directions • Mixed Land Use	• The layout was designed regarding the previous topography.	• The fact that the entrances of the buildings are at a lower elevation than the main road shows that passive cooling strategies are used appropriately in topography. • Mixed land use encourages pedestrian access and reduces the use of fossil-based vehicles. This helps to provide a sustainable energy-saving future.
• There are semi-open and open areas and public spaces such as parks and recreation areas.	• Social reinforcement areas and park areas have been preserved. Children's play and recreation areas have been created at the intersections of the streets.	• Semi-open, open areas help provide outdoor thermal comfort by reducing the heat island effect.
• Ensuring public-semi-private space street texture-courtyard hierarchy in transitions to urban areas (Özyılmaz & Sahil, 2017).	• In the Traditional Diyarbakır Street pattern, houses with courtyards directly relate to the street. However, within the scope of the urban renewal project, artificial front gardens were created by withdrawing the buildings.	• The differentiation of building-parcel-urban block relationships disrupted the traditional street texture pattern and decreased the shadow effect. This situation leads to a decrease in the effect of facade surfaces and outdoor climatic comfort.

Within the scope of the urban renewal project, street widths were increased due to security and emergency reasons, and in this context, pattern losses occurred in the urban block areas. The effect of street pattern changes on the passive cooling system is shown in Table 6. The traditional pattern of narrow streets and roads closed to private vehicle use has been changed within the scope of the urban renewal project. Increasing street widths will increase the solar radiation effect, causing facade surfaces to warm up and heat accumulation in floor coverings. This will cause the heat island effect and reduce indoor-outdoor thermal comfort. While narrow streets are a factor that accelerates the wind effect, there will also be a decrease in the wind effect due to increasing street widths. Increasing the street width has made it possible to be accessible to every street or region, which has been identified as an advantage of change by ensuring the applicability of the universal design principle. In addition, in the plan report, parking vehicles on the streets in the residential area is considered an approach aimed at solving the parking problem in the region.

Table 6. Evaluation within the framework of climate-responsive and passive cooling design strategies (street pattern)

Evaluation in the Context of Climate-Responsive Design Strategies		**Evaluation of the Alipaşa-Lalebey Neighborhood Urban Transformation Project within the Framework of Passive Cooling System**
Traditional Settlement Area	Urban Renewal Project in Alipaşa-Lalebey Neighborhood	Advantage and Disadvantage
Evaluation On an Urban Street Pattern		
  • Narrow streets protected from the heat of summer, organic street forms and dimensions in the Suriçi urban fabric emerged due to the positioning of urban blocks and parcels (Tuncer, 1999).	  • As a result of the analyses carried out through the Arcmap program, it was determined that the urban blocks did not comply with the 2016 Conservation Development Plan Revision. • Street setback distance have yet to be conserved. • Urban block pattern losses were observed at the urban scale 3-10%.	• Widening narrow streets will reduce the shadow effect and cause the surfaces to warm up. This will have a negative impact on passive cooling systems. • It has been determined that the orientation of some houses in the parcel layout is not suitable for the hot, dry climate region. This will result in the optimal orientation, which is among the passive cooling design criteria, needs to be achieved.
• As a result of the hot-dry climate effect prevailing in the Diyarbakır Suriçi urban fabric, houses open towards large courtyards, and an inward-looking structure prevails (Tuncer, 1999; Baran, 2017; Oruç, 2017).	• As a result of the digitizations carried out with the help of the ArcMap Program, pattern losses in the urban block caused the solid-void percentage to decrease by 3-15% (except for the urban block number 270).This situation caused the urban block-parcel relationship to deteriorate in the traditional pattern.	• Changing solid-void rates disrupt the traditional street pattern. This will reduce the shadow effect and thermal comfort by increasing the surfaces exposed to solar radiation indoors and outdoors.

DOI: 10.15320/ICONARP.2024.287

• The principles of conservation traditional houses'courtyard and relationship, solid-void percantage, and spatial components such as original courtyard walls, pools, and the original street covering are accepted (Soyukaya, 2015).	• While the courtyard-street relationship was provided directly in the traditional pattern, in new renewal project, the retreat of the buildings resulted in the formation of a front garden. • The front garden phenomenon does not exist in the street-courtyard relationship in the traditional Suriçi urban fabric. In order to ensure the continuity of the transportation axis, some parcels in urban blocks 274 and 289 were evacuated, and the solid-void relationship of the traditional pattern was changed.	The evacuation of parcels will increase the urban floor surfaces and cause the heat island effect.
Walkable streets - roads that do not allow private vehicle passage - shape the unique pattern (Akın & Koca, 2017; Kara, 2019).	• The organic narrow street pattern has been opened to private vehicle use to adapt to contemporary housing production styles. It has been designed to meet the parking needs of every household. In the third region, the street width, which was 3 meters, was increased to 5 meters. In the 2016 Conservation Development Plan Revision, street widths of 2-3 meters were increased to 5 meters (Regions 3 and 4).	• Services such as security, fire brigade, and ambulance can be delivered to all streets in an accessible manner.
Street widths vary between 1.90 and 2.50 mt, but they appear to increase to 3.00-4.00 mt (Dağtekin et al., 2018). The average width of the inner street is 2.2 meters, sometimes as low as 0.58 meters. Although the street pattern has an organic form, steep roads have caused the formation of	• Transportation axes are designed to allow 5-7 meter comprehensive vehicle passages. • The withdrawal of some building masses for security purposes has led to road widening. In order to provide access to every point in the 1st Region, urban block number 305, the road width has been increased to 7 meters. • In the second region, on urban block number 273, road widths have been increased up to 7 meters to ensure the continuity of the transportation axis and allow emergency passage. When the change in the borders of the urban block in the fourth region is examined, the road widths on the 267th urban block have been increased to 7 meters in order to ensure the continuity of the transportation axis, which is	• Considering the need for contemporary housing design, the parking problem due to today's traffic density has been tried to be solved. • Increasing street width increases the solar radiation effect. • The inability of the shadow effect to reach large surfaces will cause heat gain from the facade surface. • While narrow streets include a design approach that accelerates the wind effect and allows cross ventilation,

When the changes in the street characteristics are examined, the blind facades overlooking the street in the traditional pattern are designed as transparent surfaces in the new residential area. Opening windows on facades facing the street will cause uncontrolled solar radiation to be transmitted to the building surface and interior. This situation will cause indoor thermal comfort to deteriorate, especially in summer, as solar radiation falls on the surface at a very steep angle.

rectangular urban blocks (Akın & Koca, 2017).	located in the south and designed as a ring road in the Suriçi urban fabric. • Transportation axes dividing the urban block and providing transit were created later. 2. Region: 5 mt wide roads were opened in the middle of 274th urban block, and the urban block was divided into three parts.	increasing the street width • It will prevent you from benefiting from the cooling effect of the wind. • Increasing street widths will cause thermal differences in semi-open spaces to increase.
• In the traditional Suriçi street pattern, the facade orientation faces the courtyard for climatic and privacy reasons. Street Silhouette comprises blind facades and bay window passages (Direk, 2006; Ergin et al., 2020). Houses are primarily single and two-storey. • Houses are primarily single and two-storey.. • In areas where historical buildings are concentrated, the number of floors is determined as 2 (Kejanlı & Dinçer, 2011).	• Windows were opened on the facades overlooking the street, and the privacy issue was ignored. • The Conservation Development Plan designed the floor heights that form the street silhouette.	• Opening windows on facades facing the street will cause uncontrolled solar radiation to reach the interior, decreasing thermal comfort.

CONCLUSIONS AND RECOMMENDATIONS

The Historical Suriçi Urban Fabric is a cosmopolitan city that has hosted many past and present civilizations. The fact that the Suriçi region was the city's first settlement made it necessary for daily life to take place in this area for a long time. After 1950, migrations took place from the countryside to the region, and the face of the Suriçi urban fabric began to deteriorate. Due to internal migration, the region's population increased daily, and the housing stock remained insufficient. This situation has led to the emergence of the problem of illegal construction that does not belong to the original pattern. The buildings built by people with different socio-economic levels to meet their own shelter needs without a license have disrupted the continuity of the historic environment. After the conflict in 2015, urban renewal projects began to be implemented in areas that suffered physical destruction in the historical pattern. The reconstruction process initiated in Alipaşa-Lalebey Neighborhood aimed to design new living spaces compatible with the historical environment. In order to ensure the sustainability of the traces of the original pattern in new housing textures, we aimed to revise the Conservation Development Plan and create urban renewal projects in line with this plan. In this context, within the scope of the study, the urban transformation experienced in the Traditional Suriçi urban fabric has already been evaluated within the framework of passive cooling criteria. If the urban renewal project at the street texture scale is compared with the Conservation Development Plan, it can be seen that the urban block sizes, street widths, road network hierarchy and cross-sections, urban surface areas, the street facade are not designed by the Conservation Plan

DOI: 10.15320/ICONARP.2024.287

(Table 7). It has been shown that the pattern losses experienced in urban blocks will increase the street flooring areas, leading to the heat island effect and disrupting indoor-outdoor thermal comfort. It has been determined that the changes in the façade silhouette and characteristic features of the new housing texture are unsuitable for the design approach based on the original pattern.

Table 7: Changes in the Effects of Alipaşa-Lalebey Neighborhood on Passive Cooling Criteria

Passive Design Criteria		Effect on Passive Cooling Criteria
Urban components are protected according to the Conservation Development Plan	Compact City Form and Urban Density	In the traditional Suriçi urban pattern settlement configuration, the compact city form was created in line with microclimatic components such as the sun and wind. High-density and compact city form contributes to thermal comfort by increasing the shadow effect in urban areas.
	Mixed Land Use	Mixed land use encourages pedestrian access and reduces the use of fossil-based vehicles. This helps to provide a sustainable energy-saving future.
	Courtyard Settlement Pattern	Courtyard typology, which is shown as the most effective form of urban shading in hot-dry climate regions, is a form that shows high performance in terms of outdoor thermal comfort, daylight potential, natural ventilation, and cooling loads. The ratio between the height of the buildings (H) and the width of the courtyard (W) increases thermal comfort by reducing solar radiation in hot and dry climates.
	Parks and Recreation Areas	Recreation areas with both public and microclimatic effects provide outdoor thermal comfort in the hot-dry climate region.
	Ensuring Public-Semi-Private-Private Space Hierarchy in Transitions to Urban Areas	Conservation of spatial hierarchy is essential for urban memory and urban identity...
	Floor Heights and Silhouette	The floor heights of the reconstructed buildings were designed following the traditional houses.
	The Scale of Urban Blocks	There were losses in urban block sizes in all five regions. Increasing urban surfaces

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Changing components in the urban fabric of Suriçi within the scope of the Urban Renewal Project		will increase street pavements' surface temperature and cause heat island formation. Pattern losses in the urban block will reduce the shadow effect and cause the facade surfaces to warm up, decreasing indoor thermal comfort. This will result in passive cooling design inputs needing to be used optimally.
	The Scale of Parcel	Some parcels have been evacuated to ensure security and emergency transitions. The change in the layout has also altered the sizes of some parcels on the urban block. Consequently, the shadow effect and the courtyard-parcel relationship have been disrupted.
	Street Width	Some parcels were evacuated to ensure security and emergency passage. The change in urban block size has also changed some parcel sizes. In this context, the shadow effect and the courtyard-plot relationship are disrupted.
	Solid-Void Relationship	The decrease in solid-void percentages has disrupted the organic compact narrow street pattern. The decrease in the shadow effect will increase the surfaces exposed to solar radiation, leading to the heat island effect. This will result in passive cooling strategies not being used effectively.
	Street Pattern -Courtyard Relationship	The retreat of the buildings has led to the formation of the front garden concept, which is separate from the traditional pattern design approach. The change in the building-plot-block spatial hierarchy has caused the courtyard ratios to decrease and the solid-void relationship to change. This situation will lead to a temperature increase due to the shadow effect and affect the applicability of passive cooling strategies.
	Road Network And Hierarchy	The width of the main arterial roads in Suriçi city center has been increased due to emergency reasons, and passages to the main arteries have been provided from all urban blocks. In addition, roads have been opened between the streets to ensure the continuity of urban block crossings. This situation disrupted the road hierarchy and prevented the application of passive cooling strategies based on the shadow effect.
	Road Cross Sections	It has been determined that road widths increase in cross sections, and all arteries are designed to allow vehicle passage. This will result in the formation of more exposed surfaces to the sun and will lead to the heat island effect.

DOI: 10.15320/ICONARP.2024.287

	Street Facade Character	Within the scope of the urban renewal project, window surfaces were opened on all street facades. This will cause uncontrolled penetration of solar radiation into the building through transparent surfaces, decreasing indoor thermal comfort.

Traditional urban fabric and building typologies in hot-dry climate regions were designed using climate-responsive design strategies. They provided indoor and outdoor thermal comfort throughout the year without relying on mechanical or electrical-based systems. Especially in recent years, the climate crisis and the consumption of energy resources have changed the design approaches developed on an urban and architectural scale. Urban and building-scale design approaches have been developed by considering systems that take climatic features as a reference and are not dependent on any energy source. In this context, in the hot, dry climate region, passive cooling systems have been used in the traditional urban fabric and have guided today's contemporary building design. This study emphasizes the importance of developing design approaches that consider today's conditions and requirements and can use climate-responsive and passive systems when renovation work is carried out in a historical pattern. In addition, during the time until the reconstruction process's decision and implementation, design decisions considering the Conservation Development Plan should be made, and local and public administrations should carry out legal follow-up during the construction phase. This study has also shown that urban transformation projects not carried out per the Conservation Plan in a traditional pattern will disrupt the continuity of cultural heritage. In addition, the loss of urban blocks in the traditional fabric, the change in solid-void relations, and the differentiation of street patterns will not only destroy cultural heritage. However, it will also cause the characteristic approaches of many geographical designs to be kept from the next generation.

As a result of this study, a proposal can be presented to create an energy-efficient urban block and street pattern with an energy-efficient, sustainable, and integrated design approach that takes into account both local and today's contemporary conditions in transformation projects carried out in the historically protected area, with knowledge-based analyzes that take historical climatic design as a reference.

ACKNOWLEDGEMENTS/NOTES

The article is derived from the Doctoral dissertation conducted by Sevilay AKALP under the supervision of Prof. Dr. İdil AYÇAM at Gazi University, Graduate School of Natural and Applied Sciences, Department of Architecture.

REFERENCES

Abaas, Z. R. (2020). Impact of development on Baghdad's urban microclimate and human thermal comfort. *Alexandria Engineering Journal*, 59(1), 275–290.

Abanomi, W., & Jones, P. (2005). Passive cooling and energy conservation design strategies of school buildings in hot, arid region: Riyadh, Saudi Arabia. *In Proceedings of the International Conference Passive and Low Energy Cooling for the Built Environment*, Santorini, Greece (pp. 19-21).

Ahmadi, S., Yeganeh, M., Motie, M. B., & Gilandoust, A. (2022). The role of neighborhood morphology in enhancing thermal comfort and resident's satisfaction. *Energy Reports*, pp. 8, 9046–9056.

Akın, C. T., & Koca, C. (2017). Modelling Transportation Axes in Suriçi,(Diyarbakir, Turkey) and Determining their Relationship to Social Areas Allocated for Public Use. *Journal of Asian Architecture and Building Engineering*, 16(2), 333-339.

AlKubaisy, F. (2022). Significance of Courtyard House Design in the Arab World. The Importance of Greenery in Sustainable Buildings, 295-310.

Almatarneh, R. T. (2013). Energy-Efficient Building Design: Towards climate-responsive architecture-A case study of As-Salt, Jordan. *Advanced Research in Engineering Sciences* "A.R.E.S., 1(2), 23-38.

Alznafer, B. M. (2014). The impact of neighbourhood geometries on outdoor thermal comfort and energy consumption from urban dwellings: a case study of Riyadh city, the kingdom of Saudi Arabia (Doctoral dissertation, Cardiff University).

Abdallah, A. S. H., & Mahmoud, R. M. A. (2022). Urban morphology as an adaptation strategy to improve outdoor thermal comfort in urban residential community of new Assiut City, Egypt. *Sustainable Cities and Society*, 78, Article 103648. https://doi.org/ 10.1016/j.scs.2021.103648.

Aslan, M., & Dundar, M. (2022). Ecological and environmental effects of urban transformation: An example in Turkey. *Heritage and Sustainable Developmen*t, 4(1), 77-86.

Attia, S., & Gobin, C. (2020). Climate change effects on Belgian households: a case study of a nearly zero energy building. Energies, 13(20), 5357.

Aycam, I., & Varshabi, N. (2016). The analysis of form, settlement pattern, and envelope alternatives on building cooling loads in traditional Yazd houses of Iran. Gazi University Journal of Science, 29(3), 503–514.

Ayçam, İ., Akalp, S., & Görgülü, L. S. (2020). The application of courtyard and settlement layouts of the traditional Diyarbakır houses to contemporary houses: A case study on the analysis of energy performance. *Energies,* 13(3), 587.

Baharun, A., Yacob, S., Wahid, J., Ibrahim, S. H., Ngitar, V., Nawi, M. N. M., & Mohamed, O. (2020). Thermal Comfort Assessment: A Comparative Study of Passive Ventilation System in Modern and Malay Traditional House. *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, 75(3), 81-90.

Bahgat, R., Reffat, R. M., & Elkady, S. L. (2020). Analyzing the impact of design configurations of urban features on reducing solar radiation. *Journal of Building Engineering*, 32, Article 101664.

Baran, M., Yıldırım, M., & Yılmaz, A. (2011). Evaluation of ecological design strategies in traditional houses in Diyarbakir, Turkey. *Journal of Cleaner Production*, 19(6-7), 609-619.

Bekleyen, A., & Melikoğlu, Y. (2021). An investigation on the thermal effects of windcatchers. Journal of Building Engineering, 34, 101942.

DOI: 10.15320/ICONARP.2024.287

Baran, M. (2017). Eski Diyarbakır Evleri İklim İlişkisi. Dicle Üniversitesi Mühendislik Fakültesi Mühendislik Dergisi, 8(2), 423-430.

Beysanoğlu, Ş. (1999). "Diyarbakır History From Its Founding To The Present", Müzeşehir Publication, Istanbul.

Bodach, S., Lang, W., & Hamhaber, J. (2014). Climate responsive building design strategies of vernacular architecture in Nepal. *Energy and Buildings*, 81, 227-242.

Chen, J., Pellegrini, P., & Ma, G. (2021). Identifying resettlement communities' urban regeneration opportunity through GIS-based spatial analysis in Suzhou Metropolitan Area. *Urban Reg. Plan*, 6, 146.

Darçın, P. (2020). Design Principles for Ventilation with Regenerative Results: Vernacular Diyarbakır Houses. Megaron, 15(4).

DeKay, M., and G. Z. Brown. 2014. Sun, Wind & Light: Architectural Design Strategies. 3rd ed. NJ: Wiley.

Demir, H. (2021). Dicle (On Gözlü) Köprüsü'nün Somut Ve Somut Olmayan Miras Olarak Korunması. *Milli Folklor*, 17(132), 226-249.

Direk, Y. S. (2006). The Effect of Socio-Cultural Structure on Housing Formation: Diyarbakır Example. Electronic Journal of Social Sciences, 5(16), 105-113.*Diyarbakır Governorship Publication*: Diyarbakir, Turkey, 2011.

Dwiputra, I. D., Mt, I. W. K., & Winarso, H. (2021, April). Impact of urban block typology on microclimate performance in a hot-humid high-density city. *In IO. Conference Series: Earth and Environmental Science* (Vol. 738, No. 1, p. 012067). IOP Publishing.

Erdemir, İ. (2014). Sıcak-kuru iklim bölgelerinde enerji korunumu-yerleşme dokusu-form etkileşimi: geleneksel Diyarbakır evleri örneği (Doctoral dissertation, Fen Bilimleri Enstitüsü).

Ergin, Ü. Ş., Suna, K., Yılmaz, M. Ö., & uysal, Ü. E. (2020). Evaluatıon of the Climate Comfort Satisfacton in Traditional Houses of Diyarbakır Suriçi Region. *Online Journal of Art & Design*, 8(4).

Fahmy, M., & Sharples, S. (2009). On the development of an urban passive thermal comfort system in Cairo, Egypt. *Building and Environment,* 44(9), 1907-1916.

Fahmy, M., Elwy, I., & Mahmoud, S. (2022). Back from parcel planning to future heritage of urban courtyard: The 5th generation of Egyptian cities as a sustainable design manifesto for neo-arid neighbourhoods. *Sustainable Cities and Society*, 87, 104155

Ferrari, A., Kubilay, A., Derome, D., & Carmeliet, J. (2020). The use of permeable and reflective pavements as a potential strategy for urban heat island mitigation. *Urban Climate*, 31, 100534.

Forouzandeh, A. (2018). Numerical modeling validation for the microclimate thermal condition of semi-closed courtyard spaces between buildings. Sustainable Cities and Society, 36, 327-345.

Foster, S. (2021). Improved Thermal Comfort for Hawai 'i's Elementary Schools: Designing an Educational Building for Thermal Comfort Using Passive Design Techniques in the Hot and Humid Climate (Doctoral dissertation, University of Hawai'i at Manoa).

Galal, O. M., Mahmoud, H., & Sailor, D. (2020). Impact of evolving building morphology on microclimate in a hot arid climate. *Sustainable Cities and Society*, 54, 102011.

Givoni, B. (1994). Passive and low energy cooling of buildings. New York: John Wiley & Sons.

Groot, A.M.E.; Bosch, P.R.; Buijs, S.; Jacobs, C.M.J.; Moors, E.J. Integration in urban climate adaptation: Lessons from Rotterdam on integration between scientific disciplines and integration between scientific and stakeholder knowledge. *Build. Environ.* 2015, 83, 177–188.

Han, D., Zhang, T., Qin, Y., Tan, Y., & Liu, J. (2023). A comparative review on the mitigation strategies of urban heat island (UHI): a pathway for sustainable urban development. *Climate and Development*, 15(5), 379–403.

Hastings, R.S. (1989). Computer Design Tools for Climate-Responsive Architecture in Solar and Wind Technology, vol. 6, issue 4, pp. 357-363.

Hatipoğlu, H. K., & Mohammad, S. (2021). Courtyard in Contemporary Multi-Unit Housing: Residential Quality with Sustainability and Sense of Community. *İDEALKENT*, 12(33), 802-826.

Haydarovich, B. M., Yarkulov, Z. R., & Mashrab, P. (2023). Main Characteristics of Geoinformation Technologies and Modern Gis. Web of Synergy: International *Interdisciplinary Research Journal*, 2(2), 194-200.

IEA. (2022). World energy outlook 2022. Paris, France: IEA.

Change, I. C. (2014). Mitigation of climate change. Contribution of working group III to the fifth assessment report of the intergovernmental panel on climate change, 1454, 147.

İpek, B. (2020). Reconstruction of demolished historical cities, Diyarbakır-Suriçi case study area. Master Thesis.

Jamei, E., & Rajagopalan, P. (2019). Effect of street design on pedestrian thermal *comfort. Architectural Science Review*, 62(2), 92–111. https://doi.org/10.1080/ 00038628.2018.1537236.

Jiang, H. Y., Zhou, C. S., & Xiao, R. B. (2010). Spatial differentiation and social equity of public parks in Guangzhou. City Planning Review, pp. 4, 43–48.

Jin, F., Wang, C., Zhou, X., & Wang, C. (2022, December). Application of ArcGIS Spatial Analysis Techniques on Topography Teaching. In 2nd International Conference on Internet, *Education and Information Technology* (IEIT 2022) (pp. 413–418). Atlantis Press.

Kaihoul, A., Sriti, L., Amraoui, K., Di Turi, S., & Ruggiero, F. (2021). The effect of climate-responsive design on thermal and energy performance: A simulation-based study in the hot-dry Algerian South region. *Journal of Building Engineering*, 43, 103023.

Kara, O. E. (2019). Kentsel dönüşümün makro form etkileri: Diyarbakır ili merkez sur ilçesi örneği (Master's thesis, Aksaray Üniversitesi Fen Bilimleri Enstitüsü).

Kejanli, D. T., & Dinçer, İ. (2011). Conservation and Planning Problems in Diyarbakır Castle City, 95-108.

Kenawy, I. M., Afifi, M. M., & Mahmoud, A. H. (2010, November). The effect of planting design on thermal comfort in outdoor spaces. In Proceedings of the First International *Conference on Sustainability and the Future*, Egypt, Cairo (pp. 23-25).

Khalid, Z., Abaas, Z. R., & Fadhil, A. (2021). Achieving urban sustainability by revitalizing the performance of Islamic geometric pattern on residential façades. *Periodicals of Engineering and Natural Sciences*, 9(4), 729-743.

Korkma, M. (2016). Socio-economic dimensions of urban transformation (Diyarbakir sample). Master thesis.

Lima, I., Scalco, V., & Lamberts, R. (2019). Estimating the impact of urban densification on high-rise office building cooling loads in a hot and humid climate. *Energy and Buildings*, 182, 30-44.

DOI: 10.15320/ICONARP.2024.287

Lowe, S. A. (2016). An energy and mortality impact assessment of the urban heat island in the US. Environmental Impact Assessment Review, pp. 56, 139–144.

Mahmoud, H., Ghanem, H., & Sodoudi, S. (2021). Urban geometry as an adaptation strategy to improve the outdoor thermal performance in hot arid regions: Aswan University as a case study. *Sustainable Cities and Society*, 71, 102965.

Maphill. (n2024). Diyarbakır Map. https://www.maphill.com

Manioğlu, G. & Koçlar Oral, G. (2012). Evaluation of domestic dwellings in hot and dry region of Turkey concerning thermal comfort and energy efficiency. *5th International Building Physics Conference*, Kyoto, Japonya.

Manioğlu, G. ve Yılmaz, Z (2007). Energy-efficient design strategies in the hot, dry area of Turkey. *Building and Environment*, Vol. 43(7), 1301–1309.

Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S. L., Péan, C., Berger, S., ... & Zhou, B. (2021). Climate change 2021: the physical science basis. Contribution of working group I to the sixth assessment report of the Intergovernmental panel on climate change, 2.

Mirzaei, P. A., & Haghighat, F. (2010). Approaches to study urban heat island–abilities and limitations. *Building and Environment*, 45(10), 2192-2201.

Motealleh, P., Zolfaghari, M., & Parsaee, M. (2018). Investigating climate responsive solutions in vernacular architecture of Bushehr city. *HBRC journal,* 14(2), 215-223.

Muniz-G¨ aal, L. P., Pezzuto, C. C., Carvalho, M. F. H.d., & Mota, L. T. M. (2020). Urban geometry and the microclimate of street canyons in tropical climate. *Building and Environment*, 169, Article 106547.

Najah, F. T., Abdullah, S. F. K., & Abdulkareem, T. A. (2023). Urban Land Use Changes: Effect of Green Urban Spaces Transformation on Urban Heat Islands in Baghdad. *Alexandria Engineering Journal*, 66, 555-571.

Olgyay, V. (1963). Design with Climate – bioclimatic approach to architectural regionalism. Princeton: Princeton University press

Oruç, Ş. E. (2017). Diyarbakır Suriçi bölgesindeki geleneksel konut mimarisinde iklimsel faktörlerin rolü. *Dicle Üniversitesi Mühendislik Fakültesi Mühendislik Dergisi,* 8(2), 383-394.

Ouyang, W., Morakinyo, T. E., Ren, C., & Ng, E. (2020). The cooling efficiency of variable greenery coverage ratios in different urban densities: A study in a subtropical climate. *Building and Environment*, 174, Article 106772.

Panarelli, G., Di Tonno, C. and Spiegelhalter, T. (2016). Climate Responsive Architecture, Climate Change Adaption and Resource Efficiency, Franco Angeli s.r.l, Milano, ISBN 9788 891736628.

Peker, E. (2016). Provision of urban thermal comfort: a socio-technical approach to climate responsive urban design (Doctoral dissertation, University of Reading).

Peng, Y., Feng, T., & Timmermans, H. (2019). A path analysis of outdoor comfort in urban public spaces. *Building and environment*, 148, 459-467.

Piquer, B. M. (2003). A Strategy for Sustainable Development of the Built Environment for the Mediterranean Climate. University of Strathclyde.

Pour, Y. L. (2011). Reinterpretation Towards Climate Responsive Architecture: Possibility to Implement the Principles of Persian Vernacular Housing into Contemporary Architecture (Doctoral dissertation, MS thesis, National University of Malaysia. DOI: 10.13140/RG. 2.1. 5018.6322).

Rakoto-Joseph, O., Garde, F., David, M., Adelard, L., Randriamanantany, Z.A. (2009). Development of climatic zones and passive solar design in Madagascar. *Energy Conversion and Management*, 50(4), 1004–1010.

Ridha S. Urban Heat Island mitigation strategies in an arid climate Is outdoor thermal comfort reacheable 2017; vol. 1, no. Lmdc:141.

Salameh, M., Mushtaha, E., & El Khazindar, A. (2023). Improvement of thermal performance and predicted mean vote in city districts: A case in the United *Arab Emirates. Ain Shams Engineering Journal*, 14(7), 101999.

Sami, H. (2021). Sustainability Analysis of Climate Responsive Elements in Erbil Vernacular Architecture. Eurasian Journal of Science and Engineering, 7(1).

Santamouris, M., Papanikolaou, N., Livada, I., Koronakis, I., Georgakis, C., Argiriou, A., & Assimakopoulos, D. N. (2001). On the impact of urban climate on the energy consumption of buildings. Solar energy, 70(3), 201-216.

Saraydar, M., & Arabi, R. (2015). Climate Effect on Architecture: A Comparative study between Climate Responsive Architecture of Iran and Egypt. *Current World Environment*, 10(Special Issue), 928.

Semahi, S., Zemmouri, N., Singh, M. K., & Attia, S. (2019). Comparative bioclimatic approach for comfort and passive heating and cooling strategies in Algeria. *Building and Environment*, 161, 106271.

Soleymanpour, R., Parsaee, N., & Banaei, M. (2015). Climate comfort comparison of vernacular and contemporary houses of Iran. *Procedia-Social and Behavioral Sciences*, 201, 49–61.

Soyukaya, N. (2015). Diyarbakır Kalesi ve Hevsel Bahçeleri Kültürel Peyzajı Yönetim Planı. L'Hevsel à Amida-Diyarbakır: Études et Réhabilitation de Jardins Mésopotamiens. Istanbul: Institut Français D'études Anatoliennes.

Sözen, İ., & Oral, G. K. (2019). Outdoor thermal comfort in urban canyon and courtyard in hot arid climate: A parametric study based on the vernacular settlement of Mardin. *Sustainable Cities and Society*, 48, 101398.

Takebayashi, H., & Moriyama, M. (2012). Relationships between the properties of an urban street canyon and its radiant environment: Introduction of appropriate urban heat island mitigation technologies. *Solar Energy*, 86(9), 2255-2262.

Topfer, K. (2009). Energy efficiency in buildings: transforming the market. Atar Roto, 3(6).

Tuncer, O. C. (1999). Diyarbakır houses. Diyarbakır Metropolitan Municipality Culture and Art Publication, Diyarbakır [in Turkish], 7-571.

Turkish State Meteorological Service (2022).

Van Hooff, T.; Blocken, B.; Hensen, J.L.M.; Timmermans, H.J.P. Reprint of: On the predicted effectiveness of climate adaptation measures for residential buildings. *Build. Environ*. 2015, 83, 142–158.

Vatan Kaptan, M. (2020). Climate-responsive design strategy for Erbil city. Archnet-IJAR: *International Journal of Architectural Research*, 14(1), 90-111.

Xu, L., Wang, J., Xiao, F., Sherif, E. B., & Awed, A. (2021). Potential strategies to mitigate the heat island impacts of highway pavement on megacities with considerations of energy uses. *Applied Energy*, 281, 116077.

Yakut, M. E., & Ceylan, M. A. (2019). A Geographıc view on the effects of Diyarbakır Suriçi urban transformatıon project on population and settlement. *Journal Of International Social Research*, 12(63).

DOI: 10.15320/ICONARP.2024.287

Yang, W., Xu, J., Lu, Z., Yan, J., & Li, F. (2022). A systematic review of indoor thermal environment of the vernacular dwelling climate responsiveness. *Journal of Building Engineering*, 53, 104514.

Yıldırım, M. (2020). Shading in the outdoor environments of climate-friendly hot and dry historical streets: The passageways of Sanliurfa, Turkey. *Environmental Impact Assessment Review*, p. 80, Article 106318. https://doi.org/10.1016/j.eiar.2019.106318

Zare, M., & Ghanbari, J. (2022). Comparative Analysis of Vernacular Passive Cooling Techniques in Hot Humid Regions. *International Journal of Applied Arts Studies (IJAPAS)*, 7(2), 43-54.

Zhang, A., Zhen, Q., Zheng, C., Li, J., Zheng, Y., Du, Y., ... & Zhang, Q. (2023). Assessing the impact of architectural and behavioral interventions for controlling indoor COVID-19 infection risk: An agent-based approach. *Journal of Building Engineering*, 74, 106807.

Resume

Sevilay AKALP is an architect and university lecturer. She completed her master's degree at Dicle University in 2018 and is currently pursuing her Phd in the Department of Architecture at Gazi University. Currently works as a Lecturer in the Department of Architecture at Harran University. Major research interests include computational design, energy analysis modelling and sustainable building design.

İdil AYÇAM is an architect and university lecturer. She received her MSc and PhD in Architecture from the Faculty of Architecture at Gazi University. She is currently working as a professor at Gazi University and serves as the head of the Architecture Department. Her major research interests include green buildings, energy-efficient design, and sustainable building design.

Research Article

ICONARP
International Journal of Architecture and Planning
Received: 29.09.2023 Accepted: 29.03.2024
Volume 12, Issue 1/ Published: 30.06.2024
DOI: 10.15320/ICONARP.2024.288 E- ISSN:2147-9380

ICONARP

A Strategy for Spatializing Degrowth at Home: Commoning of Housing

Gamze Öztürk*
Ayşe Şentürer**

Abstract

Many theorists advocate for "economic degrowth," which entails "scaling down production and consumption activities," as a radical proposal to achieve environmental sustainability and social justice. This is in response to the increasingly destructive nature of economic growth on a planet with limited resources, as well as the unequal distribution of the costs associated with changes to planetary boundaries. The examination of spatial production and consumption processes holds significant potential for realizing the social transformation required for economic activities to operate within planetary boundaries. However, the scarcity of studies on how the ideas of degrowth can be translated into the material world highlights the need to focus on how degrowth will manifest spatially. The problem of spatializing degrowth will be addressed in this study, with a focus on housing. The injustices inherent to growth-oriented housing production processes make it imperative to discuss the spatialization of degrowth through housing. For degrowth to manifest spatially at home, the spatial modes of production inherent to economic growth, the spatial consumption patterns, and the social relations produced by space need to become compatible with the fundamental goals of degrowth. To provide a compass for aligning housing production and consumption processes with the fundamental objectives of degrowth, it is imperative to identify the toolkit employed by economic growth for spatialization and to analyze criticisms directed against existing housing degrowth experiments. Through the analysis of these two principal themes, commoning of housing emerges as a viable strategy for spatialization of degrowth at home.

Keywords:
Commoning of housing, Co-management, Co-ownership, Co-production, Spatializing degrowth

*Architecture, Istanbul Technical University, Istanbul, Turkey. (*Corresponding author*)

Email: ozturkga@itu.edu.tr

**Architecture, Istanbul Technical University, Istanbul, Turkey.

Email: senturer@itu.edu.tr

To cite this article: Öztürk, G., & Şentürer, A. (2024). A Strategy for Spatializing Degrowth at Home: Commoning of Housing. *ICONARP International Journal of Architecture and Planning,* 12 (1), 368-390. DOI: 10.15320/ICONARP.2024.288

INTRODUCTION

Until recently, human economic activities had a relatively insignificant impact on the functioning of natural systems compared to the potent forces of geological processes. However, it has become increasingly evident that human economic activities now wield a power that rivals, and even surpasses nature's own ability to alter natural cycles and impact the functioning of the planetary system. Furthermore, the pace and magnitude of change resulting from human economic activities far exceed the changes occurring in the planet's own natural cycles. Therefore, it is of utmost urgency to take immediate action to prevent sudden changes resulting from the erosion of the planet's boundaries. Scientists have identified safe threshold, referred to as the 'Nine Planetary Boundaries', within which the earth system can sustain its functioning as observed during the Holocene period.[1] To avoid sudden changes, it is imperative not to surpass these boundaries. Furthermore, experts warn that such changes may disproportionately affect vulnerable populations, as the associated costs are not equally distributed. This underscores the urgency of addressing not only the erosion of the planet's boundaries but also of social relations. The distinctive feature of capitalism, the dominant economic system, is its relentless pursuit of growth. For capitalism to thrive, individuals have historically been deprived of access to free resources, compelled to engage in paid labour, coerced into prioritizing competitive productivity over personal production, and transformed into dependent consumers. These conditions persist to this day. However, in the late 20th century, this growth-centric economic system underwent a restructuring with adoption of neoliberal principles. This led to the globalization, liberalization and privatization of economies, alongside the emergence of universal competition. Sustaining growth requires the identification of more efficient production methods, cheaper labour, access to new natural resources, and expansion of markets. However, the ever-escalating extraction of resources from increasingly distant locations and their distribution to more distant markets, as well as the absorption of growing quantities of waste, exert mounting pressure on ecosystems. The reliance on Gross Domestic Product (GDP)[2] as a measure of economic growth perpetuates the promotion of resource extraction, production, and consumption. Historical data analysis indicates that resource use increases along with GDP growth. On the other hand, many scientific studies proved that an increase in GDP does not necessarily lead to an increase in overall well-being (Hickel, 2022, p. 189). Moreover, growth-oriented policies burden vulnerable demographic groups through processes of displacement, dispossession, and ecological ramifications. Referred to as "calculated neglect" in the literature (Angus, 2021, p. 213), these policies worsen socio-economic inequalities. According to Hickel, data from the Climate Vulnerability Monitor reveals that low-income countries bear the brunt of the costs of environmental destruction, accounting for 82% of the overall impact. In 2010 alone, these nations incurred a staggering cost of $571 billion due to events such

[1] Nine Planetary Boundaries refer to the following areas of concern: climate change, changes in biospheric integrity (biodiversity loss), biogeochemical flows (an excess of nitrogen and phosphorus from artificial fertilizers), stratospheric ozone depletion, ocean acidification (CO2 dissolves in seawater, making it acidic), freshwater use (rivers being drained for agriculture), land-system change (about 42 per cent of ice-free land is used for farming), atmospheric aerosol loading, introduction of novel entities (chemical pollution) (Angus, 2021, p. 95).

[2] Simon Kuznets created a metric called Gross National Product, which provided the basis for the Gross Domestic Product (GDP) metric we use today. During World War II, governments needed to account for all economic activities, including negative ones, in order to identify every available shred of money and productive capacity for the war effort. At the Bretton Woods Conference in 1944, global leaders convened to establish the rules that would govern the world economy in the wake of the war. At this conference, GDP was established as the key indicator of economic progress. When the OECD was established in 1960, its primary objective, as outlined in its charter, was to 'promote policies designed to achieve the highest sustainable rate of economic growth'. The focus shifted from pursuing production for specific purposes to pursuing the highest rate indefinitely for its own sake (Hickel, 2022, p. 109-111).

DOI: 10.15320/ICONARP.2024.288

as droughts, floods, storms, and forest fires. This figure is expected to rise to $954 billion by 2030, representing %92 of the total costs. It is also worth noting that over 98% of deaths caused by ecological destruction occur in poor countries (2022, p.132).

The Costs of Economic Growth, a book by Ezra J. Mishan in 1967, and the 1972 report, The Limits to Growth, argue that growth pushes ecological and social limits. This topic has been a subject of ongoing debate. As noted by Plotnikova (2020), the 1972 report highlights that expanding the economy through resource extraction becomes increasingly more destructive and ultimately unattainable on a planet with finite resources. The commonly held belief that non-growth economies would lead to collapse starkly contrasts with the environmental damage and social inequalities perpetuated by growth-oriented policies. Parrique et al. assert that mainstream approaches such as green growth and sustainable development, developed to counter the global environmental crisis, are based on the strategy of decoupling economic growth from environmental impacts. However, both theoretically and empirically, this strategy has been shown to be unfeasible (2019). Sustainable development or green growth is inadequate in addressing the issue at hand because these frameworks operate under the assumption that technological advancements can eliminate the environmental impacts of growth, while disregarding the social strains imposed by growth. However, the urgency we face extends further than the erosion of planetary boundaries, reaching into social boundaries. There is a growing argument that the existing economic system's persistence presents a significant challenge in restoring the environmental and social limits that have been eroded by growth. Instead of predicting future scenarios without making any changes to our current state, it seems imperative to enact changes in the present moment based on what kind of future we envision. Thus, there is an urgent need for a fundamental shift in the economic order. Several scholars suggest that adopting the notion of degrowth, which entails reducing economic activity to align with planetary limits, could present a viable solution for substantial transformation. (Figure 1)

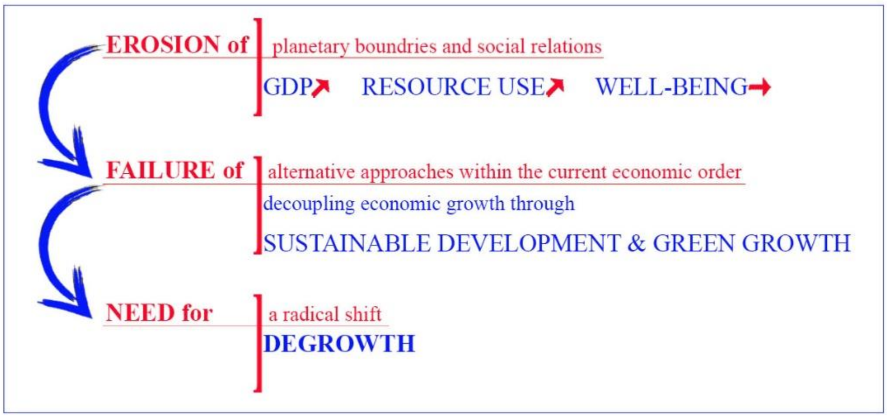


Figure 1. An urgent need for a radical shift: Degrowth.

However, in the literature on degrowth, there is limited discussion about how degrowth ideas can be implemented in the material world. Degrowth researchers have conducted numerous studies to reveal the property relations inherent in capitalist production processes, including enclosure, displacement, and privatization. However, in order for degrowth to replace capitalist production processes, there is a need for micro and macro level planning that will reverse such relationships and reorganize production processes by using alternative tools. The identification of new tools to replace those inherent in capitalist production processes, along with regulation of their purposes and domains of use, is an urgent matter. Based on the literature review conducted, this article primarily explains the concept of degrowth and highlights the problem of spatializing degrowth ideas. Subsequently, the article will address the significance of the home in the context of degrowth and emphasize the urgency of the spatialization of degrowth at home. It will delve into what housing degrowth entails and discuss various housing degrowth experiments. The need for developing a strategy for the spatialization of degrowth at home will be explained, and in the process of formulating this strategy, the toolkit used to spatialize economic growth and critiques developed for existing housing degrowth experiments will be examined as a compass. In the last section, "commoning of housing" as a strategy for the spatialization of degrowth at home will be discussed. (Figure 2)

Figure 2. The key headings of the study.

THE CONCEPT OF DEGROWTH AND THE PROBLEM OF SPATIALIZING DEGROWTH IDEAS

The acknowledgement that economic activities grounded on a binary worldview, which prioritizes humans over other living species, are responsible for environmental destruction has led to a revival of degrowth concepts in the realm of ecological economics. These concepts, which are based on interdependence, have been advocated not only by economists but also by philosophers, social scientists, and indigenous activists. The term décroissance was first introduced by André Gorz, an Austrian-born French philosopher and pioneer of political ecology, who

DOI: 10.15320/ICONARP.2024.288

emphasized that the capitalist system poses a danger to the sustainability of ecosystems and that sustainability can be achieved by reducing production rather than promoting growth (1972). The degrowth debate was deepened by works such as ecologist Howard Thomas Odum's Environment, Power, and Society (1971), economist Nicholas Georgescu-Roegen's The Entropy Law and the Economic Process (1971), which highlights the limits of growth based on the second law of thermodynamics, and Framtiden i våre hender (The Future in Our Hands, 1972) by environmentalist Erik Dammann (Paulson, 2017, p. 427). Herman Daly, one of the founders of ecological economics and a student of Georgescu-Roegen, introduced the concept of the 'steady-state economy', positing it as a sustainable model. Daly claimed that this structure, which was maintained by minimal flows of matter and energy, would provide inspiration for future degrowth thinkers (Işıkara, 2021, p. 2). According to Kallis (2018), French thinker Serge Latouche, a prominent figure in the degrowth movement, claims that the market economy, which continuously expands the commodity frontiers, is a 'modern –politically and socially constructed– invention' (p. 4-6). These ideas were echoed in the radical green movements of the 1970s and 1980s, which adopted an anti-productive position and advocated values such as social justice and democracy. However, according to the Research and Degrowth team (2023), these movements were overshadowed by the official environmental movements of the 1990s when neoliberalism was on the rise. The initial phase of the degrowth debate in the 1970s focused on the limits of growth, whereas the second phase, in the early 2000s, criticized the prevailing concept of sustainable development. Degrowth, as a proposal to depart from the current system, positions itself against the growth-oriented capitalist economic order, suggesting a post-growth, post-capitalist, or post-development movement. In other words, degrowth is first and foremost a critique of the growth-oriented economic order. It offers a fundamentally different approach to meeting our needs compared to growth, as it envisions a society where human needs are fulfilled while respecting planetary boundaries. The degrowth movement advocates for scaling down production and consumption activities to promote environmental sustainability and social justice. However, degrowth is not simply focused on downscaling. It can be characterized as a political, social, cultural, and environmental movement, offering a vision of a more equitable and sustainable society. According to Demaria et al. (2013), degrowth primarily prioritizes ecological concerns, valuing the environment for its inherent worth rather than merely as a means to support human production and consumption. This approach advocates for both environmental sustainability and environmental justice, as it involves reducing the demand for natural resources while also addressing human rights violations arising from restrictions on access to common areas where local communities sustain their lives, particularly in regions with intensive resource extraction. Furthermore, degrowth critiques economism, which is driven by the pursuit of maximizing utility, results in market-based social relations and the development of consumer-oriented societies, thus undermining the traditional social ties founded on principles of sharing and reciprocity. It is possible to assert that the cultural context of degrowth debate invites contemplation on the lifestyles transformed by economism. Furthermore, according to Demaria et al. (2013), the proposition to achieve justice by reducing economic, environmental, or social inequalities through redistribution, alongside the effort to redefine the concept of a ”good life” shed light on the societal context in which degrowth discussions are grounded. To pave the way for a better life, it is crucial to prioritize redistribution, promote a fair sharing mindset, and ensure that everyone's basic needs are met. Thus, the third pillar of degrowth lies in the necessity to redefine the concept of well-being or quality of life. As explained by Hickel (2022), it seeks to balance the economy with the natural environment by decreasing energy and resource consumption. This approach has the potential to improve human lives, a fundamental principle of degrowth (p.50).

Essentially, degrowth involves discovering methods for living that respects planetary boundaries while achieving a more equitable society by reducing the social metabolism. Degrowth envisions a society with a smaller metabolism and a different metabolic structure (D'Alisa et al., 2020, p. 21). Therefore, it encompasses not only the social production but also the reproduction of social relations. Merely changing modes of production is insufficient; there is a need to fundamentally reorganize societies. The concept of degrowth advocates for a new economic understanding centered around self-sufficiency through shared work, resources, space, and knowledge. It envisions a social ethos that prioritizes "having enough" over "having more" (Olsen et al., 2019, p. 33). However, this is not to suggest a society contented for less, but rather one that is convivial through sharing. Degrowth strategies focus on co-production for use rather than exchange, where goods are distributed on a reciprocity basis rather than for profit (D'Alisa et al., 2020, p. 34-35). By gifting goods to those in need or receiving gifts in times of need, individuals can show solidarity without participating in the market economy, thereby creating opportunities for a better life. This is an exploration of the potential for leading happier and healthier lives which requires a significant shift away from the pressure to be productive and consumption-driven habits that surround us. On the other hand, achieving a better life involves ensuring equitable access to basic needs such as food, healthcare, education and housing for everyone. Certainly, exploring how this can be achieved falls within the scope of degrowth debates. Martinez-Alier et al. (2010) argue that degrowth challenges not only the dominant ideology of growth, but also the social mentality, political institutions, and ethical premises that underpin it. Therefore, degrowth extends beyond the simple proposal for downsizing; it calls for a profound transformation in economic, social, political, and various

DOI: 10.15320/ICONARP.2024.288

other systems. Degrowth encompasses numerous transformative processes as it proposes a systemic change. Identifying the values, norms, and institutions in need of transformation is of critical importance in transitioning to a new order centered around degrowth. However, conducting studies on how the identified values, norms, and institutions can transform at both micro and macro levels appears to be equally critical. Degrowth proposes a set of values encompassing social justice, ecological improvement, interdependence, and human flourishing. Spatial production processes is vital for disseminating this set of values.

Here, the question arises: how can the transformation of values related to production and consumption processes be realized in the material world? In academic studies, there is a limited discussion on how degrowth ideas can be implemented in the processes of space production/consumption. However, expanding upon Lefebvre's (1976) assertion, which emphasized that the changes in the production/consumption of space played a pivotal role in explaining capitalist development throughout the 20th century, Harvey points out that capitalist development is an ongoing process that demands the production of spaces for communication, transportation, infrastructural development, and territorial organizations to facilitate the capital accumulation (Harvey, 2000, p. 54). Building on this, it can be argued that physical interventions are key to the social transformation required for the realization of degrowth ideas. Thus, the socio-ecological transformation aimed for by degrowth may be imagined through the processes of space production/consumption. Within these processes, there exists the possibility to reduce inequalities and improve human life through equitable redistribution of limited resources on our planet. Consequently, it becomes crucial to identify what kind of changes required within these processes. However, Xue asserts that degrowth debates have, so far, insufficiently acknowledged the crucial significance of spatial aspect in affecting social transformation (p. 405). Many other scholars also point out the gap between degrowth and its spatial aspect. In essence, academic literature emphasizes the urgent need for concretization of degrowth ideas (Van den Bergh 2011; Joutsenvirta 2016; Cosme, Santos, and O'Neill 2017). According to Wächter (2013), spatial planning holds significant potential to facilitate the shift towards degrowth, particularly through the promotion of sustainable settlement structures and the establishment of social capital via community-based facilities (p. 1067). Therefore, it is of great importance to have a profound comprehension of the spatial implications of degrowth and to explore the way in which space production/consumption processes can play a role in moving towards a degrowth-oriented future.

Here, spatializing degrowth refers to aligning the spatial production modes inherent to economic growth, the spatial consumption patterns, and the social relations produced by space with the fundamental goals of degrowth. Hence, spatializing degrowth entails harmonizing the physical and social production processes of space with the fundamental pillars of degrowth. The spatial production approach, which focuses on establishing environmental sustainability, aims to reduce material-energy flows generated during the production and utilization of space, effectively downsizing the social metabolism. Since space is where social relations are produced, spatial production processes should be shaped in a way that establishes social justice by prioritizing the needs of vulnerable social groups. To achieve primary goals of degrowth in the production and utilization of space, it is essential to consider not only changing the modes of production but also the reproduction of social relations. (Figure 3) As previously mentioned, there are few studies within the degrowth literature that addresses the issues around spatilization of degrowth in the sense described above, and among the limited research available, there exists a multitide of contrasting views. Krähmer (2022), who has conducted studies on the spatial aspect of degrowth, highlights that while proposals for degrowth can follow some common principles, degrowth researchers should avoid developing universally applicable hypotheses regarding the size and form of settlements (sf. 337-338). This article will address the problem of how degrowth can be translated into the material world, in other words, how it can be spatialized, with a particular focus on housing.

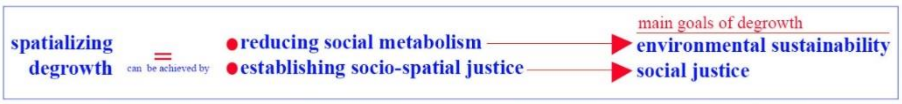


Figure 3. Description of spatializing degrowth.

THE IMPORTANCE OF SPATIALIZING DEGROWTH AT HOME AND THE CONCEPT OF HOUSING DEGROWTH

It is of great importance to explore how housing production/consumption processes can play a role in moving towards a degrowth future. The significance of home lies in its function as the place where everyday life is organized, providing the foundation for our aspirations regarding the kind of life we want to lead and the society we want to create. Our physical, social, and cognitive constructions of the home reflect our relationship with society and the planet, which profoundly affect the environment and society. By providing a foundation for autonomy and self-management, serving as a space for gaining experience and skills, and offering the basis for sharing space and knowledge, the home can be perceived as a convivial place rather than a fragmented one. Hagbert argues that the potential of the home lies precisely in the intersection of the physical, social, and cognitive aspects of 'the good life'. When the home is experienced as a place where individuals come together, it has the potential to become a focal point for fostering community bonds and social transformation (2019, p. 60-66). As discussed previously, improving human life has become a top priority within the field of degrowth. Although human needs may vary, housing is a basic need for everyone. Xue (2019) states that facilitating the fulfillment of basic human needs for all is a moral imperative, as defined in the 1948 United Nations Human Rights Declaration, which identifies

DOI: 10.15320/ICONARP.2024.288

access to a minimum standard of housing as a fundamental human right for all individuals and emphasizes the importance of distributive justice (p. 186). Given that housing is considered a fundamental human right and holds the potential for achieving the environmental and social transformation targeted by degrowth, examining how degrowth can be spatialized at home is of critical importance. The 2007-2008 global financial crisis vividly demonstrated the critical role of housing in both class struggle and political upheavals (Di Feliciantonio, 2017). While technological advancements are being employed to decouple the environmental impacts of housing production and utilization, challenges such as homelessness and accessibility continue despite the high rates of vacant housing stock. The injustices inherent to growth-oriented housing production processes make it imperative to discuss the problem of spatializing degrowth through housing, and housing needs to be prioritized as a key area for action. Despite the crucial role of the housing within the context of degrowth, considering its negative social and environmental impacts under growth dynamics, Weiss and Cattaneo (2017) found that only 4 out of every 91 articles in the degrowth literature address housing. However, limiting socio-spatial inequalities is a decisive objective of the degrowth agenda, and the widespread use of housing degrowth practices is of great importance in this regard.

Housing degrowth is a scenario that starts with housing as a fundamental right and continues with limiting the maximum cap per capita consumption and the equitable redistribution of the existing housing stock (p. 517, 533). In discussing the concept of housing degrowth, it is crucial to consider production processes, lifestyle habits, housing policies, and planning strategies. The objective of housing degrowth practices is not merely to provide an alternative to current production processes that operate with growth-oriented dynamics, but rather to explore the future of home for a more sustainable and equitable world. Housing degrowth is defined as 'a reduction of the total resources going into housing production and use, without an increase in inequality or a loss of well-being' (Tunstall, 2022, p. 1). It is important to note that housing degrowth aims not only to ensure environmental sustainability but also to enhance human life. Housing degrowth practices challenge the consumption-driven nature of housing inherent in capitalism and view home as a collaborative, convivial, sufficient, and non-commercial space. According to Mete (2022), reducing housing consumption is considered in the context of respecting environmental boundaries, while equitable redistribution strategies refer to transferring from those who possess large shares to those who possess less to achieve social justice. It is worth noting that buildings emit carbon dioxide during their construction, utilization, maintenance, and even demolition. According to Tunstall (2022), it is important to emphasize that the amount of embodied carbon dioxide generated during construction, maintenance, and demolition varies according to the size of the house, while the amount of operational carbon dioxide emitted during use varies depending on various characteristics of the house (p.7). The amount of embodied carbon dioxide decreases with longer lifespan of the house as the initial carbon expenditure is distributed over an extended period of time. On the other hand, the amount of operational carbon dioxide increases as the lifespan of the house extends due to ongoing energy consumption. This dynamic highlights the importance of considering both embodied and operational carbon dioxide over the entire lifespan of a building when assessing the environmental impact. In certain instances, replacing existing homes with ecologically efficient ones can reduce the total amount of embodied and operational carbon dioxide. Strengthening the existing building stock is more effective in reducing the total amount of embodied and operational carbon dioxide (Tunstall, 2022, p.7). Preserving and repairing existing building stock instead of constructing new buildings not only reduces total carbon dioxide emissions but also contributes to the conservation of natural resources. Moreover, repurposing the vacant building stock through various means has the potential to increase access to housing and enhance well-being. Such an approach could contribute positively to both environmental sustainability and social justice.

COMPASS FOR SPATIALIZING DEGROWTH IDEAS AT HOME

There are many practices that can be seen as attempts at housing degrowth at various scales. While some efforts consciously pursue degrowth aims, others unknowingly engage in practices that align with degrowth goals. Therefore, the aim of this article is to determine a strategy for spatializing degrowth at home. As a compass for the determination of this strategy, the toolkit used to spatialize economic growth, and the critiques developed for existing housing degrowth experiments will be examined. (Figure 4) Through the examination of these two fundamental themes, the compass may potentially reveal the right strategy for the spatialization degrowth at home.

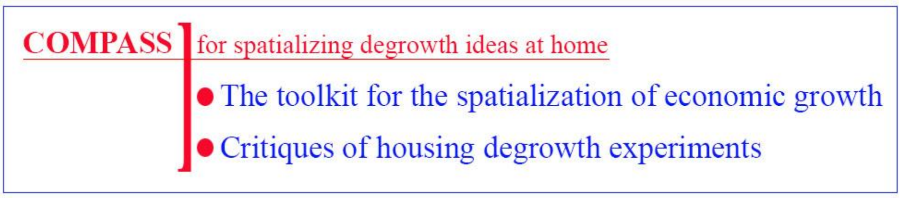


Figure 4. Compass for spatializing degrowth ideas at home.

The Toolkit for the Spatialization of Economic Growth

Identifying the toolkit used to spatialize economic growth can serve as a compass for spatializing degrowth ideas at home. According to Mete (2022), a housing degrowth future is hard to achieve without a comprehensive understanding of the obstacles posed by production processes intrinsic to growth (p. 533). Both the housing sector and housing policies aim to increase per capita and overall housing figures, improve housing quality, and enhance the financial value of housing. However, growth-based housing sectors violate the planet's boundaries of self-renewal, while also failing to adequately meet the housing needs

DOI: 10.15320/ICONARP.2024.288

of everyone. According to Parrique et al. (2019), an area worth considering, when contemplating the spatial implications of degrowth, is its criticism of the unjust and unsustainable nature of growth-driven capitalism. This critique predominantly revolves around the intrinsic metabolism of capitalist system, which inherently carries a spatial aspect, as seen in concepts such as externalization and the unequal ecological exchange. In this regard, tracing the social metabolism of architectural activities and examining their relationship with consumption patterns can provide valuable guidance. It can be argued that architecture plays facilitating role in supporting and disseminating worldviews nourished by growth. In addition, architectural practices are closely linked to economic activities as design and construction processes are shaped by market conditions. On the other hand, the exploitation of labor and resources that underlie economic growth has also become widespread in the field of architecture. The tabula rasa approach, which is mainstream in architectural activities, allows for construction on cultivable lands or empty plots (Krasny, E. et al., 2019), while urban transformation practices enable the demolition and reconstruction of existing structures. It is possible to assert that this approach has negative impacts on the environment both in terms of resource and energy utilization as well as the amount of waste produced. According to Hickel (2022), 27% of global resources are used in the construction industry, with construction materials accounting for half of the waste produced (p. 171). Furthermore, Berk & Akbulut (2022) argue that projects created under this paradigm primarily serve economic power actors rather than the public good, resulting in the exclusion of disadvantaged and marginalized segments of society from the purview of the architectural profession (p. 51). The implications of mainstream activities in the realm of housing indicate that we are facing a more pressing issue. Therefore, it becomes crucial to understand how economic growth erodes planetary and societal boundaries through housing production and consumption processes.

The construction industry, particularly the housing sector, is crucial in sustaining economic growth. The construction industry accounts for 7% of GDP, almost doubling when all its ancillary sectors are considered (Harvey, 2015, p. 96). Furthermore, 60% of all constructions pertain to housing units. In Turkey, the construction industry and 250 sub-sectors accounted for up to 35% of GDP in 2022 (Habertürk, 2022). As previously built houses need to be sold to finance new housing production, there is pressure to manipulate the demand for housing. This leads to a capital cycle of housing production ‘free from both supply and demand, proliferating from its own motion’ (Harvey, 2015, p. 13). As a result, there is a large number of unused housing units which strain natural systems. Once a non-economic domain where we fulfil our basic needs, home has become the main component of a large economic sector. The notion of home was originally meant to be a shelter. However, due to commodification, the notion of home acquires additional layers of meaning, evolving into a place where consumption-oriented lifestyles are not only encouraged but also normalized and reinforced (Lawrence, 1987). Thus, home becomes a place where possessions accumulate and technological advancements are showcased. As Swan & Ugursal (2009) point out, houses account for 30% of carbon emissions. The increase in the size of houses in square meters results in greater material and energy consumption during production processes. It also means that more equipment, furniture, and energy for heating or cooling will be spent during use. However, there is a growing trend of outsourcing traditionally home-based tasks, such as care, cooking, or maintenance, to the service sector.

Homeownership has become integral to growth narratives, often endorsed by government policies. In some cases, governments encourage homeownership to keep the population under control by turning them into debtors. According to Mete (2022), in developed countries, access to housing is viewed as an individual responsibility, with homeownership frequently linked to social status (p. 257). Moreover, insufficient regulations safeguarding tenants' rights and the perception that renting is a futile expense further perpetuate the misconception that owning a house is the only viable option. However, it's important to note that escalating rental payments has made houses accessible only to a more privileged segment. Neoliberal reforms have reduced social housing and other affordable housing policies, promoting homeownership and resulting in increased mortgage debt, as stated by Nelson (2019, p. 6). Typically, becoming a homeowner involves taking out a mortgage and sometimes additional loans to qualify for the mortgage. Household indebtedness increases as housing costs, including expenses for domestic services such as energy and water, increase, regardless of homeownership or tenancy. Consequently, this makes the house a burden for many people. The current trend of global urbanization, driven by economic growth, is leading to a crisis not only because of unaffordable housing but also due to social injustices, displacement or homelessness. Marcuse (2021) argues that the housing sector is facing a three-fold crisis under prevailing neoliberal capitalist conditions: the commercialization of the home, the lack of social housing, and the myth of homeownership. He suggests that at the heart of the current housing system lies the financialization and speculation, enabling the commercialization of the home (p. 215-230). Heeg (2013) explains that real estate gains a financial investment status due to increased housing privatization, leading to the financialization of the housing market (p. 76-77). Although the housing sector is growing, rising prices due to market rules and speculation trends make it difficult for many people to access a house.

To summarize the aforementioned points, in growth-oriented housing production and consumption processes, it is evident that a significant social metabolism is created. Households are burdened with debt, property ownership relies on speculation, access to housing requires a privileged position, and housing has become an investment instrument.

DOI: 10.15320/ICONARP.2024.288

(Figure 5) Building on this, the compass that will guide the spatialization of degrowth ideas at home highlights the need for a different social metabolism, the recognition of public capital, co-ownership, inclusivity, and acknowledgment of housing as a fundamental human right as key tools.

Figure 5. Compass 1: The toolkit for the spatialization of economic growth.

Critiques of Housing Degrowth Experiments

The action lines for housing degrowth can be considered as the practices needed to be implemented for degrowth to spatialize at home. These action lines can be categorized into two axes falling within the scope of housing degrowth field. The first axis involves regulations targeted at facilitating the adoption of degrowth values. These arrangements may vary from neighborhood-scale regulations set by local governments to legislative changes enacted by central governments. Such regulations may pertain to the use of energy and materials, waste management, and access to the commons. In addition to environmental regulations, measures aimed at reducing the demand for houses to achieve housing justice, promoting collective ownership, and employing design and planning changes can also be considered within this context. When local and central governments are unwilling to take action, individual and collective efforts can exert pressure on them to make changes. Therefore, the second axis involves the practices of certain communities that, although not explicitly implementing their actions with the intention of degrowth, could be considered as degrowth attempts. Squatting, home swapping, self-build practices, co-housing, and eco-village projects are examples of degrowth practices. Conservation is related to the legal aspect of the issue, but repairing and reusing vacant buildings or re-evaluating materials from old constructions can also be considered as degrowth practices.

Failure to achieve environmental sustainability and social justice objectives risks causing housing degrowth attempts to fail. Understanding the reasons behind the failure of these attempts is essential for spatializing degrowth at home. One significant obstacle to housing degrowth is the prevalent concept of homeownership. Homeowners may not welcome proposals for more equitable redistribution of existing housing stock, and for-profit markets may impede the fair redistribution of such stock. This reluctance stems from the need for reducing speculation and financialization in housing for

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

degrowth. Such a change would cause existing homeowners and speculators to lose capital, as the house would no longer be a lucrative investment if it was redistributed as a fundamental right. Fair redistribution may also decrease house prices. However, with concerted efforts, the prevailing market dynamics that contribute to housing injustice for a large number of individuals can be changed.

In the context of housing degrowth, residents are seen as active participants in both the production and maintenance of their houses. In some parts of the world, regulations may be lacking or inadequately enforced, allowing people to build their own houses. As pointed out by Christie & Salong (2019), self-builders in such places do not require high budgets as they do not incur the costs related to pay architects and engineers for design and calculation, sourcing materials from afar, and adhering to regulatory expenses (p. 91). In this regard, building one's own house can be considered as a form of degrowth attempt. However, the conventional approach, where design and construction are exclusively left to experts, leaves many without the necessary knowledge and skills to participate in these processes. Even if individuals possess the necessary knowledge, finding the time to be involved can be problematic, and regulations often entrust the planning and construction processes to experts, making it difficult for individuals to be actively engaged in. The removal of bureaucratic barriers appears to be crucial for the success of such endeavors.

Another practice that could be considered as an attempt towards housing degrowth is the establishment of legal regulations for minimum and maximum home sizes. As previously mentioned, downsizing homes can help mitigate the negative environmental impacts of the housing sector. According to Stefansdottir & Xue (2019), downsizing homes could involve restricting specific functions of the house or ensuring that certain functions are shared with other households (p.173). On the other hand, in terms of livability and well-being at home, the determination of functions becomes significant when setting size constraints for homes. In other words, balancing the need for social interaction and the need for private space is crucial. Otherwise, there is a risk of neglecting both physical and psychological needs such as sleep, rest, hygiene, and security. On the other hand, while smaller homes may be more accessible to low-income individuals, the reduction in home size could potentially threaten the quality of life due to the risk of increased household population. The term 'tiny house' refers to small-sized homes, typically mounted on wheels. Although they are mobile in design, tiny houses require anchoring on private property for their proliferation. To achieve this, legal barriers pertaining to land use and infrastructural challenges must be addressed. However, despite the assumption that tiny houses consume fewer resources due to their compact size, their construction is labor-intensive and expensive, rendering them mere adventure accessible primarily to a certain socioeconomic segment of society. Consequently, criticisms suggest that tiny houses, often associated with

DOI: 10.15320/ICONARP.2024.288

eco-elitisim, may lead to isolation due to the sense of seclusion they create after construction.

House sharing is an important aspect of housing degrowth as it encourages resource sharing and contributes to reduced resource consumption. House sharing encompasses various arrangements, ranging from multiple individuals sharing the same residence (extended family, friends, etc.) to more complex models such as co-housing, which consists of private homes and shared spaces. Lietaert (2010) asserts that co-housing communities provide social benefits by not only fostering environmentally conscious daily habits but also strengthening community bonds through an organization based on collaboration. Co-housing practices, in turn, may miss the diversity aspect by being places where communities from similar socio-economic backgrounds live, potentially transforming into homogenous spaces (Temel et al., 2015). Additionally, there are views advocating for the inclusion of outsiders in shared spaces within co-housing practices, aiming to promote diversity (Ruiu, 2014). Another important aspect of housing degrowth is the assessment of the existing housing stock. Squatting practices categorized under this heading appear to be highly significant for achieving equitable redistribution. However, according to Cattaneo (2019), the risk of eviction complicates the decision-making process regarding the extent of repairs that can be undertaken in squatted spaces, leading occupants to prioritize minor repairs instead of significant alterations (p.48). However, Mete observes that many experts regard the conversion of existing vacant building stock as costly and complex in terms of planning processes and bureaucratic hurdles (2022, p. 528). For example, historical buildings may encounter constraints in being repurposed to fulfill housing needs due to the requirement for faithful restoration. On the other hand, Bouzarovski, Frankowski, and Herrero (2018), describe a phenomenon wherein communities face displacement as existing building stock is transformed through “energy-efficient” upgrades, labeling this process "low-carbon gentrification." This term describes how marginalized communities, unable to afford higher housing costs caused by energy-efficient upgrades, are forced to move.

The central point of these criticisms is that when degrowth experiments adopt technology-centric approach to reduce the ecological footprint, the resulting practices become affordable only by a particular segment of society. Moreover, the eco-efficiency standards necessary for downsizing social metabolism might involve substantial costs, rendering them seemingly unaffordable for the broader part of the population. Indeed, concerns regarding inclusivity arise, as affluent communities may be the sole beneficiaries capable of affording materials and technologies meeting these standards. On the other hand, according to Nelson & Schneider (2019), housing degrowth experiments are often criticized for being reductionist and isolated, often being portrayed as independent and singular examples (p. 263). In essence, the criticisms can be summarized as suggesting that housing degrowth experiments tend to create elite eco-communities rather than fostering an equal society. (Figure 6)

Figure 6. Compass 2: Critiques of housing degrowth experiments.

A STRATEGY FOR SPATIALIZING DEGROWTH AT HOME: COMMONING OF HOUSING

In this study, in order to develop a strategy for the spatialization of degrowth at home, the toolkit used for spatializing economic growth and critiques developed for existing housing degrowth experiments are examined as a compass. Based on the first compass, the toolkit used for spatializing economic growth, the tools that can be applicable for the spatialization of degrowth ideas at home are identified: the creation of a smaller social metabolism, leveraging public capital, improving commons, promoting inclusivity, and recognizing housing as a fundamental human right. Building on the second compass, it can be asserted that practices that focus on reducing resource and energy utilization in production and consumption processes for downsizing the social metabolism risk to overlook the social dimension of the issue since they may not be accessible to everyone and may lack inclusivity. Furthermore, it can be argued that housing degrowth experiments undertaken by more vulnerable segments are more frequently hindered by bureaucratic obstacles. When the two examined compasses are juxtaposed, it becomes possible to establish the necessary objectives for the spatialization of degrowth ideas at home: reducing social metabolism, recognizing the home as a fundamental human right rather than an investment tool, and prioritizing vulnerable segments, thus promoting inclusivity. It can be argued that a strategy developed for the spatialization of degrowth ideas at home should prioritize these objectives. The commoning of housing presents significant potential as a strategy to envision a degrowth-oriented future. (Figure 7)

DOI: 10.15320/ICONARP.2024.288

Figure 7. A strategy for spatializing degrowth at home: commoning of housing.

The practice of commoning housing, characterized by co-ownership, co-production, and co-management, aligns with this strategy. Often rooted in the struggles of vulnerable social groups, commoning housing practices emerge as a promising strategy for achieving social justice. Additionally, the reliance of commoning housing practices on the principles of "co-production" and "co-management" has the potential to lead to a smaller social metabolism. The commoning of housing, based on a different ownership paradigm, positions housing as a fundamental human right by disentangling it from the market forces. As previously mentioned, the myth of homeownership was discussed as one of the potential risks in the spatialization of degrowth at home. To counter this myth, it is imperative to prevent the financialization of the housing and remove it from the market. The concept of co-ownership inherent to commoning housing not only liberates housing from the market but also offers a viable solution to the affordable housing crisis. Savini and Bossuyt (2022) point out that by transcending the traditional boundaries of public and private property arrangements, the commoning of housing challenges these premises and emerges as a new perspective aligned with the principles of degrowth (p.35). It is worth highlighting that a redefined concept of ownership would grant residents greater autonomy. Savini (2022) states that autonomy, manifested through institutional arrangements, serves as a foundation for sustaining inclusivity during commoning practices (p.3). Therefore, it can be said that commoning practices have the potential to be inclusive when they establish autonomy. According to Griffith et al. (2022), the defining characteristics of housing commons lie in the coordinated actions with a shared objective among residents. This can encompass both physical elements, such as co-habiting, sharing facilities, and collective property, as well as political values and social practices (p. 5). Various scholars have proposed comparable constitutional guidelines for housing commons.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Griffith et al. (2022) explains three main aspects of commoning practices in housing as follows: (1) an intricate ownership structure extending beyond individual or state ownership, incorporating elements of collective or cooperative tenure; (2) resident-driven collective management within the housing estate; (3) architectural design intentionally fostering daily sharing of spaces (p.2). The development of a different understanding of property signifies a shift from viewing the home as an investment tool to recognizing it as a fundamental human right. Such an understanding, by influencing pricing policies, facilitates housing accessibility for more vulnerable segments of society. The collective management of housing estate holds the potential for reducing social metabolism. Additionally, residents' involvement in design decisions mitigates the risk of overlooking physical and psychological needs such as sleep, rest, hygiene, and security, while transitioning towards a home with a smaller footprint. Moreover, Savini and Bossuyt (2022) states that four key rights, which are commissioning, management, inclusion and income, establish the essential framework for the operation of housing commons. Commissioning rights address the question who has the authority to decide on the aspects such as building's characteristics, housing units and shared facilities. Management rights dictate how a building is utilized and how self-governance is organized within the housing commons. These rights extend beyond just operational problem-solving and encompass the day-to-day use and maintenance of spaces, as well as the constitutional principles that govern the community. Inclusion rights relate to the capacity to become a member of the housing commons. Given that housing typically involves some level of exclusivity, these rights address who is eligible to participate in the housing community. Income rights involve the transfer of one's rights related to use, commissioning, and management to others in exchange for monetary compensation. This allows for the economic aspect of housing commons, where individuals may rent or sublet their housing rights (p.39). It would be beneficial to examine how the features that theoretically appear positive for the spatialization of degrowth at home operate in practice.

The Mietshäuser Syndikat, an example from Germany, is worth examining due to its embodiment of the key characteristics of housing commons. Griffith et al. (2022) states that the Mietshäuser Syndikat in Germany stands as the largest collaborative housing community in Europe, originating from squatting movements and persistently advocating for the right to the city (p.13-14). The formation of the Mietshäuser Syndikat is adapted to the legal system of Germany. As Hurlin (2019) shares, the Mietshäuser Syndikat encompasses a collection of housing projects across Germany: as of April 2017, there were 124 projects accommodating over 3000 residents –with ongoing expansion (p.235). In this structure, decision-making processes are autonomous, and residents collectively determine how they will live without external forces influencing their choices. Hurlin (2019) asserts that, in this

DOI: 10.15320/ICONARP.2024.288

context, the Mietshäuser Syndikat generates and sustains values, rationale, and discourse aligned with housing necessities and genuine social requisites. It has effectively established social and economic structures that contest the speculative practices commonly adopted by housing developers and investors. Moreover, their governance methodologies promote equity and consensus (p.242). In this model, there is a union structure where each resident contributes financially, and decisions are made by the members, not by the union itself. The association of the house's tenants holds a majority share (51%), while the remaining share (49%) is solely owned by the Mietshäuser Syndikat GmbH (Hurlin, 2019, p.236). The association owns the houses, where members pay reasonable rents, but the Mietshäuser Syndikat is organized in a structure that prevents the re-sale of houses in the market. Rents may vary based on factors such as the size of the houses or the monthly income of members. However, the determined rents are significantly below market values to enhance accessibility. The primary objective of such syndicates is to facilitate access to housing for everyone without pursuing profit, ultimately aiming for the collective management of all houses under syndicate-like structures. However, collective ownership, despite its non-profit nature, is criticized for not eliminating the concept of homeownership and for being applied primarily to a specific segment of the population. The exclusivity arises from the fact that syndicate-owned houses belong solely to the members residing within, thus depriving non-members. Additionally, living in syndicate-owned houses still requires paying rent, and although it may be more affordable than the market rate, it cannot be entirely divorced from financial motives. On the other hand, while idealizing universal housing access, there are criticisms suggesting that, by addressing the housing needs of low-income individuals through private structures instead of state intervention, such practices reinforce existing neoliberal policies. Despite these criticisms, it can be argued that these degrowth practices represent a positive starting point as they facilitate housing access for low-income individuals.

CONCLUDING REMARKS

It is of great importance to have a profound comprehension of the spatial implications of degrowth, as well as exploring how the processes of spatial production/consumption can play a role in moving towards a degrowth-oriented future. Prioritizing the problem of how degrowth can be spatialized at home, this article examines the toolkit employed by economic growth for spatialization, and the criticisms directed towards existing housing degrowth experiments as a compass, in order to provide a strategy for the spatialization degrowth at home. Based on the toolkit used in the growth-oriented housing production and consumption processes, the tools for enabling the spatialization of degrowth at home have been identified as creating a smaller societal metabolism, utilizing public capital, promoting co-ownership, inclusivity, and recognizing housing as a fundamental human right. Upon examining the criticisms against the existing housing degrowth experiments, it is observed that adopting a technology-centric approach to reduce the ecological footprint tends to create elite eco-communities. Considering the intersection of these two main headings, commoning of housing is identified as a strategy for the spatialization of degrowth at home.

The commoning of housing practices are based on three principles: co-production, co-ownership, and co-management. These practices are generally rooted in the struggle of vulnerable groups, rendering them inclusive. Furthermore, these practices promote a different paradigm of ownership, thus mediating to position housing as a fundamental human right by liberating it from the constraints of the market. Additionally, sharing and collaborative management of living spaces also hold significant potential for reducing ecological impacts. Despite potential challenges that may arise in practice, the concept of housing commons holds the significant potential to facilitate more equitable housing developments. According to Delz et al. (2020), commoning of housing practices should commence with micro-political mobilization efforts and the establishment of common networks. Achieving equitable development hinges on the universal recognition of housing as a common good. This perspective also advocates for the conversion of private property into co-ownership and emphasizes the importance of considering common ground as a valuable asset with social, ecological, and cultural significance (p. 7). Commoning housing practices hold significant potential for catalyzing substantial systemic transformation. This potential can be realized through the gradual integration of micro-political actions into macro-political frameworks, ultimately contributing to the facilitation of a degrowth-oriented future.

ACKNOWLEDGEMENTS/NOTES

The manuscript produced from a doctoral dissertation which is not delivered yet to the Graduate School of Istanbul Technical University.

REFERENCES

Alexander, S. & Ussher, S. (2012). The Voluntary Simplicity Movement: A multi-national survey analysis in theoretical context. *Journal of Consumer Culture, 12(1),* 66-68. https://doi.org/10.1177/1469540512444019

Angus, I. (2021). Antroposenle Yüzleşmek: Fosil Kapitalizm ve Dünya Sisteminin Krizi. marx-21 Yayınları.

Berk, M.G. & Akbulut, M.T. (2022, Nov&Dec). Dayanışma Mimarlığı: Mimarlık Mesleğinin Dönüşümü ve Mimarlık Kolektiflerine Bakış. *Arredamento Mimarlık, 2022(11-12*), 51-53.

Bouzarovski, S., Frankowski, J., & Herrero, S.T. (2018). Low-Carbon Gentrification: When Climate Change Encounters Residential Displacement. *International Journal of Urban and Regional Research, 42(5),* 845–863.

Cattaneo, C. (2019). How can squatting contribute to degrowth?. In Nelson, A. & Schneider, F. (Eds.), *Housing for Degrowth: Principles, Models, Challenges and Opportunities* (pp. 44-55). Routledge.

DOI: 10.15320/ICONARP.2024.288

Christie, W. & Salong, J. (2019). Housing and Climate Change Resilience: Vanuatu. In Nelson, A. & Schneider, F. (Eds.), *Housing for Degrowth: Principles, Models, Challenges and Opportunities* (pp. 80-95). Routledge.

Cosme, I., R. Santos, & D. W. O'Neill. (2017). Assessing the Degrowth Discourse: A Review and Analysis of Academic Degrowth Policy Proposals. *Journal of Cleaner Production, 149,* 321–334.

D'Alisa, G., Demeria, F. & Kallis, G. (2020). Küçülme: Yeni Bir Çağ İçin Kavram Dağarcığı (2nd ed.). Metis Yayınları.

D'Alisa, G., Deriu, M., & Demaria, F. (2020). Bakım. In D'Alisa, G., Demeria, F. & Kallis, G. (Eds.), *Küçülme: Yeni Bir Çağ İçin Kavram Dağarcığı (2nd ed.)* (p. 104-108). Metis Yayınları.

Delz, S., Hehl, R. & Ventura, P. (2020). Housing the Co-op. A Micro-political Manifesto. Berlin: Ruby Press.

Di Feliciantonio, C. (2017). Social Movements and Alternative Housing Models: Practicing the 'Politics of Possibilities' in Spain. *Housing, Theory and Society, 34(1),* 38–56.

Demaria, F., Schneider, F., Sekulova, F., Martinez-Alier, J., (2013). What is degrowth? From an activist slogan to a social movement. *Environmental Values, 22(2),* 191–215.

Griffith, E.J., Jepma, M. & Savini, F. (2022). Beyond collective property: a typology of collaborative housing in Europe. *International Journal of Housing Policy*. DOI: 10.1080/19491247.2022.2123272

Habertürk. (2022, May 16). İnşaat ve yan sektörlerin GSYH payı yüzde 35. *Habertürk*. Retrieved April 25, 2023, from https://www.haberturk.com/insaat-ve-yan-sektorlerin-milli-gelirdeki-payi-yuzde-35-3440165-ekonomi

Hagbert, P. (2019). Rethinking home as a node for transition. In Nelson, A. & Schneider, F. (Eds.), *Housing for Degrowth: Principles, Models, Challenges and Opportunities* (pp. 57-67). Routledge.

Harvey, D. (2000). Spaces of Hope. Edinburgh University Press.

Harvey, D. (2015). Asi Şehirler: Şehir Hakkından Kentsel Devrime Doğru (4th ed.). Metis Yayınları.

Heeg, S. (2013). Wohnungen als Finanzanlage. Auswirkungen von Responsibilisierung und Finanzialisierung im Bereich des Wohnens. *suburban: zeitschrift für kritische stadtforschung, 1,* 75-99.

Helfrich, S. & Bollier, D., (2020). Müşterekler. In D'Alisa, G., Demeria, F. & Kallis, G. (Eds.), *Küçülme: Yeni Bir Çağ İçin Kavram Dağarcığı (2nd ed.)* (p. 119-123). Metis Yayınları.

Hickel, J. (2022). Çoğu Zarar Azı Karar: Dünyayı Küçülme Kurtaracak (2nd ed.). Metis Yayınları.

Hurlin, L. (2019). Mietshäuser Syndikat: collective ownership, the 'housing question' and degrowth. In Nelson, A. & Schneider, F. (Eds.), *Housing for Degrowth: Principles, Models, Challenges and Opportunities* (pp. 233-244). Routledge.

Illich, I. (1973). Tools for Conviviality. Glasgow: Fontana/Collins.

Işıkara, G. (2021, December 9). Küçülme Üzerine Düşünceler. *Polen Ekoloji*. https://www.polenekoloji.org/kuculme-uzerine-dusunceler/

Joutsenvirta, M. (2016). A Practice Approach to the Institutionalization of Economic Degrowth. *Ecological Economics, 128,* 23–32.

Kallis, G. (2018). Degrowth. Agenda Publishing.

Krasny, E. et al. (2019) Architecture and care. In: Fitz, A. (Ed.), *Critical care: Architecture and urbanism for a broken planet* (pp. 33–44). Cambridge, MA & London, UK: MIT Press.

Lawrence, R. J. (1987). Housing, Dwellings and Homes: Design Theory, Research and Practice. John Wiley & Sons Inc.

Lefebvre, H. (1976). The Survival of Capitalism: Reproduction of the Relations of Production. Allison & Busby.

Lietaert, M. (2010). Cohousing's Relevance to Degrowth Theories, *Journal of Cleaner Production.* 18 (6), 576–580.

Lorek, S., (2020). Maddesizleşme. In D'Alisa, G., Demeria, F. & Kallis, G. (Eds.), *Küçülme: Yeni Bir Çağ İçin Kavram Dağarcığı (2nd ed.)* (p. 129-133). Metis Yayınları.

Marcuse, P. (2012). A Critical Approach to Solving the Housing Problem. In Brenner, N., Marcuse, P. & Mayer, M. (Eds.), *Cities for People, Not for Profit: Critical Urban Theory the Right to the City* (pp. 215–230). Routledge.

Martinez-Alier, J., Pascual, U., Vivien, F., Zaccai, E. (2010). Sustainable de-growth: mapping the context, criticisms and future prospects of an emergent paradigm. *Ecol. Econ.* 69 (9), 1741–1747.

Mete, S. (2022). Towards degrowth housing development? Lessons from a scenario-based gaming session in the Oslo region. *Local Environment, The International Journal of Justice and Sustainability, 27:4,* 517-536. https://doi.org/10.1080/13549839.2021.1964456

Nelson, A. (2019). Housing for Growth Narratives. In Nelson, A. & Schneider, F. (Eds.), *Housing for Degrowth: Principles, Models, Challenges and Opportunities* (pp. 3-13). Routledge.

Nelson, A. & Schneider, F. (2019). Summary and research futures for housing for degrowth. In Nelson, A. & Schneider, F. (Eds.), *Housing for Degrowth: Principles, Models, Challenges and Opportunities* (pp. 256-264). Routledge.

Olsen, E. S., Orefice, M. & Pietrangeli, G. (2019). From the 'right to the city' to the 'right to metabolism. In Nelson, A. & Schneider, F. (Eds.), *Housing for Degrowth: Principles, Models, Challenges and Opportunities* (pp. 33-43). Routledge.

Parrique T., Barth J., Briens F., C. Kerschner, Kraus-Polk A., Kuokkanen A., Spangenberg J.H. (2019). Decoupling Debunked. Evidence and Arguments Against Green Growth as a Sole Strategy for Sustainability. Brussels: European Environmental Bureau.

Paulson, S. (2017). Degrowth: Culture, power and change. In Gezon, L. L. & Paulson S. (Eds.), *Degrowth, culture and power* (pp. 425-448). *Special Section of the Journal of Political Ecology, 24*, 425-666.

Plotnikova, S. (2020). Designing for Degrowth: Architecture Against Climate Apartheid. AIA/ACSA Intersections Symposium | Design For Climate Action.

Research and Degrowth. (2023). *History*. https://degrowth.org/history/

Ruiu, M. L. (2014). Differences Between Cohousing and Gated Communities. A Literature Review. *Sociological Inquiry, 84:* 316–335.

Romano, O. (2020). Faydacılık Karşıtlığı. In D'Alisa, G., Demeria, F. & Kallis, G. (Eds.), *Küçülme: Yeni Bir Çağ İçin Kavram Dağarcığı (2nd ed.)* (p. 43-47). Metis Yayınları.

Savini, F. (2022). Maintaining autonomy: Urban degrowth and the commoning of housing. *Urban Studies, 00(0)*, 1-18.

Savini, F. & Bossuyt, D. (2022). Housing commons as a degrowth planning practice: learning from Amsterdam's de Nieuwe Meent. In Savini F., Ferreira, A. & von Schönfenld, K.C. (Eds.), *Post-Growth Planning. Cities Beyond the Market Economy* (p. 35-48). Routledge.

DOI: 10.15320/ICONARP.2024.288

Stefansdottir, H. & Xue, J. (2019). The quality of small dwellings in a neighbourhood context. In Nelson, A. & Schneider, F. (Eds.), *Housing for Degrowth: Principles, Models, Challenges and Opportunities* (pp. 171-183). Routledge.

Swan, L.G. & Ugursal, V.I. (2009). Modeling of end-use energy consumption in the residential sector: A review of modeling techniques. *Renewable and Sustainable Energy Reviews, 13(8),* 1819–35.

Temel, Robert, and Constance Weiser. (2015). Baugruppen in Aspern Seestadt. Chronologie Einer Planerischen Innovation**.** In Gruber, E. (Ed), *Gemeinsam Bauen Wohnen in der Praxis. Workshopreihe 2014 über, für und mit Baugruppen in Wien* (p. 20–29). Wien: Verein Initiative für gemeinschaftliches Bauen und Wohnen.

Tunstall, R. (2022). An empirical test of measures of housing degrowth: Learning from the limited experience of England and Wales, 1981–2011. *Urban Studies Journal, 1-19.* https://doi.org/10.1177/00420980221121198

Xue, J. (2022). Urban planning and degrowth: a missing dialogue, *Local Environment. 27(4)*, 404-422. DOI: 10.1080/13549839.2020.1867840

Van den Bergh, J. (2011). Environment Versus Growth — A Criticism of "Degrowth" and a Plea for "a-Growth. *Ecological Economics, 70,* 881–890.

Wächter, P. (2013). The Impacts of Spatial Planning on Degrowth. *Sustainability, 5,* 1067-1079. doi:10.3390/su5031067

Weiss M. & Cattaneo C. (2017). Degrowth – taking stock and reviewing an emerging academic paradigm*. Ecological Economics, 137,* 220–230.

Resume

Gamze ÖZTÜRK is a PhD candidate in Architecture Design at Istanbul Technical University. She completed her undergraduate degree in architecture at ITU and also pursued the master's program with her thesis titled "Gaze Regulations on Architecture." Her doctoral research primarily focuses on housing for degrowth. Since 2014, she has been working as the exhibition and programmes manager for the Istanbul Biennial at the Istanbul Foundation for Culture and Arts (IKSV).

Ayşe ŞENTÜRER is a full professor of architecture at the Istanbul Technical University (ITU), Faculty of Architecture, Department of Architecture. She completed her undergraduate, graduate and doctorate degrees at ITU. She teaches upper pool architectural design studios and diploma project at the undergraduate school, gives courses and supervises thesis at the architectural design graduate program concentring on theory, design and criticism including architectural theory, design theory, representation, and aesthetics.

ICONARP
International Journal of Architecture and Planning
Received: 23.08.2023 Accepted: 02.02.2024
Volume 12, Issue 1/ Published: 30.06.2024
Research Article *DOI: 10.15320/ICONARP.2024.289 E- ISSN:2147-9380*
ICONARP

The Impact of Covid-19 on Real Estate Demand Based on Green Spaces: Case Study of Türkiye (Ankara)

Hatice Gül Önder *
Göktuğ Şahin **
Aslı Özdarıcı Ok ***

Abstract

The COVID-19 pandemic in 2020 revealed its impact on various sectors inside our country. The aim of this study is to evaluate the impact of changing socio-economic lifestyle habits during the COVID-19 pandemic on the demand for real estate in Çankaya and Keçioren districts of Ankara., specifically regarding open and green areas. The study's approach involves doing statistical analysis on a dataset consisting of around 28,400 entries from the REIDIN Data&Analytics. This analysis is performed using the E-Views Economic Analysis software. Linear regression analysis and the Kalman Filter Method are used. Then, spatial analyses were performed using GIS by using kernel density analysis. It has been observed that Çankaya's unit pricing per square meter has been found to be higher than those of Keçiören. Based on the residential real estate type, the rate of preference for houses with gardens and distinctive green areas was 4.17% in 2018, 4.22% in 2019, and 4.45% in 2020 in Çankaya district, and 0.13% in 2018, 0.15% in 2019, and 0.14% in 2020 in Keçiören district. Comparisons indicate that the rates in Keçiören are very low. It was concluded that demand for green-space real estate in the Keçiören district increased after the pandemic compared to the pre-pandemic period. On the other hand, in the Çankaya district, there has been a decrease in monthly demand for real estate with green areas since March 2020. During the same period, demand for real estate with green areas in Çankaya remained stable.

Keywords:
COVID-19 pandemic, Real estate demand, Open-green space, Spatial and econometric analysis

*Department of Real Estate and Property Management, Academy of Land Registry and Cadastre, Ankara Hacı Bayram Veli University, Ankara, Turkey. (Corresponding author)
E-mail: gul.onder@hbv.edu.tr

**Department of Economics, Faculty of Economics and Administrative Sciences, Ankara Hacı Bayram Veli University Ankara, Turkey.
E-mail: goktug.sahin@hbv.edu.tr

*** Department of Real Estate and Property Management, Academy of Land Registry and Cadastre, Ankara Hacı Bayram Veli University, Ankara, Turkey.
E-mail: asli.ok@hbv.edu.tr

To cite this article: Onder, H.G., Sahin, G., & Ozdarici Ok, A. (2024). The Impact of Covid-19 on Real Estate Demand Based on Green Spaces: Case Study of Türkiye (Ankara). *ICONARP International Journal of Architecture and Planning,* 12 (1), 391-416. DOI: 10.15320/ICONARP.2024.289

INTRODUCTION

In 2020, the COVID-19 pandemic, which is believed to have originated in Wuhan, China, at the end of 2019 and spread globally, has reached growing public health problem. While there is a decline in demand for accommodations, food and beverages, transportation, education, entertainment, and touristic tours, there has been an increase in demand and significant changes in consumer behavior in other sectors, including health, cargo, and electronic commerce (Izzah, Dilaila and Yao 2021; Baker, Farrokhnia, Meyer, Pagel, and Yannelis 2020; Dones and Young 2020; d'Acci, 2019). The pandemic has caused changes in the real estate industry as well as all other industries. Global restrictions imposed to mitigate the effects of the pandemic have reshaped work, education, shopping, and health habits in residential areas under the slogan "stay at home." In addition to providing shelter, residences now serve the basic functions of working, learning, healthy living, and shopping. Those residing in high-rise buildings such as apartments, residences, and housing blocks have sought to live in detached houses with gardens, balconies, terraces, or houses close to green areas, which they consider to be more free and healthier, and to continue their outdoor activities. This has altered the demand for real estate among users during the pandemic (Mattarocci and Roberti 2020; Severino 2020; Çörek Öztaş 2020; Beuscher and Rudel, 2009).

During the time of the pandemic, there was more demand for detached houses and houses close to green spaces. This caused the prices of these types of housing to go up. Particularly appealing are houses with gardens, balconies, or terraces, a playground within walking distance, active and passive green spaces, recreation areas, sports areas, and walking tracks. Because of this, people in the real estate industry have sped up the production of "residence areas suitable for pandemic life," which have functions that are integrated with natural and subsequently introduced landscape elements, green living spaces, and outdoor spaces (Çörek Öztaş 2020).

The COVID-19 Pandemic, one of the global breaking points, has also had multidimensional effects, particularly on the city economy. There has been a negative impact on the disposable income of those who have been forced to stop working as a result of the pandemic-induced recession or who face an increased risk of layoffs or pay cuts. Additionally, it has been observed that factors other than income are responsible for observable shifts in real estate demand patterns, as is the case in all economic sectors (Ling, Wang and Zhou 2021; Balcı and Türk 2020; Signorelli, Capolongo, D'Alessandro and Fara 2020; Aisha and Susanto, 2018; Beuscher and Rudel, 2009). When evaluating the studies conducted by real estate sector stakeholders, it has been emphasized that a residence can be considered a healthy home if it has a garden, terrace, balcony, natural ventilation, proximity to green areas, and earthquake-resistant construction (Latinopoulos, 2022; Worden, Hazer, Pyke and Trowbridge

DOI: 10.15320/ICONARP.2024.289

2020; Severino 2020; Çörek Öztaş 2020; Sohn, Kim, Kim and Li, 2020; Kilnarova and Wittmann, 2017).

This study's objective is to assess the effect of shifting socioeconomic lifestyles on real estate demand during the COVID-19 pandemic in the context of open and green spaces. Different social, cultural, and economic structures in the Çankaya and Keçiören districts of Ankara have different real estate requirements. In this context, the benefits of open and green spaces to society, because of their effect on the demand for real estate, have been explained, including those in terms of public health and welfare and cultural development.

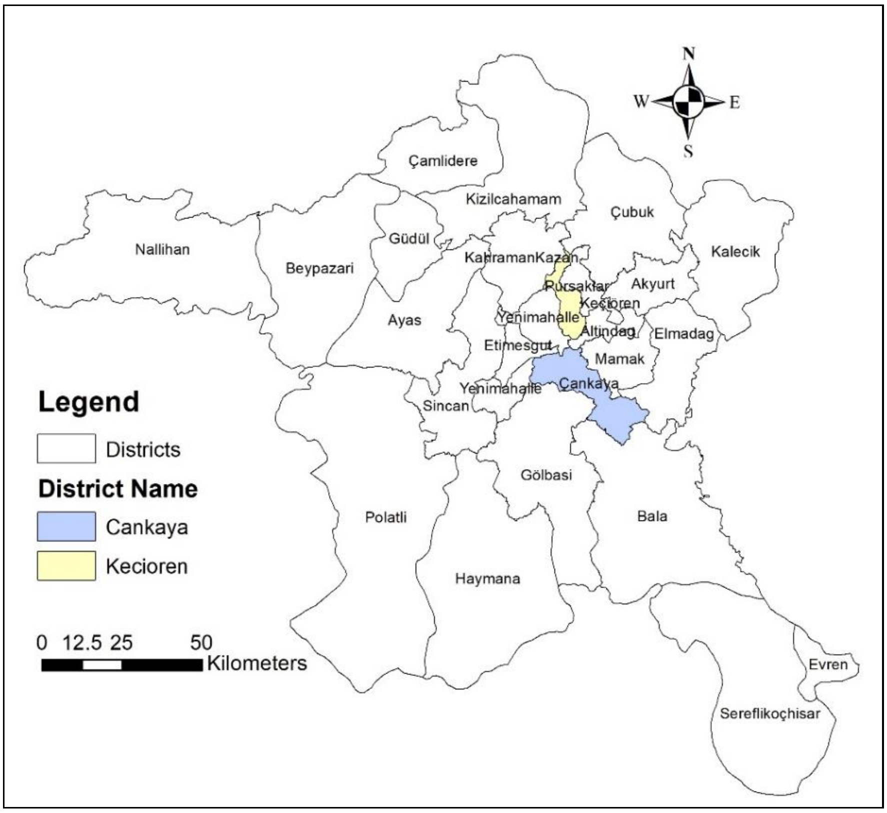


Figure 1. Districts of Ankara

In urban areas, the growth of population and construction occur simultaneously. It indicates that the more people in a community, the more construction there is. Among the twenty-five districts of Ankara, where the population density is high, it is planned to compare two districts with different socio-economic levels as the study area. In this context, the districts of Çankaya and Keçiören were chosen, and the study area was restricted to these two districts (Figure 1).

MATERIAL AND METHOD

This study assesses how the demand for real estate in the context of open and green spaces during the COVID-19 pandemic period is affected by shifting socioeconomic life habits. In this context, the epidemic began in our country in March 2020, thus 2018 and 2019 considered the pre-pandemic period and 2020 and 2021 considered the post-pandemic

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

period in the period covering the years 2018-2021. Over these time periods, the topic will be the focus of statistical, econometric, and spatial analyses, and the outcomes will be used to reveal changes in real estate demand and their relationships to green spaces. The method determined in this context consists of four main steps in general terms (Figure 2):

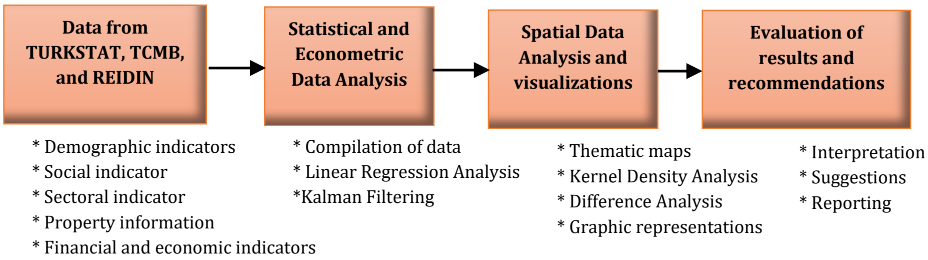


Figure 2. Methodology of the study

The first step in the study is to collect and interpret data from Turkish Statistical Institute (TURKSTAT), The Central Bank of the Republic of Türkiye (TCMB), and REIDIN Data & Analytical Real Estate Data Services. The data collected in the second step were compiled, and statistical and econometric analyses were performed with the help of E-Views Econometric Analysis software. Two different models named Model 1 and Model 2, were used in the context of econometric analysis of real estate demand. Model 1 employed linear regression analysis, whereas Model 2 utilized the Kalman filter method. In the third step, spatial analyses were performed on the compiled data using Kernel Density Analysis with the ArcGIS v.10.8.1 software, thematic maps were produced within the framework of the obtained findings, and the results were visually presented. Finally, the analyzed data and outputs were interpreted, and a set of suggestions were given.

ANALYSES AND FINDINGS

Within the scope of the analysis, monthly real estate sales reports from July 2014 through December 2020 were utilized. The REIDIN Data & Analytics database was queried for the relevant data. The date of March 2020 was identified as the start of the pandemic in Türkiye and was selected as the dummy variable; after this date, the analysis defined the pandemic period. To examine the demand for green space in the Keçiören and Çankaya districts of Ankara, the following real estate subtypes were combined with the green space variables. Variables called 'vineyard', 'garden', 'farm', and 'farmhouse', as well as 'cadastral land', 'miscellaneous land', 'detached house', 'prefabricated house', 'field', 'villa', and 'mansion', were chosen as the determinants of green area according to real estate subtypes (Table 1). In the analyses, these variables were chosen to represent the demand for green space. To make comparisons between the districts of Çankaya and Keçiören, comparable variables were selected from common types and date ranges. To represent the amount of green space in the analysis, the monthly frequency of sales advertisements was considered. In addition, different levels of

DOI: 10.15320/ICONARP.2024.289

significance-based filtering were performed. E-Views Econometric Analysis software was utilized in the performed analyses.

Table 1. Determinants of green area according to real estate subtypes for the districts of Keçiören and Çankaya (REIDINRebis, 2021b)

Real estate subtypes	**Keçiören**	**Çankaya**
Vineyard	30	200
Garden	585	668
Farm	39	44
Farmhouse	74	118
Mansion	13	59
Miscellaneous land	211	NA
Detached house	133	1,507
Prefabricated house	31	353
Field	635	5,277
Villa	359	18,002
Total	**2,110**	**26,228**

The approach determined here is that, using the demand-creation model, if there is a need for green space, household demand for this type of property should increase. As a result, an increase in demand will result in an increase in supply. In other words, the number of real estate types represented as green areas in the advertisement should increase or decrease. In this regard, the study discusses the number of real estate properties with their own green area that are submitted to monthly advertisements as a dependent variable. As a result, the changes in the number of real estate advertisements (around 28,400 data) with their own green area presented before and after the COVID-19 pandemic were examined using the dummy variable, which takes the value "0" before the COVID-19 pandemic and "1" after the COVID-19 pandemic.

Two models were used in the econometric analysis of the demand for real estate with its own green area presented in the study. First, with fixed parameters, the change in demand for green area real estate before and after the pandemic was examined using linear regression analysis, which was designed as Model 1. Furthermore, because the coefficients were obtained with the Model 1 estimation, the Kalman Filter Method designed as Model 2, was used as the next step. At this point, the goal was to observe the monthly changes in the effects during the pandemic period using a model with time-varying parameters, and Model 2 was used in this direction. Model 2 yielded results on the direction and impact of demand during the pandemic period. The following sections contain information and findings about these models.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Model 1: Linear Regression Analysis

In this model, linear regression analysis was utilized. The Linear Regression Analysis is a statistical technique used to determine the impact of other independent variables on the dependent variable's ability to demonstrate a certain change. The purpose of Linear Regression Analysis is to determine how well the independent variables, also known as features, predict the values of the dependent variable, also known as the target.

According to the equation used in the study,

$$Y_i = \alpha + \beta k_i + \varepsilon_i \qquad \text{(Eq.1)}$$

Y_i represents the number of monthly postings, while k_i is a dummy variable with a value of 0 before March 2020 and 1 after, α and β are the parameters of the model, ε is the error term. For the coefficient estimates in the model, Newey-West Varying Variance and Autocorrelation Consistent (HAC) standard errors were utilized. In cases of autocorrelation or varying variance, consistent estimators were thus obtained (Newey and West, 1986).

According to the findings from the analysis of the number of sales advertisements, the demand for real estate with green areas increased after the pandemic compared to the period before the pandemic in Keçiören district. In the Çankaya district, the demand for real estate with green areas decreased after the pandemic compared to the period before the pandemic.

Model 2: Kalman Filter

The Kalman Filter is an algorithm that generates predictions in a state space model with the least mean square error (Kalman, 1960; Kalman and Bucy, 1961; Kalman, 1963). It is an iterative technique for updating the one-step ahead estimate of the state mean and variance based on the information obtained. The Kalman Filter is a very useful tool because the state-space model provides a broad formulation for linear models that can easily handle time-varying parameters, measurement errors, and missing data. Furthermore, there are two major advantages to representing a dynamic system in state space: First, the state space form allows unobserved variables to be included in and predicted by the observable model. Second, the powerful recursive Kalman (Bucy) Filter can be used to analyze state space models. As a result, the related method estimates model parameters using maximum likelihood methods. One of the most essential steps in the analysis of the Kalman Filter is to set up the system composed of measurement and transition equations (Kalman, 1960). In the Kalman filter method, the measurement equation relates the observed measurements to the underlying state of the system. On the other hand, the transition equation is the system of equations that demonstrates how the varying parameters in the measurement equation

DOI: 10.15320/ICONARP.2024.289

change over time. The model was built as follows to obtain the varying parameter estimates:

Measurement equation	$\boldsymbol{Y_i = \alpha_i + \beta_i k_i + \varepsilon_i}$	$\boldsymbol{\varepsilon_i \sim \text{iid } N(0, \sigma_\varepsilon^2)}$	(Eq.2)
Transition equation	$\boldsymbol{\alpha_i = \alpha_{i-1} + \eta_i}$	$\eta_i \sim \text{iid } N(0, \sigma_\eta^2)$	(Eq.3)
	$\boldsymbol{\beta_i = \beta_{i-1} + e_i}$	$e_i \sim \text{iid } N(0, \sigma_\eta^2)$	(Eq.4)

Table 2. Time-varying parameter estimates for the districts of Keçiören and Çankaya (July 2019 to December 2020).

Date	**Keçiören**	**Çankaya**
July 2019	-12.1113	-56.8636
August 2019	-6.3057	-30.3160
September 2019	-5.4483	-36.7920
October 2019	-3.3678	-34.4690
November 2019	-2.7760	-34.9476
December 2019	-2.9179	-35.0599
January 2019	-1.7651	-35.0630
February 2020	-0.4244	-35.0579
March 2020	-0.3098	-35.0562
April 2020	0.2349	-35.0572
May 2020	-0.3917	-35.0581
June 2020	-1.0007	-35.0582
July 2020	-0.7065	-35.0583
August 2020	-0.7425	-35.0582
September 2020	-0.7858	-35.0581
October 2020	-0.7443	-35.0582
November 2020	-0.7520	-35.0584
December 2020	-0.8068	-35.0583

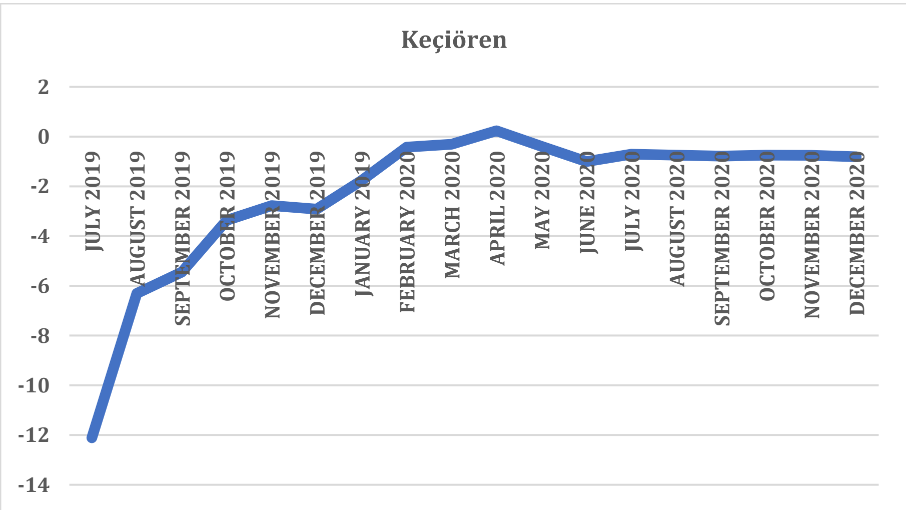


Figure 3. Time-varying parameter estimates for the districts of Keçiören (July 2019 to December 2020).

While there was an increase in demand for real estate with green areas in Keçiören in April 2020, just after March 2020, which was regarded as the beginning of the pandemic for the district of Keçiören, the demand decreased in the subsequent months. In the period beginning in July 2019 and ending in April 2020, there is a downward trend in the demand for real estate in green areas. In addition, based on the obtained estimates of time-varying parameters, there has been a decrease in the monthly demand for real estate with green areas during the relevant pandemic period beginning in April 2020. As a result of the pandemic, the decline in demand was at its greatest in June. However, there was a decline in demand up until July 2020, and it is observed that it remained stagnant (Figure 3).

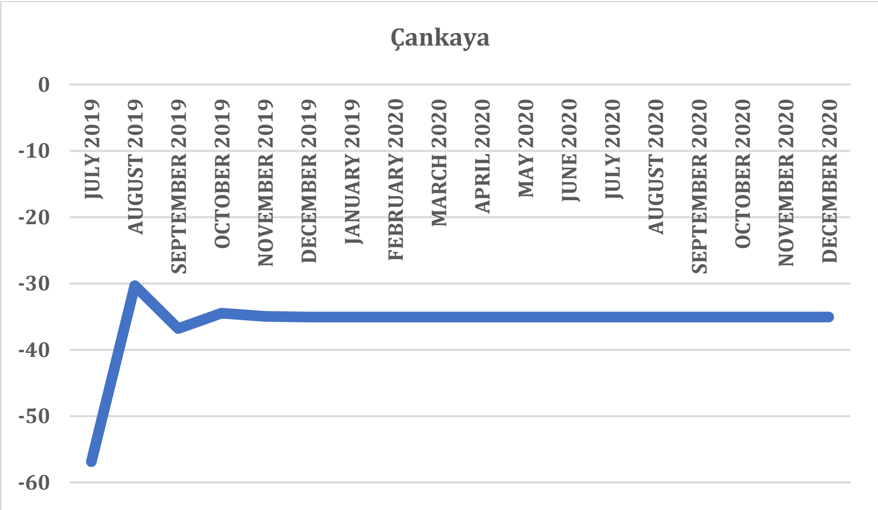


Figure 4. Time-varying parameter estimates for the districts of Çankaya (July 2019 to December 2020).

According to the time-varying parameter estimates obtained for the Çankaya district, when examined from the start of the pandemic, there has been a decrease in the monthly demand for real estate with green areas in Çankaya since March 2020, with the general decline in the relevant period following a stable course. Furthermore, a general examination of the period between July 2019 and December 2020 reveals that the decrease in demand decreased between July 2019 and August 2019, then increased between August 2019 and September 2019, and then decreased again from this date until October 2019. The subsequent period, which includes the pandemic period, shows a stagnant course in the decline in demand (Figure 4).

SPATIAL DATA ANALYSES

The current population of Ankara province and Çankaya and Keçiören districts for 2021 were obtained from the population data collected by TURKSTAT every year through the address-based population registration system. The total population of Ankara consists of 5,747,325 people. While the total population of Çankaya district is 949,265; the total population of Keçiören district is 942,884 (TURKSTAT, 2021). The total population of Çankaya and Keçiören districts corresponds to approximately 33% of Ankara's total population. This means that one out of every three people residing in Ankara lives in Çankaya or Keçiören

DOI: 10.15320/ICONARP.2024.289

districts (Figure 5). (Detailed maps containing populations on a neighborhood basis are included in appendix a and b)

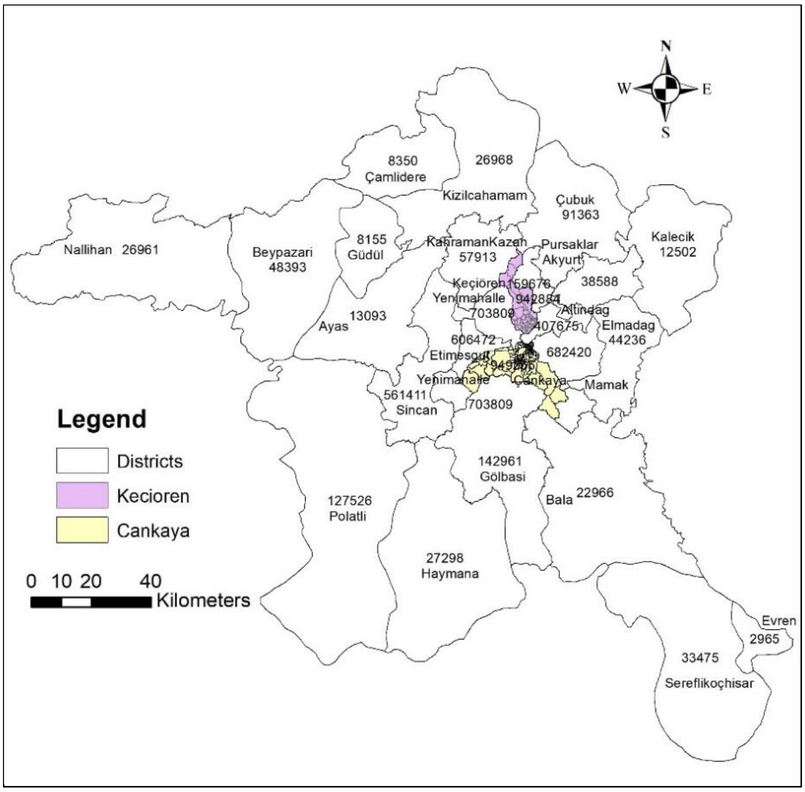


Figure 5. Neighborhood population map

Accordingly, when the two districts are compared, the population is concentrated in the Alacaatlı, Birlik and Üniversite of the Çankaya district, while in Keçiören, it is concentrated in the Atapark, Kuşcağız, Yayla, Ayvalı, Bağlarbaşı, Esertepe, Şehit Kubilay, Pınarbaşı, Etlik, Kanuni, İncirli neighborhoods.

Table 3. Average income in Ankara, Çankaya and Keçiören over time (TL) (2014-2020) (REIDINRebis, 2021a)

Years	Ankara (TL)	Çankaya (TL)	Keçiören (TL)
2014	1,889	3,297	1,638
2015	2,019	3,594	1,745
2016	2,181	3,928	1,885
2017	2,558	3,487	2,134
2018	2,787	3,745	2,380
2019*	3,282	4,552	2,793
2020*	3,795	5,555	3,244

* 12-month average exchange rate for 2019 is 1 USD=5.6814 TL and 1 EURO=6.3595 TL; for 2020 is 1 USD=7.0160 TL and 1 EURO=8.0284 TL. (TCMB, 2021)

The increase in monthly income per capita and the increase in real estate acquisition can be said to have a direct proportional increase with each other. As a result, it is worthwhile to examine the annual increase in monthly income per capita in Ankara and two selected districts. When the change in monthly income per capita in Ankara is examined by year, it is seen that there is a directly proportional increase based on the years studied (no data is available for 2021). The annual increase rate of this increase is observed to range between 8% and 15%. When the change in monthly income per capita for Çankaya and Keçiören districts is compared over time, the average income in Çankaya is approximately 40% higher than the average income in Keçiören (Table 3).

The Socio-Economic Rating (SER) displays the relative socio-economic rankings as well as regional rankings at the district and neighborhood levels. The goal is to rank the regions based on their welfare, livability, and cultural levels using the variables used. In this context, the variables used are sales and rent values for the welfare level; population, housing density, number of stores, rail public transportation systems, number of health institutions, life satisfaction data, number of beds per 1000 people in hospitals, population per family doctor, population per 112 Station, population per ambulance, total crime rates, household numbers, airborne particulate matter concentrations (PM_{10}), and culture.

REIDIN SER regions are clustered based on their similarity to one another into nine distinct predetermined classes. There are nine classes determined: A+, A, A-, B+, B, B-, C+, C, C-, and this classification demonstrates the socioeconomic superiority of districts and neighborhoods to one another. The final SER score ranking is for 2020. SER scores were compared in the Çankaya and Keçiören neighborhoods in this context, which explains the selection of the two test areas in the study (Table 4).

Table 4. SER values by districts of Ankara (REIDINRebis, 2021a)

District	SER Value	District	SER Value	District	SER Value
Çankaya	**A+**	Altındağ	C	Kahramankazan	C-
Yenimahalle	B	Mamak	C	Polatlı	C-
Gölbaşı	B-	Beypazarı	C-	Çubuk	C-
Etimesgut	B-	Kızılcahamam	C-	Elmadağ	C-
Keçiören	**C+**	Pursaklar	C-	Akyurt	C-
		Sincan	C-		

According to Table 4, Çankaya averaged an A+ on the SER, whereas Keçiören averaged a C+. Çankaya has higher average sales prices and rental values on a residential basis than Keçiören in 2020, at a level that will affect the welfare level; the livability level is higher in terms of demographic structure, transportation and health services, and air quality; and in terms of education level and cultural structures, the cultural level is higher.

When the House Price Index (HPI) (2017=100) data, calculated to monitor the quality-adjusted price changes of houses in Türkiye, is analyzed, a continuous increase in the HPI is observed both in Türkiye and in Ankara between the years 2018 and 2021, as shown in Figure 5. It was concluded that the rate of increase in HPI, particularly in 2020 and 2021, was higher for both Türkiye and Ankara during the studied period than in previous years.

DOI: 10.15320/ICONARP.2024.289

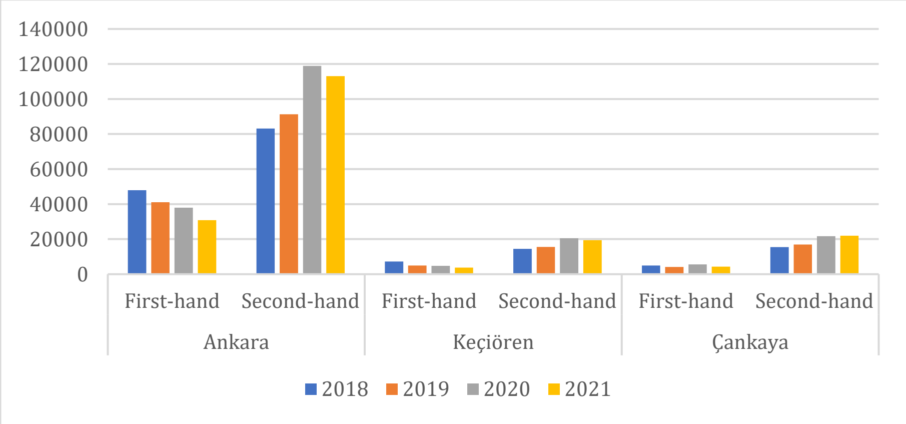


Figure 6. Total house sales in Ankara, Çankaya and Keçiören over time (2018-2021) (REIDINRebis, 2021b)

Based on the housing sales data for the districts of Keçiören and Çankaya, as shown in Figure 6, a total of 20.526 (4.932 first-hand, 15.594 second-hand) houses were sold in 2019, 25.283 (4.761 first-hand, 20.522 second-hand) houses were sold in 2020 and 2021, and 23.170 (3.755 first-hand, 19.415 second-hand) houses were sold in 2021. Çankaya had the sale of 21.120 residences in 2019 (4.158 first-hand, 1.962 second-hand), 27.278 residences in 2020 (5.569 first-hand, 21.709 second-hand), and 26.229 residences in 2021 (4.304 first-hand, 21.925 second-hand). As is the case throughout Ankara, it is observed that second-hand housing sales are primarily carried out in the Keçiören and Çankaya districts, which account for about one third of all housing sales.

Table 5. Price per square meter and year-on-year fluctuations for Keçiören and Çankaya from 2018 to 2019. (REIDINRebis, 2021b)

Years	**Keçiören (TL)**	**Çankaya (TL)**	**Rate for Keçiören**	**Rate for Çankaya**
2018	1515	2518	4%	2%
2019*	1583	2565	16%	16%
2020*	1839	2969	37%	29%
2021	2514	3829		

* 12-month average exchange rate for 2019 is 1 USD=5.6814 TL and 1 EURO=6.3595 TL; for 2020 is 1 USD=7.0160 TL and 1 EURO=8.0284 TL. (TCMB, 2021)

The difference between 2018 and 2021 has grown in direct proportion for both districts according to the m^2 housing sales prices in the Keçiören and Çankaya districts. The Çankaya district has higher m^2 price values than the Keçiören district. Keçiören has a higher variation in the rate of increase in m^2 prices than Çankaya district for 2018–2019, despite Çankaya district having higher housing m^2 prices for the 2019–2020 and 2020–2021. For the years 2018-2019, the change is 4% in Keçiören and 2% in Çankaya; 16% in Keçiören and Çankaya for the years 2019-2020; and 37% in Keçiören and 29% in Çankaya for the years 2020-2021 (Table 5).

Upon analyzing the sales statistics of the districts of Çankaya and Keçiören based on real estate categories, it is evident that focusing types constitute the majority of transactions. Compared to the district of

Çankaya, house sales in Keçiören are 3–9% higher. When sales in the Çankaya and Keçiören districts are examined by residential real estate type, the rate of preference for housing types with gardens and green areas (e.g., farmhouse, mansion, detached house, villa) is determined to be 4.17% in 2018, 4.22% in 2019, and 4.45% in 2020 for the Çankaya district. When each type of house is evaluated separately, total sales tend to decrease over time. On the other hand, in the Çankaya district, there is a slight increase in the preference level for housing types with their own green areas. When compared to Çankaya district, the rates in Keçiören district are very low. It was calculated that it would be 0.13% in 2018, 0.15% in 2019, and 0.14% in 2020. When each type of home is evaluated separately, it is possible to conclude that sales of apartments are rising while sales of other types are falling. In the Keçiören district, the preference level for housing types with distinctive green areas increased slightly in 2019 and then decreased again in 2020.

Determination of the densities of green areas

The density and distribution of green spaces (such as parks, playgrounds, forests, picnic areas, recreational areas, etc.) were analyzed. Most parks and other green spaces can be found in the southern part of the district Keçiören, which contains a total of 421. Northern and western Çankaya are where you'll find most of the district's green spaces. There are 546 parks and other green spaces in this area (REIDINMap, 2021).

The Kernel Density Analysis function of ArcGIS v.10.8.1's Spatial Analysis Tool was used to express the density of points related to green areas. This function calculates the density per unit area based on the number of points and lines provided and a default search radius. In this study, the density was calculated using the software's default parameters (Silverman's Rule of Thumb). The thematic map showing the change in home sales in the Çankaya and Keçiören districts over time was overlaid with maps displaying green area densities to reveal the relationship between home sale prices and green space. On the map, the regions with green tones indicate areas with a high concentration of green areas in the district. The spaces with dense green areas are represented by the dark green areas produced by the kernel density analysis, while the spaces with less dense green areas are shown by a gradual opening of the green color tone.

According to Figure 7, the part where the green areas in Keçiören are concentrated to Ayvalı (27), Kuşcağız (22), Etlik (20), Bağlarbaşı (19), Atapark (19), Esertepe (18), Yayla (16), Kavacık Subayevleri (13), İncirli (13), Osmangazi (12), Sancaktepe (12), Şehit Kubilay (12), Basınevleri (11), Kanuni (11), Kalaba (10), Ovacık (10), Şefkat. (10), and Yeşiltepe (10) neighborhoods.

DOI: 10.15320/ICONARP.2024.289

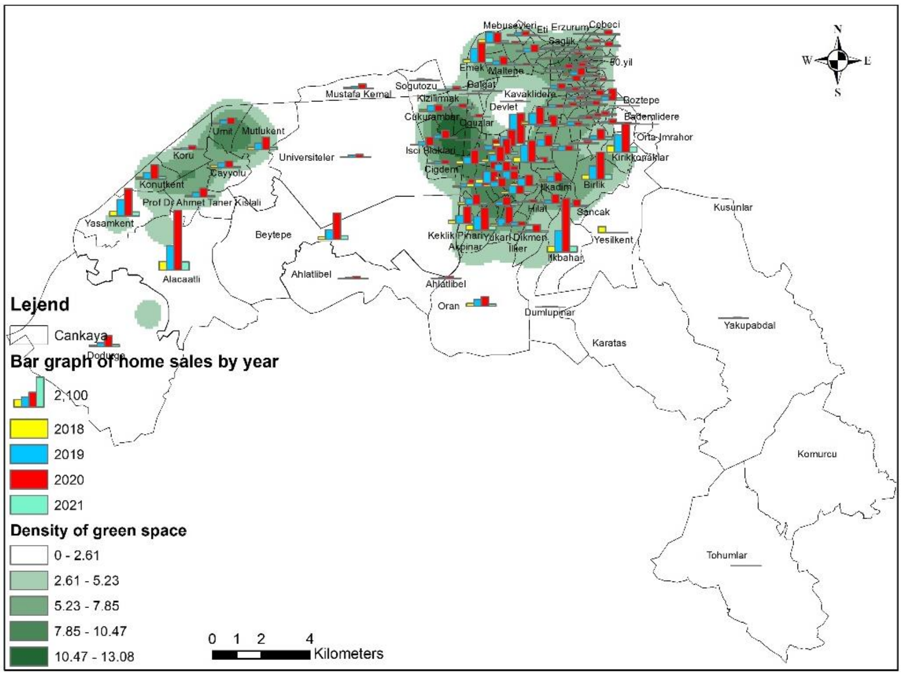


Figure 7. The relationship between the number of housing sales in Çankaya district over the years and green areas

According to Figure 8, the part where the green areas in Çankaya are concentrated (together with the number of green areas) is located at Mutlukent (28), Prof. Dr. Ahmet Taner Kışlalı Mh. (24), Birlik (23) Ümit (22) Koru (19), Konutkent (16), Yaşamkent (16), İşçi Blokları (14), Alacaatlı (12), Yıldızevler (12), Oran (12), Çukurambar (12), Çayyolu (11), Kırkkonaklar (11), Huzur (10), Çiğdem (10), Yukarı Dikmen (10), and Dodurga (10) neighborhoods.

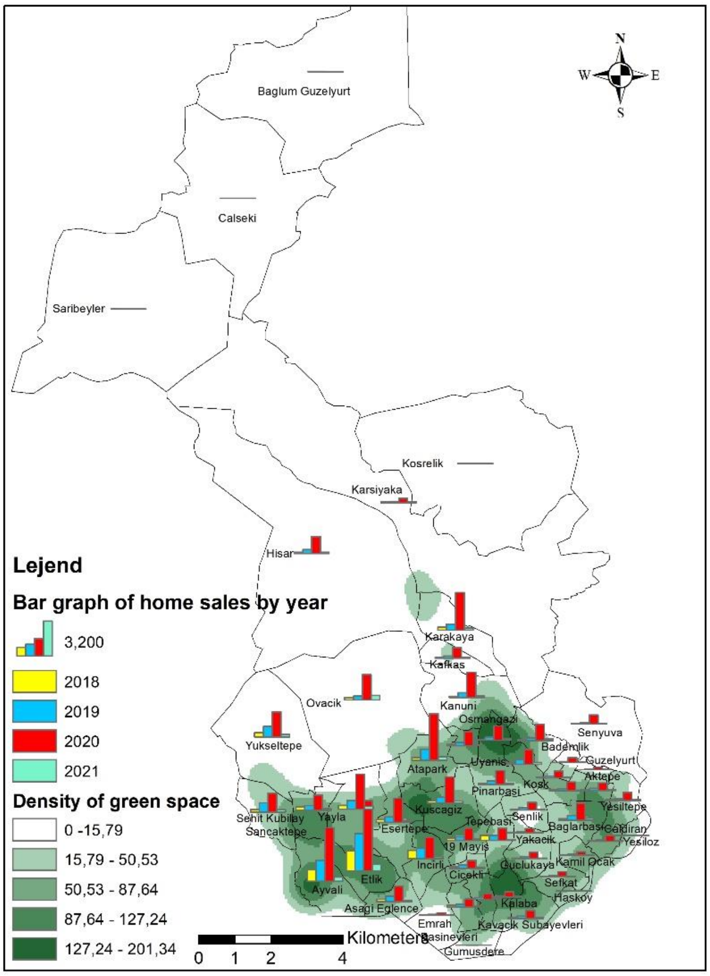


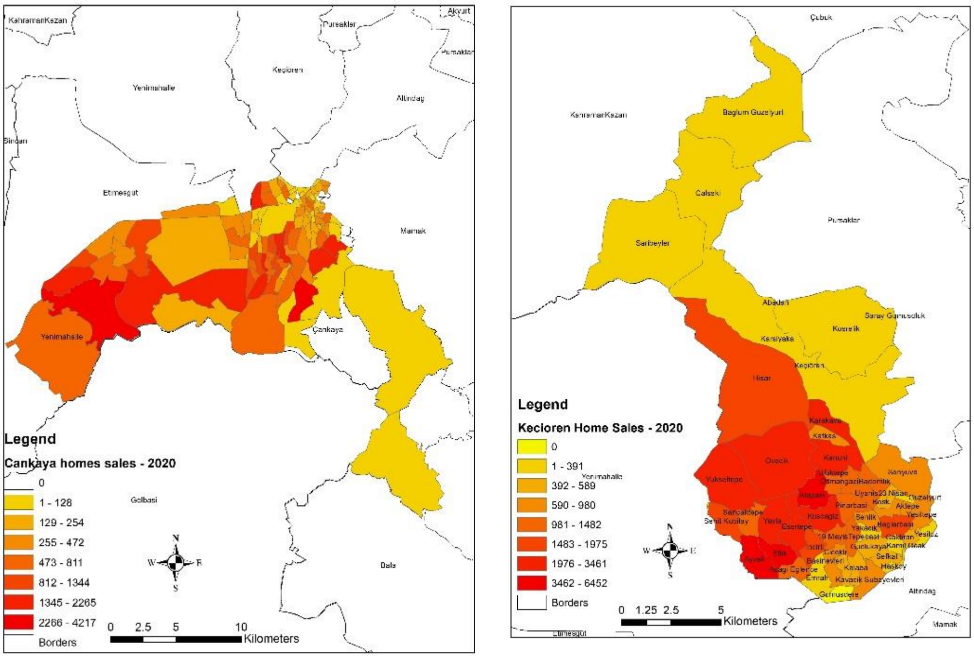
Figure 8. The relationship between the number of housing sales in Keçiören district over the years and green areas

The bar graphs of the housing sales for the neighborhoods of Çankaya and Keçiören for four different dates (2018, 2019, 2020, and 2021) are overlaid in Figures 7 and Figure 8 to show the relationship between the annual house sales in the neighborhoods and the green spaces. When the distribution of housing sales preferences was examined, it became clear that homes close to green spaces are in high demand.

Producing Thematic Maps

To map the real estate sales data of the Çankaya and Keçiören districts, the housing data were first grouped in the database. The data were then classified into 8 classes using the Natural Breaks-Jenks Method in the ArcGIS v.10.8.1 environment, and thematic maps for real estate sales data and difference maps showing the change between years were generated. The findings obtained through thematic maps and difference maps generated based on 2018, 2019, 2020, and 2021 were expressed spatially while mapping the real estate sales data of the Çankaya and Keçiören districts.

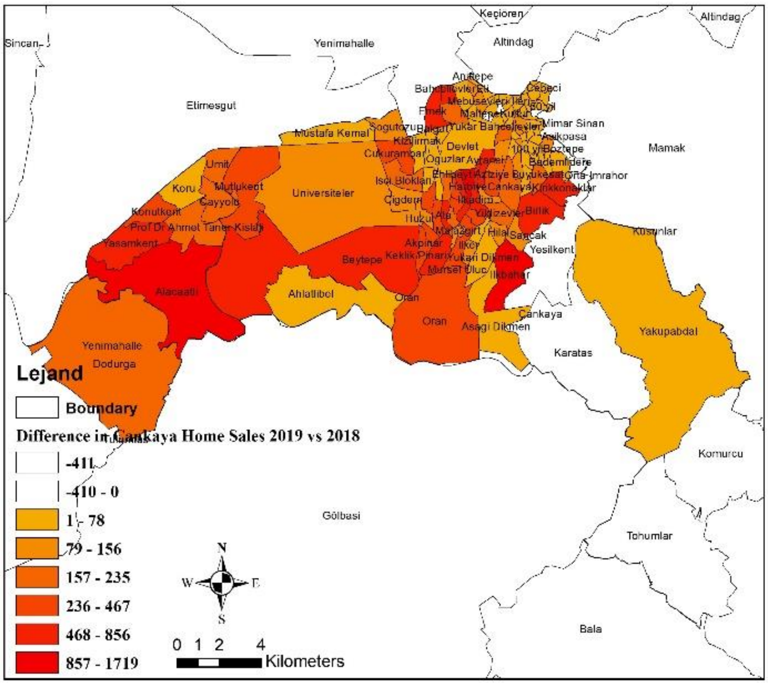
DOI: 10.15320/ICONARP.2024.289



(a) (b)

Figure 9. The The year 2020, when the highest sales were realized in Çankaya (a) and Keçiören (b) districts

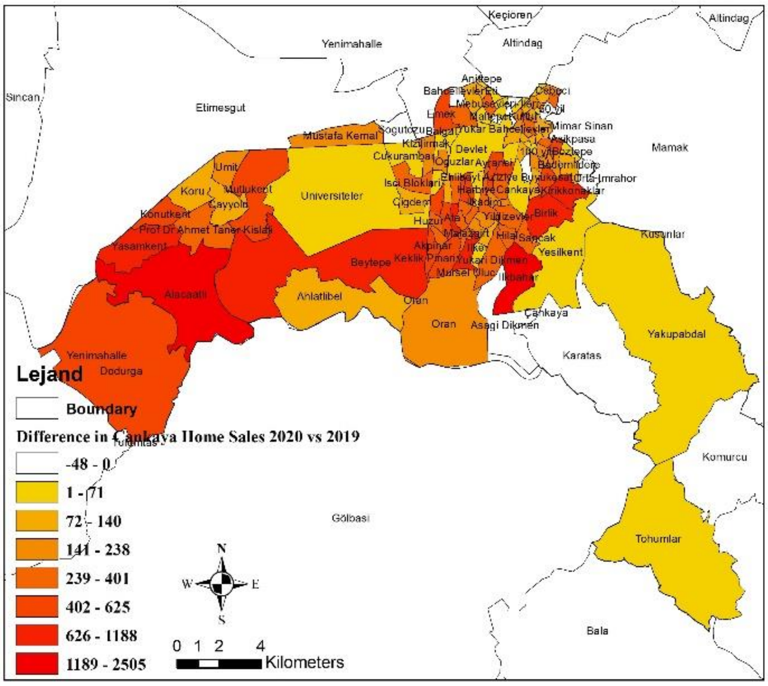
According to Figure 9, when the number of housing sales in Çankaya and Keçiören districts is analyzed by years, the top 10 neighborhoods with the highest sales in 2020, for Çankaya, are Alacaatlı, Bahar, Harbiye, Kırkkonaklar, Yaşamkent, Birlik, Beytepe, Ata, Keklikpınarı, and Emek neighborhoods. For Keçiören district, it is seen that the top 10 neighborhoods with the highest sales in 2020 are Etlik, Ayvalı, Atapark, Karakaya, Yayla, Kuşcağız, Ovacık, Kanuni, Yükseltepe and Esertepe neighborhoods.



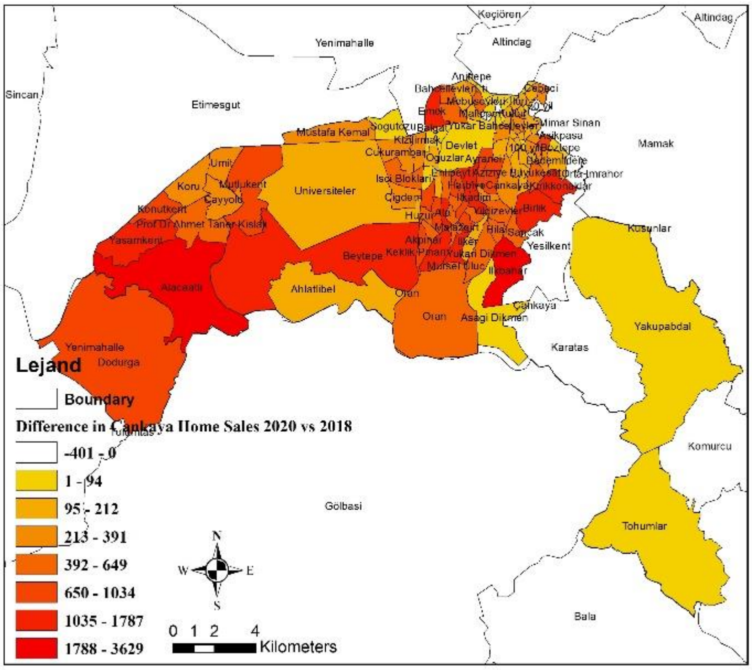
(a)

Figure 10. Differences in house sales in Çankaya district between the years 2018-2019 (a), 2019-2020 (b), and 2018-2020 (c)

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024



(b)

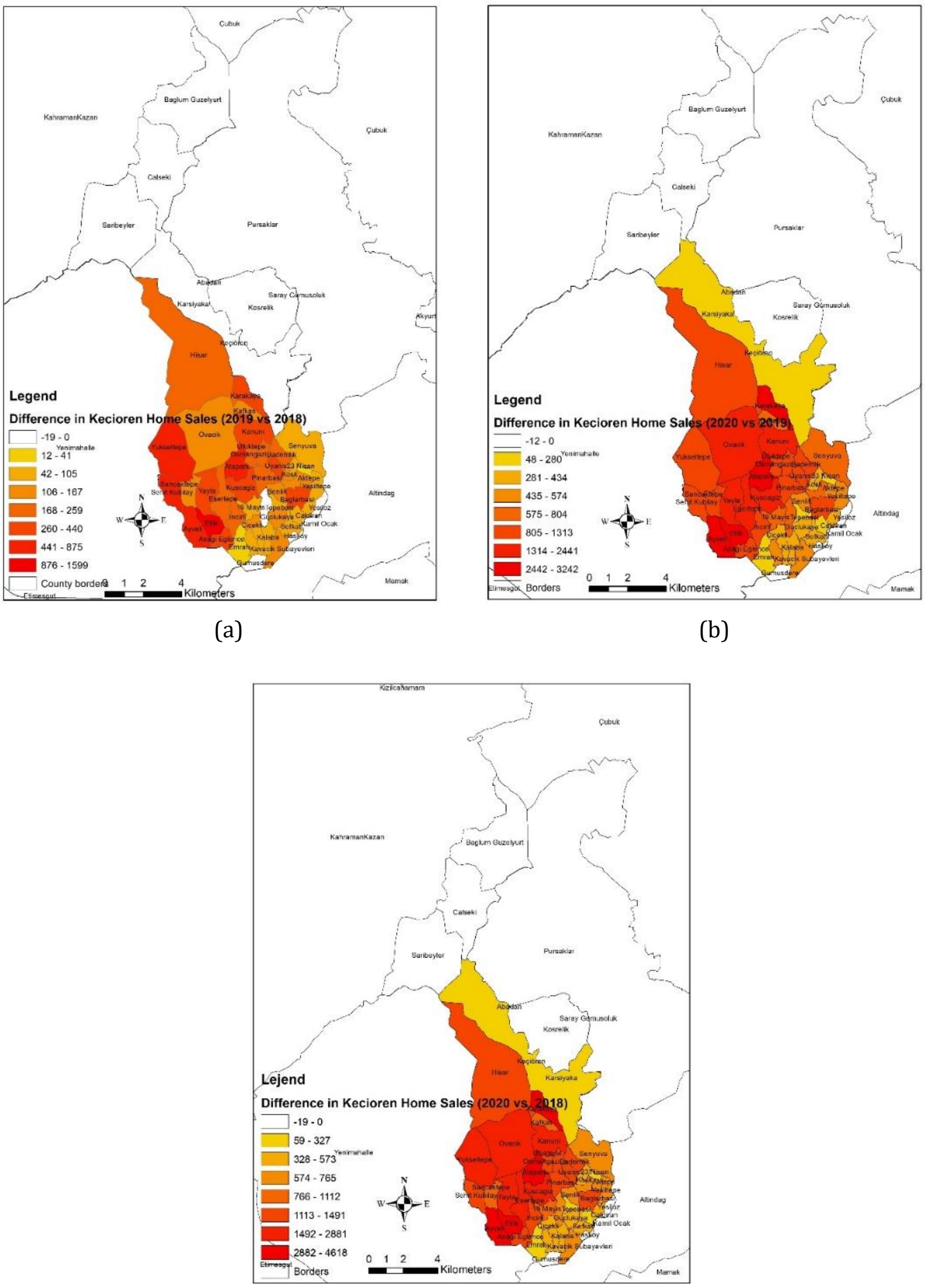


(c)

The variation in housing sales in the Çankaya district in 2018, 2019, and 2020 is shown in Figure 10. On the map, the neighborhoods with the highest real estate sales are highlighted in red, whereas the neighborhoods with the lowest sales are highlighted in light yellow. The difference between 2018 and 2019 is the most significant, according to Harbiye (1719), Alacaatlı (1124), and İlkbahar (1116); the difference between 2019 and 2020 is the most significant, according to Alacaatlı (2505), İlkbahar (2269), and Beytepe (1188); the difference in home sales was the most pronounced between 2018 and 2020, particularly

DOI: 10.15320/ICONARP.2024.289

in Alacaatlı neighborhood, the most sales were provided in 2020, with 4,217 house sale. The greatest housing sales differences are between 2018 and 2020, according to an analysis of the three different maps of the Çankaya district.



(a) (b)

(c)

Figure 11. Housing sales differences of Keçiören district between the years 2018-2019 (a), 2019-2020 (b), and 2018-2020 (c)

Figure 11 shows that when the difference maps showing the change in house sales in Keçiören district between 2018, 2019, and 2020 are analyzed, it was observed that sales in the difference maps of 2018 and 2019 are more intense at Etlik (1599), Ayvalı (875), and Atapark (774). Atapark (3242), Etlik (3019), Ayvalı (2995) and Karakaya (2904) have the highest sales data between 2019 and 2020, while Etlik (4618), Atapark (4016), Ayvalı (3,870), and Karakaya (3188) have the highest sales data between 2018 and 2020. When the three difference maps of Keçiören district was evaluated together, the highest sales were realized in Etlik with 6452 residences in 2020. Again, for this neighborhood, it was seen that the difference in house sales is the highest in the period between 2018-2020.

CONCLUSION AND RECOMMENDATIONS

With the emergence of the COVID-19 pandemic at the end of 2019, many sectors at the local, national, and global levels were impacted by the epidemic's negative social, economic, and physical consequences. The deterioration of health, confinement to homes, alienation from social environments, cessation of education, feeling of isolation, fear of death, and depression have caused physical and social deterioration. Production declines, business closures, layoffs, workforce loss, unexpected changes in trading activities, some sectors declining and others becoming more prominent, financial concerns, and other factors resulted in economic losses and inequalities. As a sector affected by all these negatives, the real estate sector, which is at the heart of people's shelter and protection, has attempted to develop a perspective and implement measures to overcome the situation with the least amount of damage. During the pandemic period, solutions to problems in the real estate sector were sought, and decisions were made to implement housing-type investments that would allow users to overcome the problem socially and physically. In this context, designing healthier, more livable, functional, nature-integrated, and sustainable housing areas has become the construction industry's primary goal, and this has directly affected the real estate industry, causing the process to transform positively for users. Users have begun to prefer detached houses with their own green areas, gardens, balconies, terraces, or houses near green areas to avoid the restlessness and depression caused by staying at home during the pandemic period.

On the other hand, the change in housing prices and demand, which cannot be solely attributed to the global epidemic, has also been significantly influenced by the economic change in certain periods or the country's real estate sector decisions. The TCMB reduced the policy rate from the second half of 2019 to the first half of 2020, before increasing it in the fourth quarter of 2020. The policy interest rate continued to rise in the first quarter of 2021, while it fell significantly in the fourth quarter of this year (TCMB, 2021). Taking this into account, although it has been observed that housing sales in Türkiye tend to increase after the first months of the pandemic process, with housing loan interest rate cuts and the facilitation of loan supply conditions, the rise in policy rates, the change in conditions, and the increase in construction costs, it has entered a new period of decline because of the effects of global economic fluctuations.

Although the increase-decrease in housing demand varies with financial sufficiency, individual preferences, needs, and demands that

DOI: 10.15320/ICONARP.2024.289

arise because of the period's conditions are also effective in the demand for housing type. Therefore, the pandemic period has brought some changes in housing demand. People living in high-rise buildings preferred structures with gardens, balconies, terraces, or demanded accommodation units with open and green areas or near open green areas for education, work, shopping-rest or requested accommodation units near an open green space for a healthy life. This shift in demand has resulted in an increase in housing prices. This demonstrated that green spaces were not only used for recreation but also contributed to bettering citizens' health, integrating citizens with nature, and increasing the value of the dwelling.

Due to the defined reasons explained above, the districts of Çankaya and Keçiören examined in this study have the highest population in Ankara. When income levels are examined, Çankaya's income level is higher than Ankara's overall, whereas Keçiören's income level is lower than the Ankara average. The average income in the Çankaya district is approximately 40% higher than the average income in the Keçiören district. Based on the socioeconomic rating levels, Çankaya is at A+ and Keçiören is at C+. The value of the house to be purchased increases in direct proportion to the income. Thus, houses with higher prices are sold in Çankaya district compared to Keçiören. The reason for this is because the unit prices per square meter in Çankaya (2,565 TL/m^2-2019; 2,969 TL/m^2-2020) are greater than those in Keçiören. (1,583 TL/m^2-2019; and 1,839 TL/m^2-2020). According to the residential real estate type, the rate of preference for houses with gardens and distinctive green areas (farmhouse, mansion, detached house, villa, waterside residence) was 4.17% in 2018, 4.22% in 2019, and 4.45% in 2020 in Çankaya district, and 0.13% in 2018, 0.15% in 2019, and 0.14% in 2020 in Keçiören district. When compared to the Çankaya district, the rates in Keçiören are very low[1].

After the pandemic, demand for green-space real estate in the Keçiören district increased in comparison to the pre-pandemic period. The demand for real estate with green areas in Çankaya district decreased after the pandemic compared to the period before the pandemic. Following March 2020, which was considered the start of the pandemic, for the Keçiören district, there was an increase in demand for real estate with green areas in April, followed by a decrease in demand in the following months compared to April. According to the time-varying parameter estimates obtained, the monthly demand for real estate with green areas in general has decreased beginning in April 2020. While the decrease in demand was at its peak in June 2020, there has been a decrease in demand since July, and it has continued to stagnate since then.

[1] m^2 prices in 2019 for Keçiören is 279 $ and 249 € while Çankaya is 452 $ and 403 €; in 2020 for Keçiören is 262 $ and 229 € while Çankaya is 423 $ and 370 € (TCMB, 2021).

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

When examining the pandemic period specifically for the Çankaya district, there has been a decrease in monthly demand for real estate with green areas since March 2020. During the same period, it was observed that the decrease in demand for real estate with green areas in Çankaya remained stable. Furthermore, general examinations showed that the decrease in demand decreased between July 2019 and August 2019, then increased between August 2019 and September 2019, and then decreased again from this date until October 2019. The subsequent period, which includes the pandemic period, shows a stagnant course in the decline in demand.

When the years between 2018 and 2020 were examined, it was observed that the following neighborhoods had the most house sales: Alacaatlı, Harbiye, Kırkkonaklar, İlkbahar, Yaşamkent for Çankaya, and Etlik, Ayvalı, Atapark, İncirli, Karakaya for Keçiören. The relationship between the number of house sales and green areas in both Çankaya and Keçiören districts between these years demonstrates that housing sales preferences are over areas on or near green areas.

Between 2020 and 2021, sales dropped dramatically, and no useful data could be found. In other words, as the pandemic process gradually lost its impact, housing sales have fallen between these years. As a result, this particular situation may be studied as a different topic.

The fact that there are more apartment-style homes and less green space in the Keçiören district than in the Çankaya district shows how much more people needed open green spaces during the pandemic. During this time, people in Keçiören have been looking for homes with their own green space. In the Çankaya district, there are more homes with their own green space, there is more green space in the district, and it is easier to get to green spaces than in Keçiören. This shows that home ownership hasn't changed much since the pandemic, and it is still going in the same direction. One possible reason for the drop in demand for homes in this area during and after the pandemic is that the prices per square meter of houses in Çankaya with their own green spaces went up faster than the interest in these kinds of houses.

If a general evaluation is done, the population of the district, the size of the household, differences in cultural structure, changes in tastes and preferences, and the desire for physical and mental relaxation of people who have to stay at home because of the pandemic can be seen as possible socio-cultural reasons for the different demand for housing with different sizes and features in each district. Also, different income levels of the districts, the government's housing policies, the interest rates on housing loans, and making it easier to get loans can all be seen as possible economic factors that will lead to a preference for more expensive housing. Also, the speculation that housing prices will go up even more in the future because it's hard to know the pandemic situation as a speculation that led to the increase in housing prices by making more people want to live in the districts (appendix c).

DOI: 10.15320/ICONARP.2024.289

Considering these evaluations, the following recommendations for green areas and their relationship to real estate can be made:

- When developing city plans, green spaces should be planned in a balanced and systematic manner throughout the city, rather than separately from residential areas.
- The amount of urban green space per capita should be reconsidered, taking into account the population of the neighborhoods as well as the possibility of using them as a resting and regeneration area, as well as a gathering area in emergencies such as natural disasters.
- Access to open and green space in the immediate vicinity of existing residential areas should be enhanced.
- In the residential areas that are planned to be built, it should be ensured that the natural and built environments are planned in an integrated manner.
- In addition to considering elements that improve ventilation, such as balconies and terraces, new residences should prioritize the planning of residential areas with gardens, open spaces, and green areas.
- Interior design elements for ventilation, maximum daylight use, and efficient energy use should be prioritized in the interior design of new houses to be built.
- Functional interior designs incorporating natural elements (roof garden, open-closeable terrace-balcony garden, winter garden, etc.) should be implemented in accordance with demand changes manifested at various times and for various reasons.

The importance of green spaces in terms of citizens' quality of life and a healthy city life in terms of physical and social aspects has been demonstrated by this study. The results demonstrate that green spaces close to residential areas not only raise the value of homes but also significantly improve people's quality of life. Therefore, when planning residential areas, city officials should consider the proximity of green areas visible from the house and within walking distance as an important criterion. Green areas near residences will benefit citizens' health, both physically and psychologically, and will serve as places where people can get away from indoor spaces, be alone with nature, and relieve stress. Furthermore, green areas near residential areas can be used as a gathering area in the event of disasters and emergencies, as well as an activity area for citizens to socialize.

REFERENCES

Aisha, S., & Susanto, D. (2018). Green estate in jakarta: Branding or reality. *E3S Web of Conferences*, *67*, 04025. https://doi.org/10.1051/e3sconf/20186704025

Baker, S. R., Farrokhnia, R. A., Meyer, S., Pagel, M., & Yannelis, C. (2020). How does household spending respond to an epidemic? Consumption during the 2020

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

covid-19 pandemic. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3565521

Balcı D. & Türk A (2020). COVID-19 sonrası kent planlamasında yaşanacak olası değişimler üzerine. *Journal of Turkish Studies*, *Volume 15 Issue 8*(Volume 15 Issue 8), 3389-3400. https://doi.org/10.7827/TurkishStudies.45905

Beuschel, V., & Rudel, T. K. (2009). Can real-estate developers be "green"?: Sprawl, environmental rhetoric, and land use planning in a New Jersey community. *Society and Natural Resources*, *23*(2), 97-110. https://doi.org/10.1080/08941920802013981

Çörek Öztaş Ç. (2020) Pandemi dosyası-3: Koronavirüsün konut mimarisi ve kent planlamasına etkisi, WRI Sürdürülebilir Şehirler Türkiye, Retrieved from: https://wrisehirler.org/haberler/pandemi-dosyas%C4%B1-3-koronavir%C3%BCs%C3%BCn-konut-mimarisi-ve-kent-planlamas%C4%B1na-etkisi (Access date: 18.01.2021)

d'Acci, L. (2019). Quality of urban area, distance from city centre, and housing value. Case study on real estate values in Turin. *Cities*, *91*, 71-92. https://doi.org/10.1016/j.cities.2018.11.008

Dones, R. L. E., & Young, M. N. (2020). Demand on the of courier services during covid-19 pandemic in the Philippines. 2020 7th International Conference on Frontiers of Industrial Engineering (ICFIE), 131-134. https://doi.org/10.1109/ICFIE50845.2020.9266722

Izzah, N., Dilaila, F., & Yao, L. (2021). The growth of reliance towards courier services through e-business verified during COVID-19: Malaysia. Journal of Physics: Conference Series, 1874(1), 012041. https://doi.org/10.1088/1742-6596/1874/1/012041

Kalman RE (1960) A new approach to linear filtering and prediction problems. Journal of Basic Engineering, Transactions of the ASME, Series D, 82, 35-45.

Kalman RE (1963) New methods in Wiener filtering theory, in Bogdanoff, J. L. and Kozin, F. (eds), Proceedings of the first symposium on engineering applications of random function theory and probability, New York, Wiley, 270-388.

Kalman, R. E. (1960). A new approach to linear filtering and prediction problems. Journal of Basic Engineering, 82(1), 35-45. https://doi.org/10.1115/1.3662552

Kilnarová, P., & Wittmann, M. (2017). Open space between residential buildings as a factor of sustainable development – case studies in Brno (Czech Republic) and Vienna (Austria). IOP Conference Series: Earth and Environmental Science, 95, 052008. https://doi.org/10.1088/1755-1315/95/5/052008

Latinopoulos, D. (2022). Evaluating the importance of urban green spaces: A spatial analysis of citizens' perceptions in Thessaloniki. Euro-Mediterranean Journal for Environmental Integration, 7(2), 299-308. https://doi.org/10.1007/s41207-022-00300-y

Ling, D. C., Wang, C., & Zhou, T. (2020). A first look at the impact of covid19 on commercial real estate prices: Asset level evidence. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3593101

Mattarocci G. & Roberti S. (2020). Real Estate and the Effects of the COVID-19 Pandemic in Europe. A New World Post COVID-19, 177.

Newey, W. K., & West, K. D. (1987). A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. Econometrica, 55(3), 703. https://doi.org/10.2307/1913610

DOI: 10.15320/ICONARP.2024.289

REIDINMap (2021) Parks and other green spaces in Çankaya and Keçiören, (Access date: 10.01.2021)

REIDINRebis (2021a) The Socio-Economic Rating (SER) by districts of Ankara. (Access date: 10.01.2021)

REIDINRebis (2021b) Total house sales in Ankara, Çankaya and Keçiören between 2018-2021(Access date: 10.01.2021)

Severino R. (2020). Housing and the future of real estate demand, Report of Real Estate Investment in JLL IP Inc. Retrieved from: https://www.us.jll.com/en/trends-and-insights/research/housing-and-real-estate-demand (Access date: 18.01.2021)

Signorelli, C., Capolongo, S., D'Alessandro, D., & Fara, G. M. (2020). The homes in the COVID-19 era. How their use and values are changing. Acta Bio Medica Atenei Parmensis, 91(9-S), 92-94. https://doi.org/10.23750/abm.v91i9-S.10125

Sohn, W., Kim, H. W., Kim, J.-H., & Li, M.-H. (2020). The capitalized amenity of green infrastructure in single-family housing values: An application of the spatial hedonic pricing method. Urban Forestry & Urban Greening, 49, 126643. https://doi.org/10.1016/j.ufug.2020.126643

TURKSTAT (2021). Turkish Statistical Institute, Population data for 2021. https://www.tuik.gov.tr

TCMB (2021). The Central Bank of the Republic of Türkiye. https://www.tcmb.gov.tr

Worden, K., Hazer, M., Pyke, C., & Trowbridge, M. (2020). Using LEED green rating systems to promote population health. Building and Environment, 172, 106550. https://doi.org/10.1016/j.buildenv.2019.106550

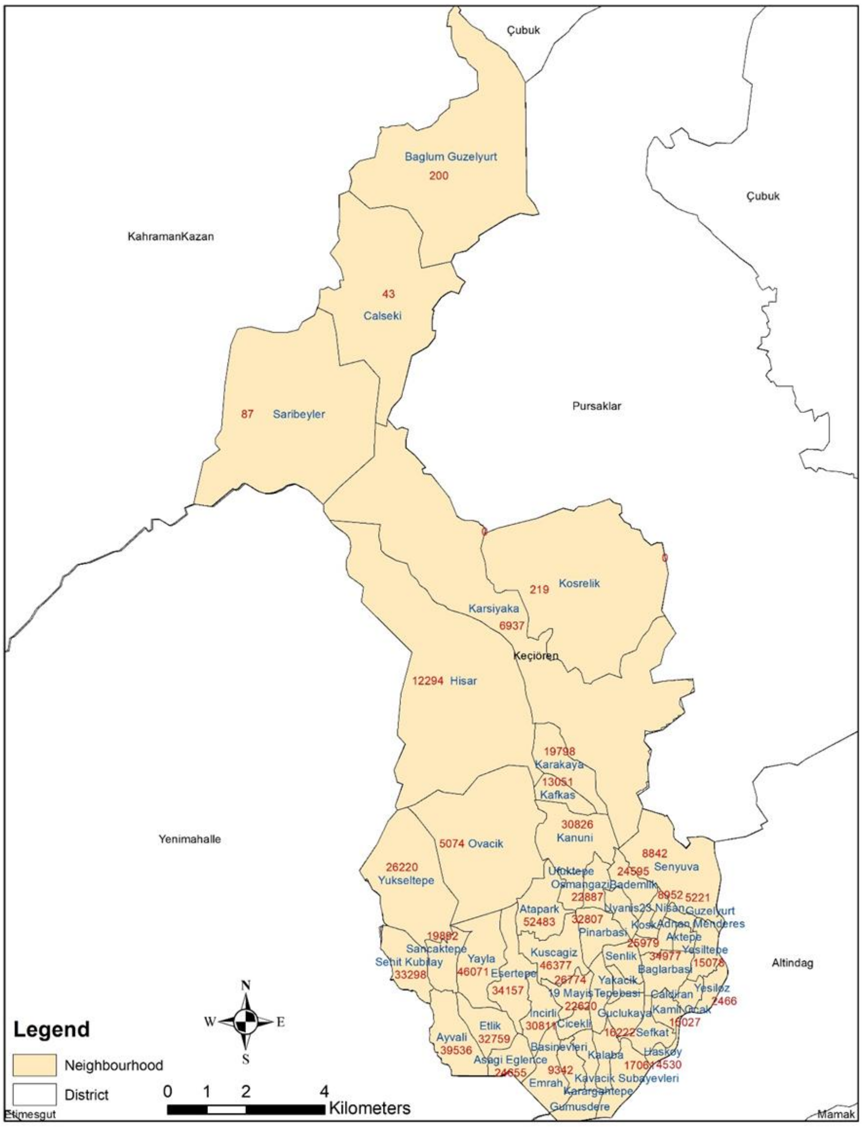
Resume

Hatice Gül ÖNDER received her PhD degree from Gazi University, Ankara, Turkey, in 2018. She is now an Associate Professor Dr. at the Academy of Land Registry and Cadastre in Ankara Haci Bayram Veli University, Ankara, Turkey. Her research interests are in urban planning, urban transportation planning, real estate and property management.

Göktuğ ŞAHİN received his PhD degree in Economics from Yildirim Beyazit University, Ankara, Turkey, in 2020. He is now an Associate Professor Dr. at the Faculty of Economics and Administrative Sciences in Ankara Haci Bayram Veli University, Ankara, Turkey. His research interests are macroeconomics, environmental economics, energy economics, cultural economics and monetary economics.

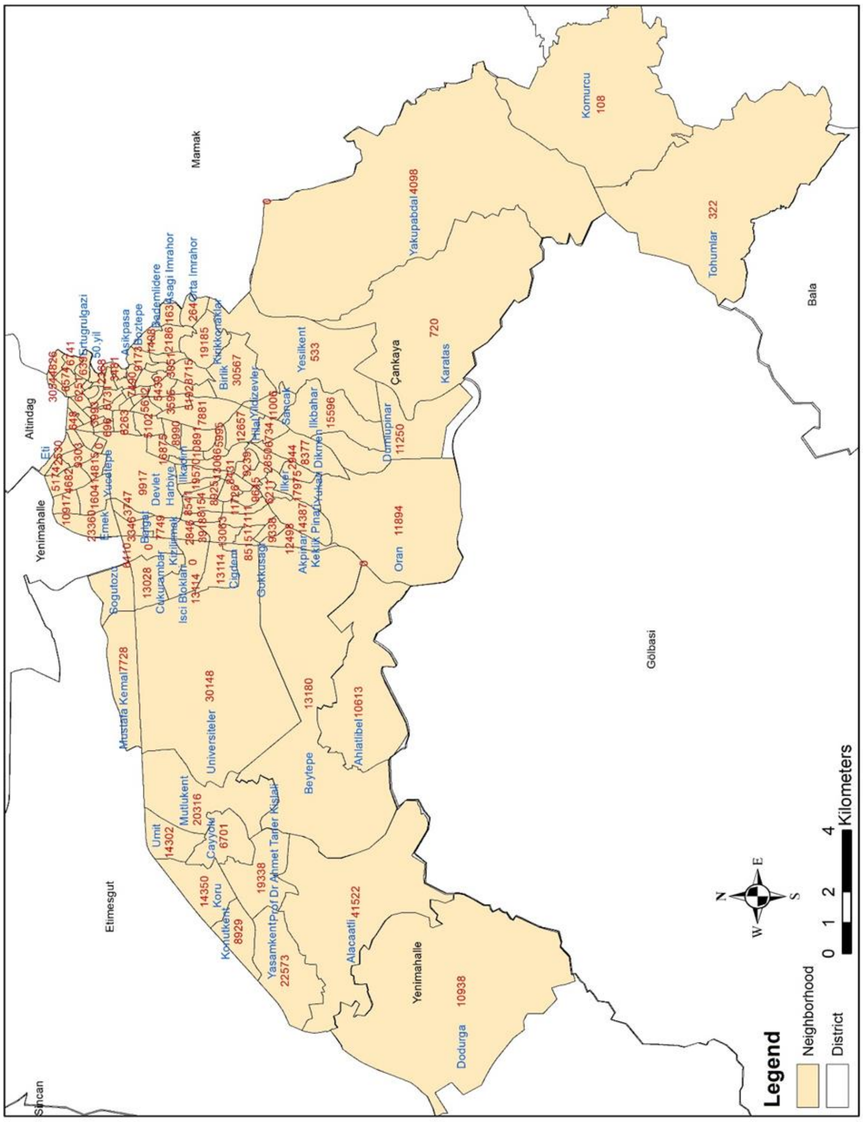
Aslı ÖZDARICI OK received her PhD degree from Middle East Technical University, Ankara, Turkey, in 2012. She is now a Professor Dr. at the Academy of Land Registry and Cadastre in Ankara Haci Bayram Veli University, Ankara, Turkey. Her research interests are in applications of land and mass evaluation, object detection, image classification for remote sensing.

Appendix a. Keçiören's neighborhood population map

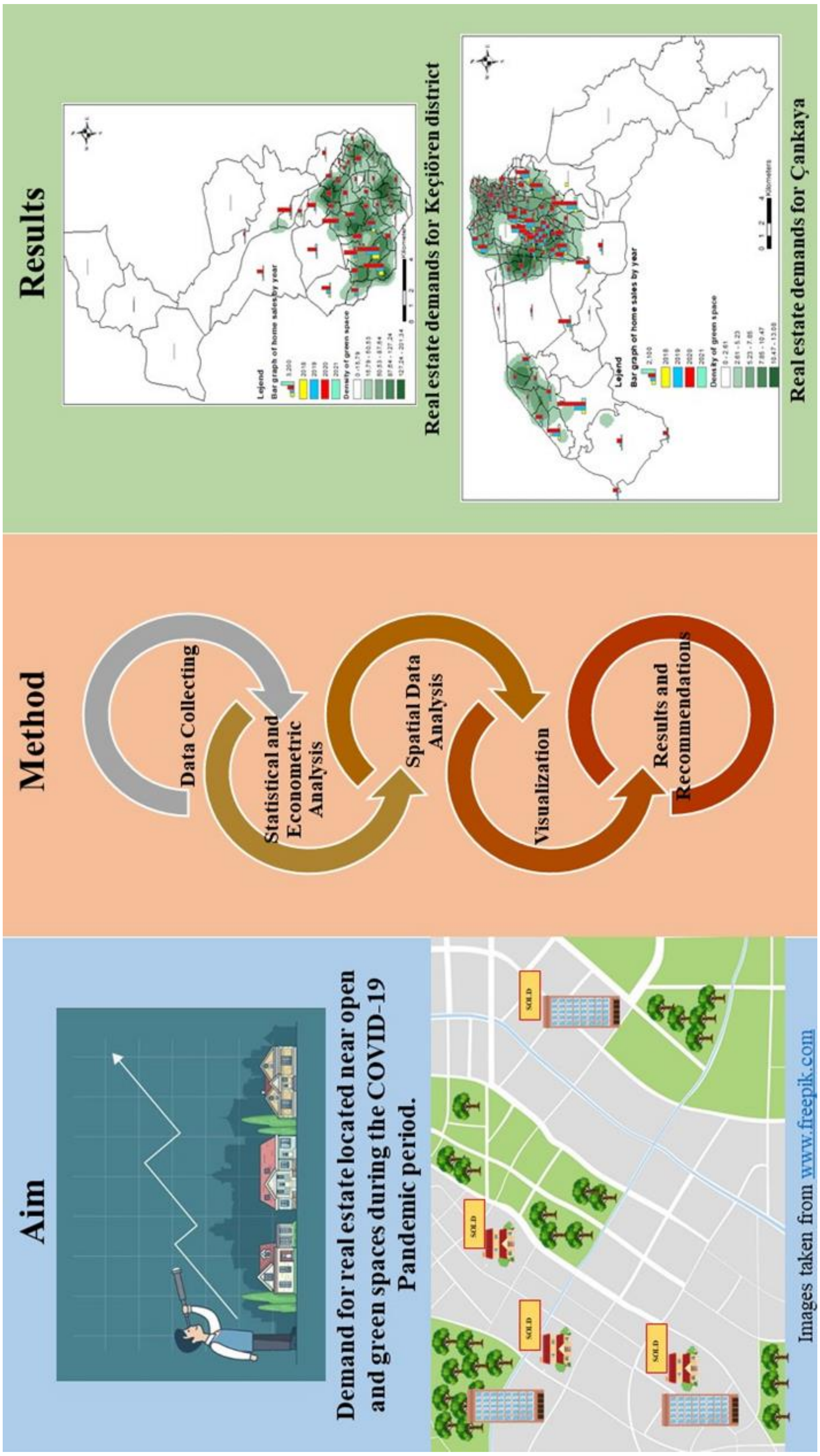


DOI: 10.15320/ICONARP.2024.289

Appendix b. Çankaya's neighborhood population map



Appendix c. Graphical abstract



DOI: 10.15320/ICONARP.2024.289

ICONARP
International Journal of Architecture and Planning
Received: 24.06.2023 Accepted: 03.01.2024
Volume 12, Issue 1/ Published: 30.06.2024
Research Article
DOI: 10.15320/ICONARP.2024.290 E- ISSN:2147-9380

ICONARP

Determination of Drinking Water Basin Protection Zones: Case of Beyşehir Basin, Türkiye

Halil Burak Akdeniz*
Sinan Levend**
Şaban İnam***

Abstract

Global climate change, one of the most important problems of today, and human activities have negative effects on the sustainability of natural resources. It has become necessary to establish planning and management mechanisms for the sustainable use of drinking water basins within the protection-use balance. Beyşehir Basin, Türkiye was chosen as the study area. The aim of this study is to present a new model approach for the use of Analytical Hierarchy Process and Geographic Information Systems, based on the unique topographic, hydrological, and environmental characteristics of the basin, in the determination of the drinking water basin protection zones. Thirteen criteria, which affect the reaching of the pollutants to the water surface and reflect the topographic, hydrological, and environmental characteristics of the basin, were used in the determination of the protection zones. As a result of the study, it was determined that 2.83% of the basin is in the absolute protection zone, 44.97% in the short-range protection zone, 35.93% in the medium-range protection zone and 16.26% in the long-range protection zone. In the last stage, the conservation areas determined by the current legal regulations for the basin and the protection zones determined by the model approach were spatially and areally compared. According to the results of the comparison, it was determined with the proposed protection model that the absolute protection, the short-range protection, and the medium-range protection zones increased areally, and the spatial distributions of these protection zones were shaped according to the structure of the basin.

Keywords:
AHP, Drinking water basin, GIS, Protection zones, Sustainable watershed management

*Faculty of Engineering and Natural Sciences, Konya Technical University, Konya, Turkey. (Corresponding author)
Email: hbakdeniz@ktun.edu.tr

**Faculty of Architecture and Design, Konya Technical University, Konya, Turkey.
Email: slevend@ktun.edu.tr

***Faculty of Engineering and Natural Sciences, Konya Technical University, Konya, Turkey.
Email: sinam@ktun.edu.tr

To cite this article: Akdeniz, H.B., Levend, S., & İnam, Ş. (2024). Determination of Drinking Water Basin Protection Zones: Case of Beyşehir Basin, Türkiye. *ICONARP International Journal of Architecture and Planning,* 12 (1), 417-443. DOI: 10.15320/ICONARP.2024.290

INTRODUCTION

The main reason why Earth is called the blue planet is that more than 70% of its surface is made up of water. Although this rate seems high, only 3% of the total water in the world is fresh water and freshwater resources are not evenly distributed throughout the world (EEA, 2018). In addition, although water is the most basic source of life for all living things, the water source suitable for use in the world is less than 1% of all water resources (Muluk et al., 2013). This shows that water is a scarce natural resource.

In addition, climatic changes and social developments after the Industrial Revolution adversely affected the quantity and quality of water resources. Phenomena such as rapid increase in world population, excessive use of fossil fuels, urbanization, industrialization, and agricultural activities, which are also the main causes of climate change and water scarcity arising from global warming, lead to pressure and destruction on all natural resources, especially water resources (Cicek et al., 2015; WHO, 2022).

Today, the demand for water is increasing day by day. According to the United Nations International Children's Emergency Fund (UNICEF) and World Health Organization (WHO) data, 1 out of every 3 people experience water shortages because they cannot access adequate and healthy drinking water (UNICEF & WHO, 2019). The fact that people cannot reach a safe drinking water source shows that they must use and consume drinking water containing high levels of microbial microorganisms and chemicals. It is predicted that approximately half of the world's population will live in water-stressed basins by 2050 (Uyduranoglu Oktem & Aksoy, 2014).

The annual amount of usable water per capita in Türkiye is approximately 1350 m^3. Considering that this amount is 10,000 m^3 in water-rich countries, it shows that Türkiye is a country experiencing water scarcity. In Türkiye, which has a semi-arid character in terms of water, pressure has increased in water resources in terms of quantity and quality with the effect of population growth and climate change (TOB, 2018). By 2030, the population of Türkiye is expected to be 100 million and the need for water is expected to increase day by day (Kunt et al., 2020). By 2045, it is estimated that the amount of water needed in Türkiye will be three times the current water consumption (TOB, 2018). In addition, the pollutants formed in the basins because of urban, industrial, and agricultural activities cause deterioration of surface and even underground water quality. However, the absence of a water law in Türkiye that addresses and regulates all aspects of water and the fact that many institutions and organizations have authority in the management of water resources cause conflicts between institutions and laws in the process of protecting and using water resources. In this context, Türkiye will become a country experiencing water stress unless measures are taken for the protection and sustainable use of water resources (Ozturk

DOI: 10.15320/ICONARP.2024.290

et al., 2016). In this context, it is of great importance for sustainable Türkiye to evaluate the potential of water resources, protect their quality, prevent pollution, and use them efficiently in a very purposeful way.

In line with this awareness and the principles of the Water Framework Directive adopted in the process of orientation with the European Union (EU), some arrangements have been made both at the institutional level and in the legal legislation for the protection of drinking water basins in Türkiye (Cicek et al., 2015). The most important regulation made for the protection, improvement and sustainability of drinking water basins are undoubtedly the Regulation on the Protection of Drinking-Utility Water Basins and the Declaration of the Procedures and Principles for the Preparation of the Drinking-Utility Water Basin Protection Plan based on this regulation. These legal regulations necessitate the preparation of protection plans and the determination of special provisions for each drinking water basin with a scientific study, considering the characteristics of drinking water basins. However, although the legal regulations emphasize that a mathematical model should be used in the determination of the watershed protection zones, it is seen in the planning studies that the characteristics of the basins are not considered sufficiently, and the watershed protection zones are created by determining the distances to create bird flight buffer zones. This approach, in which natural thresholds are not adequately considered, is not sufficient to guide policies for the protection, improvement and sustainability of drinking water basins (Kuru & Tezer, 2020).

Geographic Information System (GIS) is a decision support system designed for the collection, storage, processing, analysis, and display of large volumes of data from various sources. By using GIS, the determination watershed protection zone can be analysed much more quickly, comprehensively, cost-effectively, with higher accuracy and systematically. Multi-Criteria Decision Making (MCDM) methods provide convenience to decision makers in designing and solving complex problems with many criteria or evaluating possible alternative ways (Feizizadeh et al., 2014). Spatial MCDM methods, on the other hand, were developed based on combining spatial analyses in GIS with MCDM methods. Today, many MCDM methods such as Analytical Hierarchy Process (AHP), Analytic Network Process (ANP), Inner Product of Vector, Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) are successfully applied in a wide variety of GIS applications (Afzali et al., 2014; Beskese et al., 2015; Sisman et al., 2021, Akdeniz et al., 2023). The AHP is a method of "measurement through pairwise comparisons and relies on the judgments of experts to derive priority scales" (Saaty, 2008). AHP, provides a framework for selecting a preferred alternative from among a set of potential solutions to a problem, therefore leads to more sustainable watershed planning and management decisions (Yavuz & Beycan, 2013). It has been one of the most widely used MCDM tools (Vaidya & Kumar, 2006).

The aim of the study is to present a model for the use of GIS technologies and AHP method, which is one of the multi-criteria decision-making methods based on the unique topographic, hydrological, and environmental characteristics of the basin, in determining the protection zones, which is the main determinant in the planning of drinking water basins in line with the principle of protection and use. Thus, an objective method of determining drinking water basin protection zones has been defined for the limitation of activities that will affect the quality and quantity of drinking water. Within the scope of the study, the Beyşehir basin was determined as the study area. The main reason for choosing the Beyşehir basin as the study area is that Beyşehir Lake, which is the largest freshwater source in Türkiye, is located within the borders of the basin and it is predicted that the basin will experience significant water scarcity soon (OSIB, 2016).

This study makes a unique contribution to the literature, as it considers the determination of the basin's unique topographical, hydrological, and environmental characteristics with GIS and MCDM method instead of determining the protection zones based on distance in drinking water basins. In addition, it will be an important base for the determination of more sustainable policies at the basin scale.

WATERSHED PROTECTION IN TURKIYE

Although the basin planning approach is a multidimensional concept in socio-cultural, economic, and ecological sense, the essence of basin planning studies includes determination of policies for the protection of water resources, which are of vital importance for humans and all other living things. For this reason, many countries use different methods for the protection of drinking water resources in their studies on basin planning and management. The most widely used method is the creation of protection zones for the protection of water resources. While conservation precautions are being increased in the areas nearer to the lake or the water resource, the conservation precautions are diminished in the further areas (Ozdemir & Ozkan, 2007). Protection zones are determined by considering the characteristics of the basins during the basin planning process. Then, policies are determined on how to carry out urban, industrial, and agricultural activities that affect the quality or quantity of water resources according to the nature of each protection zone. Determination of the protection zones for drinking water resources is a powerful protection method for restricting the activities or pollutants that cause the quality of surface and even groundwater to deteriorate (Ozdemir, 2021).

EU countries have different protection legislation to prevent activities that threaten drinking water resources, and different methodologies for determining protection zones (Ozdemir, 2021). Due to the gradual decrease in the amount of usable water caused by increasing demand, pollution, and drought in Türkiye (TOB, 2018), legal arrangements have been made to determine the protection zones of

DOI: 10.15320/ICONARP.2024.290

water basins in line with the Water Framework Directive accepted by the EU. Undoubtedly, the main regulation among these regulations is the Regulation on the Protection of Drinking-Utility Water Basins, published by the Ministry of Agriculture and Forestry, which obliges the preparation of watershed-scale protection plans and the determination of special provisions for the protection, improvement, and sustainability of water resources (Date: 28.10.2017; No. :30224). The main purpose of the said regulation is *"...to regulate the procedures and principles regarding the protection and improvement of the quality and quantity of all surface and groundwater resources from which drinking water is provided or planned to be provided."*

The regulation requires the preparation of drinking water basin protection plans, in which special provisions are defined for each basin, with a participatory approach, considering the unique characteristics they have, integrated with the basin management plan. The regulation also determines the principles for the determination of protection zones for the protection of drinking water resources. In this context, the zone with a width of 300 meters in horizontal bird flight starting from the highest water level of the drinking water source is defined as the absolute protection zone. The permitted activities for the absolute protection zone are limited. The regulation defines an area of 700 meters starting from the absolute protection border towards the outer border of the basin as a short-range protection zone, the area of 1000 meters from the short-range protection zone to the outer border of the basin as a medium-range protection zone and the area from the medium-range protection zone to the outer border of the basin as a long-range protection zone. Beyşehir Basin Special Provisions have been prepared by the General Directorate of Water Management, based on the Environmental Law No. 2872 and the Regulation on Water Pollution Control No. 25687, to protect the existing water quality and quantity of Beyşehir Lake and its Basin, from which drinking water is supplied, and to ensure its sustainable use. These special provisions regulate the legal and technical principles regarding the activities in the basin. While the regulation restricts the activities in protection zones close to the water surface more severely, it stretches the activities in the protection zones away from the water surface towards the periphery of the basin.

The Ministry of Agriculture and Forestry has published the declaration on the Procedures and Principles for the Preparation of the Drinking-Utility Water Basin Protection Plan (Date: 20.02.2019; Number: 30692) in line with the Regulation on the Protection of Drinking-Utility Water Basins. In order to ensure the sustainability of drinking water, the declaration regulates the procedures and principles for the activities regarding the determination of the protection zones and principles in the drinking water basin, considering the characteristics of the water basins. In the second paragraph of Article 8 of the declaration, how protection zones in water basins will be determined is explained as follows: *"Protection zones are determined by considering the environmental* *pressures and effects in the basin, and the physical, geological, hydrological, ecological and socio-economic conditions of the basin."*

The declaration also emphasizes the need to determine the protection principles (special provisions) regarding what kind of activities can or cannot be done in the protection zones determined for the basins, with the drinking water basin protection plans. However, there is no explanation in the declaration on how the physical, geological, hydrological, ecological, and socio-economic characteristics of the basin will be handled or what method will be used in the process of determining protection zones. This causes deficiencies and differences in the applications for the determination of protection zones.

MATERIALS AND METHODS

Study Area

Beyşehir Basin is one of the nine sub-basins of Konya Closed Basin, which is the largest closed basin in Türkiye. The basin is located within the provincial borders of Konya, Isparta and Antalya and has a size of 473,690.27 hectares (Figure 1). The study area is located between 38° 12' 00'' – 37° 15' 00'' north latitudes and 32° 9' 00'' – 31° 7' 00'' east longitudes. According to the census data of 2021, the total population of the settlements within the borders of the basin is 126,180. Beyşehir Lake, Türkiye's largest freshwater lake, is located within the borders of the basin. Beyşehir Lake, with an area of approximately 67,251.59 hectares, is one of the most important water resources that meet the drinking water needs of the region. Today, Beyşehir Lake and its immediate surroundings are under protection as both a natural protection area and a drinking water basin.

The elevation of the Beyşehir Basin is between 1118 and 2985 m (Figure 1). The basin is surrounded by mountains, except for the plains in the east and north of the lake. In terms of climate characteristics, the basin shows transitional characteristics between Mediterranean and Continental climates. While the annual average precipitation is between 480 and 550 mm in the north of Beyşehir Basin, it is 650-750 mm in the south. There are many seasonal and continuous river networks in the Beyşehir Basin. The basin is fed by surface flow of 26 brooks/streams, 45 underground and aboveground springs and precipitation.

Study Desing

In this study, it is emphasized that the protection zones should be determined by using the topographic, hydrological, and environmental criteria specific to the basin to produce an alternative to the approach of determining the protection zones based on bird flight distances defined in the Regulation on the Protection of Drinking-Utility Water Basins. In this context, "height, slope, erosion, geology, distance to riverbeds, distance to water surface, rainfall, drainage density, vegetation, land capability classes, distance to solid waste landfills and distance to mining sites" criteria of the study area were used. Compliance degrees and scores

DOI: 10.15320/ICONARP.2024.290

of the criteria were evaluated under the main theme of “the pollutants reaching the water surface” and were determined based on literature research and expert opinions.

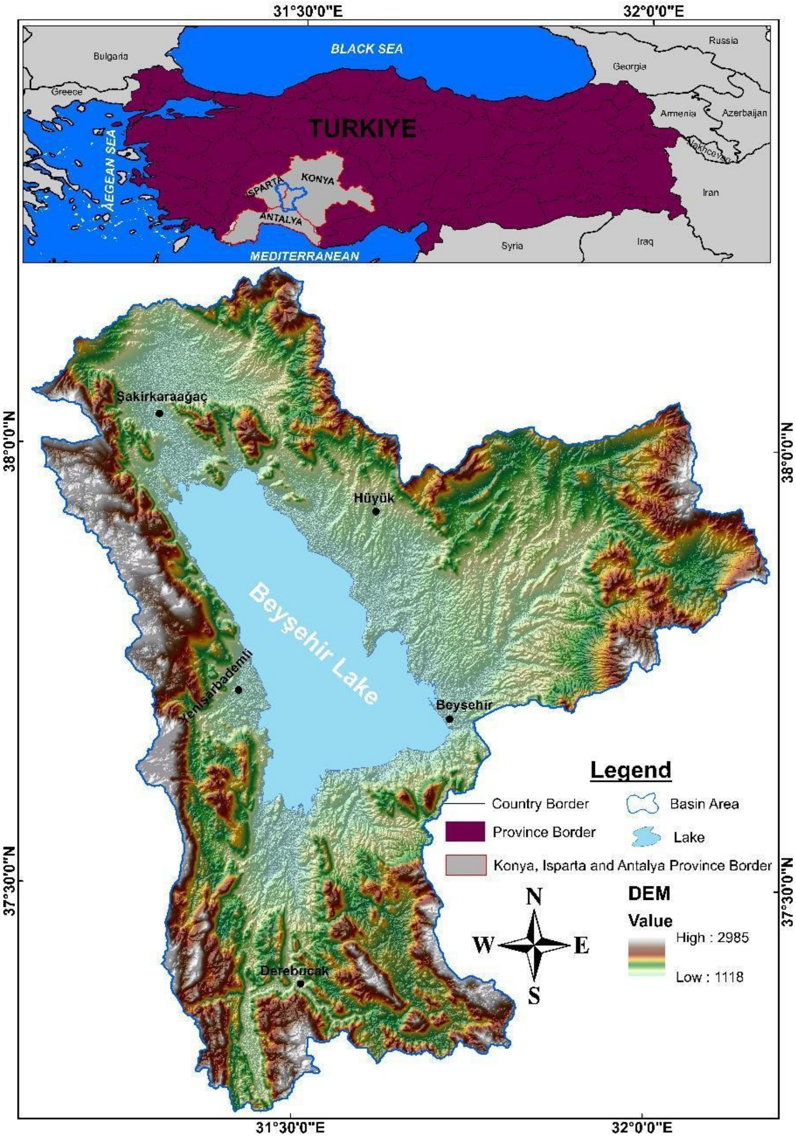


Figure 1. Location of Beyşehir Basin

Which criterion has higher or lower importance in determining the drinking water basin protection zones was determined by the AHP method, which is one of the MCDM methods. The criteria maps and the weights determined by the AHP method were overlapped using the “weighted overlay” analysis, and the protection zones of the Beyşehir drinking water basin were determined. At the last stage of the study, the approach to determination of protection zones based on distance defined in the legal legislation and the results of the model approach used in the study were compared on a spatial and areal basis and suggestions were developed for the sustainable use of the basin. The workflow of the study is shown in Figure 2.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

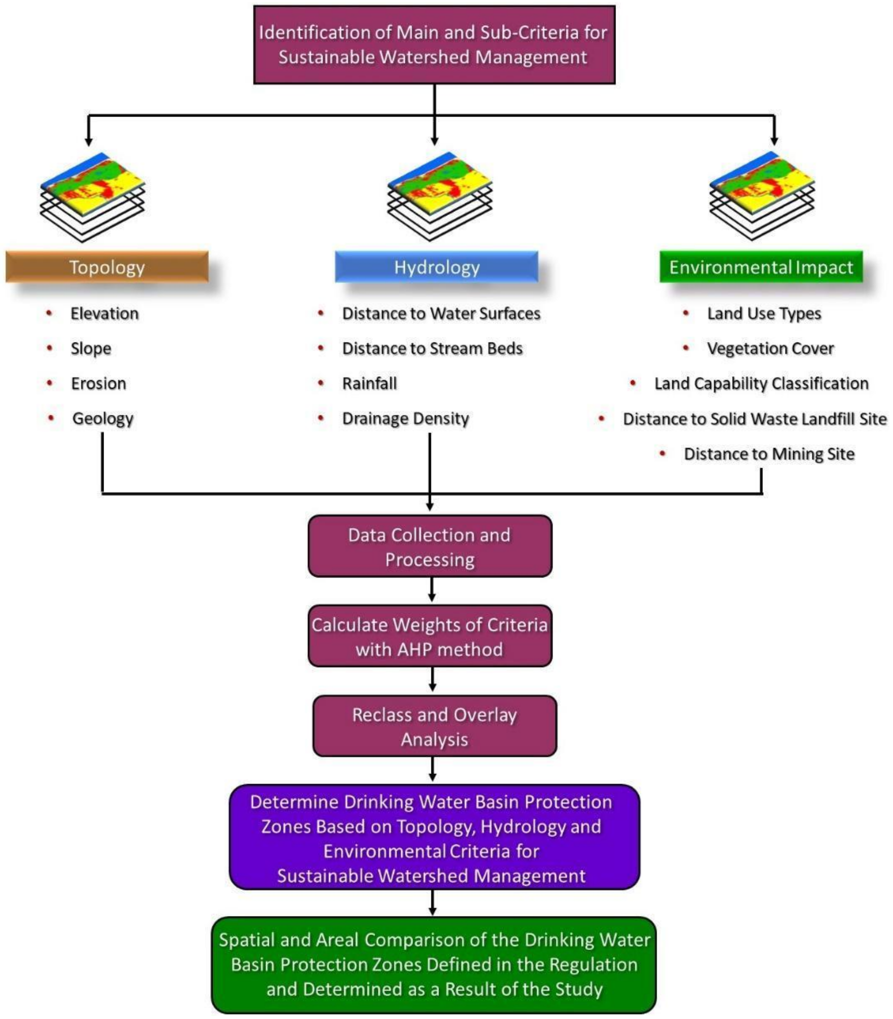


Figure 2. Workflow of GIS based AHP model for determination of drinking water basin

Identification of Criteria

One of the most important steps in the determination of the watershed protection zones is to determine the criteria that can directly or indirectly affect the pollutants reaching the water surface. In the legal regulations regarding the protection of drinking water basins in Türkiye, the protection zones are determined by considering the distance of the pollutants to the water surface. However, the data on distance to the water surface alone is insufficient to explain the possibility of the negative effects of the pollutants reaching the water surface. For this reason, multiple criteria should be considered, not a single criterion, in the determination of the protection zones for the drinking water basin. In this study, protection zones were determined by using topographic, hydrological, and environmental criteria specific to the basin. In the study, the evaluation criteria characterizing the drinking water basin protection zones were determined by considering the studies in the literature (Kuru & Tezer, 2020; Ozdemir, 2021; Deh et al., 2017; Erdogan & Karagüzel, 2016; Eba et al., 2013; Ake et al., 2020), the characteristics of the basin and the opinions of experts on the subject. The criteria were grouped under three main criteria as "topology, hydrology and environmental impact" (Table 1). Thirteen sub-criteria were determined

DOI: 10.15320/ICONARP.2024.290

under the main criteria. Elevation, slope, erosion, and geology sub-criteria were grouped under the main criterion of “topology”. Distance to stream beds, distance to water surface, rainfall and drainage density sub-criteria were grouped under the main criterion of “hydrology” and vegetation cover, land use types, land capability classification, distance to solid waste landfill site and distance to mining sites sub-criteria were grouped under the main criteria of “environmental impact”. In the study, the lake area was determined as an “absolute protection zone” in all criteria to protect the water quality and quantity of Beyşehir Lake and to ensure its sustainable use. Therefore, the Beyşehir Lake area was not included in the area calculations.

The data used in the study was obtained from a wide variety of data sources. A land use map was obtained from the CORINE 2018 data produced in line with the land cover classification determined by the European Environment Agency. Digital Elevation Model (DEM) was obtained from Shuttle Radar Topography Mission (SRTM) data. Slope maps of the study area were produced using DEM data. The geological structure of the study area was created by digitizing the 1:100000 scale geological maps obtained from the 2nd Regional Directorate of Mineral Research and Exploration (Konya). Stream beds and water surfaces were digitized using 1:25000 scale topographic maps and OpenStreetMap (OSM) data. Drainage density was calculated using stream beds and basin area data. Inverse Distance Weighted (IDW) method was applied to the rainfall data between the years 2011-2020 taken from the meteorological stations in the study area and the average rainfall map was produced for the Beyşehir basin. Erosion, vegetation cover, land capability classes, solid waste landfill site and mining site data were obtained from Konya Metropolitan Municipality. All data were converted to Universal Transverse Mercator (UTM), Zone 36 N projection system. ArcGIS software was used for data collection, storage, processing, spatial analysis, and mapping.

In the study, the protection zone classifications of the criteria were created according to the classification of protection zones (absolute protection zone, short-range protection zone, medium-range protection zone, long-range protection zone) defined in the Regulation on the Protection of Drinking-Utility Water Basins in Türkiye. Absolute protection zone was rated as 4, short range protection zone was rated as 3, medium range protection zone was rated as 2, and long-range protection zone was rated as 1. The protection zone rates and scores of the criteria were determined by literature research and the Beyşehir basin was arranged to adapt to the environmental conditions based on expert opinions. All criteria were graded and scored by considering the “The degree of effect of surface water on mobility and the state of transmitting the negative effects of pollutants to the drinking water surface” (Kuru & Tezer, 2020). The protection zone rates and scores of the criteria are shown in Table 1.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Table 1. Protection zone rating and scores of drinking water basin criteria.

Main Criteria	Sub-Criteria	Unit	Protection zone rating and score			
			Absolute protection zone (4)	Short Range Protection zone (3)	Medium Range Protection zone (2)	Long Range Protection zone (1)
Topology	Slope	%	>15	10-15	5-10	<5
	Elevation	m	2500<	>2000-2500	>1500-2000	1000-1500
	Erosion	-	Very severe	Severe	Moderate	Mild or none
	Geology	-	Marble	Schist, Volcanic Rocks	Clastic and Carbonate Rocks, Limestone	Alluvion
Hydrology	Distance to Stream Beds	m	<1000	>1000-2000	>2000-3000	>3000
	Distance to Water Surfaces	m	0-300	>300-1000	>1000-2000	>2000
	Rainfall	mm	>675	>600-675	>525-600	>450-525
	Drainage Density	Km/Km²	>3	>2-3>	>1-2	<1
Environmental Impact	Land Use Type	-	Wetlands and Water bodies	Agricultural areas	Forest and seminatural	Artificial surface
	Vegetation Cover	-	Steppe, Shrubbery, Reeds,	Pasture, Meadow	Maquis shrubland	Broad-leaved tree, Pinales
	Land capability classification	-	6th Class, 7th class, 8th class	4th class, 5th class	3rd class,	1st class, 2nd class
	Distance to Solid Waste Landfill Site	m	0-500	>500-1000	>1000-2000	>2000
	Distance to Mining Site	m	0-500	>500-1000	>1000-2000	>2000

Topology

Land-use contains potential sources of water reservoirs pollution (Deh et al., 2017). It also plays an important role in the rainwater runoff, retention of suspended solids and pollutants absorption (Douay & Lardieg, 2010). In this study, land use was examined in five classes (agricultural, artificial, forest and seminatural, wetlands and water bodies). Wetlands and water bodies are classified as absolute protection zones since they are the type of land use where drinking water is provided. Agricultural fertilizers and pesticides are used in agricultural production, so agricultural lands carry a high risk of water reservoir pollution. For this reason, agricultural areas are classified as short-range protection zones. Since forest areas have high water holding capacity due to their natural structure, they reduce the severity of erosion and prevent the leakage of pollutants to the water surface.

Slope is one of the most important criteria for determining protection zones, as it shows whether pollutants can flow or leak from the surface (Aller et al., 1987). As the degree of slope increases, the water holding capacity of the soil decreases, and the flow rate and amount of erosion and surface water increases (Ozdemir, 2020). Therefore, the potential for contamination of surface waters increases. In the study, the areas with high slope degree (>15%) were classified as absolute protection zones, while the areas with low slope degree (<5%) were classified as long-range protection zones.

DOI: 10.15320/ICONARP.2024.290

Similarly, elevation is as important as slope since it affects the rate and amount of surface water flow. Pollutants are more likely to reach surface waters in regions with high elevations (Kuru & Tezer, 2020). In the study, the areas with an elevation of 1000-1500 m were determined as absolute protection zones.

Soils formed on slopped topography and containing less vegetative cover are eroded and transported in accordance with the severity of the factors. Erosion is exacerbated by the removal of vegetation, heavy rains, overgrazing and incorrect land use decisions. The erosion degree of the study area (very severe, severe, moderate, mild or none) was determined based on the classification of the Ministry of Agriculture and Forestry. Very severe erosion refers to areas where all the topsoil and more than 25% of the subsoil has been eroded, while mild or no erosion refers to areas where less than 25% of the topsoil has been eroded. Erosion soils carry their pollutants to surface waters, which causes the contamination of surface water with organic waste, heavy metals and chemicals, and damage to drinking water ecosystems. Therefore, in the study, areas with very severe erosion degree are classified as absolute protection zone, and areas with mild or no erosion degree are classified as long-range protection zones.

The geological structure of the land is another important topographic criterion that is effective for the pollutants to reach the water surface. Geological structures such as alluvium, sandstone, limestone, pebble, mudstone, etc. with high permeability absorb surface water and reduce the access of pollutants to the water surface, while geological structures such as marble, schist, gneiss cannot absorb surface water due to their low permeability level and increase the mobility of water containing pollutants (Kuru & Tezer, 2020). In the study, areas with marble geological structure were classified as absolute protection zones, and areas with alluvial geological structure were classified as long-range protection zones.

Hydrology

Watershed lines and stream beds, where the surface water flow rate and flow amount are relatively high, make it easier for pollutants to reach the drinking water surface (Kuru & Tezer, 2020). Therefore, these areas and buffer zones need to be cleared of pollutants. In the study, areas less than 1000 meters away from stream beds were determined as absolute protection zones.

In order to protect the water quality and quantity of the drinking water surface and to ensure its sustainable use, it is necessary to determine the protection distances that will prevent the pollutants from reaching the water surface. These distances were determined in the Regulation on the Protection of Drinking-Utility Water Basins in Türkiye. In the study, the distance to the water surface criterion was classified using the protection distances in the legal legislation.

Rainfall is a key parameter in the process of assessing vulnerability to pollution of surface water (Eba et al., 2013). The duration and the amount of rainfall determine the onset of runoff when the soil has reached the maximum infiltration capacity (Codvelle et al., 2001). Rainfall makes it easier for pollutants to reach the water surface. As the amount of rainfall increases, the probability of transporting pollutants to the water surface also increases. In the study, areas with an annual average rainfall of more than 675 mm were classified as absolute protection zones.

Drainage density is the average river length per km2, which shows the degree of fragmentation of the basin by the rivers. Pollution of water resources is also linked to the hydrographic network density/drainage density underlying these resources (Codvelle et al., 2001). In areas where the drainage density and slope are high, the flow rate and amount of water is high, and its infiltration is low (Demiroglu & Dowd, 2014). Therefore, areas with high drainage density were classified as absolute protection zones.

Environmental impact

Vegetation is one of the other important criteria affecting the movement of surface water and the access of pollutant sources to the drinking water surface. While the amount of erosion increases in areas with insufficient vegetation, surface water and the pollutants carried by surface water can reach longer distances (Kuru & Tezer, 2020). In forested areas with dense vegetation, erosion severity is low and water holding capacity is high. Therefore, in the study, areas with broad-leaved and coniferous vegetation were classified as long-range protection zones, while areas with steppe, shrubbery, and reeds were classified as absolute protection zones.

Another important criterion in the contamination process of surface waters is soil. Because soil plays an important role in the transfer of pollutants from the soil surface to the water surface due to its natural structure (Macary et al., 2007). Pollution transport is graded as fast or slow according to whether the soil medium is fine-grained or coarse-grained (Ozdemir, 2020). If the soil medium is fine-grained such as silt or clay, the soil permeability is lower and the transport of pollutants to the water surface is reduced (Erdogan & Karaguzel, 2016). In the study, the soil criterion was examined by considering the “land capability classes” defined in the legal legislation in Türkiye. Land capability classes are determined by considering the characteristics of the soil and the land, such as soil structure of the land, soil depth, degree of erosion, ground water, stoniness, salinity, and alkalinity. Land use capability consist of eight classes (I, II, ..., VIII). Classes I and II are lands with low degree of slope, water and wind erosion, high water holding capacity and less permeable soil. On the contrary, Classes VII and VIII, are lands with a high degree of slope, severe water and wind erosion, coarse-grained soil

DOI: 10.15320/ICONARP.2024.290

structure and high permeability. In the study, classes I and II were classified as “absolute protection zones”.

Solid waste landfill sites are important resources of surface water and groundwater contamination due to the leakage of leach- ate, a complex mixture of pollutants having high chemical oxygen demand, high ammonium nitrogen content and lasting toxicological characteristics (Han et al., 2016; Li et al., 2014). Waste placed in landfill sites or open dumps are subjected to either surface water and groundwater underflow or infiltration from precipitation (Mor et al., 2006). Many studies have indicated that the major surface water and groundwater pollutants from solid waste landfills include chloride (Cl^-), sodium (Na^+), ammonium (NH_4^+), total dissolved solids (TDS), organic matter such as chemical oxygen demand (COD), heavy metals and phosphate (Akinbile, 2012; Smahi et al., 2013). Therefore, in the study, the areas 500 meters away from the solid waste landfills were classified as “absolute protection zones”.

Mining poses a great risk for people accessing clean drinking water (Khan et al., 2013). Mining driven by human demand for minerals and metals is a major contributor to the current observed environmental pollution. Both heavy metals and metalloids are contaminants in areas of mining and smelting, posing a very serious and significant threat to the microfauna in watershed and for the hydrological cycle (Gu, 2018). Therefore, in the study, the areas 500 meters away from the mining sites were classified as “absolute protection zones”.

The Analytic Hierarchy Process (AHP): A Multiple Criteria Decision-Making Method

AHP is a multi-criteria decision-making method based on the binary comparison of criteria, rather than evaluating all criteria together, in problems involving multiple criteria and alternatives. Pairwise comparison provides the comparison of the criteria used in decision analysis and determines the value for each of these criteria (Vaidya & Kumar, 2006). When making pairwise comparisons, searching for the answer to the question “How important is criterion A compared to criterion B?” forms the basis of the method. The advantages of using the AHP method among other multi-criteria decision making methods in the literature are explained as follows; (I) all types of information related to problems can be included in the discussion process; (ii) judgment is structured in such a way that all the information are considered; (iii) the rules of discussions are based on knowledge, skill and experience of the expert; (iv) the weights for each relevant factor are obtained automatically by normalized principal eigen vector calculation of the decision matrix; and (v) inconsistencies in the decision process can be detected and corrected (Thanh ve De Smedt, 2012; Kayastha et al., 2013). However, the biggest disadvantage of this method is that the rating values given differ among experts and can be evaluated by experts who do not have sufficient knowledge about the subject.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Pairwise comparisons are made using the scale developed by Saaty (1977). The pairwise comparison of criteria is made using a scale from 1 to 9 if there is a direct relationship between the criteria, and from ½ to 1/9 if there is an inverse relationship between the criteria. The value of 1 in the scale means that one criterion has equal importance compared to the other criterion, and the value of 9 means that one criterion is more important than the other criterion.

Pairwise comparison matrices are formed because of pairwise comparisons between criteria. In this study, pairwise comparison matrices were created for the main criteria [3x3], for the topology sub-criterion [4x4], for the hydrology sub-criterion [4x4] and for the environmental impact sub-criterion [5x5]. Mathematical calculations are made for the row and column elements in the pairwise comparison matrices and the weight of each criterion is determined (Cay and Uyan, 2013). The "consistency ratio (CR)" should be calculated to evaluate whether the experts' decisions are consistent in pairwise comparisons. CR reveals the random probability of the values obtained in a pairwise comparison matrix (Yılmaz, 1999). If CR ≤ 0.10, the pairwise comparison matrix is consistent, and the weights produced can be used. If CR ≥ 0.10, the pairwise comparison matrix is inconsistent and needs to be rearranged (Saaty, 1990). The process steps of the AHP method are explained in more detail in Figure 3.

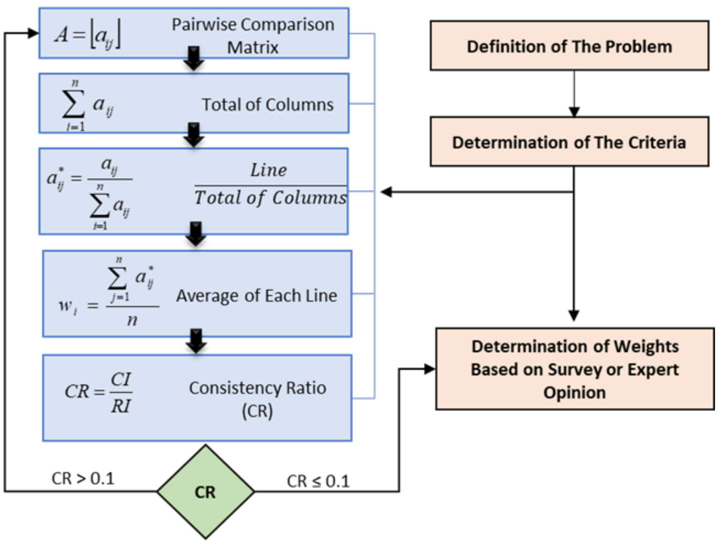


Figure 3. AHP process flow diagram (Sisman and Aydinoglu, 2020)

In this study, which aims to determine the protection zones of drinking water basin, the pairwise comparison matrices of the main and sub-criteria were formed by taking the geometric average of the opinions of 15 academicians who are experts in their fields. 8 of the experts are academicians in the department of city and regional planning and 7 of them are academicians in the department of geomatics engineering. The internal control of the pairwise comparison matrices created by the decision makers was checked by calculating the consistency ratio. The

DOI: 10.15320/ICONARP.2024.290

"Expert Choice" program was used to calculate the main and sub-criteria weights.

RESULTS

The spatial data for the protection zones of the Beyşehir drinking water basin were prepared and made ready for analysis. The main and sub-criteria weights calculated by the AHP method are given in Table 2. When Table 2 is examined, it is seen that the criterion with the highest importance in the main criterion comparison is "Hydrology (0.594)". The weight of the main criterion "Environmental Impact" was calculated as 0.249, and the weight of the main criterion "Topology" was calculated as 0.157. The consistency ratio of the pairwise comparison matrix created for the main criteria was calculated as 0.06.

When the sub-criteria weights of the "Hydrology" criterion are examined, while the most important sub-criterion is "distance to water surfaces (0.408)", the least important criterion is "rainfall (0.102)" (Table 2). The weights of the "Distance to stream beds" and "drainage density" sub-criteria were calculated as 0.38 and 0.11. The consistency ratio of the pairwise comparison matrix created for these sub-criteria was calculated as 0.01.

When the sub-criteria weights of the "Environmental Impact" main criterion are examined, it is observed that the most important sub-criterion is "land capability classes (0.312)", the least important criteria are "distance to solid waste landfill site (0.141)" and "distance to mining site (0.141)" (Table 2). The weights of the "vegetation cover" and "land use type" sub-criteria were calculated as 0.251 and 0.155. The consistency ratio of the pairwise comparison matrix created for these sub-criteria was calculated as 0.02.

When the sub-criteria weights of the "topology" main criterion are examined, it is seen that "geology (0.383)" has the highest degree of importance compared to the other sub-criteria (Table 2). This criterion is followed by "erosion (0.342), slope (0.168) and elevation (0.107)" sub-criteria, respectively. The consistency ratio of the pairwise comparison matrix created for these sub-criteria was calculated as 0.02.

In pairwise comparison of AHP criteria and sub-criteria, the aim is to measure whether experts behave consistently. Saaty (1990) accepts that the comparisons are consistent if the consistency ratio is less than 0.10. In the study, it was determined that the consistency ratios calculated for the main and sub-criteria ranged from 0.01 to 0.06. This result shows that the pairwise comparisons and matrices made by the experts are consistent.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Table 2. Main and sub-criteria weights and consistency ratio.

Main Criteria	Weight	Sub-Criteria	Weight	Consistency Ratio
Topology	0.157	Slope	0.168	0.02
		Elevation	0.107	
		Erosion	0.342	
		Geology	0.383	
Hydrology	0.594	Distance to stream beds	0.380	0.01
		Distance to water surfaces	0.408	
		Rainfall	0.102	
		Drainage density	0.110	
Environmental Impact	0.249	Land use type	0.155	0.02
		Vegetation cover	0.251	
		Land capability classes	0.312	
		Distance to solid waste landfill site	0.141	
		Distance to mining site	0.141	

The protection zones map of each sub-criterion used in the determination of the drinking water basin protection zones is given in Figure. 4. The area amounts (ha) and ratios (%) belonging to the protection zones of each criterion are given in Table 3. When the sub-criteria evaluated under the topology main criterion were examined, it was determined that 4.88% of the study area was determined as absolute protection zone by slope, 4.88% by height, 45.11% by erosion and 0.39% by geology (Table 3). When the sub-criteria evaluated under the main criterion of Hydrology were examined, it was seen that 33.08% of the study area was determined as absolute protection zone by distance to stream, 1.66% by distance to water surfaces, 23.74% by rainfall and 0.00% by drainage density (Table 3). According to the sub-criteria of land use type, vegetation cover, land capability classes, distance to solid waste landfill site and distance to mining site, which were evaluated under the main environmental impact criteria, 1.36%, 53.04%, 69.11%, 0.08% and 21.75% of the study area were determined as the absolute protection zones, respectively.

When Figure 4 was examined, it was determined that the vicinity of Beyşehir Lake and the areas with high elevations are generally within the absolute protection zone boundaries in all sub-criteria protection zones map.

DOI: 10.15320/ICONARP.2024.290

Table 3. Drinking water protection zones area according to sub-criteria analyses and their ratio.

Criteria	Absolute protection zone		Short range protection zone		Medium range protection zone		Long range protection zone	
	Ha	%	Ha	%	Ha	%	Ha	%
Slope	19854.18	4.88	46614.15	11.47	105693.85	26.01	234276.60	57.64
Elevation	19853.48	4.88	46614.68	11.47	105694.39	26.01	234276.23	57.64
Erosion	183357.70	45.11	94919.94	23.35	81601.53	20.08	46559.61	11.46
Geology	1567.01	0.39	55580.07	13.67	282444.48	69.49	66847.22	16.45
Distance to stream beds	134457.07	33.08	100511.22	24.73	74390.59	18.30	97079.90	23.89
Distance to water surfaces	6745.31	1.66	16093.99	3.96	27527.64	6.77	356071.84	87.61
Rainfall	96491.89	23.74	64798.96	15.94	177462.47	43.66	67685.46	16.66
Drainage Density	0.00	0.00	0.00	0.00	0.00	0.00	406438.78	100.00
Land use type	5516.85	1.36	144887.68	35.64	250484.77	61.63	5549.48	1.37
Vegetation cover	215562.45	53.04	28560.1	7.02	5494.57	1.35	156821.66	38.59
Land capability classes	280884.23	69.11	34612.54	8.51	31701.37	7.80	59240.64	14.58
Distance to solid waste landfill site	313.55	0.08	942.40	0.23	3769.74	0.93	401413.09	98.76
Distance to mining site	88397.88	21.75	30449.67	7.49	54953.24	13.52	232637.99	57.24

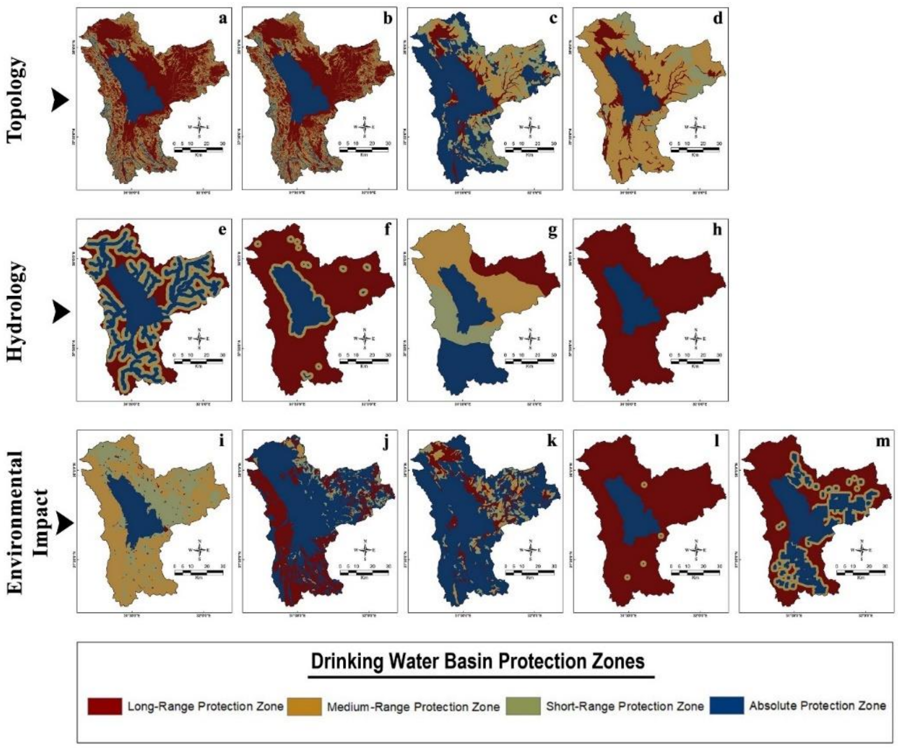


Figure 4. Protection zone maps of sub-criteria [(a) slope, (b) elevation, (c) erosion, (d) geology, (e) distance to stream beds, (f) distance to water surfaces, (g) rainfall, (h) drainage density, (ı) land use type, (j) vegetation cover, (k) land capability classes, (l) distance to solid waste landfill site, (m) distance to mining site].

The protection zones map of the main criteria in determining the drinking water protection zones of the Beyşehir basin is shown in Figure 5. When the protection zone ratios of the study area were evaluated according to the main criteria, 2.07% was determined as absolute protection zone by topology main criterion, 0.89% by hydrology main criterion and 7.43% by environmental impact main criterion (Table 4).

Table 4. Drinking water protection zones area of the main criteria and their ratio to the total area.

Criteria	Absolute protection zone		Short range protection zone		Medium range protection zone		Long range protection zone	
	Ha	%	Ha	%	Ha	%	Ha	%
Topology	8416.67	2.07	138330.41	34.04	141732.68	34.87	117959.02	29.02
Hydrology	3609.90	0.89	20183.41	4.97	222655.5	54.78	159989.97	39.36
Environmental Impact	30212.53	7.43	171379.15	42.17	200137.57	49.24	4709.53	1.16

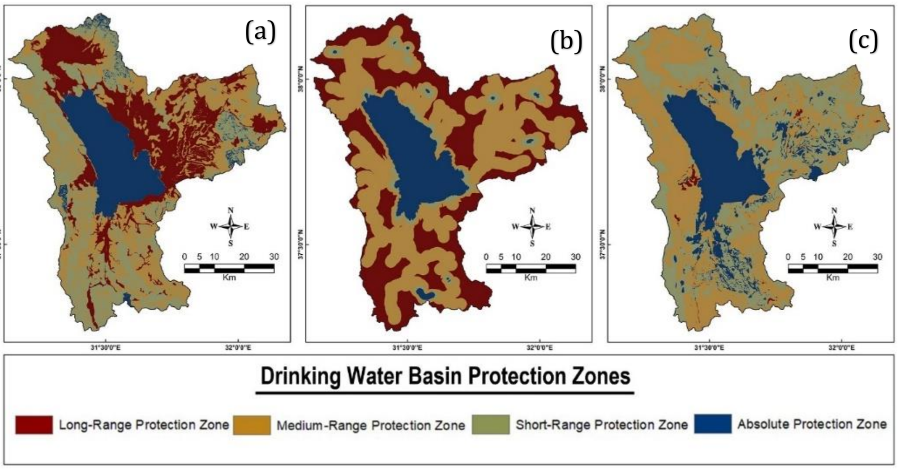


Figure 5. Protection zones maps of main criteria (Topology (a), Hydrology (b) and Environmental impact (c)).

According to the approach of determining the protection zones based on the distance specified in the regulation on the protection of drinking water basins, 0.13%, 0.97%, 1.60% and 97.30% of the Beyşehir basin are within the boundaries of absolute protection zone, short-range protection zone, medium-range protection zone and long-range protection zone, respectively. As a result of the proposed model application, it was determined that 2.83%, 44.97%, 35.93% and 16.26% of the basin are within the boundaries of the absolute protection zone, short-range protection zone, medium-range protection zone and long-range protection zone, respectively (Table 5).

DOI: 10.15320/ICONARP.2024.290

Table 5. Comparison of the areal and proportional amount of the Protection zones Based on the Distance Specified in the Regulation on the Protection of Drinking Water Basins and the protection zones produced by the model.

Protection zones	Regulation		Model	
	Ha	%	Ha	%
Absolute Protection zone	547.66	0.13	11487.01	2.83
Short-range Protection zone	3921.22	0.97	182784.47	44.97
Medium-range Protection zone	6514.97	1.60	146044.33	35.93
Long-range Protection zone	395454.93	97.30	66122.97	16.26
Total Area of the Basin	406438.78		406438.78	

The maps of the distance-based protection zones specified in the regulation on the protection of drinking water basins of the Beyşehir basin and the protection zones determined because of the proposed model are shown in Figure 6.

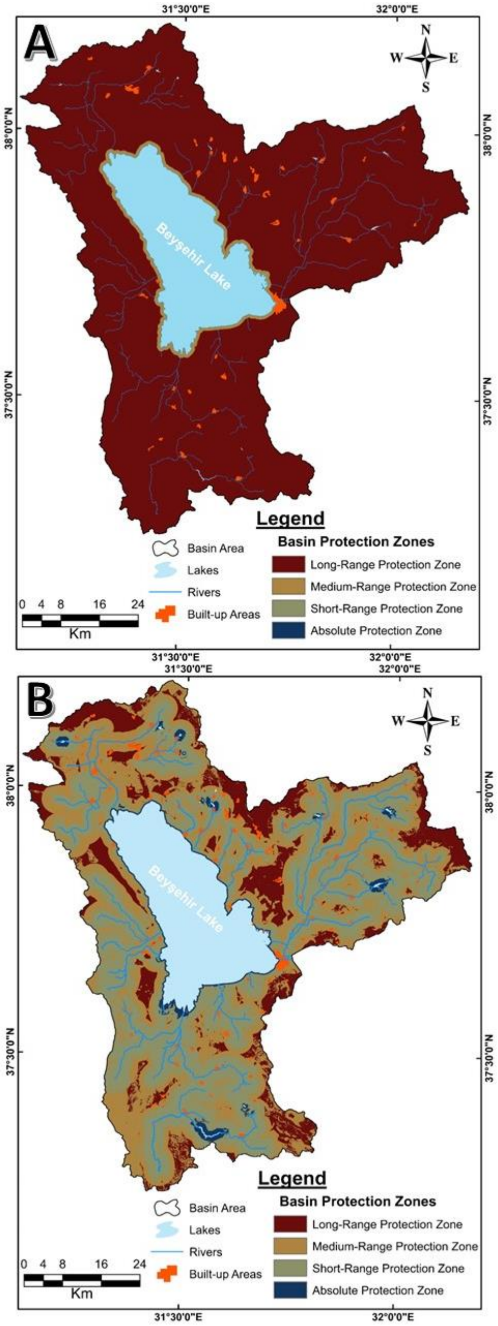


Figure 6. The boundary maps of distance-based protection zones specified in the regulation (A) and the protection zones determined because of the proposed model (B).

DISCUSSION

Different methodological approaches are used by the EU member and candidate countries to define the drinking water protection zones. While some countries adopt the distance-based protection zone approach, many countries determine the protection zones according to the characteristics of the basin. Depending on the amount of data available, simple, or complex calculations, methods or modelling approaches have been applied to determine the boundaries of protection zones (Ozdemir, 2021). For example, the drinking water basin protection zones in the Tuscany Region of Italy have been determined using an approach considering the geological, hydrogeological, hydrodynamic and hydrogeochemical characteristics of the basin (Menichini et al., 2015). In

DOI: 10.15320/ICONARP.2024.290

Germany, watershed protection zones have been determined using an integrated approach with modelling studies, considering the geological, hydrogeological, and hydrological characteristics of the basin (Hölting & Coldewey, 2019). However, in Türkiye, the protection zones of drinking water basins are determined by the distance-based protection zone approach included in the legal legislation. The most important aim of this study is to protect the existing water quality and quantity of the Beyşehir basin, which contains Türkiye's largest freshwater lake, and to ensure its sustainable use. For this purpose, Beyşehir drinking water basin protection zones were determined with a new approach that considers the topographical, hydrological, and environmental characteristics of the basin and uses the AHP method and GIS technologies.

The AHP method is a multi-criteria decision-making method that allows evaluation of multiple criteria together and is frequently used in the literature. However, the subjectivity of weights and scores assigned to criteria in AHP method is a limiting factor (Anoh et al., 2012; Deh et al., 2017). The values attributed to criteria have often tended to overestimate or underestimate the degree of vulnerability in the watershed. In the study, the opinions of 15 expert academicians who are experienced and knowledgeable in their field were taken to correct or minimize this subjectivity in assigning weights and points to the criteria in the evaluation of the sensitivity of the water source to pollution. The accuracy of the study results could not be compared since there was no different approach for the determination of Beyşehir basin protection zones. Despite these limitations in the method, the results of the study were examined by the experts and the reliability of the produced drinking water basin protection zones map was confirmed.

When the results of the distance-based protection zones approach specified in the regulation and the model/approach developed in this study were compared, it was seen the "absolute protection zone" specified in the regulation increased by 2.70% spatially (Table 5). While the "absolute protection zone" was limited only to the water surface of Beyşehir Lake in the regulation, both Beyşehir lake and all dam lakes in the basin showed expansion around the water surfaces in the model (Figure. 6). Similarly, in the model, there was a significant increase (44%) in "short-range protection zones". The "short-range protection zone" expanded not only around the Beyşehir lake, but also around the river and its branches in a large part of the basin. It is seen that the watershed protection zones are shaped according to the specific morphological structure of the basin (Figure. 6). The study findings confirm the study of Kuru and Tezer (2020), which uses a similar approach for the determination of a protection zone in a different drinking water basin. Kuru and Tezer (2020), in their study on the determination of watershed protection zones in Türkiye, found that the amount of "absolute and short-range protection zones" increased spatially and the protection zones of the basin expanded according to the regulation.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

The model proposed by the study has shown that it is not appropriate to determine the protection distances with an approach that only considers the water surface. For the protection and sustainable use of the ecological structure of the basin, the model reveals the necessity of expanding the protection zones along the riverbeds carrying water to the basin, based on the topographic structure of the basin and other environmental criteria mentioned above. In order for this new model to be implemented in drinking water basins, protection principles should be determined by experts and decision makers and should be based on legal regulations.

The WFD (2000/60/EC) emphasized that the stakeholders in the basin have an important role in protecting the quality and quantity of water during integrated drinking water basin management. Stakeholders include local citizens, farmers, public authorities, private sector representatives. In order to make the basins sustainable, it is not sufficient only to determine the boundaries of the basin-specific protection zones and to implement the policies. It is also necessary to work in coordination with stakeholders. Therefore, after the protection zone boundaries and policies for each basin are determined, informative meetings should be held with stakeholders, training should be provided, and works should be carried out together in order to decide on the best watershed management plans to meet the socio-economic and environmental demands of the basin. Thus, more effective sustainable water management will be ensured for drinking water basins by reducing the use of polluting resources, both with the protection zone boundaries determined according to the topographical, hydrological, and environmental characteristics of the basin and legal regulations and with conscious stakeholders.

CONCLUSIONS AND RECOMMENDATIONS

In Türkiye, legal regulations for the protection of water quality and quantity of drinking water basins are insufficient. The main reason for this is that the regulations do not consider the characteristics of the basin and the boundaries of the protection zones are determined based on distance. In this framework, it is necessary to determine the protection zones and restrictions by considering the characteristics of each basin in terms of ensuring the balance of protection and use of drinking water basins and their sustainability.

This study aims to fill the above-mentioned gap. The study proposes a model based on AHP and GIS, in which topographic, hydrological, and environmental characteristics are considered in the determination of protection zones. The model aims to prioritize the criteria related to the basin in a systematic way with the AHP method and to obtain fast and reliable results by using the spatial analysis capability of GIS. In this framework, using the proposed model, it was determined that the protection zones produced for the Beyşehir basin (Konya-Türkiye), which is the sample area of the study, are more inclusive than the

DOI: 10.15320/ICONARP.2024.290

determined protection zones. When the protection zones produced by the proposed model were compared with the protection zones determined by the current legal regulations, it was determined that the area amounts of absolute protection zone, short-range protection zone and medium-range protection zone increased, and their spatial distribution was shaped according to the original morphological structure of the basin.

While the study makes a clear contribution to the literature on the protection of water basins, it also has some limitations. The study only focuses on surface water quantity and quality. For this reason, no investigation was made on the quality and quantity of groundwater within the scope of the study. In addition, the hydrogeological and hydrogeochemical characteristics of the basin were not included in the study due to data limitations. The above-mentioned deficiencies should be considered in future studies on this subject.

It is expected that the results of this study will guide the managers and authorities in the use, protection, management, sustainability of water resources and in making land use decisions in Beyşehir drinking water basin. The legal regulations in Türkiye need to be reconsidered to apply this new model, which evaluates the basin-specific features together in the determination of protection zones. In addition, the participation of all stakeholders who will be affected by the decision in the planning and implementation of drinking water basins will contribute to the sustainable water management of the basin.

REFERENCES

Afzali, A., Sabri, S., Rashid, M., Mohammad Vali Samani, J., & Ludin, A. N. M. (2014). Inter municipal landfill site selection using analytic network process. *Water Resources Management*, 28(8), 2179-2194. https://doi.org/10.1007/s11269-014-0605-3

Akdeniz, H.B., Yalpir, S., & Inam, S. (2023). Assessment of suitable shrimp farming site selection using geographical information system based Analytical Hierarchy Process in Turkey. *Ocean & Coastal Management*, 235, 106468. https://doi.org/10.1016/j.ocecoaman.2022.106468

Ake, G. E., Eba, A. E. L., Ble, L. O., Adebayo, A., Assi, J. J., Saley, M. B., & Biemi, J. (2020). Contribution of geomatics to the delimitation of protection perimeters: case of Agbo River in Agboville (South East of Côte d'Ivoire). *Journal of Environmental Protection*, 11(06), 470. https://doi.org/10.4236/jep.2020.116028

Akinbile, C. O. (2012). Environmental impact of landfill on groundwater quality and agricultural soils in Nigeria. *Soil and Water Research*, 7(1), 18-26. https://doi.org/10.17221/4/2011-SWR

Aller, L., Bennett, T., Lehr, J. H., Petty, R. J., & Hackett, G. (1987). DRASTIC: a standardized system for evaluating ground water pollution potential using hydrogeologic settings, Robert S. Kerr Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, 622s.

Anoh, K. A., Jourda, J. P., Kouamé, K. J., Koua, T. J. J., Eba, A. E., & Lazar, G. (2012). Demarcation of protection perimeters for surface waters of Taabo (Ivory

Coast) watershed using GIS and multicriteria analysis. *Environmental Engineering & Management Journal*, 11(12).

Beskese, A., Demir, H. H., Ozcan, H. K., & Okten, H. E. (2015). Landfill site selection using fuzzy AHP and fuzzy TOPSIS: a case study for Istanbul. *Environmental Earth Sciences*, 73(7), 3513-3521. https://doi.org/10.1007/s12665-014-3635-5

Cay, T., & Uyan, M. (2013). Evaluation of reallocation criteria in land consolidation studies using the Analytic Hierarchy Process (AHP). *Land Use Policy*, 30(1), 541-548. https://doi.org/10.1016/j.landusepol.2012.04.023

Codvelle, A., Ricard, J., & Schoen, R. (2001). Mapping the hazard of pollution of surface and groundwater by plant substances in the Midi-Pyrénées. Manual 46p.BRGM/RP-51456 FR.

Cicek, N., Ozonat, Ç., & Er, A. (2015). Drinking water protection studies in Turkey, Sustainable Watershed Management (143-150). London: Taylor & Francis Group.

Deh, S. K., Kouame, K. J., Eba, A. E. L., Djemin, J. E., Kpan, A., & Jourda, J. P. (2017). Contribution of geographic information systems in protection zones delineation around a surface water resource in Adzope Region (Southeast of Côte d'Ivoire). *Journal of Environmental Protection*, 8(13), 1652. https://doi.org/10.4236/jep.2017.813102

Demiroglu, M., & Dowd, J. (2014). The utility of vulnerability maps and GIS in groundwater management: a case study. *Turkish Journal of Earth Sciences*, 23(1), 80-90. https://doi.org/10.3906/yer-1205-6

Douay, D., & Lardieg, E. (2010). Délimitation des Aires d'Alimentation des captages prioritaires du bassin Adour Garonne. Méthodologie de cartographie de la vulnérabilité intrinsèque des captages d'eau superficielle, 28.

Eba, A. E. L., Kouamé, K. J., Jourda, J. P., Aké, G. E., Saley, M. B., Anoh, K. A., & Deh, S.K. (2013). Demarcation of surface water protection perimeters by using GIS: case of Gagnoa Reservoir in West Central of Côte d'Ivoire. International *Journal of Scientific & Engineering Research*, 4(4), 1311-1320.

EEA, (2018). Water is life. Kopenhag: European Environment Agency.

Erdogan, M., & Karaguzel, R. (2016). A new hydrogeologically based approach to determining protected areas in drinking water supply reservoirs: a case study in the Alasun subbasin (Burdur,Turkey). *Environmental Earth Sciences*, 75(2), 1. https://doi.org/10.1007/s12665-015-4845-1

Feizizadeh, B., Roodposhti, M.S., Jankowski, P., & Blaschke, T. (2014). A GIS-based extended fuzzy multicriteria evaluation for landslide susceptibility mapping. *Computers & Geosciences*, 73, 208-221. https://doi.org/10.1016/j.cageo.2014.08.001

Garipagaoglu, N., & Uzun, M. (2021). Havza yönetiminin gelisim evreleri ve farklı modelleri. *International Journal of Geography and Geography Education*, 43, 338-357. https://doi.org/10.32003/igge.816758

Gu, J. D. (2018). Mining, pollution, and site remediation. *International Biodeterioration & Biodegradation*, 128, 12. https://doi.org/10.1016/j.ibiod.2017.11.006

Han, Z., Ma, H., Shi, G., He, L., Wei, L., & Shi, Q. (2016). A review of groundwater contaminationnear municipal solid waste landfill sites in China. *Science of the Total Environment*, 569, 1255-1264. https://doi.org/10.1016/j.scitotenv.2016.06.201

DOI: 10.15320/ICONARP.2024.290

Hölting, B., & Coldewey, W.G. (2019). Hydrogeology. Springer textbooks in earth sciences, geography, and environment. Germany, 34, pp.

Kayastha, P., Dhital, M. R., & De Smedt, F. (2013). Application of the analytical hierarchy process (AHP) for landslide susceptibility mapping: A case study from the Tinau watershed, west Nepal. *Computers & Geosciences*, 52, 398-408. https://doi.org/10.1016/j.cageo.2012.11.003

Khan, S., Shahnaz, M., Jehan, N., Rehman, S., Shah, M. T., & Din, I. (2013). Drinking water quality and human health risk in Charsadda district, Pakistan. *Journal of Cleaner Production*, 60, 93-101. https://doi.org/10.1016/j.jclepro.2012.02.016

Kunt, M., Gurbuzler, D., Erkal, İ. F., & Yıldırım, K. (2020). 6. Türkiye cevre durum raporu. Ankara: T.C. Cevre ve Şehircilik Bakanlıgı.

Kuru, A., & Tezer, A. (2020). Içme suyu havzası koruma sınırlarının belirlenmesine yeni yontem onerisi: Kırklareli barajı içme suyu havzası örnegi. *Gazi Üniversitesi Mühendislik Mimarlık Fakültesi Dergisi*, 35(1), 519-536.

Li, Y., Li, J., & Deng, C. (2014). Occurrence, characteristics, and leakage of polybrominated diphenyl ethers in leachate from municipal solid waste landfills in China. *Environmental Pollution*, 184, 94-100. https://doi.org/10.1016/j.envpol.2013.08.027

Macary, F., Balestrat, M., Puech, C., & Saudubray, F. (2007). Method to evaluate the spatial contamination potential due to agriculture of surface water at different space scaling: application on the Coteaux de Gascogne.

Menichini, M., Prato, S. D., Doveri, M., Ellero, A., Lelli, M., & Masetti G.et al. (2015). An integrated methodology to define protection zones for groundwater-based drinking water sources: an example from the Tuscany Region, Italy. Acque Sotterranee -Italian *Journal of Groundwater*, 4(1), 21–27. https://doi.org/10.7343/as102-15-0129

Mor, S., Ravindra, K., Dahiya, R. P., & Chandra, A. (2006). Leachate characterization and assessment of groundwater pollution near municipal solid waste landfill site. *Environmental Monitoring and Assessment*, 118(1), 435-456. https://doi.org/10.1007/s10661-006-1505-7

Muluk, Ç. B., Kurt, B., Turak, A., Turker, A., Calışkan, M. A., Balkız, O., & . . . Zeydanlı U (2013). Türkiye'de suyun durumu ve su yönetiminde yeni yaklasımlar: cevresel perspektif. Istanbul: Is Dunyası ve Surdurülebilir Kalkınma Dernegi - Doğa Koruma Dernegi.

OSIB, (2016). Iklim degisikliginin su kaynaklarına etkisi projesi. Ankara: T.C. Orman ve Su Isleri Bakanlıgı, Su Yönetimi Genel Müdürlüğü.

Ozdemir, A. (2020). Determination of protection zones in drinking water basins: a case study from Turkey, Sapanca Lake Basin. *Environmental Earth Sciences*, 79(8), 1-15. https://doi.org/10.1007/s1266502008916-5

Ozdemir, A. (2021). A framework for drinking water basin protection. *Water and Environment Journal*, 35(4), 1362-1375. https://doi.org/10.1111/wej.12735

Ozdemir, F. Y., & Ozkan, O. S. (2007, March). Importance of geological characteristics at determining basin conservation borders: sample of Lake Beyşehir (Konya) basin. In International Congress on River Basin Management, Vol. 22, 24.

Ozturk, I., Tanık, A., Özabalı Sabuncugil, A, Ertürk, A., Ekdal, A., Yaykıran, S., & Kalfazade, M. (2016). Iklim degisikliginin su kaynaklarına etkisi projesi, hidrolojik modelleme ve değerlendirme. Ankara: Su Yönetimi Genel Müdürlüğü.

Saaty, T. L. (1977). A scaling method for priorities in hierarchical structures. *Journal of Mathematical Psychology*, 15(3), 234-281. https://doi.org/10.1016/00222496(77)90033-5

Saaty, T. L. (1990). How to make a decision: the analytic hierarchy process. *European Journal of Operational Research*, 48(1), 9-26. https://doi.org/10.1016/0377-2217(90)90057-I

Saaty, T. L. (2008). Decision making with the analytic hierarchy process. International *Journal of Services Sciences*, 1(1), 83-98. https://doi.org/10.1504/IJSSCI.2008.017590

Sisman, S., & Aydinoglu, A. C. (2020). Using GIS-based multi-criteria decision analysis techniques in the smart cities. International Archives of the Photogrammetry, Remote Sensing & Spatial Information Sciences.

Sisman, S., Akar, A. U., & Yalpir, S. (2021). The novelty hybrid model development proposal for mass appraisal of real estates in sustainable land management. *Survey Review*, 1-20. https://doi.org/10.1080/00396265.2021.1996797

Smahi, D., Hammoumi, O.E., Fekri, A. (2013). Assessment of the impact of the landfill on groundwater quality: a case study of the Mediouna Site, Casablanca, Morocco. J. *Water Resour. Prot*, 5, 440-445. https://doi.org/10.4236/jwarp.2013.54043

Thanh, L. N., & De Smedt, F. (2012). Application of an analytical hierarchical process approach for landslide susceptibility mapping in A Luoi district, Thua Thien Hue Province, Vietnam. *Environmental Earth Sciences*, 66(7), 1739-1752. https://doi.org/10.1007/s12665-011-1397-x

TOB, (2018). Ulusal su planı (2019-2023). Ankara: T.C. Tarım ve Orman Bakanlığı.

UNICEF, & WHO (2019). Progress on household drinking water, sanitation, and hygiene 2000-2017: Special focus on inequalities. New York: United Nations Children's Fund (UNICEF) and World Health Organization.

Uyduranoglu Oktem, A., & Aksoy, A. (2014). Türkiye'nin su riskleri raporu. İstanbul: WWF Türkiye.

Vaidya, O.S., & Kumar, S. (2006). Analytic hierarchy process: An overview of applications. *European Journal of Operational Research*, 169(1), 1-29. https://doi.org/10.1016/j.ejor.2004.04.028

WHO (2022). Guidelines for drinking-water quality: fourth edition incorporating the first and second. Geneva: World Health Organization.

Yavuz, F., & Baycan, T. (2013). Use of swot and analytic hierarchy process integration as a participatory decision-making tool in watershed management. *Procedia technology*, 8, 134-143.

Yılmaz, E. (1999). Analitik Hiyerarşi Süreci kullanılarak çok kriterli karar verme problemlerinin çözümü. *DOA Dergisi*, 5, 95-122.

Resume

Halil Burak AKDENİZ, graduated from İzmir Kâtip Çelebi University Department of Geomatics Engineering. He completed his M.Sc. in the Department of Geomatics at the Konya Technical University and e currently has been studying for Ph. D at the same university. He has been working as a research assistant in Konya Technical University Department of Geomatic Engineering since 2019. His research focuses on the cadastre, land management, GIS, and marine and coastal management.

Sinan LEVEND is an assistant professor at Konya Technical University, Türkiye. He received his bachelor's degree in 2004, MSc. in 2008 and PhD. in 2015

DOI: 10.15320/ICONARP.2024.290

from the Department of Urban and Regional Planning of Selçuk University. TÜBİTAK supported him within the scope of the International Postdoctoral Research Fellowship Program in 2018-2019 for post-doctoral studies at the University of Liverpool. He is conducting research activities in the areas of urban planning, urban policy, decision making, neighbourhood planning and GIS.

Şaban İNAM has been working as an assistant professor in Konya Technical University Department of Geomatics Engineering since 1986. He participated in various scientific research projects to urban renewal and cadastre. His research focuses on the cadastre, land management, urban renewal, urban land readjustment.

ICONARP
International Journal of Architecture and Planning
Received: 09.02.2023 Accepted: 29.04.2024
Volume 12, Issue 1/ Published: 30.06.2024
Research Article *DOI: 10.15320/ICONARP.2024.291 E- ISSN:2147-9380*
ICONARP

Spatial Trends of Capital Concentration in Türkiye: An Analysis of the Top 1000 Industrial Firms

Umut Erdem*
Sibel Ecemiş Kılıç**

Abstract

Industries, firms, and capital are geographically concentrated in the core regions of the countries which leads to regional disparities. Türkiye, as a developing country, suffers from high regional disparities, especially regarding east-west duality. In this context, this study analyzes the spatial concentration of the top firms in the regions of Türkiye (81 NUTS 3) in the 1999-2019 period, using the İstanbul Chamber of Industry's top 500 and second 500 companies' datasets. As one of the few studies conducted in this field, this study reveals important results. The differences regarding the spatial concentration of capital accumulation are decreasing in Türkiye; however, the level of capital accumulation disparities is quite uneven and high. The number of top firms is decreasing in the core regions of Türkiye, namely İstanbul (535 to 321), Ankara (73 to 58), and İzmir (104 to 76). Considering the decline in Turkey's largest companies, it is clear that these losses indicate a large loss of industrial assets. On the other hand, the number of firms among the top 1000 firms is increasing in the regions called Anatolian Tigers, namely Gaziantep (17 to 61), Kayseri (16 to 28), Sakarya (4 to 14) and Konya (10 to 22). The analyses show that the east-west duality has not changed but is restructured with the emergence of the New Industrial Spaces of Türkiye. It can be said that the areas where capital is concentrated have changed.

Keywords:
Capital accumulation, Economic geography, Regional disparities, Türkiye

*Department of City and Regional Planning, İzmir Democracy University, İzmir, Turkey. (*Corresponding author*)
Email: umut.erdem@idu.edu.tr

**Department of City and Regional Planning, Dokuz Eylül University, İzmir, Turkey.
Email: sibel.ecemis@deu.edu.tr

To cite this article: Erdem, U., & Ecemiş Kılıç, S. (2024). Spatial Trend of Capital Concentration in Türkiye: An Analysis of the Top 1000 Industrial Firms. *ICONARP International Journal of Architecture and Planning,* 12 (1), 444-462. DOI: 10.15320/ICONARP.2024.291

INTRODUCTION

Regional disparities are quite high in Türkiye. This is not a challenging argument because it is a well-known phenomenon that the western part of the country is more developed than the eastern part (Çelebioğlu and Dall'Erba, 2010; Gezici and Hewings, 2004; Karahasan, 2015). Infrastructure like industrial zones, airports, highways, harbors, innovation centers, and human capital are concentrated in the western part of Türkiye, whereas regions of eastern Türkiye lack these assets. Still, regional disparities in Türkiye are not a static process, but a dynamic process that regional economies are transforming.

Evolutionarily, history shows that regional economies are transforming and restructuring according to regional dynamics embedded in space. Therefore, the spatial configuration of capital accumulation is changing accordingly. This restructuring process is crystallized in the shrinkage of the core regions in Türkiye and the rise of the Anatolian Tigers located on the periphery. This process is, of course, a complex process with multiple layers and multiple actors. However, two dynamics come to the fore regarding their power to explain the causality and relatedness of the shrinkage of core cities and the rise of Anatolian Tigers. The former is deindustrialization and financialization of the core regions, and the latter is competition between capital fractions. Historically, the core regions of Türkiye are in the western part, and their numbers are few. Today, core regions of Türkiye are still in the western part, but after 1980, we see that Anatolian Tiger regions took the stage with power triggered by liberal policies.

Such transformation and restructuring of the regions are evident and can be observed in the spatial distribution of the top firms over time. Top firms refer to a concept based on the ranks of the 1000 industrial firms in Türkiye. The ISI (İstanbul Chamber of Industry) ranks Turkish industrial firms according to their sales from production. Regional capital accumulation is surely more than the spatial distribution of the top 1000 firms of Türkiye. Nevertheless, it is a unique and fair proxy for measuring the uneven geography and spatial restricting of capital accumulation in Türkiye because the spatial distribution of the top firms is quite immanent to the spatial development processes of Türkiye (Akın and Seyfettinoğlu, 2022). There are no proper data for measuring the concentration and accumulation of capital in regions and the rise of the Anatolian Tiger regions. In this study, we use the number of top firms to refer to the level of capital accumulation in the regions. If a region has a higher number of top firms, then the spatial concentration of capital is also quite high in this region. The fact that the concentration of capital in a place where it was not concentrated before is a unique and difficult fact, especially for the backward regions. In this regard, use of the top 1000 firms' data for investigating regional capital accumulation in Türkiye reveals the importance of this study.

The present paper aims to answer the following questions (i) Are there large capital concentration disparities across the Turkish NUTS III

DOI: 10.15320/ICONARP.2024.291

regions? (ii) how is the east-west duality changing? (iii) how the capital accumulation historical cores and Anatolian Tiger regions (new industrial spaces) in Türkiye are evolving? and reports quite significant results that the uneven geography of capital accumulation in Türkiye is not static but restricting. The number of the top 1000 firms is decreasing in core regions, whereas their numbers are increasing in regions called "Anatolian Tigers".

The following part belongs to the literature review. In part three, we discussed data and dataset development. The fourth part belongs to exploratory spatial data analyses. In the fifth part, we discuss the results.

LITERATURE REVIEW

Spatial capital accumulation and the concentration of capital in particular places are dateless topics in the economic geography literature. There are two main approaches existing in the literature; the former is based on Marxist geography and the latter is based on economic geography literature. According to the Marxist approach (Harvey, 2012; Smith, 2010; Das, 2017), the capital accumulation process is a necessity in which capital tends to accumulate in specific places to increase the speed of production and the volume of surplus accumulation. In capitalist economies, capital tends to concentrate on particular cities and regions, historically, for faster access to better means of production, high-quality raw materials, cheap labor pool, productive new production techniques, and high technology. Profit maximization through the fastest production at the lowest costs is the primary driver of unequal regional capital accumulation (Das, 2017; Harvey, 2012). Thus, industries, firms, and capital tend to be geographically concentrated in the core regions of the countries (Balland et. al, 2019, p. 1252; Boschma and Lambooy, 1999).

On the other hand, economic geography approaches highlight space-specific assets. According to the economic geography approaches, the spatial concentration of firms and capital are heavily dependent on space-specific assets like infrastructure, organization capacity, human capital, and type and level of capitalism (Storper, 1997). Some regions have better spatial assets than other regions that poor regions are not able to develop because these assets are embedded in space and not easy to copy and develop. Thanks to these assets, market dynamics lead to the concentration of firms in particular regions, which leads to high-level regional disparities in countries worldwide.

Two notable reasons are the engines of these restructuring processes. (i) The first is related to the local capabilities of the regions. As regions accumulate further capital, their economies and capabilities grow, and new firms emerge. Regions specialize more in new capabilities related to pre-existing capabilities, which refers to a path-dependent process. (ii) The second is that the core regions tend to move their firms, industrial zones, and other complexes (capabilities) to neighboring regions and to regions that have a relatively lower level of capital, but still have higher capital compared to other regions, because of the financial transition of the economies in the core regions. Therefore, new capabilities are emerging in neighboring and other high-level capital-accumulated regions, thereby resulting in increasing regional disparities. There is a consensus in the literature that focuses on the structural change observed in core regions in developed countries that deindustrialization and financialization are processes in which regions will inevitably relegate their industries to surrounding regions because of the process of deindustrialization and financialization[1].

Several studies existing in the literature that investigated the deindustrialization process of Türkiye Karahasan (2015), Karahasan et al. (2016), and Karahasan (2020) show that the deindustrialization process of Türkiye is not random, but it follows well-known paths of economic policy. Besides, Doğruel (2013) and Doğruel and Doğruel (2018) report a decrease in industrial production in old industrial areas. Although our study establishes the causality of the change in the geographical pattern of the top 1000 companies over the years with these concepts, since the focus of the study is not deindustrialization and financialization in Turkish cities, we leave the deepening of these issues to future studies on a regional or sub-regional scale.

All these path-related spatial assets and structural changing processes lead to the unequal accumulation of successful firms in particular places such as Silicon Valley in the USA, Il de France in France, and Baden-Württemberg in Germany; on the other hand, as in the Detroit example, the loss of firms in the specialized sector causes problems such as shrinkage, population loss, and economic contraction (Storper, 1997).

Türkiye as a developing country is a unique case for understanding the uneven geography of capital accumulation across regions. Because (i) regional disparities are lower in developed countries than in developing countries. Since developed countries have higher capital, their spatial distribution is more balanced, which means that capital is concentrated in a particular place (one or two regions) in developing countries because capital is scarce. It is quite common that only one region has a very high number of investments, population, firms, and capital, and these unequal distributions lead to high regional disparities. Interior and coastal China (Rodríguez-Pose, 2010), south and north Italy (Taylor et al., 1997), south and north Mexico (Gonzales-Rivas, 2007) and east-west duality of Türkiye (Gezici and Hewings, 2004; Duran and Erdem, 2017) are well-known examples of high regional disparities that lead to unequal accumulation of capital, firms, etc. across the regions.

And (ii) the spatial distribution of the capital in Türkiye is immanent to the capital groups or fractions (Ercan, 2009). There are two evident capital groups (fractions) that play crucial roles in the restructuring of the accumulation process of capital in Türkiye. The first capital group consists of firms formed around the association Turkish Industrialists' Businessmen's Association (TÜSİAD), called the "Big İstanbul Capital Group" where its members are mostly concentrated in İstanbul. The second group is the Independent Industrialists' and Businessmen's

[1] The concepts of financialization and deindustrialization are frequently used to explain the economic change and transformation that occurs in the regions where capital is most concentrated in countries. The sub-concepts and dynamics of these concepts are not included within the scope of this study. The study aims to establish causality by examining the inequality of capital concentration between regions and the changes in the spatial distribution of 1000 industrial companies. Analyses regarding the concepts intended to conceptualize change and transformation in the regions were left to subsequent studies due to both the focus of the study and the lack of data.

DOI: 10.15320/ICONARP.2024.291

Association (MÜSİAD), which is called the "Anatolian Capital Group". The members of this group concentrated on the regions located in central Türkiye, which are also called "new industrial places" of Türkiye (Eraydın, 2002; Ercan, 2009; Deniz, 2022). Again, we are using the concept of capital fractions as an explanatory of the regional uneven capital concentration process of Türkiye, but because of the lack of access to proper data, we cannot analyze the top 1000 list regarding the capital groups. Although we cannot determine the share of capital groups in the top 1000 lists, we support the arguments of studies that claim it is an important explanation of the spatial configuration of capital concentration[2].

In these regards, analyzing the uneven spatial concentration of capital and its restructuring process is important and can provide important insights into the design of future regional development policies for reducing regional uneven distribution of capital across Türkiye. To better understand the evolution of the regional distribution of capital accumulation in Türkiye, we analyzed the top 1000 firms published by the İstanbul Chamber of Industry (ISO).

DATA and METHODS

The ISI (İstanbul Chamber of Industry) has published separate datasets for the top 500 and second top 500 industrial firms of Türkiye annually since 1997. For each year in the period 1997-2019, the data covers the ranking of the firms among I-500 and II-500, their post-address, city, the volume of sales from production, number of employees of the firms. It is not wrong to assume that the ISI dataset is reliable and consistent data because it has been consistently published for more than two decades.

Data

To analyze the geographical variation of the top 500 and second top 500 firms of Türkiye, (i) 22.000 firms (22 years x 1000 firms) are geo-coded to their latitudes and longitudes to explore the geographic distribution of the capital accumulation by their postcodes and addresses. The *Tidygeocoder*[3] and *tmaptools*[4] packages in R environment are used for geocoding the locations by using free OpenStreetMap Nominatim API[5]. The data for firms was categorized into the NUTS III level regions according to their locations. The annual dataset of firms with regional and sectorial breakdowns between 1997 and 2019 is analyzed from an evolutionary spatial perspective by using maps, graphs, and cartogram techniques with social realist approach (Sayer, 2010).

Spatial Evolution of Top 1000 Firms

Throughout history, capital has tended to accumulate in certain regions to take maximum advantage of proximity externalities because proximity leads to faster circulation of capital (Harvey, 2012). The speed of capital circulation is the main reason for the uneven spatial

[2] The number of capital fractions is, surely, more than two (TUSIAD and MUSIAD) in Türkiye but for not to distract the focus of the study, we treat these two capital groups as dominant capital groups. For further information about the capital groups and their historical dynamics in the development process of the economy of Türkiye please see: Ercan, (2009).

[3] For more information on tidygeocoder please see https://cran.r-project.org/web/packages/tidygeocoder/readme/README.html

[4] For more information on tmaptools please see https://rdrr.io/cran/tmaptools/man/geocode_OSM.html

[5] For more information on nominatim api please see https://nominatim.org/release-docs/latest/api/Overview/

development in which core regions can circulate their capital faster by exploiting their peripheries (Harvey, 2012). This leads to dualities between backward and developed regions, which lack capital accumulation and concentration (ports, industrial areas, labor, human capital, firms, sectorial diversity and specialization, transformation capacity, and other social and economic dynamics).

East-west duality in Türkiye dates back to the capitalization of its economy (Pamuk, 2014). After the establishment of the new republic in 1923, Türkiye turned to the Western world because of the intensity of the capital they had due to their early capitalist economies (Tekeli, 2001; Pamuk, 2014). Developing economies have fewer alternatives to accumulate their capital in particular places, mostly they tend to accumulate in one place, which is İstanbul in Türkiye, Buenos Aires in Argentina, and New Mexico in Mexico, and examples can be multiplied. In Türkiye, most of the investments and capital were accumulated in the İstanbul region because of its historical and geographical proximity to Europe and its coastal location (Gezici and Hewings, 2004). Thus, the İstanbul region is the financial core of the economy of Türkiye. The other core regions are Ankara, İzmir, and Bursa, which are the secondary industrial core regions of Türkiye (located in western Türkiye), where they have a capital intensity much higher than the average of Türkiye but lower than İstanbul.

Capital Fractions

Another form of east-west duality also exists in the capital groups of Türkiye, which is immanent to the regional disparities of the country (Ercan, 2009). The history and spatial dynamics of capital groups or capital fractions in Türkiye are important for understanding the dynamics of the regional distribution of top firms and unequal capital accumulation in Türkiye (Gündoğdu, 2009). In line with the historical background of the country, top firms are in the western part of Türkiye, especially in the İstanbul region and the Ankara and İzmir regions (Tekeli and Menteş, 1982), where these firms and capital owners formed a capital group called “Big İstanbul Capital Group”. These firms are the pioneers of private capital formation processes and the growth and capitalization of the economy of Türkiye. The TÜSİAD is the final institution of this group, which consists of the biggest actors of private capital in Türkiye, established in 1970, and supports a transition to a free-market economy (Sarı and Aydın, 2010). Table 1 clearly shows that most members are located in the İstanbul, Ankara, and İzmir regions. Except for the Kocaeli and Bursa regions, the number of members from other regions is lower than 10, and the number of members decreases around 2 and 3 as the distance increases from the core regions of Türkiye.

The rest of the country also has a capital intensity that is relatively low compared with these core regions and consists of small- and medium-scale firms formed by a capital group called “Anatolian Capital Group” which has been supported by import substitution-oriented policies

DOI: 10.15320/ICONARP.2024.291

during the 1980s (Ercan, 2009). With the January 24 policies that initiated rapid and uncontrolled trade liberalization in Türkiye, MÜSİAD was established by Anatolian Capital Group to take a position together against liberal free-market dynamics and to become more visible (Özsöz, 2017). This capital group was clustered in certain regions in Anatolia, and the regions where it was clustered were later called Anatolian Tigers regions (ATR) (Eraydın, 2002). The concept of new industrial spaces is also used to refer to Anatolian Tiger regions (Eraydın, 2002). It is also possible to see which regions are Anatolian Tiger regions from Figures 1 and 2 those small accumulations formed by a few numbers of dots (firms) spread to the regions in central and eastern Anatolia.

We assume that the majority of the members of TÜSİAD were among the top 1000 firms by ICI at the beginning of the analysis period. We assume and claim that with the rise of MÜSİAD member companies in the following years, the number of TÜSİAD member companies on the list may have decreased and TÜSİAD member companies may have shifted to lower ranks in the list. Making this comment is more likely when other cities are examined, especially when looking at the regional distribution of TÜSİAD member companies in regions other than İstanbul, Ankara, and İzmir. It appears that more companies are on the list than the number of TÜSİAD member companies. Such a difference between the number of firms among the top 1000 firms and the number of TÜSİAD members in these regions clearly indicates the existence and domination of MÜSİAD and other capital groups in these regions.

Table 1. Regional Distribution of TUSIAD members in 2023. Source: Own Calculations

Regions	Count
İstanbul	535
Ankara	64
İzmir	56
Kocaeli	15
Bursa	13
Denizli	7
Antalya	5
Kayseri	2
Mersin	2
Tekirdağ	4
Eskişehir	3
Aydın	2
Konya	3
Adana	2
Kahramanmaraş	2
Samsun	3
Gaziantep	1
Uşak	1
Kütahya	1
Trabzon	1
Abroad*	6
Total	728

Note that: * Abroad refers to the Turkish members that located out of Türkiye.

Aware and cautious that we have oversimplified and over-reduced, we claim that this is the mainframe of the regional disparities of Türkiye, in which financial and industrial cores with most of the top firms are in western Türkiye, especially in İstanbul. Besides, small-scale regions with a few top 1000 firms are in central and eastern Türkiye. Most TÜSİAD members are in the core regions of Türkiye, and it is not wrong to suggest that most MUSİAD members are located in regions called Anatolian Tigers in central and eastern Türkiye[6]. Although several policies like regional funding and promotion strategies for the backward regions were applied to reduce the level of disparities in balancing the east-west duality of Turkish regions, the duality has not changed but was restructured with a transition due to the tension between the capital groups (Ercan, 2009). The spatial evolution of the top 1000 firms in Türkiye can provide insights into the transition of capital accumulation and monitor the level and evolution of the spatial dynamics of regional disparities in Türkiye. In this regard, the spatial evolution of the top 1000 firms in Türkiye is analyzed to further explore the evolution of regional disparities in Türkiye.

[6] We do not deny that the MÜSİAD members among the top 1000 were initially from the regions in central and eastern Anatolia, but this situation may turn into a pattern in which MÜSİAD members from the western regions are also included in the list over the years. We would like to kindly take the attention of the researchers to uncover these topics in future researches.

The East - West Duality

Unequal spatial accumulation of capital and economic capabilities is crystallizing in the east-west duality of Türkiye. This duality refers not only to the spatial decomposition of capital but also to the decomposition of capital regarding the groups and fractions. Both spatial and fractional decompositions of capital are immanent to each other. Competition between the different capital groups causes a restructuring of the capital accumulation distribution across the regions. In this paper, we claim that this restructuring is visible in the change in spatial distribution of the top firms.

The spatial distribution of the top 500 and second top 500 (total 1000 for each year) firms in Türkiye are displayed on regional maps by geocoding their addresses for the years 1997 and 2019 in Figures 1 and 2. Red dots refer to the top 500 firms, and blue dots refer to the second top 500 firms. Figures 3 and 4 shows the spatial distribution of firms on an unequal cartogram. The east-west duality, which has century-long roots, is quite clear in Figure 1 and Figure 2. Every dot in Figure 1 and Figure 2 refers to one firm. In the 1997 map, a very high share of the firms is in the core regions of the western part of the country, whereas few firms are in the central part, and very few firms are in the eastern part, clearly. The spatial distribution patterns of the red and blue dots overlap.

The spatial distribution pattern of the firms in 1997 did not change significantly in 2019, although the number of blue and red dots increased in the northern-eastern part and in the southern part of the country. A comparison of the maps of 1997 and 2019 shows that the east-west duality has not changed structurally. In addition, blue dots increase in the regions around İstanbul and especially in central Türkiye.

DOI: 10.15320/ICONARP.2024.291

These are quite clear in Figure 3 and 4, in which the regions are distorted according to their share of the number of firms they have. The distorted shapes of the country that look like a "Nemo" changed slightly. Clearly, it is remarkable that the areas of the eastern regions located in the tail of the Nemo expanded. In addition, the area of the eastern regions located close to the tail and the regions located in the central part expanded further. On the other hand, the shapes of the İstanbul, Ankara, and İzmir regions shrank from 1997 to 2019, which means that the number of top firms decreased in these regions.

As seen in Figure 1 to Figure 4, the number of firms in regions where the "Big İstanbul Capital Group" accumulated is decreasing, whereas the number of firms is increasing in the regions where the "Anatolian Capital Group" is heavily concentrated. In line with these, it is possible to claim that the east-west duality is transforming. To better understand this transformation, we analyzed the evolution of the number of firms analyzed for each region. These results are consistent with Kent and Donduran (2020), who analyzed the size of firms and regional disparities.

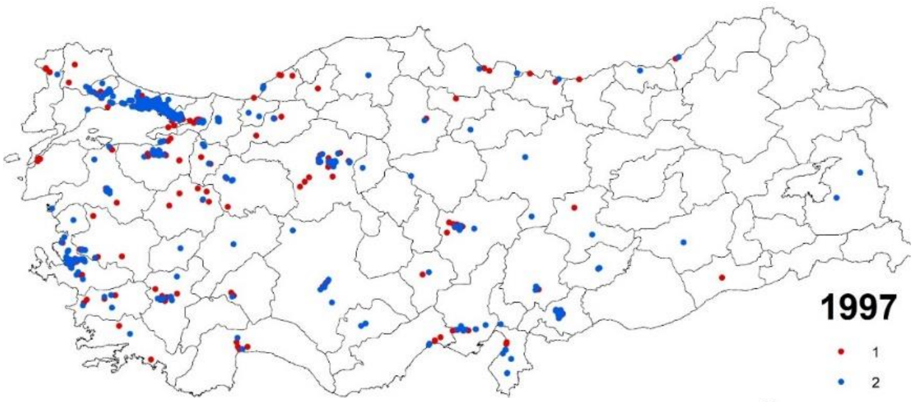


Figure 1. Spatial Distribution of the top 500 and second top 500 industrial firms of Türkiye for the year of 1997.
Note: Red dots refer to top 500 firms, and blue dots refer to the second top 500 firms. Source: Own Calculations

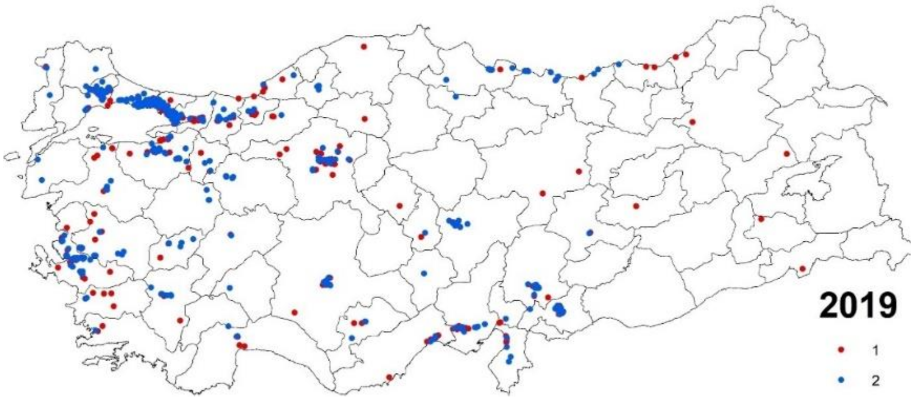


Figure 2. Spatial Distribution of the top 500 and second top 500 industrial firms of Türkiye for the year of 2019.
Note: Red dots refer to top 500 firms, and blue dots refer to the second top 500 firms. Source: Own Calculations

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

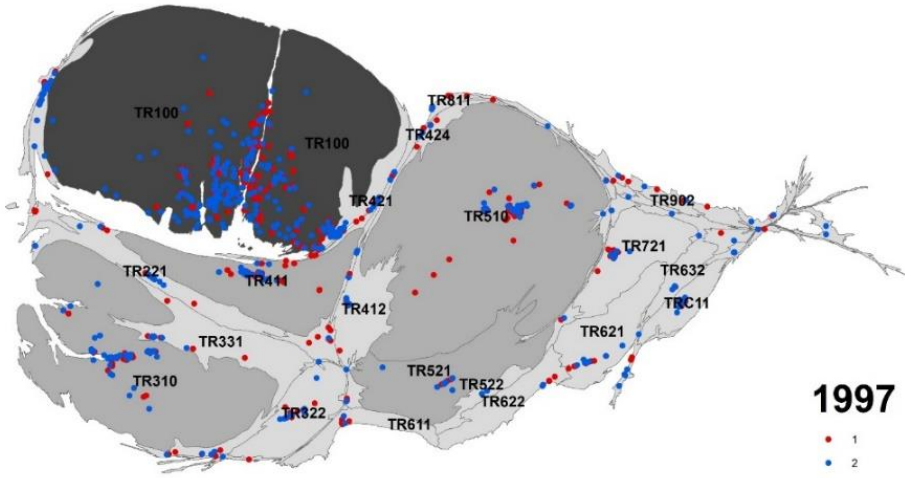


Figure 3. Spatial Distribution of the top 500 and second top 500 industrial firms on unequal cartogram of Türkiye for the year of 1997.
Note: Red dots refer to top 500 firms, and blue dots refer to the second top 500 firms. Company counts weighted.
Source: Own Calculations. For more information on cartogram mapping please see https://www.dannydorling.org/?page_id=3132 and the book The human atlas of Europe: A continent united in diversity https://www.jstor.org/stable/j.ctt1t8937s

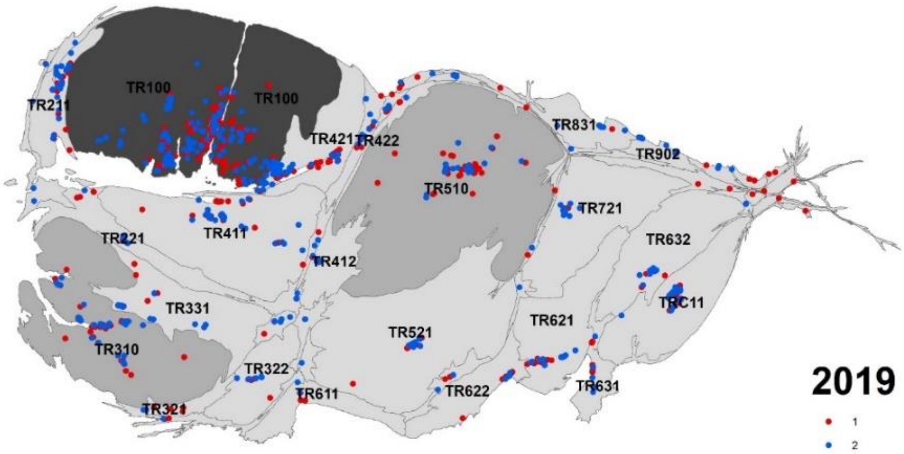


Figure 4. Spatial Distribution of the top 500 and second top 500 industrial firms on unequal cartogram of Türkiye for the year of 2019.
Note: Red dots refer to top 500 firms, and blue dots refer to the second top 500 firms. Company counts weighted.
Source: Own Calculations. For more information on cartogram mapping please see https://www.dannydorling.org/?page_id=3132 and the book The human atlas of Europe: A continent united in diversity https://www.jstor.org/stable/j.ctt1t8937s

Evolution of Historical Cores and New Industrial Spaces in Türkiye

Table 1 presents the distribution of the top 1000 firms to regions by years. Figures 5 and 6 were created to monitor region-specific change trends annually. To trace the region-specific change trends on a yearly basis, Figures 5 and 6 are created. Each graph belongs to a region, and the cross-sectional average is one in the region-specific time series. The trend lines for the top 500 and second top 500 firms are obtained by dividing the annual number of firms in the region by the average of a region-specific time series. The Red line shows the trend for the top 500 firms, and the blue line shows the trend for the second top 500 firms.

Considering the number of the first 1000 companies located in the historical core regions of Türkiye;

- İstanbul: The number of firms decreased from 535 to 321 (-40%) in the 1997-2019 period. Figure 5 (A) clearly shows the evolution of the decreasing trend of top firms in İstanbul at first glance. Both the red and blue lines show a rapidly decreasing trend. The 2008 global financial crisis is a breaking point for the top 500 firms. The trend appears to fluctuate around similar values until 2008 and then starts to decrease. Initially, the number of firms among the

DOI: 10.15320/ICONARP.2024.291

second largest 500 firms is higher than that among the top 500 firms; however, their number falls below the number of top 500 firms in 2019. Regarding the capital fractions, the regional distribution of the TÜSİAD members shows that TÜSİAD members are highly located in İstanbul in 2023, but their share in the top 1000 firms is evidently decreasing in the analysis period.

- İzmir: The number of firms decreased from 104 to 76 (-26.9%) in the 1997-2019 period. In Figure 5 (B), the red line, which shows the trend of the top 500 firms in the regions, has a sharp decreasing trend until 2011 and then starts to increase slightly until 2019. The trend of the second-top 500 firms started to decrease after the 1999 and 2008 global financial crises.
- Ankara: The number of firms decreased from 73 to 58 (-20.6%) in the 1997-2019 period. For the region, Figure 5 (C) shows that the number of the top 500 and second top 500 firms decreased, although not as sharply as in the İstanbul and İzmir regions.

These results from figures and tables confirm that the number of top 500 and second top 500 firms is decreasing significantly in the core regions where they had almost 70% of the top 1000 firms in 1997. This ratio decreased to 45 in 2019.

Table 2. Distribution of top 1000 firms to regions by years, Source: Own Calculations

Region	Code	1997	1999	2002	2008	2014	2019
İstanbul	TR100	535	514	496	435	370	321
İzmir	TR310	104	114	89	83	71	76
Ankara	TR510	73	75	61	60	61	58
Bursa	TR411	44	42	64	65	66	65
Denizli	TR322	21	20	32	22	21	18
Manisa	TR331	19	21	17	19	21	25
Kocaeli	TR421	18	25	26	52	63	74
Adana	TR621	18	21	17	23	23	25
Gaziantep	TRC11	17	16	16	31	56	61
Kayseri	TR721	16	18	25	27	28	28
Balıkesir	TR221	14	12	11	15	12	12
Eskişehir	TR412	12	12	12	11	8	9
Konya	TR521	10	11	12	20	24	22
Mersin	TR622	9	7	6	7	9	11
Karaman	TR522	6	6	3	5	3	4
Zonguldak	TR811	6	5	4	6	5	5
Bolu	TR424	5	6	6	5	5	4
Ordu	TR902	5	5	6	6	7	8
Antalya	TR611	5	4	7	9	6	7
Kahramanmaraş	TR632	5	3	8	11	20	25
Sakarya	TR422	4	4	6	6	17	14
Kütahya	TR333	4	4	5	3	3	2
Giresun	TR903	4	4	3	1	2	3
Aydın	TR321	4	3	4	6	6	6
Edirne	TR212	3	3	3	4	3	2
Malatya	TRB11	3	2	1	2	2	1
Samsun	TR831	2	5	7	11	13	14
Tekirdağ	TR211	2	3	5	9	14	22
Trabzon	TR901	2	2	3	5	5	3
Niğde	TR713	2	2	3	1	0	1
Çanakkale	TR222	2	2	2	4	2	4

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Kırşehir	TR715	2	2	2	1	1	1
Isparta	TR612	2	2	2	0	2	2
Amasya	TR834	2	2	2	0	2	2
Rize	TR904	2	1	1	2	2	2
Adıyaman	TRC12	2	1	1	1	0	0
Hatay	TR631	1	3	9	11	11	12
Karabük	TR812	1	1	1	2	4	5

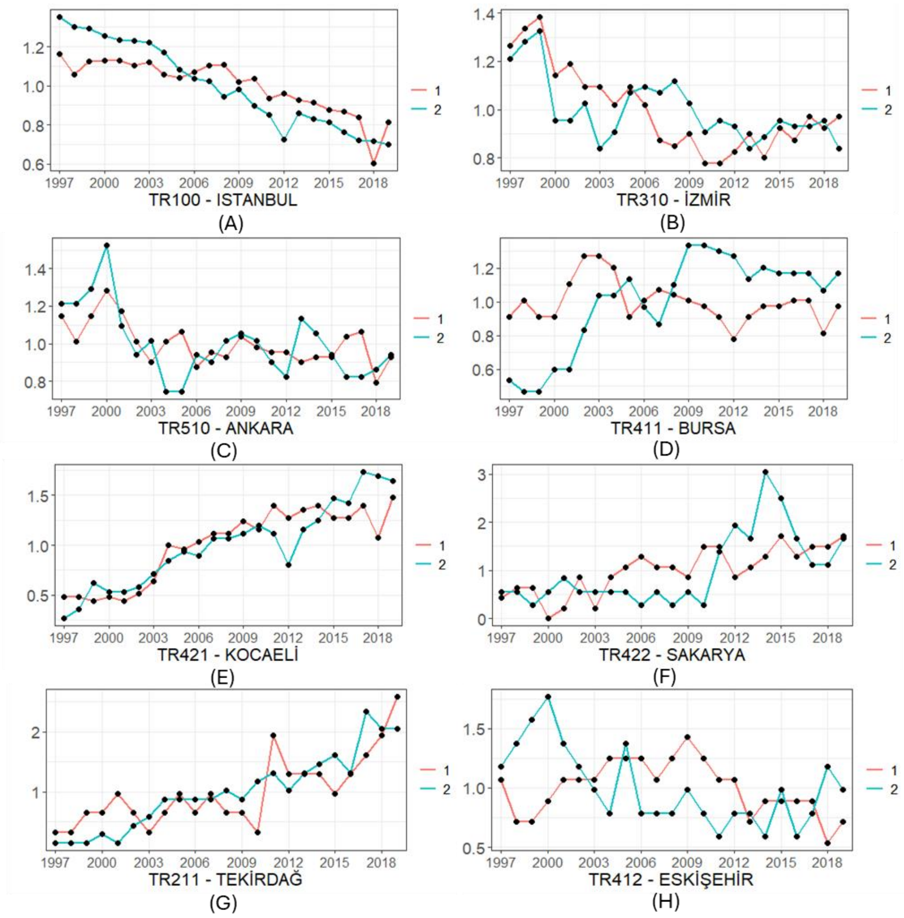


Figure 5. Evolution of top 500 and second top 500 industrial firms in major regions of Türkiye for the period of 1997 - 2019. Note: Red line refers to top 500 firms, and blue line refer to the second top 500 firms. Cross-sectional average is 1 in all figures. Source: Own Calculations

The decrease in the number of the top 1000 firms in core regions also indicates an increase in the number of top 1000 firms in other regions. In this context, we can claim that such increases occur in the regions around or close to İstanbul and in the Anatolian Tiger regions. Figure 5 (D)-(H) shows the annual change trend of the top and second top 500 firms in the regions close to or around İstanbul. It is widely discussed in the literature that the core regions of the countries had transition processes called deindustrialization, which refers to a transition from industrial cores to financialization cores. Policies based on the transfer of industrial areas of core regions to neighboring and backward regions are quite common in European Regions.

Considering the number of the first 1000 companies located in the regions near the historical core regions of Türkiye;

- In Bursa, which has been a center of trade and industry throughout its history and is close to İstanbul, but the proximity effect of

DOI: 10.15320/ICONARP.2024.291

İstanbul has decreased due to the inland sea between them, the number of top firms increased from 44 to 65 between 1997 and 2019. The Bursa region is dominated by the big İstanbul Capital and Anatolian Capital Group. Both the red and blue lines show increasing trends (Figure 5D). While the top 500 also maintained its existence during the period, the number of second-top firms increased.

- Tekirdağ, İstanbul, Kocaeli, and Sakarya regions are developing by integrating from west to east. Because these three regions are very close to İstanbul, it is quite clear in Figures 5 (G), (E), and (F), respectively, that these regions receive the highest share of the deindustrialization processes of İstanbul. Both the number of top 500 and second top 500 firms is apparently increasing in these three regions. These trends are consistent with the industrial relocation policies of the İstanbul region. The increase in the Kocaeli regions, where industrial investments have been implemented in connection with the İstanbul region since the beginning of the new republic, is almost five times higher than that in the Tekirdağ and Sakarya regions. Tekirdağ and Sakarya regions are secondary neighbors of the İstanbul region; however, the increases in the top 500 and second top 500 firms in these two regions are quite significant, with the number of firms increasing 10 times for Tekirdağ region and almost four times for the Sakarya region. It is still possible to claim that both the Big İstanbul Capital Group and the Anatolian Capital Group dominate these regions. Anatolian Tigers or New Industrial Spaces are concepts for defining the regions whose share in the Turkish economy and industrial production has increased remarkably and rapidly since the 1980s. Most of the firms located in these regions are SMEs formed by families who were able to accumulate low-level capital due to the late capitalist economies of these regions. In this regard, the evolution of the second-top 500 firms in these regions is quite significant and provides important insights into the regional restructuring of the new industrial clusters in Türkiye. The number of the top 500 and second top 500 firms is increasing in these regions with different patterns. Figure 5 (A)-(J) shows the changes in the trend of these regions.

In almost all regions in Figure 6, it is seen that the blue line has a high upward trend in all or part of the 1997 - 2019 period. Regions that come to the fore in the increasing trend of the blue line are especially the regions of Konya, Kayseri, Gaziantep, Adana, Samsun, and Ordu. In some regions, the red line is also consistent with the trend of the blue line. These regions are Konya, Gaziantep, and Samsun, where the number of top 500 and second top 500 firms increased between 1997 and 2019. The number of top 1000 firms increased two times in

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Konya, and this ratio is more than three for the Gaziantep region and seven for the Samsun region.

There are also regions where the number of companies in the top 500 has increased like the Manisa and Hatay regions, although their second top 500 firm numbers are fluctuating between 1997 and 2019. The number of top 1000 firms increased 12 times between 1997 and 2019 in the Hatay region. There was not such a high increase for the Manisa region (Figure 6 (H). The number of top 500 firms in the Denizli region, which is seen as a success story among Anatolian Tiger regions in terms of economic growth, is almost constant after 2010, and the number of second top 500 firms decreases after 2003, which shows the transformation of the regional economy. Analyses show that by 2019, the Denizli region is far behind the Konya, Kayseri, and Gaziantep regions.

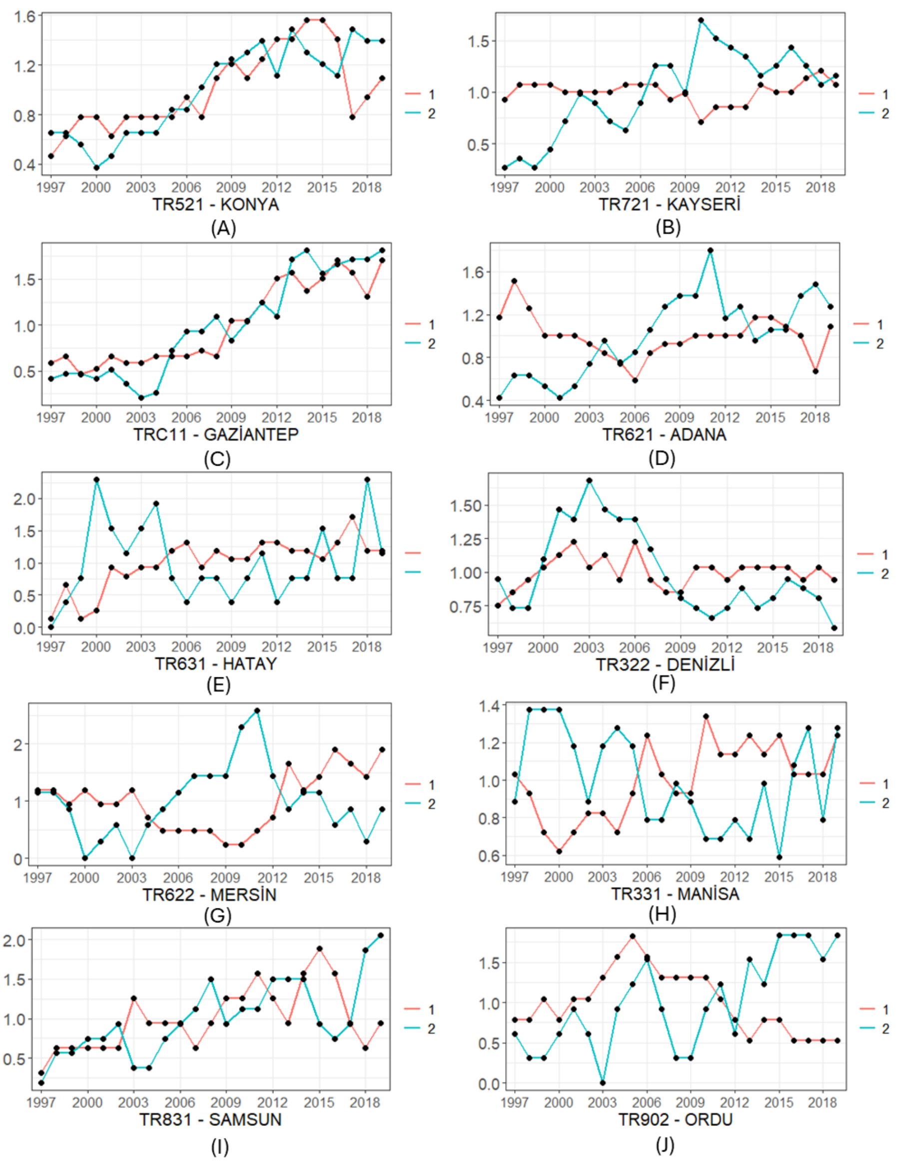


Figure 6. Evolution of top 500 and second top 500 industrial firms in Anatolian Tigers (New Industrial spaces) regions of Türkiye for the period of 1997 - 2019. Note: The red line refers to the top 500 firms, and the blue line refers to the second top 500 firms. The cross-sectional average is 1 in all figures. Source: Own Calculations

While these regions initially had a few firms far below their average values of the 1997-2019 period, their firm numbers are later much higher than their averages. This provides information about the traces of capital

DOI: 10.15320/ICONARP.2024.291

accumulation in the regions. Capital accumulation processes are path-dependent and formed by decision makers and capital groups. In these regards, the analyses show that regional policies that favoured the regions with the subsidization policies and the redistribution processes of the wealth created throughout the country can create capital accumulation in these regions.

DISCUSION AND CONCLUSION

The concept of regional disparities is not an old fact for a country like Türkiye, many developing countries suffer from regional imbalances. However, our paper differs from the existing literature by approaching the regional disparities of capital accumulation as a dynamic process. Indeed, the east-west duality is well documented in the literature. What is neglected by the studies dealing with regional disparities is that such duality is changing according to the dynamics that are embedded into regions and intervention policies formed by governments and capital fractions.

It can be stated that east-west duality still maintains its validity in general, but we want to draw attention to the fact that regional disparities regarding capital accumulation are not static but dynamic in Türkiye. The east-west duality was restructured between 1997 and 2019. Our main finding and argument in this study is that interregional inequalities in Türkiye are changing and transforming spatially. However, despite such changes and transformations, the level of inequalities between regions remains high. This is consistent with studies reporting club convergence across regions of Türkiye like Aksoy et al. (2019) and Duran & Erdem (2017). This process has changed and transformed by social and economic policies embedded in the dynamic processes of the regions, which are not easy to measure and capture because of the lack of proper data. Therefore, this study fills an important gap in the literature that focuses on regional capital accumulation disparities. The assessment of uneven geographical capital accumulation spatiality and historically is crucial because unbalanced accumulation of capital, regional disparities in other words, leads to cohesion and stability problems for the countries. The novelty of this paper is based on the use of top 1000 firm data as a proxy for the spatial configuration of capital accumulation across regions.

Analyses show that the increases and decreases in the top 1000 firms in regions are not random but very location specific. At first glance, the analyses revealed that the number of firms (among the top 1000 firms) is decreasing in core regions of Türkiye like İstanbul, Ankara, and İzmir, which means that the number of firms among the top 1000 firms is increasing in other regions. In the core regions, where the top 1000 companies owned almost 70% in 1997, the number of top 500 and second top 500 companies is decreasing significantly, which is consistent with the results of Özarslan (2006), which showed the decentralization of the manufacturing Industry and the rise of the service sector in traditional regional centers (İstanbul, İzmir, Ankara). As discussed

[7] Urban continuum is a concept that refers to urban areas consisting of urban integrity with little or no intervening natural areas. For more information on urban continuum please see https://vizyon2050.istanbul/haberdetay-1-7-istanbul_metropoliten_alan_plan_surecleri

[8] The shift from Fordism to Post-Fordism refers to the emergence of the globalizing urban system and a new form of worldwide restructuring of capitalism that began to appear in the 1970s. The analysis is made with reference to two socio-political transformations. One is demand and production elasticity resulting from the emergence of a new international division of labour controlled by industrial districts consist of small and medium scale firms instead of global firms. The other is the crisis of the Fordist-Keynesian technological institutional system that dominated the old, industrialized world in the post-World War II period which refer to a shift from mass production to flexible production.

[9] The concept of Anatolian Tigers refers to the regions that rise after 1980s in Turkey mainly by the emergence of small and medium sized enterprises. The term itself comes from the Asian Tiger that is used for calling the countries of Hong Kong, Singapore, South Korea, and Taiwan that grew more than 7 percent annually with the rapid industrialization for more information please see: https://www.economist.com/special-report/2019/12/05/after-half-a-century-of-success-the-asian-tigers-must-reinvent-themselves?utm_medium=cpc.adword.pd&utm_source=google&ppccampaignID=18151738051&ppcadID=&utm_campaign=a.22brand_pmax&utm_content=conversion.direct-response.anonymous&gad_source=1&gclid=Cj0KCQjwqP2pBhDMARIsAJQ0CzpQcPe-xEDYH4YtIOqCL7Bcos5_uUb-Yv8Vqm2TvkKimEI6XCuC6dkaAk-REALw_wcB&gclsrc=aw.ds

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

earlier, the financialization of the core regions and relocation of the industries in line with the deindustrialization policies may explain the decrease in the number of top firms in the İstanbul (Erbil, 2017), İzmir (Özatağan and Eraydın, 2014), and Ankara (Bostan et al., 2010) regions.

As for the regions where the number of large firms increases, the number of top firms is mostly increasing in the regions that are border neighbors of the İstanbul region. Currently, an urban continuum[7] exists between the cities of Tekirdağ, İstanbul, Kocaeli, and Sakarya (from west to east). It is not wrong to suggest that the spatial configuration of the top firms in these regions is dominated by the İstanbul capital (Evren and Sakarya, 2018). The trend we revealed in this study using data between 1997 and 2019 has been discussed in the literature with different conceptualization attempts like “industrial growth in the hinterland provinces” (Ataay, 2004) and “development-oriented regions” (Albayrak and Erkut, 2010).

Our findings are consistent with the literature that analyzes the industrialization processes of Türkiye. Ataay (2004) reports that the Marmara region is the most developed and developing region of Türkiye, and the industry, which was concentrated in İstanbul, Kocaeli, and Bursa before 1980, has spread to the hinterland of neighboring provinces. These hinterland neighboring provinces were classified as second-stage developed provinces by the Ministry of Industry and Technology (Ministry of Industry and Technology, 2017), which surround the first-stage developed provinces. Our findings are also consistent with the Kazancık (2007) report that İstanbul is dominant in almost all sub-sectors in the manufacturing industry, and neighboring regions within İstanbul’s sphere of influence resemble the sectoral structuring of İstanbul.

The number of top 1000 firms is also increasing obviously in new industrial spaces of Türkiye (Anatolian Tiger regions). Eraydın (2002) suggests that the shift from Fordism to Post-Fordism[8] is an important dynamic of the rise of new industrial spaces in Türkiye. The top firms in the Anatolian Tiger[9] regions are SMEs that are flexibly able to adapt their mode of production, and their technology upgrades are easier than the big industrial complexes. In addition, subsidy policies were applied by the governments to these regions to increase the cluster externalities in these regions. Our findings are consistent with the emergence of New Industrial Zones defined as Anatolian Tigers by Özaslan (2006), the conceptualization of "development-oriented regions" by Albayrak and Erkut (2010), and the rise of Konya, Kayseri, Karaman, and Yozgat provinces that have become competitive in some sectors with “green capital” investments after 1980 by Ataay (2004).

Additionally, the TÜSAD-MÜSİAD duality is an important factor in the increase in capital accumulation in the Anatolian Tiger regions. Although we wanted to examine the changes in the members of TÜSAD and MÜSAD, among the top 1000 companies, according to regions during the study period, we could not access the member lists within the scope of the law

[10] We would like to encourage the researchers to for the research questions like how many companies are members of TÜSİAD-how many companies are members of MUSIAD? Has the distribution of the memberships of the top 1000 companies in these two organizations changed over time? Did this change have an impact on the geographic distribution of capital accumulation?

DOI: 10.15320/ICONARP.2024.291

on access to information[10]. However, the distribution of TÜSIAD members by region provides us with data supporting our argument that TÜSAD members are predominantly concentrated in western regions and that the majority of the new firms that are entered into the top 1000 list are from eastern regions.

When the results of the study are examined, we see that both tools from the economic geography literature and those from the Marxist geography literature can be used to reveal the unequal spatial distribution dynamics of capital accumulation in Türkiye. Based on the assumption that regional unequal capital accumulation in Türkiye involves a changing and transforming spatiality and causality, we would like to underline the necessity of considering the process as evolutionary, as we did in the study. Both approaches can reveal different reasons for explaining the historical causality of regional capital concentration inequality in Türkiye. However, a data set such as the rankings of companies cannot reveal sufficient correlation and causality to make different readings about how the process is shaped. For this purpose, in-depth interviews with companies and representatives of different capital fractions are required.

New regional development policies that can balance the regional disparities in Türkiye can be formed using the results derived from analyses of the evolution of the spatial distribution of the top 1000 firms. These policies will help decision-makers manage the diversification of the regions by developing strategies that support the specialization of a new sector that it has not previously specialized in.

ACKNOWLEDGEMENTS/NOTES

The authors would like to thank the Istanbul Chamber of Industry and Selin Gürgan from TUSIAD for the data sharing and would like to thank to the editor and referees for their valuable comments that improved the quality of the paper.

REFERENCES

Akın, B., & Seyfettinoğlu, Ü. K. (2022). Factors determining the location decision: Analysis of location choice preferences of the ICI-1000 companies with the nested logit model. Central Bank Review, 22(1), 57-75.

Aksoy, T., Taştan, H., & Kama, Ö. (2019). Revisiting income convergence in Türkiye: Are there convergence clubs?. Growth and Change, 50(3), 1185-1217.

Albayrak, A. N., & Erkut, G. (2010). Türkiye'de Bölgesel Rekabet Gücü Analizi. Megaron, 5(3).

Altınbaş, S., Doğruel, F., & Güneş, M. (2002). Türkiye'de Bölgesel Yakınsama: Kalkınmada Öncelikli İller Politikası Başarılı Mı?. VI. ODTÜ Uluslararası Ekonomi Kongresi, 11, 14.

Ataay, F. (2004). Türkiye'de kentsel ve bölgesel gelişme dinamikleri (1923-2000). İçinde Küreselleşme Kıskacında Kent ve Politika, Ed. M. Güneş, Detay Yayıncılık, Ankara, 5-62.

Balland, P. A., Boschma, R., & Rigby, D. L. (2016, January). Relatedness, knowledge complexity and technological opportunities of regions: A framework for Smart Specialization. In Conference Paper: First SMARTER Conference on Smart Specialisation and Territorial Development.

Boschma, R., & Lambooy, J. (1999). Why do old industrial regions decline? An exploration of potential adjustment strategies.

Bostan, M., Erdoğanaras, F., & Görer Tamer, N. (2010). Relocation Process and its characteristics in manufacturing Industry Firms in Ankara Metropolitan Area. METU Journal of the Faculty of Architecture, 27(1).

Çelebioglu, F., & Dall'Erba, S. (2010). Spatial disparities across the regions of Türkiye: an exploratory spatial data analysis. The Annals of Regional Science, 45, 379-400.

Das, R. (2017). David Harvey's theory of accumulation by dispossession: A Marxist critique. World Review of Political Economy, 8(4), 590-616.

Deniz, C. (2022). The Formation of Provincial Capital: Value Regimes and the Politics of Labour in Anatolia. LIT Verlag Münster.

Doğruel, A. S., & Doğruel, F. (2018). Two phases of deindustrialization policies in İstanbul. Journal of Research in Economics, 2(2), 186-207.

Doğruel, F. (2013). Deindustrialization of old industrial regions in Turkey. Rives méditerranéennes, (46), 93-108.

Duran, H. E., & Erdem, U. (2017). Regional inequality and international trade in Türkiye: A dynamic spatial panel approach. A| Z ITU Journal of the Faculty of Architecture, 14(3), 25-39.

Eraydın, A. (2002). Yeni sanayi odakları: Yerel kalkınmanın yeniden kavramlaştırılması. ODTÜ Mimarlık Fakültesi.

Erbil, T. (2017). Planning dilemmas in deindustrialization process in İstanbul. A| Z ITU Journal of the Faculty of Architecture, 14(2), 43-56.

Ercan, F. (2009). Sermayeyi haritalandırmaya yönelik kavramsal düzenekler. Praksis, 19, 9-53.

Erdem, U. (2016). Regional human capital distribution and disparities in Türkiye. Review of Urban & Regional Development Studies, 28(1), 16-31.

Evren, Y., & Sakarya, A. (2018). Resilience, the Rivet Effect, and the Changing Geography of Production Chains in the Turkish Automotive Industry. PLANLAMA-PLANNING, 28(1).

Gezici, F., & Hewings, G. J. (2004). Regional convergence and the economic performance of peripheral areas in Türkiye. Review of Urban & Regional Development Studies, 16(2), 113-132.

Gonzales Rivas, M. (2007). The Effect of Trade Openness on Regional Inequality in Mexico. The Annals of Regional Science, 41(3), 545-561. doi:10.1007/s00168-006-0099-x

Gündoğdu, İ. (2009). Sermayenin bölgesel kalkınma eğilim (ler) i: Kalkınma ajansları yasası üzerine tarihsel-coğrafi materyalist bir inceleme. Praksis, 19, 267-302.

Harvey, D. (2012) History versus theory: A commentary on Marx's method in Capital. Historical Materialism, 20(2), 3-38.

Karahasan, B. C. (2015). Dynamics of regional new firm formation in Türkiye. Review of urban & regional development studies, 27(1), 18-39.

Karahasan, B. C. (2020). Regional Deindustrialization in Turkey. Topics in Middle Eastern & North African Economies: Proceedings of the Middle East Economic Association, 22(1).

Karahasan, B. C., Dogruel, F., & Dogruel, A. S. (2016). Can market potential explain regional disparities in developing countries? Evidence from Turkey. The Developing Economies, 54(2), 162-197.

DOI: 10.15320/ICONARP.2024.291

Kazancık, B. L. (2007). Bölgesel Gelişme Ve Sektör-Bölge Yığınlaşmaları. Bölgesel Kalkınma ve Yönetişim Sempozyumu Bildiriler Kitabı. TEPAV, İzmir.

Kent, O., & Donduran, M. (2020). Firma Büyüklüğü ve Bölgesel Farkliliklar. İstanbul Ticaret Üniversitesi Sosyal Bilimler Dergisi, 19, 404-425.

Kervankıran, İ. & Eteman, F. S. (2020). Turizm ve bölgesel gelişme: Türkiye'de illerin turizm gelişmişlik düzeylerinin belirlenmesi. Ege Coğrafya Dergisi, 29(2), 125-140.

Özaslan, Metin (2006) : Spatial Development Tendencies and Emergence of New Industrial Districts in Türkiye in the Post-1980 Era, 46th Congress of the European Regional Science Association: Enlargement, Southern Europe and the Mediterranean", August 30th - September 3rd, 2006, Volos, Greece, European Regional Science Association (ERSA), Louvain-la-Neuve

Özatağan, G., & Eraydin, A. (2014). The role of government policies and strategies behind the shrinking urban core in an expanding city region: The case of İzmir. European Planning Studies, 22(5), 1027-1047.

Özsöz, C. (2017). İslâm ekonomisi ve yeni muhafazakâr orta sınıfın temsilcisi olarak MÜSİAD. Sosyolojik Düşün, 2(1), 1-11.

Pamuk, Ş. (2014). Türkiye'nin 200 yıllık iktisadi tarihi. Türkiye İş Bankası Kültür Yayınları, İstanbul.

Rodríguez-Pose, A. (2012). Trade and regional inequality. Economic Geography, 88(2), 109-136.

Sanayi ve Teknoloji Bakanlığı (2017), İllerin Sosyo-Ekonomik Gelişmişlik Sıralaması 2017, Kalkınma Ajansları Genel Müdürlüğü Yayını Sayı: 3, Araştırma Raporu Sayı : 3, Ankara.

Sarı, S. G., & Aydın, S. (2010). Türkiye'de Büyük Burjuvazinin Örgütlü Yükselişi: Siyasal ve Yönetsel Süreçlerin Biçimlenmesinde TÜSİAD. Bolu Abant İzzet Baysal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 10(1), 43-68.

Sayer, A. (2010). Method in social science: revised 2nd edition. Routledge.

Smith, N. (2010). Uneven development: Nature, capital, and the production of space. University of Georgia Press.

Storper, M. (1997). The regional world: territorial development in a global economy. Guilford press.

Taylor, J., & Bradley, S. (1997). Unemployment in Europe: A comparative analysis of regional disparities in Germany, Italy and the UK. Kyklos, 50(2), 221-245.

Tekeli İ, ve G. Menteş (1982 (1976)) "Türkiyede Holdingleşme ve Holding Sistemlerinin Mekanda Örgütlenmesi", İ. Tekeli (der.), Türkiyede Kentleşme Yazıları içinde, Ankara: Turhan, 261-297.

Tekeli, İ. (2001). Modernite aşılırken kent planlaması. İmge kitabevi.

Resume

Umut ERDEM is an assistant professor in the İzmir Democratic University department of City and Regional Planning dealing with Regional Science, Regional Development Policies, Spatial Statistics, and GIS science. He has a BSc from Süleyman Demirel University City and Regional Planning, an MSc from İzmir Institute of High Technology city and Regional Planning, and a PhD from Dokuz Eylül University City and regional planning.

Sibel ECEMIŞ KILIÇ is a full professor of City and Regional Planning in Dokuz Eylül University. She has a BSc, an MSc, and a PhD from the Department of City and Regional Planning at Dokuz Eylül University. She teaches regional and metropolitan planning.

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Research Article

ICONARP
International Journal of Architecture and Planning
Received: 09.12.2023 Accepted: 25.01.2024
Volume 12, Issue 1/ Published: 30.06.2024
DOI: 10.15320/ICONARP.2024.292 E- ISSN:2147-9380

ICONARP

Transformation of Transitional Elements with Muqarnas from Early Ottoman Period to Classical Ottoman Period

Hüdai Sırrı Şenalp*
Can Şakir Binan**

Abstract

Since the beginning of the Ottoman era, muqarnas have been incorporated into building designs. Along with advances in construction techniques, muqarnas were used structurally in the construction of mosques, baths, madrasahs and palaces as a means of transition to the dome. From the 14th century during the early Ottoman period, the Timurtaş Pasha Mosque in Bursa (1379-92) and the Iznik Green Mosque (1378-91) were built with a focus on maintaining visual structural integrity within interior spaces. This was a common practice that persisted until the mid 18th century. While muqarnas can reinforce the visual integrity of a building as a transitional element, in some cases it can also transfer the weight of the dome to the walls and strengthen the building's structure when designed in the form of pendentives and squinches. It is important to note this duality in the use of muqarnas in the construction of buildings. The muqarnas utilised in the interiors during this period had a brick base, hidden by plaster on the outside. Many monumental buildings display this aspect of muqarnas, which requires expertise, particularly during restoration. Very little research has been conducted in this field. In the study, the transitional elements to the muqarnas dome, starting from the early Ottoman Period, will be examined until the Classical Ottoman Period, and the formal analysis between the 14th and 16th centuries will be made to understand the nature of the change it showed. After the literature review It is aimed to reach a synthesis with the inferences made through field research based on outputs.

Keywords:
Early Ottoman period, Classical Ottoman period, Muqarnas, restoration, Transitional zone

*Faculty of Architecture, Yildiz Technical University, Istanbul, Turkey. (*Corresponding author*)
Email: hssenalp@gmail.com

**Faculty of Architecture, Yildiz Technical University, Istanbul, Turkey.
Email: binancb@gmail.com

To cite this article: Şenalp, H. S., & Binan, C. Ş. (2023). Transformation of Transitional Elements with Muqarnas from Early Ottoman Period to Classical Ottoman Period. *ICONARP International Journal of Architecture and Planning,* 12 (1), 463-503. DOI: 10.15320/ICONARP.2024.292

INTRODUCTION

Muqarnas is an architectural feature that enables the transition from one geometric plane to another in three dimension. This is achieved via a two-dimensional plan that is raised to the third dimension. Muqarnas has been present in Islamic architecture since the 10th century and has been used across a vast geographical area, spanning from the Iberian Peninsula to the Indian subcontinent. Muqarnas exhibits varying geometric principles depending on the material in use and can be constructed from stone, brick, wood, plaster, and tile for both structural and ornamental purposes. The muqarnas acts as a console or niche and assists in the formation of the covering of a dome as a transitional feature within the structure.

Given the scope provided, Hillenbrand's (1970) study of Seljuk domed chambers in northwestern Iran highlights the significance of tri-lobed squinches in the construction of Seljuk dome chambers. Camilla and David Edwards (1999:88) provide crucial evidence that the opening up of tri-lobed arches initiates the framework forming muqarnas.

Later on, there are important studies that contribute to the literature on the evolution and changes of transitional elements in Ottoman architecture. Notable works include Batur's (1980) catalogue research, which helps us understand the nature of curvilinear structures and transitional zones of Ottoman mosques. The significance of Ekrem Hakkı Ayverdi's four-volume corpus (1989) on the early stages of Ottoman architecture cannot be overstated. The corpus is a valuable contribution to the field of study as it is based on photographic evidence and primary sources.

Ottoman baths provide valuable information on transition elements. After examining Murat II Hammams and the muqarnas domes in Edirne, Büyükdığan (1989:275) concludes that there is an effort to evenly distribute the muqarnas elements throughout the entire structure. Say's (2011) significant catalogue study explores the hammams of the early Ottoman period, from the beginning of the 14th century up to the 16th century. The study concludes that muqarnas became prevalent in this typology from the second half of the 14th century. Akyildiz (2018) expands on this literature by delving into the construction techniques of Ottoman baths in Edirne in detail, providing valuable information on how muqarnas were built according to the building typology.

Furthermore, the architecture of the Western Anatolian beyliks shows how the construction techniques of East and West were combined to create unique elements and building techniques in relation to classical Ottoman architecture. According to Kolay (2017:133-138) during this period, certain architectural elements emerged as experimental features and were only used in this region and time period before being abandoned. However, many of these elements were also applied in contemporary Ottoman architecture and played a role in the formation of Classical Ottoman architecture. In doing so, the arrangement of pendentives, squinches, and triangular elements as

DOI: 10.15320/ICONARP.2024.292

turkish triangles developed in previous cultures has been experimented with in various ways (Figure 1 and 2). It is noted that the tradition of muqarnas decoration, which was also applied in Iranian, Anatolian, Syrian and Egyptian Mamluk architecture in the 14th century, can be considered as an extension of the tradition in the region.

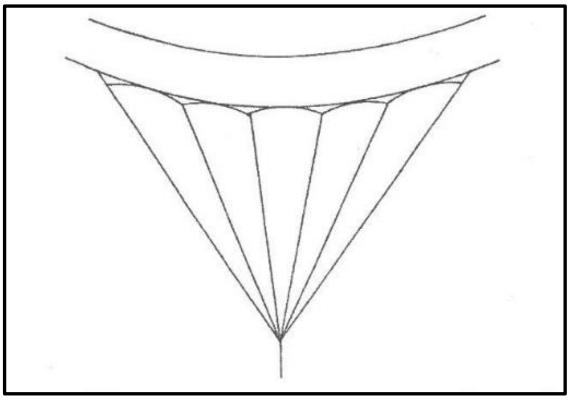


Figure 1. Pendentive fragmentation of Karatay Madrasa as Turkish triangles in Seljuk Anatiolia. (Kolay, 2017 p. 55)

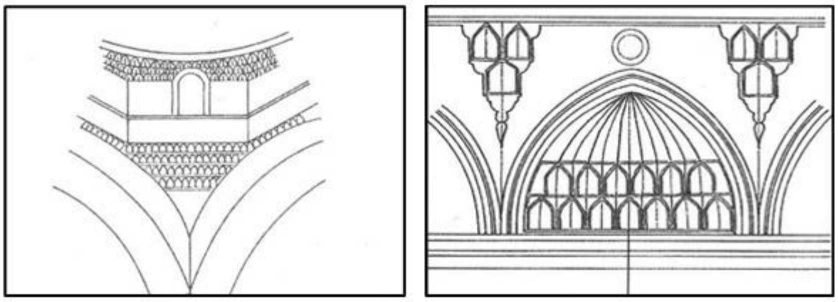


Figure 2. The convergence of East and West in Western Anatolia. Muqarnas pendentive of Selçuk Isa Bey Mosque (left) and muqarnas squinch of Milas Firuz Bey Mosque (right) Source: Kolay, 2017 p. 60 and p. 76

Indeed this view highlights the significance of local construction traditions and the development of muqarnas squinches and pendentives in the region. In this regard, Fukami's (2017) study of the transitional zones in the Egyptian Islamic architectural tradition is significant in drawing parallels between two different architectural traditions, as the Egyptian tradition, along with Ottoman architecture, has at least two centuries of experimentation in the history of transitional zones.

When analysing studies on transitional elements in Ottoman architecture, the subject of transitional elements with muqarnas is only mentioned in general terms, without sufficient detail. Therefore, this study aims to determine the process of change regarding the transitional elements with muqarnas during the Ottoman period through literature research and field studies. To shed light on this transformation process, it is crucial to scrutinise the basic elements of transitional architecture with muqarnas including squinch, pendentive, Turkish triangles, as well as the use of brick and plaster materials in the surrounding area and their evolution over time.

TRANSITIONAL ELEMENTS BETWEEN THE DOME AND THE WALLS AND THEIR DIVISION INTO LEVELS OF MUQARNAS IN THE ISLAMIC ARCHITECTURE THROUGHOUT HISTORY

According to Edwards and Edwards (1999:72) architects have developed two solutions for accommodating a circular dome above a square or rectangle-shaped space throughout history. The first solution is the pendentive, which illustrates the traditional Roman approach. The second solution is the squinch, an architectural feature of Sassanid origin. Over time, squinches have been divided into smaller squinch vaults in the transition zone to the dome, and then transformed into muqarnas, which may serve both structural and decorative purposes.

The incorporation of the squinch in Sassanid tradition involved transitioning to a dome with a single arch. However, the Ismail Samani Mausoleum (943 AD) in Bukhara marked the first instance of dividing the squinch into two parts. As one of the most significant structures in early Islamic Architecture, this marked the initial step in transforming the squinch into muqarnas elements. The Arab-Ata Mausoleum (978 AD), another erected tomb during the Samanid period, is situated in the village of Tim, approximately 200 km from Bukhara and 80 km from Samarkand. It uncovered the foremost multi-layered structural muqarnas vault in the transition zone to the dome. Therefore, it is possible to posit that Samanid architecture is important in terms of squinch fragmentation into muqarnas (Figure 3).

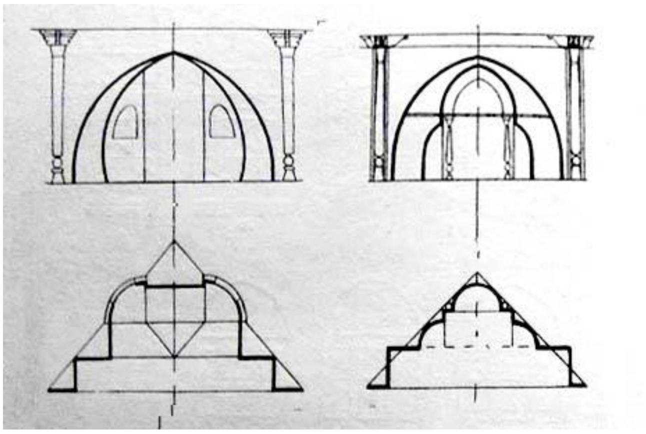


Figure 3. Squinch fragmentation of Samanid buildings. Squinches of Ismail Samani Tomb (Left) followed by the Afrasiyab Palace (middle) and then the Arab-Ata Mausoleum (Right) Source: Akhrarov and Rempel (1971).

During the Great Seljuk period, from the 11th century until the Mongol invasion, muqarnas was commonly utilized in the construction of buildings in Central Asia, Iran and Khorasan. In particular, the muqarnas squinch was extended horizontally in the transition zone in the Friday mosques of Ardistan (Figure 4) (1058-60 AD), Isfahan (1080 AD, south dome) and Barsian (1098 AD). The squinch was partitioned into four muqarnas rows with the construction of the Gulpaygan Friday Mosque (1118 AD). This innovation of the 11th century spread to the rest of Great Seljuk lands in the 12th century.

DOI: 10.15320/ICONARP.2024.292

Figure 4. Masjid-i Jami Ardistan: Squinch in the transitional zone. Source: Camilla and David Edwards (1999) p:73

Following the division of squinch, the dome was also divided into muqarnas elements after the 11th century. Kılıçoğlu (2017:70) states the nature of this division lies in the achievement of continuous muqarnas units in the form of transitional elements, such as squinches and pendentives. This means that the juxtaposition of transitional elements in the muqarnas form, as in the Arabata Mausoleum, paved the way for the creation of muqarnas domes. Again, there are muqarnas domes using brick material in the hypostyle harim area of the Great Mosque of Isfahan (1088 AD) (Figure 5). Tabbaa (1985:63-4) in listing the first examples of muqarnas domes, notes the importance of the muqarnas dome of the Imam Dur Mausoleum in Samarra, completed in 1090, which is one of the first known examples in which the structure is constructed of brick and the finishing material is plaster (Figure 6). In Maghrib, during the repairs of the Al-Qarawiyyin Mosque in Fez between 1135-40, the domes along the qibla axis were decorated with plaster muqarnas, and in Syria the Bimaristan Nur Al-Din in Damascus in 1154, at the main entrance to the building muqarnas portal, and in the interior muqarnas dome were used.

Figure 5. Muqarnas dome in the Great Mosque of Isfahan. Source: MIT Libraries, Aga Khan Visual Archive, photograph by Khosrow Bozorgi n.d. https://dome.mit.edu/handle/1721.3/67524

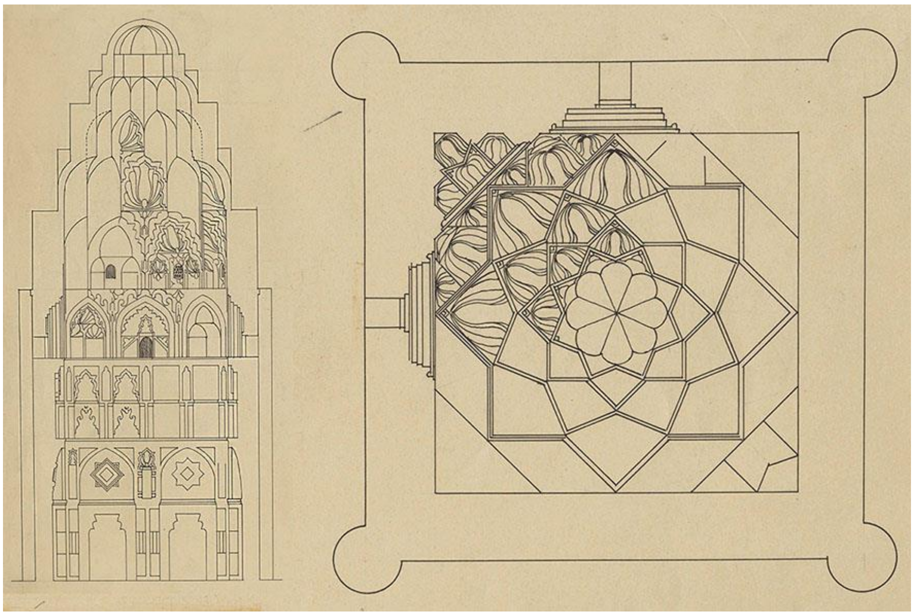


Figure 6. Section and plan of the Imam Dur Mauseloum. Source: Guide to the Ernst Herzfeld Papers in the Department of Islamic Art, Metropolitan Museum of Art: Harris Brisbane Dick Fund, 1943 OCLC Number: 962019803 Drawing: Ernst Herzfeld. https://libmma.contentdm.oclc.org/digital/collection/p16028coll11/id/7176/rec/3

DOI: 10.15320/ICONARP.2024.292

ANATOLIAN GEOGRAPHY AND BUILDING TRADITIONS AROUND

To analyze how the materials and design of the muqarnas evolved during the early Ottoman period to the Classical Ottoman period, we must examine how local building traditions impacted each other in Anatolia (Figure 1). Brick served as both a structural and finishing material in Mā Warāʾ al-Nahr, Khorasan and Iran, where the first Seljuk monuments were situated, during the 11th and 12th centuries.

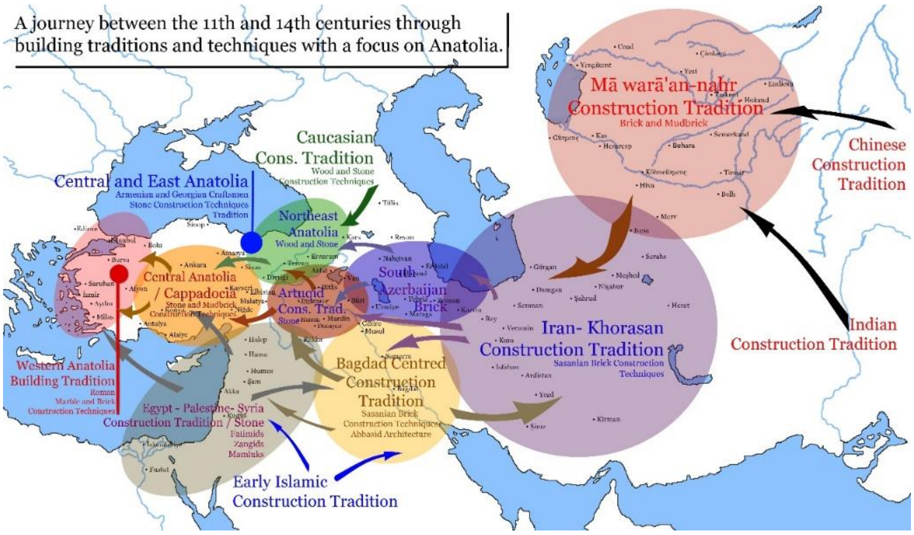


Figure 7. 11th - 14th century Anatolian geography-specific journey of construction traditions and techniques. Source: Authors.

In Northeastern Anatolia, the dominant building traditions were that of Armenians and Georgians, utilising stone and wood. On the other hand, in Western and Central Anatolia, the Romans mostly employed brick and stone. These two vast regions were linked by the Black Sea region and as stated by Rogers (1969:154) characterised by the prevalence of Christian architecture. Cappadocia extended from Southeastern Anatolia, Syria, and Egypt where Islamic stone traditions, represented by Zangids, were common. To the south of the stone tradition lies Mesopotamia, where the Sassanid approach to brick building techniques was employed and built upon by the Umayyad and Abbasid architectural traditions (Arce, 2006). Figure 7 gives the account of these interrelated geographical relationships between the building traditions.

Immediately to the west of Iran and Khorasan, to the north of Mesopotamia and to the east of Anatolia lies the region known as South Azerbaijan. Within this region, there are centres such as Van, Marand, Urmia, Nakhchivan, Maraga, and Qazvin. The Qazvin school of architecture stands out from the rest of the Seljuk architecture. This building tradition is formed through the fusion of various building styles. The Friday mosques of Urmia and Marand (Figure 8) can be considered pioneering as in these buildings the transitional zone is divided into courses of muqarnas, distinguishing them from another Great Seljuk works (Hillenbrand, 1976:96). Specifically, plastered muqarnas utilized over brick in the transition zone towards the Urmia Friday Masjid's dome serves as an example.

Figure 8. Transitional zone over mihrab in Great Mosque of Marand. Source: Anisi A. (2023) p.318

Plaster, as finishing material also utilised in the Timurid tradition, mainly in cities such as Shahr-i Sebz, Samarkand, Herat, and Shiraz. This tradition had an important role for the plaster adorned muqarnas work that started during the Early Ottoman period in the fourteenth century. The documentation of craftsmen from this region in various art forms substantiates their presence in other branches of art (Samkoff, 2014:204).

The handling of brick traditions in the building practices of Eastern Anatolia differs from those in the West, where stone material predominates. This creates a distinct form of architecture in the Artuqid region, where the Great Seljuk brick building tradition is replaced by a limestone building tradition. Notably, the city of Ahlat showcases this new architecture. Pancaroğlu (2012:41-42) asserts that the signatures of craftsmen and architects from Ahlat can be observed on numerous works of Anatolia's earliest significance, and that Ahlat was the inaugural centre in Anatolia to materialize the muqarnas into stone.

DOI: 10.15320/ICONARP.2024.292

Figure 9. Muqarnas squinch in Great Mosque of Niğde. Source: Öney (1976) p.29

Figure 10. Transitional zone with muqarnas in Great Mosque of Divriği. Source: www.divrigiulucamii.com/tr/Sivas_Divrigi_Ulu_Camii_2.html

This Artuqid tradition was introduced to Central Anatolia through Divriği and underwent a significant transformation in the Niğde Alaaddin Mosque. The interior design of both the Great Mosque of Niğde and Divriği are unique (Figures 9 and 10). Consequently, the use of muqarnas in the transition zones was restricted. The muqarnas tradition, however, was chiefly manifested through the main portals. However, it is important not to underestimate the role of the Ayyubid stone tradition of Aleppo and Damascus. This tradition has more examples in transitional zones compared to the Anatolian Seljuks. The Syrian stone tradition has always been highly regarded as much as the Anatolian counterpart.

When we look at the developments related to muqarnas in Egypt in the 14th century, we see that the technique of stone muqarnas transition elements in Syria began to influence the examples in Egypt. The

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

transition zone of the Kubbet al-Muazzaf Alaeddin Sanjar (1322 AD is similar to the Syrian examples: The stone dome of the Firdaws Madrasa (Aleppo, 1235 AD), the east room of the Mashhad Husayn (Aleppo, late thirteenth century), and the muqarnas of the entrance half-dome of the khānkāh of Baybars al-Jashnakīr (Cairo, 1306-10 AD). These examples suggest that the Syrian stone muqarnas technique was brought to Cairo in the early fourteenth century, and it has been noted that this technique was used in Cairo not only for the muqarnas of the crown door, but also for the transition zone of the dome (Fukami, 2017:111).

TRANSITIONAL ELEMENTS WITH MUQARNAS IN ANATOLIA UNTIL END OF ANATOLIAN SELJUKS

When analyzing Anatolian transitional elements with muqarnas, it becomes evident that Artuqid works are the most prominent. A prime example of this tradition in the northwestern region is the Silvan Great Mosque, which was completed in 1157 (Figure 11). The dome above the mihrab, measuring 13.50m in diameter and featuring muqarnas squinches, is a unique instance in the western world that incorporates the principles used in the dome constructed by Melikşah in the Isfahan Friday Mosque of the Great Seljuks (Altun, 1991). Muqarnas was utilized in the transition from the drum to the squinches and also inside the squiches in the main dome of Kızıltepe Dunaysır Ulu Camii, dated 1205. It is apparent that all of these features were constructed by using stone techniques.

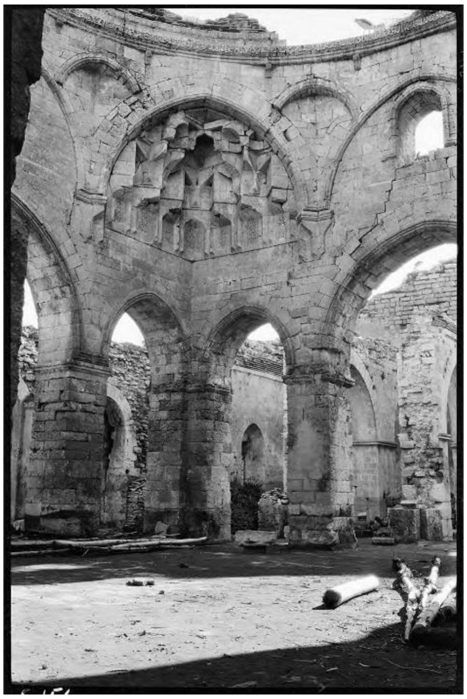


Figure 11. Figure 11 Great Mosque of Silvan, stone muqarnas squinch. Source: https://gertrudebell.ncl.ac.uk/p/gb-3-1-19-1-156

The Great Mosque of Malatya, completed in 1224, continues the principles of the Great Seljuk school regarding brick construction techniques (Figure 12). The muqarnas structure in the transition area to the dome and other decorative programme demonstrate the continuation of the same architectural style.

DOI: 10.15320/ICONARP.2024.292

Similarly, the construction of original examples from the Anatolian Seljuk period continues with the Niğde Alaeddin Mosque, completed in 1223. In all three domes on the qibla side, the transition to the dome is supported with muqarnas squinches. The dome situated above the mihrab of the Divriği Great Mosque, which was built between 1228 and 1243, represents a significant example with regards to the separation of the squinch into muqarnas and the creation of a muqarnas belt within the dome. These examples are also crafted using stone material, serving as a continuation of the examples found in both Artuqid South-east Anatolia and Syria.

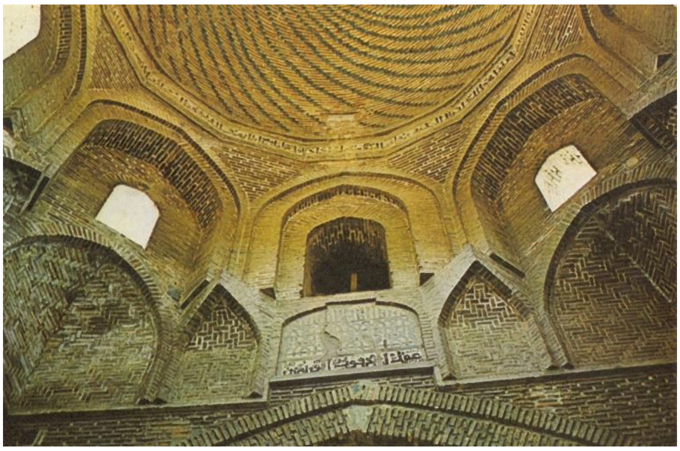


Figure 12. Great Mosque of Malatya, built in the style of Great Seljuk School Source: Öney (1976) p.82

Upon analysis of other Anatolian Seljuk works from this era, a noteworthy observation regarding muqarnas arises. During the onset of the period of Islamic Architecture in Central and Western Anatolia under the Anatolian Seljuks, Konya in particular, which boasts a considerable number of works, abstained from utilizing muqarnas in the transition to the dome and instead implemented Turkish triangles - an interpretation of pendentive tradition unique to the Seljuks. Many Seljuk works in Konya feature Turkish triangles (refer to Table 1).

Table 1. The use of transitional elements in Seljuk monuments in Konya.

DATE	MONUMENT	SPACE	TRANSITION TO	TRANSITIONAL ELEMENT	LOCATION IN THE SPACE
1251	Karatay Madrasa	Harim	Main Dome	Turkish Triangle	Pendentive
Before 1265	Ince Minareli Madrasa	Harim	Main Dome	Turkish Triangle	Pendentive
1220	Alaaddin Mosque	Harim	Dome over the mihrab	Turkish Triangle	Drum with Trianges
13. c. 3. quarter	Tahir and Zühre Masjid	Harim	Main Dome	Turkish Triangle	Drum with Trianges
1283	Sahip Ata Complex	Khangah	Main Dome	Turkish Triangle	Pendentive
		Tomb	Main Dome	Turkish Triangle	Drum with Trianges
13. c. 2nd half	Hoca Hasan Masjid	Harim	Main Dome	Squinch	Squinch

13. c.	Aksinne Masjid	Harim	Main Dome	Turkish Triangle	Drum with Trianges
13. c. 2. half	Sırçalı Masjid	Harim	Main Dome	Turkish Triangle	Drum with Trianges
1215	Taş Masjid	Harim	Main Dome	Squinch	Squinch
13 c.	Beyhekim Masjid	Harim	Main Dome	Turkish Triangle	Drum with Trianges

In this example, the Turkish triangles are shaped in two different ways. In the first one, the squinch is extended by spreading the load transfer undertaken by the squinch to the triangular belt. This belt divided into triangles which connect the walls and the dome at the level of drum (Figure 13). In the second one, the pendentive was divided into triangles and a different design was obtained from the Roman-Byzantine tradition (Figure 1).

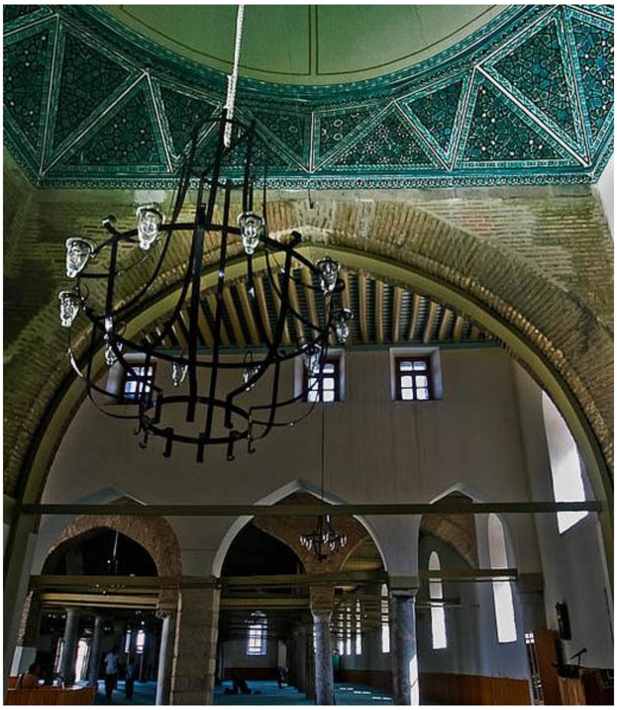


Figure 13. Turkish triangle transition in Alaaddin Mosque, Konya. Source: Senalp H.S. (2012)

The utilization of muqarnas in the transition zone of the Anatolian Seljuk era is remarkably rare. In the restricted occurrences where it is observable, stone is the favored material, with restricted instances found solely in the eastern region of Anatolia.

ANATOLIAN GEOGRAPHY AND BUILDING TRADITIONS AROUND

From the use of stone muqarnas in the transitional zone during the Anatolian Seljuk period, to the utilisation of brick muqarnas tradition by the Anatolian Beyliks and Ottomans, an individual examination is required. Initially, we must investigate how the brick muqarnas tradition arrived in Anatolia as a decorative form.

There are indications that the brick muqarnas tradition in the Great Seljuks was transported to Anatolia in the second half of the 12th century. Brickwork on the pishtaq of the Ishak Nur Tomb in Gürgan,

DOI: 10.15320/ICONARP.2024.292

Iran, the muqarnas consoles of the Kılıçarslan II Pavilion in Konya, and the Bekar Sultan Tomb in Gülağaç all date back to the 12th century and suggest the tradition's presence in the Great Seljuk domains. After conducting dendrochronological examinations on the wooden beams supporting the muqarnas consoles of Kılıçarslan Pavililon, the results indicated that they date back to the Kılıçarslan II period in 1173 and 1174 (Kuniholm, 2002:133). It is worth noting that the minaret balcony of the Iranian Giyasiye Madrasa (1133) are repeated in the Great Mosque of Sivas (1213) and Aksaray Eğri minarets (McClary, 2014).

Likewise, as stated by McClary (2014) the Nahcivan Mümine Hatun Tomb features similar muqarnas niche application, which is also observable in the Sifahane of Izzeddin Keykavus. Although these applications are sparse and not employed in the transition area to the dome, they suggest the presence of brick muqarnas tradition in Anatolia.

When examining the use of plaster material in other areas during this time period, discoveries were made in archaeological excavations at Konya Alâeddin Kosk, Kubadabad Palace, and Felekabad Palace. Gpysum material was also utilised as a mihrab border in Sahib Ata Khangah apart from these examples (Öney, 1992:73).

When studying Turkish triangles in terms of materials, the transition elements to the dome during the Seljuk period were either left as bricks or covered with tile mosaics applied onto plaster.

Portals were the most commonly used muqarnas element during the Anatolian Seljuk era. Although they appear to have a monolithic structure when viewed from the front, there is a hidden order in the background. Figures 14 and 15 reveal exposed stone blocks resulting from the deterioration process of the 1st portal of Afyon Sultandağ İshaklı Han.

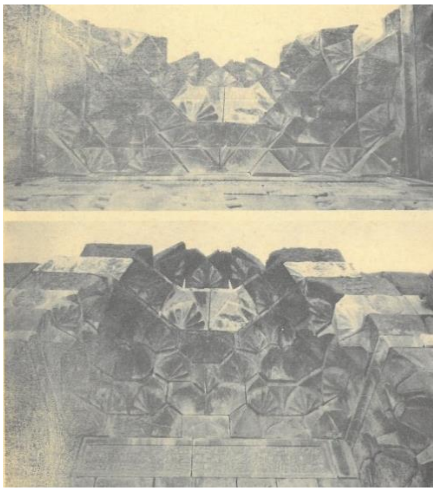


Figure 14. Afyon Sultandag Ishaklı Han 1st Portal, Ödekan, A. (1977) p.252

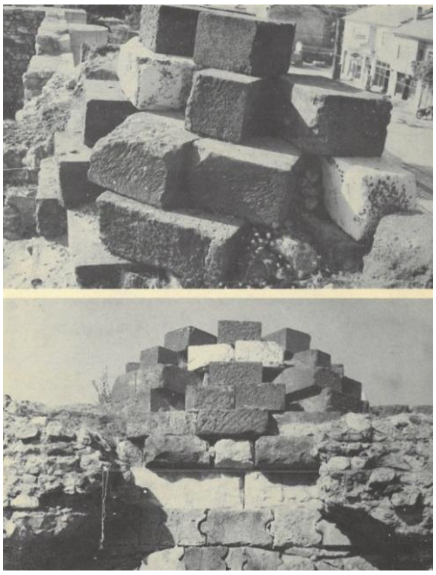


Figure 15. Afyon Sultandag Ishaklı Han 1st Portal, Ödekan, A. (1977) p.252

The use of stone material continued in the Ottoman period. In the Anatolian Seljuk period, stone blocks were fixed with mortar from the back, while in the Ottoman period, the blocks were both fixed to each other with clamps and constructed with relieving arches since the load of the building was placed on them (Figures 16 and 17).

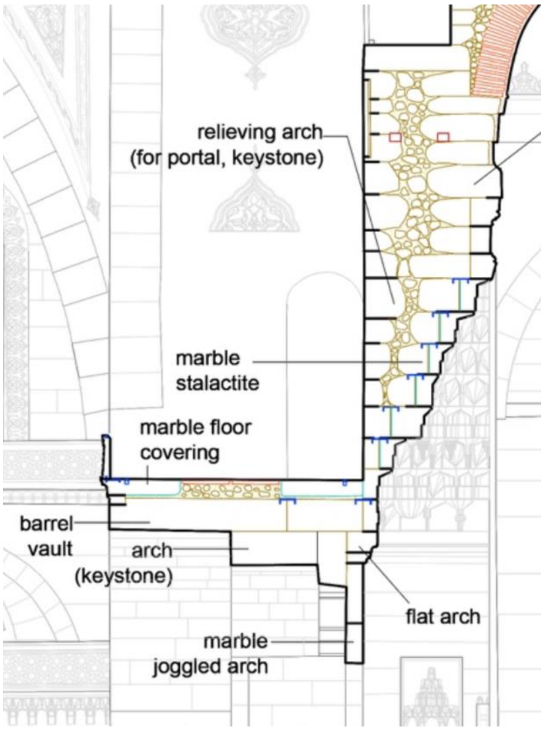


Figure 16. Section of the portal muqarnas in Lüleburgaz Sokollu Mosque. Source: Etyemez Çıplak, L. (2017) p.340

DOI: 10.15320/ICONARP.2024.292

Figure 17. Portal relieving arch seen in cross-section (centre left) Source: Mustafa Cambaz

The conclusion to be drawn from this is that since the muqarnas material was placed on top of each other in an overlapping manner, a structural perspective on other materials will also be required. It can be said that this type of overlapping was also developed in this period in the form of making muqarnas by using courses of bricks on top of each other with mortar.

ANATOLIAN BEYLIKS AND EARLY OTTOMAN PERIOD

During the time of Anatolian Beyliks and Early Ottoman period, muqarnas took over from Turkish triangles as a preferred transition element to the dome in mosques, baths, and madrasas. While the Anatolian Seljuk period mostly utilized muqarnas in stone portals, tile mihrabs, and brick minarets, its use in transitional zones became prominent in the Anatolian Beyliks and early Ottoman period.

The principalities of Aydınoğulları, Saruhanoğulları, Menteşeoğulları, and Osmanoğulları, established following the decline of the Anatolian Seljuks, encountered the building practices of Western Anatolia during their conquests (Kolay, 2017:11). This led to the emergence of exceptional examples, resulting in a distinct material and design in the muqarnas tradition.

Moving on to the Anatolian Beyliks period, it is clear that there was an increase in the use of muqarnas. Particularly the abovementioned Beyliks, who favoured experimenting with various styles over the Anatolian Seljuk works, initiated the usage of plaster as a coating material on bricks. During that era, mihrabs, crown doors, and transitional areas to the dome had muqarnas with brick structure and plaster finishing material applied (Senalp, 2012:50).

At the portal of Manisa Ulu Cami, a 1366 AD Saruhanogullari structure, the brick muqarnas is visible with the plaster stripped away. The Aydınoğulları constructed Selçuk İsa Bey Mosque, where the mihrab's dome transitioned from the drum using pendentive muqarnas. Half of the pendentive was embellished with tile muqarnas and the other half with plane triangles. Furthermore, the minaret balcony features a plaster finish on a brick muqarnas base.

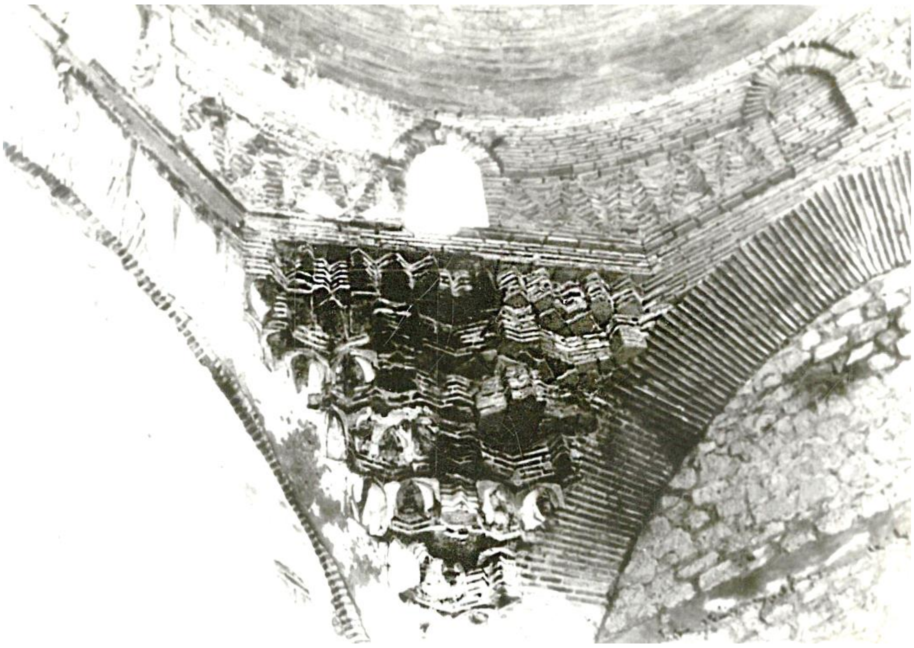


Figure 18. Muqarnas pendentive at Karacabey Mosque. Remnants of plaster details over muqarnas are remarkable. Source: Hassa Mimarlik Archive.

In the early Ottoman mosques, the process of dividing the transition zone into parts can be traced from the earliest periods. In the Alaaddin Bey Mosque, the oldest datable Ottoman mosque, as well as in the Karacabey Mosque in Bursa, triangular elements made of brick can be easily seen, above the muqarnas pendentive in the latter (Figure 18 and 19). This transitional element, called the triangular belt, which emerged as a structural division of the transitional zone, continued up to the corner domes of the courtyard portico of the Istanbul Bayezid II Mosque (Table 2).

DOI: 10.15320/ICONARP.2024.292

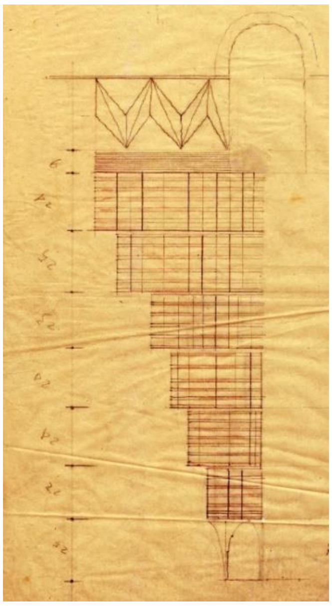


Figure 19. Drawing of the brick structure of the transitional zone and muqarnas pendentive in Bursa Karacabey Mosque. Source: Salt Research Ali Sami Ülgen Archive, Inventory No: TASUDOC0226039

Table 2. Use of Muqarnas in the Transitional Zone in the Early Ottoman Period

THE USE OF MUQARNAS IN THE TRANSITION ZONE IN THE EARLY OTTOMAN PERIOD						
DATE	**LOCATION**	**BUILDING NAME**	**SPACE**	**TRANSITION BETWEEN**	**TRANSITIONAL ELEMENT TYPE**	**LOCATION IN SPACE**
1377	BURSA	TIMURTAS PASA MOSQUE	HARIM MAIN DOME	OCTAGONAL DRUM - WALLS	PENDENTIVE	AT FOUR CORNERS
1377	IZNIK	YEŞİL MOSQUE	ENTERANCE PORTICO CENTRAL DOME	OCTAGONAL DRUM - WALLS	PENDENTIVE	AT FOUR CORNERS
1382	MUDURNU	YILDIRIM HAMMAM	HOT ROOM	OCTAGONAL DRUM - WALLS	PENDENTIVE	AT FOUR CORNERS
1388	BOLU	ORTA HAMMAM	HOT ROOM	OCTAGONAL DRUM - WALLS	PENDENTIVE	AT FOUR CORNERS
1388	IZNIK	IMARET OF NILUFER HATUN	EASTERN ROOM	OCTAGONAL DRUM - WALLS	PENDENTIVE	AT TWO SIDES ASSIMETRICALLY
1389	BERGAMA	DEBBAGLAR HAMAM	HOT ROOM	THE WHOLE DOME - PIERS	PENDENTIVE	CIRCULAR
1394	MILAS	FIRUZ BEY MOSQUE	HARIM MAIN DOME	SQUINCH - WALLS	SQUINCH	AT DIAGONAL CORNERS
1395	BURSA	YILDIRIM BAYEZID COMPLEX - MADRASA	MAIN ROOM	UNDER OCTAGONAL DRUM - WALLS	PENDENTIVE	AT FOUR CORNERS

14 04	BALAT	ILYAS BEY COMPLEX HAMAM	HOT ROOM	DOME - SQUINCH	PENDENTIVE	AT EIGHT CORNERS
14 13	EDIRNE	ESKI MOSQUE	HARIM CENTRAL DOME	SQUINCH - WALLS	SQUINCH	AT FOUR CORNERS
14 19	BURSA	YEŞİL MOSQUE COMPLEX - MOSQUE	EASTERN DOME	UNDER OCTAGONAL DRUM - WALLS	PENDENTIVE	AT FOUR CORNERS
			SOUTHWESTERN DOME	UNDER OCTAGONAL DRUM - WALLS	PENDENTIVE	AT FOUR CORNERS
			SOUTHEASTERN DOME	UNDER OCTAGONAL DRUM - WALLS	PENDENTIVE	AT FOUR CORNERS
			NORTHWESTERN DOME	UNDER OCTAGONAL DRUM - WALLS	PENDENTIVE	AT FOUR CORNERS
14 21	BURSA	MAHKEME HAMAM	ENTERANCE ROOM	SQUINCH - WALLS	SQUINCH	AT FOUR CORNERS
14 22	EDIRNE	GAZI MIHAL HAMAM	HOT ROOM	UNDER OCTAGONAL DRUM - WALLS	PENDENTIVE	AT FOUR CORNERS
14 35	EDIRNE	TAHTAKALE HAMAM	HOT ROOM	UNDER OCTAGONAL DRUM - WALLS	PENDENTIVE	CIRCULAR
			WARM ROOM	UNDER OCTAGONAL DRUM - WALLS	PENDENTIVE	CIRCULAR
			CAMEKAN	ABOVE UNDER OCTAGONAL DRUM - WALLS	PENDENTIVE	AT FOUR CORNERS
14 44	SELANIK	BEY HAMAM	SICAKLIK	ABOVE UNDER OCTAGONAL DRUM - WALLS	PENDENTIVE	AT FOUR CORNERS
14 45	PLOVDIV	SEHABETTİN PASA MOSQUE	HARIM	DRUM - WALLS	PENDENTIVE	AT FOUR CORNERS
			SEMI DOME OVER THE MIHRAB	SQUINCH - WALLS	PENDENTIVE	AT TWO CORNERS
14 48	EDIRNE	UC SEREFELI MOSQUE	HARIM	DRUM - PIERS	PENDENTIVE	CIRCULAR
14 57	BURSA	KARACABEY MOSQUE	HARIM	OCTAGONAL DRUM - WALLS	PENDENTIVE	AT FOUR CORNERS
14 68-	SKOPJE	DAVUTPASA CİFTE	MEN'S HOT ROOM	DRUM - PENDENTIVE	PENDENTIVE	CIRCULAR

DOI: 10.15320/ICONARP.2024.292

97		HAMAM				
1453 - 1481	ISTANBUL	TAHTAKALE HAMAM	ENTERANCE ROOM	SQUINCH - WALLS	SQUINCH	AT FOUR CORNERS
			HOT ROOM	DOME - DRUM	DRUM	CIRCULAR
			PRIVATE CUBICLE (HALVET)	SQUINCH - WALLS	SQUINCH	AT FOUR CORNERS
1472	ISTANBUL	RUM MEHMET PASA COMPLEX - MOSQUE	SEMI DOME OVER THE MIHRAB	SQUINCH - WALLS	UNDER SQUINCH ARCH	AT TWO CORNERS
1473	ISTANBUL	MURAD PASA COMPLEX - MOSQUE	HARIM	SQUINCH - WALLS	PENDENTIVE	CIRCULAR
1478	ISTANBUL	TOPKAPI PALACE FATIH PAVILLION	SOUTHERN DOME	DOME - DRUM	PENDENTIVE	CIRCULAR
				SQUINCH - WALLS	SQUINCH	AT FOUR CORNERS
1485	ISTANBUL	DAVUTPAŞA COMPLEX - MOSQUE	HARIM	SQUINCH – PENDENTIVE - WALLS	SQUINCH AND PENDENTIVE	AT FOUR CORNERS
1488	EDIRNE	DARUSSIFA OF THE BAYEZID II COMPLEX	CENTRAL DOME	HEXAGONAL DRUM - WALLS	PENDENTIVE	CIRCULAR
1505	ISTANBUL	BAYEZID II COMPLEX MOSQUE	HARIM	MAIN DOME DRUM	UNDER CATWALK	CIRCULAR
1505	ISTANBUL	BAYEZID II COMPLEX - HAMMAM	MEN'S COLD ROOM	SQUINCH - WALLS	PENDENTIVE	AT FOUR CORNERS
			MEN'S WARM ROOM	DOME - WALLS	PENDENTIVE	AT FOUR CORNERS
			WOMEN'S HOT ROOM	DOME DRUM	DRUM	CIRCULAR
			MEN'S HOT ROOM	DOME DRUM	DRUM	CIRCULAR
1510	ISTANBUL	ATIK ALI PASA MOSQUE	SEMI DOME OVER THE MIHRAB	DOME - WALLS	PENDENTIVE	AT TWO CORNERS
			SIDE DOMES	DOME – DRUM - WALLS	PENDENTIVE	AT FOUR CORNERS
1520	ISTANBUL	TOPKAPI PALACE	PRIVY CHAMBER	DRUM - WALLS	PENDENTIVE	AT FOUR CORNERS

The transformation of the transition elements to the dome from brick to muqarnas in a short period of time may be attributed to the widespread use of plaster material, which is relatively easier to shape (Figure 18). As a matter of fact, in this period muqarnas were either carved out of plaster or cast into molds made of wood (Senalp, 2012:49) For example, when we look at the examples of muqarnas made of marble and plaster from the same period, while the plaster examples capture the quality of Seljuk stonework, the marble examples remain relatively large and simple in the mihrab of Iznik Yeşil Mosque. The reason for this is the difficulty of carving the muqarnas in marble with fine details and the ease of application brought by plaster (Senalp, 2012:84).
Since plaster is a perishable material, there is a need to examine which examples in which buildings are unique in this period. Bursa Orhan Bey Mosque (1339) mihrab with muqarnas and Timurtaş Pasha Mosque (1377) portal muqarnas are two examples from the same period (Senalp, 2012:52).
Considering these examples, it can be assumed that the Timurtaş Pasha Mosque example was built towards the end of the 14th century, while the Orhan Mosque mihrab was actually built later, given that its ornamentation is quite advanced. However, Ayverdi, who visited the ruins of the early Ottoman buildings, wrote about the mihrab of the Orhan Mosque as follows:

"Gabriel has stated that it is from the original; since there is no evidence that it was newly made, it is absurd to think otherwise. The 14th century was a period when plaster work in Anatolia was very sophisticated and rich. In addition, fragments of the mihrab plaster can be found in the ruins of the Orhan Mosque in Iznik, the ruins of the Samsa Çavuş Mosque in Genbenuz village and the magnificent mihrabs of the Hüdavendigar, Şehadet and Çekirge Mosques in Behram Kal'e village."
(Ayverdi, 1989:80)
The evidence for Ayverdi's view is the mihrab of the Iznik Hagia Sophia mosque, which was converted into a mosque by Orhan Gazi in 1331. From the plans of this mihrab, it can be seen that the places where the bricks protrude are decorated with plaster muqarnas, as in the Orhan Mosque, because one of the construction methods is to use plaster muqarnas on a brick base. The accuracy of this assessment is apparent upon comparison of the mihrab plans (Senalp, 2012:52).
During the initial stage of Ottoman Architecture, muqarnas were first employed as a pendentive in the transition zone to the dome at Bursa Timurtaş Paşa (Figure 20) and İznik Yeşil Mosque (Figure 21). It is apparent that the transition to the dome using pendentives in the form of muqarnas began with the Mudurnu Yıldırım Hamam among the baths constructed during this era. The Bolu Orta Hamam, constructed in 1388, features muqarnas elements displaying exceptional design and craftsmanship including badem, yaprak, kazayagi, and fitil. Plaster was used to decorate the bath interiors.

DOI: 10.15320/ICONARP.2024.292

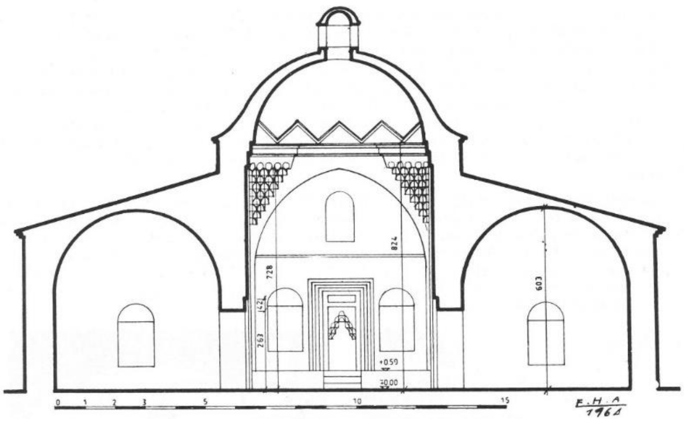


Figure 20. Bursa Timurtaş Paşa Mosque (1377) section. Source: Ayverdi (1989) p. 389

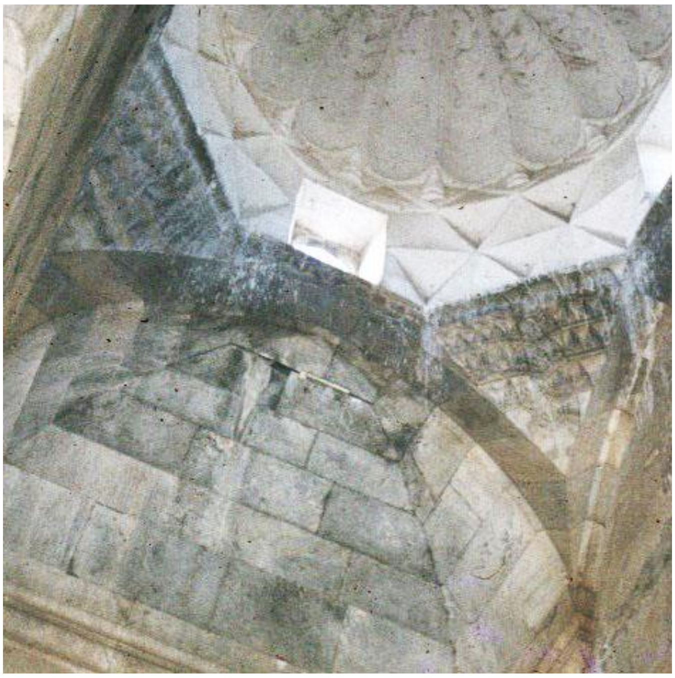


Figure 21. İznik Yeşil Mosque Central Portico Dome, stone muqarnas pendentive. Source: Salt Research Kemal Söylemezoğlu Archive, Inventory No: TSOH253

At the Debbağlar Hamam in Bergama, a significant advancement was achieved in the implementation of muqarnas during the transition to the dome (Figures 22 and 23). From the centre of the dome to the drum, pendentives, and piers, the dome over the hot room section is adorned with muqarnas. This instance exemplifies the ease and speed with which plaster muqarnas can be created in the presence of skilled craftsmen. Other significant baths constructed during this time include the Iznik İsmail Bey Hamam and the Palace, Gazi Mihal, Topkapı, Yeniçeri, and Beylerbeyi Hamams in Edirne. These baths form a part of the Murad II period.

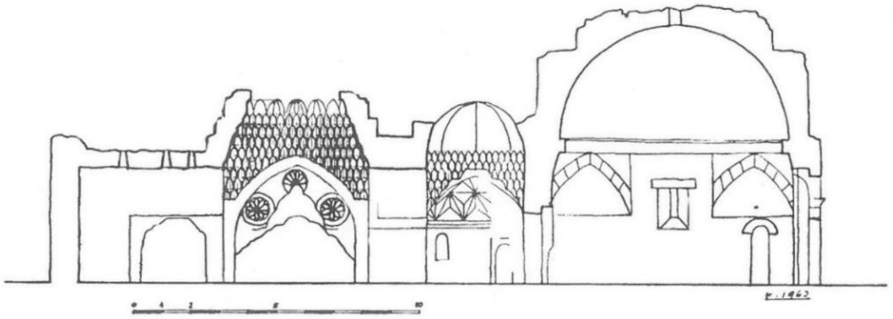


Figure 22. Bergama Debbağlar Hamam. Source: Kula-Say S. (2011) p:148

Figure 23. Bergama Debbağlar Hamam. Source: Kula-Say S. (2011) p:151

Deteriorated parts of these hamams gives account for the construction technique of the plaster. Once brick base is formed, iron nails are driven into the joint mortar so that their heads protrude 2-3 cm in order the plaster to hold on the muqarnas substructure, before the plaster layer is applied (Akyıldız, 2018:346-347).

As a consequence, plaster was used as a coating material on brick muqarnas, and this technique was continuously refined from the time of Orhan Gazi. The 1370s saw the inception of an extensive programme of brick and plaster muqarnas, which continued until the Battle of Ankara in 1402. The Fetret Period then resulted in the discontinuation of these practices for a period of time.

The Bursa Yıldırım Complex (1395 AD) represents the first group of buildings just before this period where muqarnas were extensively employed. The mosque utilized prismatic Turkish triangles in the transition areas to the dome, applying them as plaster on brick. Marble material was selected for the muqarnas niches on the entrance facade. A muqarnas-shaped pendentive, similar to the one in the Timurtaş Pasha Mosque, was appropriately used to transition to the dome in the main hall of the madrasa building. Furthermore, a muqarnas dome adorns the enterance hall of the madrasa, which is first of its kind along with the one in Debbağlar Hamam (Figure 24).

DOI: 10.15320/ICONARP.2024.292

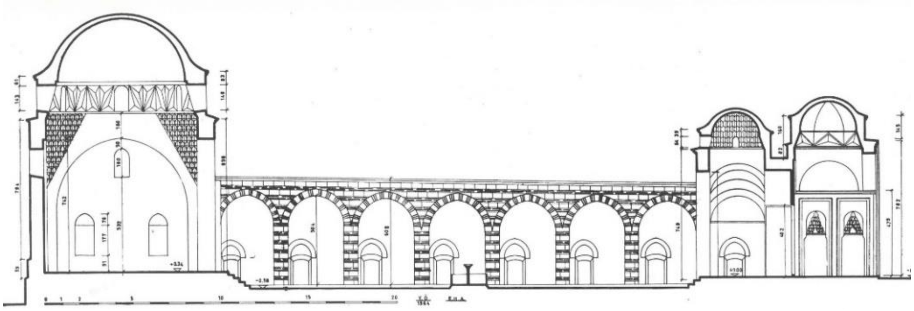


Figure 24. Bergama Debbağlar Hamam. Source: Kula-Say S. (2011) p:151

The Great Mosque of Edirne, namely Eski Cami, which is the first major structure of the Ottoman Empire, features a muqarnas-shaped squinch in its central dome, while the remaining domes are Turkish triangles. The Yeşil Mosque complex in Bursa has Turkish triangles spanning the main area, with the four zawiya domes taking on a pendentive-shaped muqarnas design.

During the reign of Murad II, the emergence of bath construction programs led to a rise in the implementation of muqarnas. The craftsmen involved in these programs were skilled in both prismatic Turkish triangles and muqarnas elements, which were used in their repertoire of materials. This trend would persist rapidly until the end of the reign of Mehmed II. During the early Ottoman era, a custom of using muqarnas in the baths led to the creation of a squinch in the enterance room section of the Bursa Mahkeme Hamam and a pendentive from the bottom of the drum to the walls of the Gazi Mihal Hamam. It is noteworthy to mention the Tahtakale Hamam in Edirne as well. In the hot room and warm room sections, the octagonal drum passes beneath the dome in the form of a pendentive, while in the enterance room section, the muqarnas ornamentation extends up to the upper level of the pendentive dome drum and forms a circular design.

During this time period, the tradition of transitioning to the dome with muqarnas began to emerge in the Balkans, with it being used as a pendentive in the harim and the dome above the mihrab in Şihabettin Pasha Mosque in Plovdiv. Selanik Bey Hamam, along with its hot room section, and Davutpaşa Hamam in Skopje, implemented the muqarnas transition programme in almost all of its areas during the reign of Mehmed II.

Transitional elements with muqarnas began to be utilized in Istanbul after the city's conquest. The Tahtakale Hamam in Eminönü was constructed as a continuation of the program initiated during the reign of Murad II. The enterance room, hot room, and khalvet sections are equally sophisticated as the muqarnas present in the Edirne Tahtakale Hamam. Additionally, the south side domes of the Fatih Pavilion in Topkapı Palace feature a circular transition from the drum to the dome (Figure 25), mirroring the design seen in the Selçuk İsa Bey Mosque and Firuz Bey Mosque (Figure 2). A squinch was also used to transition from the drum to the walls at a lower level (refer to Figure 13).

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

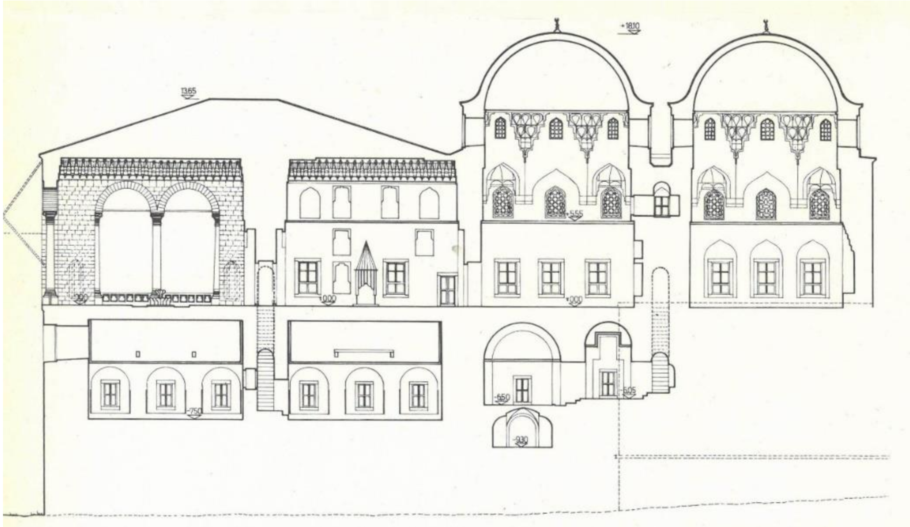


Figure 25. Topkapı Palace Fatih Pavililon. Eldem ve Akozan (1981) Pl. 73

The Davutpaşa Mosque in Istanbul introduced a novel transition design utilizing muqarnas. The large muqarnas situated at the four corners commence as a squinch and then connect to the walls as pendentives, as shown in Figures 26 and 27. This mode of application was likewise utilised in the Sekibaşı Hammam located in Muğla.

Figure 26. Corner muqarnas is presented in the form of both squinch and pendentive in Davutpasa Mosque. Senalp, H. S. (2012)

DOI: 10.15320/ICONARP.2024.292

Figure 27. Corner muqarnas plan view, Davutpasa Mosque. Senalp, H.S. (2012)

During the 2015-2019 restoration of Davutpaşa Mosque, a brick muqarnas structure was revealed from below after the plaster on these muqarnas was removed. In addition, there are stone courses between the rows of brick muqarnas, revealing a stone-brick alternation technique (Figure 28 and 29).

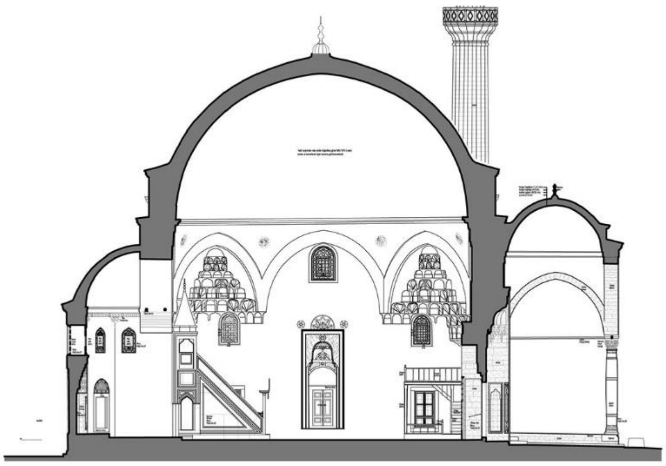


Figure 28. Transition to the dome in Davutpaşa Mosque. Source: https://www.avundukmimarlik.com.tr/tr/istanbul-fatih-davutpasa-camii-2030/

Figure 29. After removing the plaster layer on the muqarnas at Davutpaşa Mosque, the underlying brick structure is revealed. Author : Can Şakir Binan (2017)

Another instance similar to the dimensions of the Davutpaşa Mosque muqarnas can be observed in the half dome positioned above the mihrab of the Atik Ali Paşa Mosque in Istanbul (Figure 30). During the transition to the dome in this case, the lower part of the muqarnas actually need to terminate at the corner conforming to the shape of the pendentive. However, in the final stages, the muqarnas acquires a squinch shape, departing from the corner and then concluding on the wall surface. A comparable implementation was also utilized in the enterance room section of the Edirne Tahtakale Hamam.

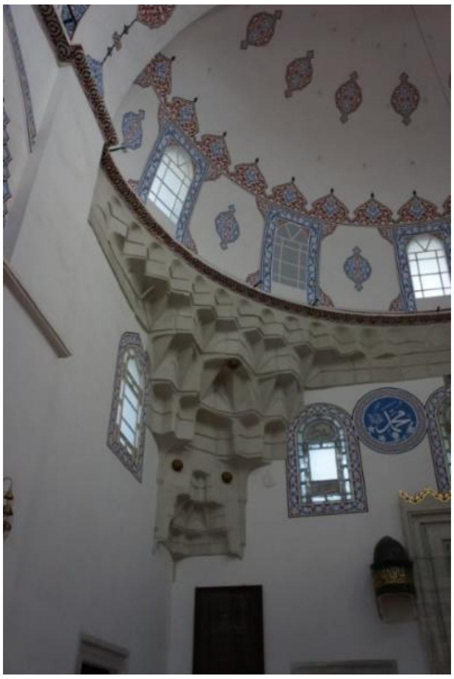


Figure 30. Atik Ali Paşa Mosque transition to the dome above mihrab. Senalp, H.S. (2012) sf: 88.

DOI: 10.15320/ICONARP.2024.292

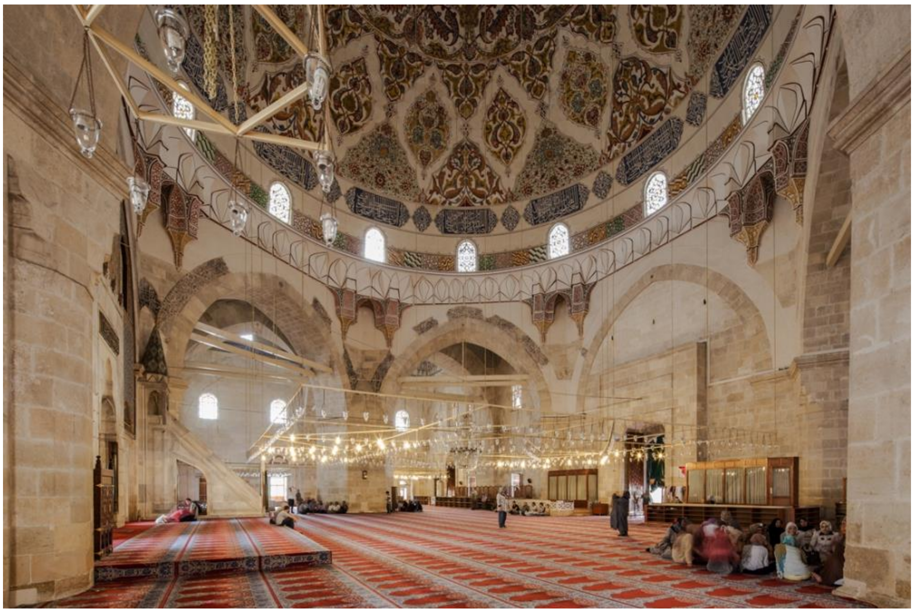


Figure 31. Circularly arranged muqarnas belt in Uc Serefeli Mosque. Source: https://www.kulturportali.gov.tr/turkiye/edirne/gezilecekyer/uc-serefeli-cami

One advanced stage in the transition with muqarnas involves surrounding the inner wall while making the transition. The circular utilization of muqarnas, initially implemented in the Bergama Debbağlar Hamam, was subsequently deployed in the hot room and warm room areas of the Edirne Tahtakale Hamam dating back to 1435. One of the primary applications of muqarnas in dome transition is facilitating the passage between the hexagonal drum, arches, and piers in Edirne Üç Şerefeli Mosque (Figure 31). This approach was similarly employed in the central area of Darussifa of Bayezid II Complex, which also features a hexagonal drum. Muqarnas are circularly arranged from the dome drum in the Murat Pasha Complex Mosque in Istanbul, connecting the dome with pendentives.

At the Bayezid II Complex situated in Istanbul, muqarnas applications are prominently featured on the courtyard portal and domes. Within the mosque's interior, muqarnas were exclusively applied to the main and half dome catwalks in the transition areas leading up to the domes. Additionally, the squinch located in the men's cold room section of the hamam, which is also part of the complex, was segmented and decorated with muqarnas underneath the squinch and squinch arches. An earlier instance of a niche adorned with a segmented muqarnas can be discovered in the muqarnas portal of Davutpaşa Mosque (1475 AD) (Figure 32).

Figure 32. Segmented muqarnas portal, Davutpaşa Mosque. Source: Sav (2021) p.285

Another employment of muqarnas in Istanbul is its use below the squinch and squinch arch. The use of muqarnas on the half dome situated above the mihrab of Rum Mehmed Pasha Mosque is one of the earliest examples, and was subsequently incorporated in Gebze Çoban Mustafa Pasha, Üsküdar Mihrimah Sultan, Kazasker İvaz Efendi, Nişancı Mehmet Pasha, and Cerrahpaşa Complexes constructed by Sinan.

TRANSITIONAL ELEMENTS IN THE CLASSICAL OTTOMAN PERIOD

During the Classical Period, the tradition of transitioning to the dome with muqarnas was expanded with new techniques following Sinan's appointment as chief architect. Analysis of the enrichment in the transition space revealed mainly circular applications forming a belt (Table 3).

Table 3. Use of Muqarnas in the Classical Ottoman Period

THE USE OF MUQARNAS IN THE TRANSITION ZONE IN THE CLASSICAL OTTOMAN PERIOD						
DATE	LOCATION	BUILDING NAME	SPACE	TRANSITION BETWEEN	TRANSITIONAL ELEMENT TYPE	LOCATION IN SPACE
1529	GEBZE	COBAN MUSTAFA PASA COMPLEX - MOSQUE	HARIM	SQUINCH - WALLS	UNDER SQUINCH ARCH	AT FOUR CORNERS
1547	ISTANBUL	USKUDAR MIHRIMAH SULTAN COMPLEX - MOSQUE	HARIM	SQUINCH - WALLS	UNDER SQUINCH ARCH	AT THREE CORNERS
1548	ISTANBUL	SEHZADE	HARIM	QUARTER	PENDENTIVE	CIRCULAR

DOI: 10.15320/ICONARP.2024.292

		COMPLEX - MOSQUE		DOMES - WALLS		
1551	ISTANBUL	HADIM IBRAHIM PASA COMPLEX - MOSQUE	HARIM	SQUINCH - WALLS	PENDENTIVE	AT FOUR CORNERS
1556	ISTANBUL	AYASOFYA HASEKI HAMMAM	SICAKLIK	DRUM - WALLS	PENDENTIVE	CIRCULAR
1558	ISTANBUL	SULEYMANIYE COMPLEX - MOSQUE	HARIM	HALF DOMES - WALLS	PENDENTIVE	AT FOUR CORNERS
			SIDE DOMES	DOME - DRUM - WALLS	PENDENTIVE	CIRCULAR
1565	BABAESKI	ALI PASA MOSQUE	HARIM	HEXAGONAL DRUM – HALF DOME AND PIERS	PENDENTIVE	CIRCULAR
			HARIM	HALF DOMES - WALLS	PENDENTIVE	CIRCULAR
1572	ISTANBUL	KADIRGA SOKULLU MEHMET PASA MOSQUE	HARIM	HALF DOMES - WALLS	PENDENTIVE	CIRCULAR
1574	EDIRNE	SELIMIYE COMPLEX - MOSQUE	HARIM	OCTAGONAL DRUM - SQUINCH AND PIERS	PENDENTIVE	CIRCULAR
			HARIM	SQUINCH – PIERS AND WALLS	PENDENTIVE	CIRCULAR
			THE DOME OVER MIHRAB	DRUM - WALLS	PENDENTIVE	AT TWO SIDES SIMETRICALLY
1586	ISTANBUL	KAZASKER IVAZ EFENDI MOSQUE	HARIM	HALF DOMES - WALLS	PENDENTIVE	AT TWO SIDES SIMETRICALLY
			THE DOME OVER MIHRAB	HALF DOME SQUINCH - WALLS	UNDER SQUINCH ARCH	AT TWO SIDES SIMETRICALLY
1589	ISTANBUL	NISANCI MEHMED PASA COMPLEX - MOSQUE	HARIM	HALF DOMES - WALLS	PENDENTIVE	CIRCULAR
			HARIM	HALF DOME	UNDER	CIRCULAR

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

				SQUINCH - WALLS	SQUINCH ARCH	
1594	ISTANBUL	CERRAHPASA COMPLEX - MOSQUE	HARIM	HALF DOMES - WALLS	PENDENTIVE	CIRCULAR
			THE DOME OVER MIHRAB	HALF DOME SQUINCH - WALLS	UNDER SQUINCH ARCH	CIRCULAR
1620	ISTANBUL	SULTAN AHMED MOSQUE	HARIM	QUARTER DOMES - WALLS	PENDENTIVE	CIRCULAR
1665	ISTANBUL	YENİ MOSQUE AT EMINONU	HARIM	QUARTER DOMES - WALLS	PENDENTIVE	CIRCULAR
1711	ISTANBUL	YENİ VALİDE COMPLEX AT USKUDAR-MOSQUE	HARIM	SQUINCHES - ARCHES	PENDENTIVE	AT FOUR CORNERS
			HARIM	DRUM	UNDER CATWALK	CIRCULAR
1735	ISTANBUL	HEKİMOGLU ALI PASA COMPLEX - MOSQUE	HARIM	HALF DOMES - WALLS	PENDENTIVE	CIRCULAR

Within the Şehzade Mehmed Mosque's harim during this era, muqarnas are arranged in a circular manner around the inner shell of the building at the transition from the quarter domes, which serve as squinches, to the walls. Previously, the muqarnas positioned beneath the squinch were unable to create a united inner shell due to their insufficient size. The ongoing ornamentation of these muqarnas rows on the piers, mihrab top, and exit portal reveals a deliberate attempt to construct a band at the point of transitioning to the domes (Figure 33).

DOI: 10.15320/ICONARP.2024.292

Figure 33. The transition zone with muqarnas in Şehzade Mosque leading to the domes. Source : https://upload.wikimedia.org/wikipedia/commons/f/f3/Sehzade_mosque_Istanbul_2009_04_21.jpg

Batur (1980:137) illustrates the structure-decoration relationship achieved by Sinan in the Şehzade Mosque by explaining how the dome-to-wall transition is divided into three stages. In the first stage pendentives connects the dome with four piers and four large bearing arches. The second stage occurs in a belt situated at the edge of the half domes. The belt comprises three arches and the pendentives connecting them. These arches open onto small, half dome-shaped squinches. In the third stage, the circular base of these squinches connects with the structural elements (walls or arches) filled with muqarnas.

It can be stated that the notion of muqarnas filling, as given above and stated in numerous literary sources as well, does not constitute a filling per se, particularly for the transitional zones of the classical Ottoman structures. The restoration project spanning from 1986 to 1999 at the Şehzade Mosque revealed that the muqarnas pendentive was created using a series of alternating stone and brick. A comparable technique was also detected in the central portico dome of the Hadım İbrahim Paşa Mosque which also incorporates iron reinforcement elements. One reason for constructing such a muqarnas could be viewed as a way to reduce the weight of the pendentive (as shown in Figures 34 and 35).

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

Figure 34. Below : Exedra no. 9, deteroirated muqarnas pendentive in Şehzade Mosque. Courses of stone and brick muqarnas structure is observed. Source: Şen, Y. (2019) p:284 Above: The borders showing the below picture muqarnas pendentive after restoration Source : https://www.turkiyenintarihieserleri.com/?oku=412

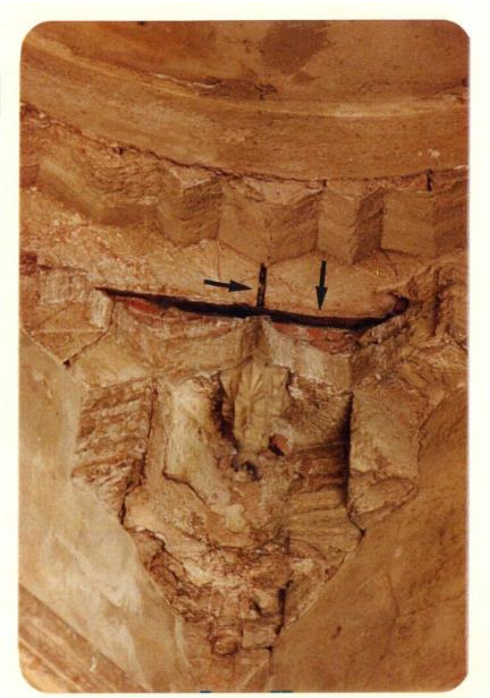


Figure 35. Stone and brick pendentive with iron element at the central portico dome of the Hadım İbrahim Paşa Mosque. Tanyeli, 1990 s:242

Following the Şehzade Mosque, Sinan proceeded with the implementation of pendentives under the segmented domes, which function as squinch. This feature, classified as a squinch in the men's cold room section of the Bayezid II Hammam, was also utilized in the Haseki Hürrem Complex Mosque and the Hadım İbrahim Paşa Complex Mosque (Figure 36). The sliced squinch design resolved its connection with the wall through the use of a muqarnas pendentive.

DOI: 10.15320/ICONARP.2024.292

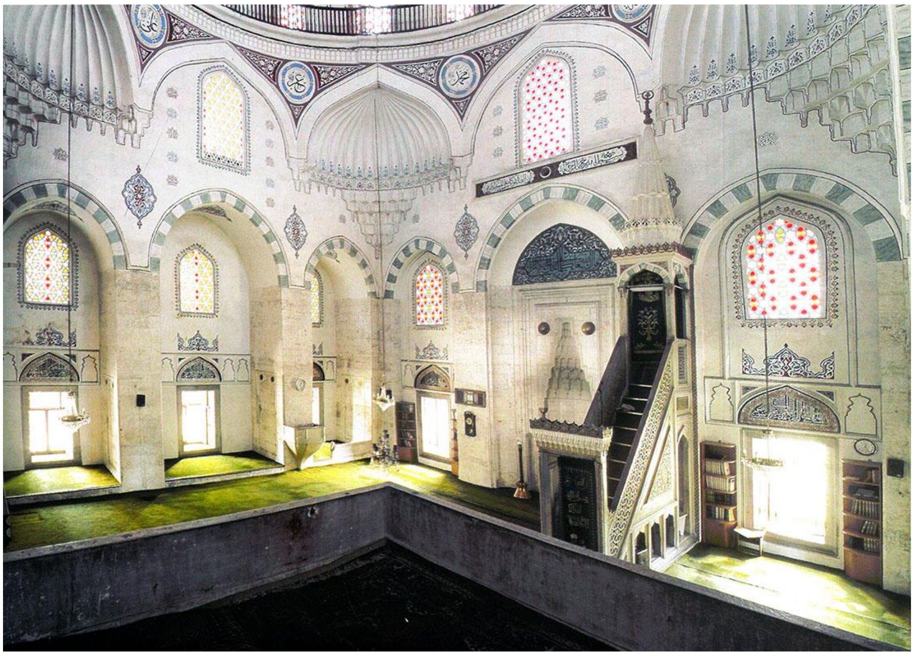


Figure 36. Hadım İbrahim Paşa Mosque, Silivrikapı, Interior. Günay (2007) p.43

Sinan utilized the muqarnas belt element to transition from the octagonal drum to the dome within the sicaklik section of the Hagia Sophia Haseki Hürrem Hammam, constructed in 1556.

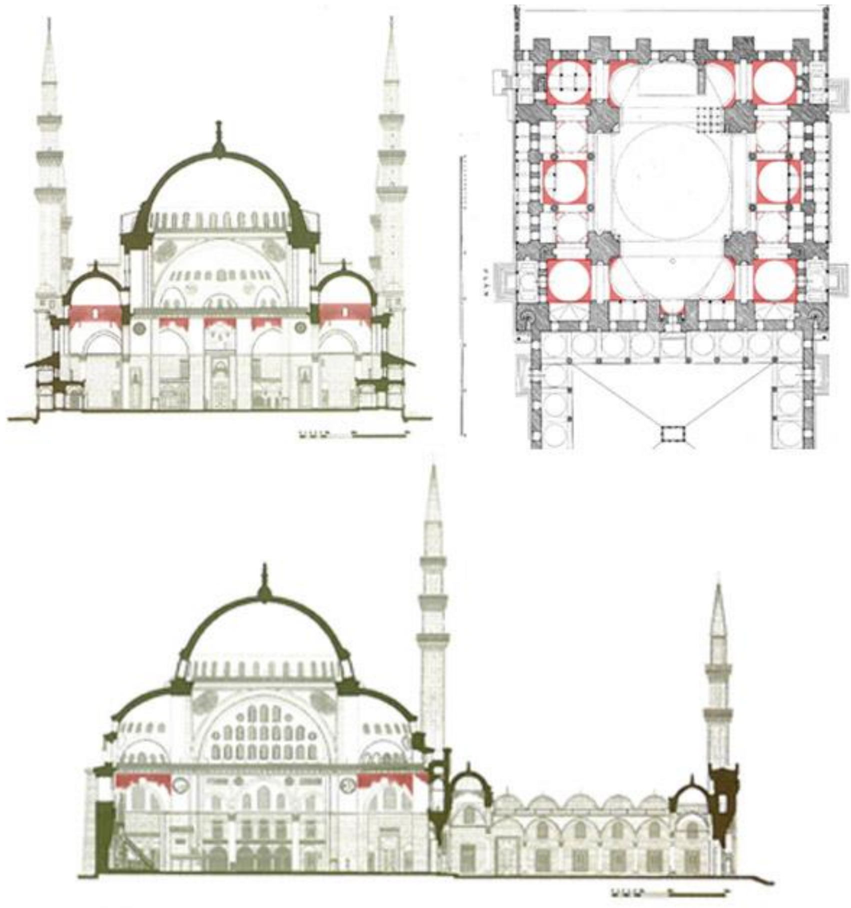


Figure 37. Transitional zone with muqarnas in the Suleymaniye Mosque Sections and Plan: Ali Saim Ülgen. Yenişehirlioğlu and Madran, 1989.

The construction of a muqarnas belt in the Süleymaniye Mosque, opened in 1557, was limited by the plan scheme with two half domes.

However, muqarnas elements were utilized in a circular pattern from the drum to the pendentives in all side domes except the harim, as shown in Figure 37. The resulting muqarnas belt consists of a series of domes that encircle the outer periphery of the building's harim area, which is bordered by piers. On the walls facing the qibla and the courtyard portico, the muqarnas belt circumvents the piers and continues to rotate around the building by passing under the squinches and half domes and its level remains unchanged. Excluding the small gap on the mihrab, it is evident that in Süleymaniye Mosque it is intended to encircle the entire structure with a muqarnas band, albeit featuring a distinct design.

In the Babaeski Ali Pasha Mosque (1565), the muqarnas belt was first applied to two levels of the building. The first level is the transition from the hexagonal drum to the semi-domes and pillars. At this level, it was designed in four muqarnas courses of unprecedented size and scale. The second level is the transition from the semi-domes and pillars to the wall of the building (Figure 38). This example is important because it is the first time that this transition has been achieved on two levels. In the Kadırga Sokollu Mosque (1572), which has a hexagonal drum, the muqarnas band under the semi-domes was again applied in a single stage.

Figure 38. Two levels of muqarnas belt system. Source: https://www.archnet.org/sites/2777?media_content_id=42865

DOI: 10.15320/ICONARP.2024.292

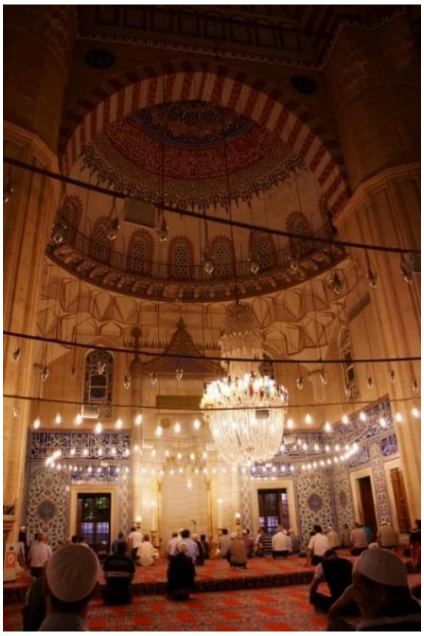


Figure 39. Selimiye Mosque transition to the dome above mihrab. Senalp H.S. (2012)

In the Edirne Selimiye Mosque, completed in 1574, the transition with muqarnas, which had been tried with a hexagonal drum in the Babaeski Ali Pasha Mosque, was this time tried with an octagonal drum. When the hexagonal drum was used, a transition of six semi-domes was required. Since the octagonal drum is used in this building, the domes at the corners act as squinches. Here the transition from the octagonal drum to the squinches and piers was made at the first level, and the transition from the squinches and piers to the building walls and arches at the lower level was made at the second level. There is the third layer just under the mihrab semidome (Figure 39). This example is one of two unique examples of the use of the muqarnas belt at the Ali Pasha Mosque (Figure 40).

ICONARP – Volume 12, Issue 1 / Published: 30.06.2024

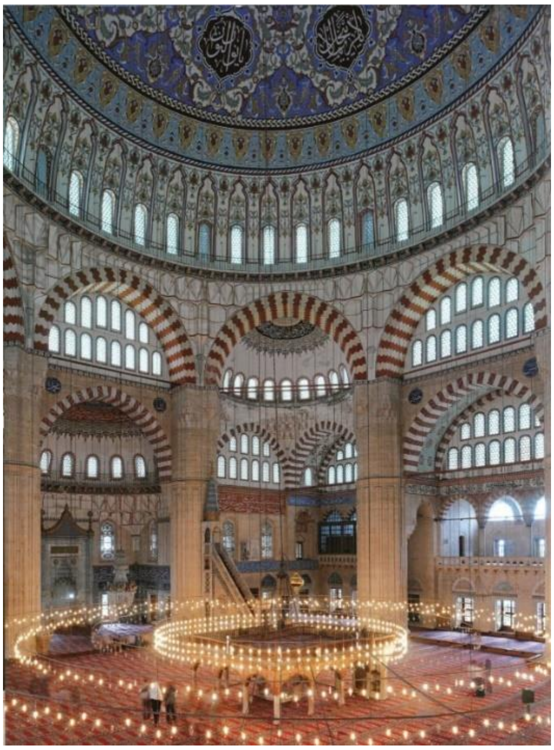


Figure 40. Transition to the dome in three layers of muqarnas starting from the semidome over mihrab in the Selimiye Mosque. Kuban (2007) Fotoğraf: Cemal Emden s:306

An analysis of Sinan's last works shows that he was the first to design small squinches under the semi-domes of medium-sized mosques with hexagonal and octagonal drums and pendentives with muqarnas in different rhythms. This innovation, first tried in the dome above the mihrab of the Kazasker İvaz Efendi Mosque, is in the form of alternating squinches of with and without muqarnas. In the semi-domes of Nişancı Mehmed Paşa Mosque, which sits on an octagonal drum, squinches were applied under the semi-domes on the side axis perpendicular to the qibla and the qibla axis, and pendentives were applied under the other four skipped semi-domes (Figure 41). In these examples, the inner wall of the building is circularly wrapped with muqarnas at a certain level. Davud Ağa, the chief architect after Sinan, continued this circular scheme in the Cerrahpaşa Mosque, which rests on a hexagonal drum, and repeated the formation of the dome over the mihrab in the İvaz Efendi Mosque.

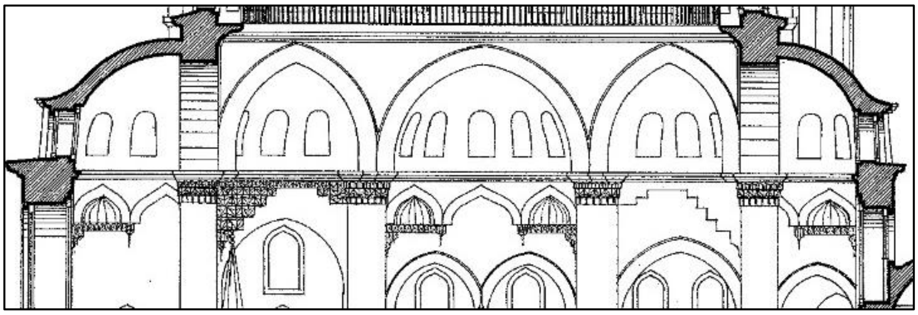


Figure 41. Transitional zone with muqarnas in the Nişancı Mehmet Paşa Mosque. Section: Ali Saim Ülgen. Yenişehirlioğlu and Madran, 1989.

After these dates, it can be observed that the use of muqarnas gradually declined, both due to the slowdown in construction activity and the fact that they were not favoured in the buildings that were constructed.

DOI: 10.15320/ICONARP.2024.292

However, the tradition continued in large buildings such as the Blue Mosque and the Eminönü Valide Mosque. In both buildings, a muqarnas belt was traditionally applied under the quarter domes/squinches, encircling the entire structure. In Üsküdar Yeni Valide complex (1711 AD) pendentives were placed under the squinches, and circular muqarnas were placed under the catwalk in the main dome drum, as in the Bayezid Mosque in Istanbul. The last building in which muqarnas were used as a transitional element is the Hekimoğlu Ali Pasha Mosque (1735 AD), where the semi-domes are connected to the walls by pendentives with muqarnas. An important point to note in these examples is the simplification of muqarnas designs after Sinan and the corresponding reduction in the size of the muqarnas units.

CONCLUSION

The use of materials and structures in different ways in different geographical regions has influenced the architectural designs and construction techniques of buildings, in doing so the materials and construction techniques of muqarnas have also changed. The transition of the muqarnas material from brickwork to stone and then back to brickwork in transitional zones made possible the production of very rich examples. The use of tiles or plaster on brick and the craftsmanship developed on these finishes increased the richness.

One of the reasons for this transition is the presence of brick construction techniques, especially locally in Western Anatolia. This is particularly evident in the works of Menteşeoğulları, Saruhanoğulları, Aydınoğulları and Osmanoğulları, who played a role in the transformation of brick construction techniques from the Roman period to Islamic architecture. The brick muqarnas, together with the plaster finish on them, became a lighter and more practical alternative to the stone material.

The use of the muqarnas as a transitional element, from the early Ottoman period to the classical Ottoman period, gave architects and craftsmen the opportunity to create a wide repertoire. The most important factor that led to this opportunity is the possibility of detailed muqarnas workmanship using coating materials such as plaster on brick muqarnas, rather than a material such as marble, which is difficult to transport and work with. Undoubtedly, although the examples with muqarnas give the impression of being made of plaster, in many examples the spilled plaster has revealed overflowing rows of bricks in some places (Figure 42). In many examples, these rows of bricks were made with delicate brickwork and were produced as muqarnas ready to be plastered.

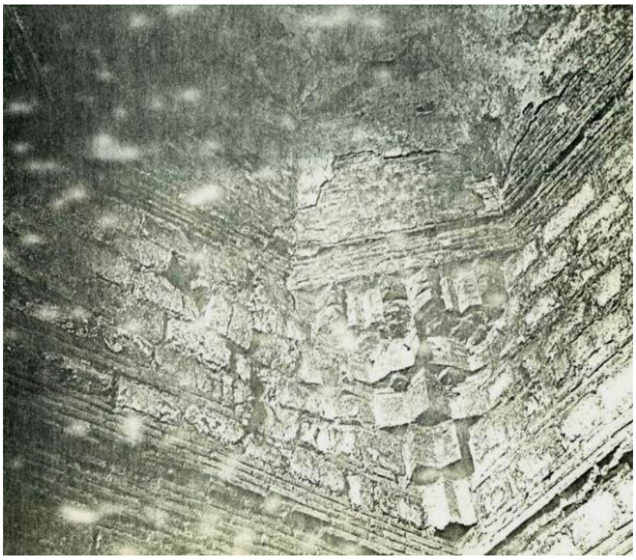


Figure 42. Alternating stone and brick muqarnas is visible on the dome pendentive of the Batı Tabhane in the Edirne Bayezid Mosque, as the plaster muqarnas has fallen off. Batur, 1980. p.84

While the Turkish triangles used in the Seljuk period increased the plastic effect of the transition zone and became a means of better integration with the dome, their use in the early Ottoman period together with muqarnas facilitated geometric transitions and helped to create a richer design. The use of muqarnas in transitional zone did not prevent the use of Turkish triangles, and both Turkish triangles and muqarnas were used together in early Ottoman baths and many other buildings.

In the early Ottoman period, the muqarnas of the 'inner covering space' began to be used, starting with the 'last congregation courtyard' dome of the İznik Yeşil Mosque and the interior pendentives of Timurtas Pasa Mosque. Of course, the slightly earlier tile muqarnas pendentives and the muqarnas belt above those of the Isa Bey Mosque in Selcuk, an Aydinogullari monument, are also worthy of mention. In the Timurtaş Paşa Mosque, muqarnas courses were used in the form of pendentives in the central areas such as the harim. It has been determined that the squinches, which come from the Central Asian and Iranian traditions, are the earliest structures with muqarnas in buildings such as the Milas Firuz Bey Mosque and the Bursa Mahkeme Hamam. In the Davutpaşa Mosque in Istanbul, an innovation was introduced and a single muqarnas element was used as both a squinch and a pendentive.

When we come to the muqarnas belts, the muqarnas transition in the Isa Bey Mosque, from the drum to the dome above the mihrab was transformed over time into a small uninterrupted muqarnas belt in various hamams. The first large-scale example of a muqarnas belt was in the Üç Şerefeli Mosque. This idea led later designers to use it in most of the buildings. The Bayezid II Darüşşifa in Edirne, Sinan's large scale projects such as Şehzade, Süleymaniye, Babaeski Ali Paşa, Edirne Selimiye and Post-Sinan works of Sultanahmed and Eminönü Valide Cami mosques continued to use muqarnas belt. When analysing these examples, it can be argued that the Selimiye Mosque is the most developed example of the relationship between structure and

DOI: 10.15320/ICONARP.2024.292

muqarnas, considering the dimensions of the muqarnas, their level heights and the flow of the muqarnas at different levels of the building.

After Mimar Sinan, the dimensions of the interior muqarnas were reduced, starting with the Blue Mosque. As a result of this reduction, it was possible to have more rows of muqarnas in a pendentive. It can be assumed that this design decision to increase the number of rows of muqarnas is intended to give the impression that the architectural elements are shrinking vertically. This should be a design decision to make the interiors of the buildings appear larger.

The final point in the relationship between structure and ornament is reached in the Selimiye Mosque. Immediately after the threshold of the dome, which rests on an octagonal drum, there is a series of large muqarnas and the entire dome surrounds the base of the dome. After the muqarnas, the arches and squinches are connected to the eight pillars and extend to the ground. At the same time, the huge dimensions of the muqarnas continue under the semidome of the mihrab. It can be said that the relationship between the user and the muqarnas is strengthened here.

It shows that the use of the muqarnas evolved and transformed from an element that provided a structural transition to one that effectively integrated the integrity of the interior space, becoming one of the most important architectural elements of the classical period without losing its structural qualities.

REFERENCES

Altun, A. (1991). Artuklular. Türkiye Diyanet Vakfı İslam Ansiklopedisi. 3: 418-419. Ankara: TDV Yayınları.

Akhrarov, I. and Rempel' L. (1971) Reznoi shtuk Afrasiyaba. Gafur Guljam Publ. House for Literature and Art, Tashkent. 160 pp.

Anisi, A., (2023). "Saljuq Architecture in Iran; Masjid-i Jam'of Marand". Pazhoheshha-ye Bastan Shenasi Iran, 13(37), 313-331.

Arce, I.R. (2006). Umayyad Arches, Vaults & Domes: Merging and Re-creation. Contributions to early Islamic construction history. In: Malcolm Dunkeld et al [eds] Proceedings of the Second International Congress on Construction History: Queens' College, Cambridge University, 29th March–2nd April 2006, pp.195–220. Queens' College, Cambridge University. United Kingdom: Construction History Society, Cambridge.

Ayverdi, E. H. (1989) Osmanlı Mimarisinin İlk Devri-I. Ertuğrul, Osman, Orhan, Gaziler Hüdavendigar ve Yıldırım Bayezid 630-805 (1230-1402). Istanbul Fethi Cemiyeti Yayınları, Istanbul.

Batur, A. (1980) Osmanlı Camilerinde Örtü ve Geçiş Öğeleri I, İstanbul.

Büyükdığan, İ. (1989) "İkinci Murat Çağı Edirne Hamamlarında Alçı Mukarnas Bezeme". Istanbul Teknik Üniversitesi Fen Bilimleri Enstitusu.

Edwards, C. and Edwards, D. "The Evolution of the Shouldered Arch in Medieval Islamic Architecture" Architectural History , Vol. 42, (1999), sf. 68-95 98

Eldem, S. H. and Akozan, F. (1981) Topkapı Sarayı, Bir Mimari Araştırma. Ankara. Kültür veTurizm Bakanlığı Eski Eserler ve Müzeler Genel Müdürlüğü.

Etyemez Çıplak, L. (2017) "Understanding the construction technique of Mimar Sinan's buildings: the case of Lüleburgaz Sokullu Mehmed Paşa Mosque" Middle East Technical University, MA Thesis. The Graduate School of Natural and Applied Sciences.

Fukami, N. (2017) The Use of Muqarnas in the Transitional Zone of Domes in Egyptian Islamic Architecture From the Fatimid to the End of the Mamluk Era, Orient, Volume 52, 93-119.

Günay, R. (2007) Sinan The Architect and His Works. Yem Yayın, İstanbul.

Hillenbrand, R. (1976). Saljūq Dome Chambers in North-West Iran. Iran, 14, 93–102.

McClary, R. P. (2014). "Brick Muqarnas on Rum Saljuk Buildings – The introduction of an Iranian Decorative Technique into the Architecture of Anatolia" Transkulturelle Perspektiven 3/2014 – 1.

Kılıçoğlu, S. (2017) İslam Sanatında Geometrik Bezemenin Kökeni ve Mukarnas Kubbe. Yüksek Lisans Tezi, Yıldız Teknik Üniversitesi, Fen Bilimleri Enstitüsü, 147p.

Kolay, İ. A. (2017) Batı Anadolu 14. Yüzyıl Beylikler Mimarisinde Yapım Teknikleri. Atatürk Kültür Merkezi Başkanlığı, Ankara.

Kuniholm, P. (2002). Dendrochronologically Dated Ottoman Monuments. A historical archaeology of the ottoman empire: Breaking new ground, Edited by Uzi Baram and Lynda Carroll. New York: Kluwer Academic/Plenum Publishers.

Ödekan, A. (1977), Osmanlı Öncesi Anadolu Türk Mimarisinde Mukarnaslı Portal Örtüleri, İstanbul Teknik Üniversitesi Yayınları, Istanbul.

Öney, G. (1992) Anadolu Selçuklu Mimari Süslemesi ve El Sanatları, Türkiye İş Bankası Yayınları, İstanbul.

Pancaroğlu, O. (2012). "The House of Mengüjek in Divriği: Constructions of Dynastic Identity in the Late Twelfth Century". The Seljuks of Anatolia: Court and Society in the Medieval Middle East. Ed. A. C. S Peacock ve Sara Nur Yıldız. New York.

Rogers, J. M. (1969). Recent Work On Seljuk Anatolia. Kunst Des Orients, 6(2), 134–169.

Samkoff, A. (2014). From Central Asia to Anatolia: the transmission of the black-line technique and the development of pre-Ottoman tilework. Anatolian Studies, 64, 199–215.

Say, S. K. (2011) "Kubbeye Doğru: Erken Dönem Osmanlı Hamamlarında Eğrisel Örtüye Geçiş Sistemleri". Tarihçi Kitapevi, İstanbul.

Sav, M. (2021) Davut Paşa Camii ve Restorasyonuna İthaf 2015-2019. Vakıflar Genel Müdürlüğü, İstanbul.

Şen, Y. (2019) Performance assessment of restoration applications and renovations in Prince Mehmet Mosque (1986-1999). Unpublished MA Thesis, Fatih Sultan Mehmet Vakıf Üniversitesi, Lisansüstü Eğitim Enstitüsü, İstanbul.

Senalp, H. S. (2012), The Evolution of Ottoman Muqarnas, (Osmanlı Mukarnasının Evrimi) Yüksek Lisans Tezi, School of Oriental and African Studies / University of London.

DOI: 10.15320/ICONARP.2024.292

Tabbaa, Y. (1985). The Muqarnas Dome: Its Origin and Meaning. Muqarnas, 3, 61–74

Tanyeli, G. (1990). Osmanlı Mimarlığında Demirin Strüktürel Kullanımı. Unpublished Phd Thesis, Istanbul Technical University, Institute of Science and Technology, İstanbul.

Ülgen, A. S. (1989). Mimar Sinan yapıları (Katalog), yay. haz. F.Yenişehirlioğlu, E. Madran, TTK Yayınları, Ankara.

Resume

Hüdai Sırrı ŞENALP graduated from Yildiz Technical University, Faculty of Architecture, Department of Urban and Regional Planning in 2010. In 2012, he completed an MA in Art History and Archaeology at SOAS, University of London. During this course, he started his research in the field of muqarnas with a dissertation entitled "The Evolution of Ottoman Muqarnas". He is continuing his Ph.D. research on the construction techniques, conservation and restoration problems of muqarnas at Yildiz Technical University, Faculty of Architecture.

Can Şakir BİNAN was born in 1956 in Istanbul, graduated from Galatasaray High School in 1976, and graduated from IDMMA Faculty of Architecture, Department of Architecture in 1981. With his thesis titled "A Research on Conservation Criteria of 13th Century Anatolian Caravanserais", he became a Doctor at Istanbul Technical University in 1991, Associate Professor in 1996 and Professor at Yıldız Technical University in 2010. His areas of expertise are History of Architectural Conservation, Conservation and Restoration Technology, World Heritage, International texts in the field of Conservation and Medieval Anatolian Architecture. In addition to his books, articles and research on Architectural Conservation and Restoration, he is a member of ICOMOS Turkey National Committee and served as the Chairman of the Istanbul Cultural and Natural Heritage Conservation Board No. 3 between 2001-2010.