INNOVATIVE RESEARCH IN ARCHITECTURE, PLANNING AND DESIGN

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Assoc Prof. Zuhal ÖZÇETİN, Ph.D,

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Chapter 1

Energy Efficient Urban Planning in Antalya City

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ABSTRACT

One of the most important and lasting measures to be taken in cities for the reduction of urban heat island effect in the process of combating against climate change and global warming is energy efficient planning and design approaches. Energy efficient planning requires to be sensitive to the climatic and topographic features of the region. The present study aims to develop an energy efficient planning approach that will support the master planning and design processes of the city of Antalya, where extreme climate events are experienced due to global warming in recent years. The effect of urban heat island as well as the changes in land cover/use and vegetation presence/change leading to heat island formation in cities was investigated. The climatic and regional microclimatic characteristics of the city were determined by means of the surface temperatures calculated by satellite imagery and the climatic values measured from the fixed land stations to determine the heat island domain. Urban features directing the energy efficient planning and design such as zoning plans, construction situation, wind direction, aspects, sunshine hours, sky view factor, insolation and shading ratios, the presence of vegetation and so on were examined in urban, rural, and semi-rural settlement blocks, which were selected according to land use and temperature relations. Energy efficient planning and design tools have been suggested for the settlement blocks in three main districts, which are defined as separate urban climate zones. The results of climatic measurements conducted in Antalya city for one year and surface temperature analysis conducted in August revealed that both the surface heat island and the urban heat island effects are seen in the whole city including rural and semi-rural areas. It was found that the main reason for this is the reduction of land cover changes and vegetation density in rural and semi-rural areas; that the heat island effect is alleviated between 6 and 9 °C due to the impact of the sea on the coastal areas and the green areas and water surfaces in the inner parts of the city; that the temperature difference between the city center and rural and semi-rural areas is 2.60 – 3.80 °C; that the vegetation density in the green areas in the city center is between 0,4 – 0.6; and that the surface of natural areas and agricultural lands was reduced 24 % in two decades. It was concluded that this methodological approach can be applied to other cities. For this purpose, it is necessary to customize the general energy efficient planning criteria according to the climate classes, in which the cities are located, with research on urban heat island and microclimate of the city in question.

Keywords: Antalya, energy efficient planning, urban heat island, climate change, cities in climate change, urban climate zones

INTRODUCTION

Global climate change and global warming refer to the increase in average surface temperatures of the Earth and the resulting changes in climate, caused by human activities such as the burning of fossil fuels, changes in land use, the destruction of natural areas and forests, and industrial activities. These activities lead to the accumulation of greenhouse gases in the atmosphere, which intensifies the natural greenhouse effect (Turkish State Meteorological Service, 2015).

In the Fourth Assessment Report (2011) of the Intergovernmental Panel on Climate Change (IPCC), it is stated that the overall temperature increase in the Mediterranean Basin will reach 1°C to 2°C, drought will be felt in extensive regions, and there will be an increase in heat waves and extremely hot days, particularly in inland areas. In Turkey, it is estimated that the annual average temperature will increase by 2.5°C to 4°C in the coming years, reaching 4°C in the Aegean and Eastern Anatolia regions, and 5°C in the inland areas. Both the IPCC report and a series of national and international scientific modeling studies indicate that Turkey will have a hotter, drier, and more uncertain climate structure in near future.

Climate change has historical evidence dating back to 300 years ago. The greenhouse effect and greenhouse gases in the atmosphere have been studied by the scientific community since the 17th century. Until 1970, these studies were carried out solely by scientists, but they gained global attention with the First World Climate Conference. It is widely accepted that urbanization and climate change are mutually related (Kahraman and Şenol, 2018:353).

Since the 1970s, the visible emergence of general environmental issues, advancements in science and technology, and the studies conducted by environmental economists have made climate change one of the key agenda items for countries. The main objective that has been highlighted in these studies is to limit greenhouse gas emissions to ensure that global temperature increase remains at 2°C. This is because a 2°C increase would lead to water resource depletion, a 5°C increase would result in a rapid melting of glaciers and a 5 meter rise in sea levels, and a 6°C increase would cause a world order characterized by massive human migrations due to the destructive effects of climate change (Yapraklı and Bayramoğlu 2017:433-434).

In the year 1987, the United Nations World Commission on Environment and Development introduced the concept of "sustainability" in the Brundtland Report. This concept addresses the environmental issues and development by advocating for a process of "sustainable development" that ensures the well-being of future generations without causing harm to the resources they will rely on (Karakaya and Sofuoğlu 2015:1).

The report argued that the economic imperative to maximize economic production must be accountable to an ecological imperative to protect the eco-sphere, and a social equity imperative to minimize poverty, hence the ‘three E’s’ of sustainable development: environment, economy and equity. The applications from sustainability principles to the process of urbanization have given rise to the concept of "sustainable urban development".

This concept has supported various rule-compliant models for eco-settlements that propose a vision of sustainable habitats at every level, such as eco-cities, eco-towns, eco-neighborhoods, and so on. Eco-city is a concept that combines ecology and urbanism, aiming to establish a relationship between humans, nature, and the city, and envisioning healthy, clean, and sustainable settlements for future generations. Priorities for eco-cities include making cities climate and environmentally friendly, reducing greenhouse gas emissions, decreasing fossil fuel usage, recycling solid waste and generating energy from waste, and promoting renewable energy use (Kocabaş 2013:1).

Cities are major contributors to climate change. According to UN Habitat (2023; 2011;10), despite occupying less than 2% of the Earth's surface, cities consume 75% of the world's energy and contribute to over 60% of carbon dioxide emissions, thus accelerating climate change. They are also the areas most affected by the global dimensions of climate change.

The reduction of green spaces and evaporative surfaces in cities, along with the increase in concrete and asphalt-covered areas and structural spaces, leads to changes in meteorological parameters and contributes to local and regional-scale climate change. As a result, large cities become spaces with unique climates. This climatic differentiation in urban areas is referred to as the "urban heat island". The term "urban heat island" defines the actual difference in surface and air temperatures between the city and its surroundings. The urban heat island effect occurs due to factors such as concrete surfaces, lack of vegetation cover and surface moisture, air pollution, and the canyon effect created by buildings (Yüksel and Yılmaz, 2008:938).

As of 2021, the city of Antalya is the fifth largest city in Turkey after Istanbul, Ankara, Izmir, and Bursa, with a population of 2.619.832 people. It is also the sixth largest city in terms of its surface area, covering 20.909 square kilometers. Located on the Mediterranean coast, Antalya is rapidly growing and is one of Turkey's most important tourism centers. The annual population growth rate was determined to be 1,45 % between 2019 and 2020; and 2,77 % between 2020 and 2021 (TUİK, 2023).

The city of Antalya receives significant migration from neighboring provinces, mainly due to employment opportunities in tourism, agriculture, industry, and the service sector. Starting in the 1970s, tourism investments and the dependence on the agricultural sector have led to a rapid increase in migration, which has been a significant factor in the population growth of the city since 1985.

Antalya city has experienced three major periods that have shaped its macroform and municipal boundaries. The first period occurred in 1994 when Antalya city expanded and reached a significant population size, leading to its transformation into a metropolitan municipality. The sub-municipalities of Muratpaşa, Kepez, and Konyaaltı were established as the main constituent municipalities of the city. During this period, the city's land area expanded from 2.600 hectares to 9.600 hectares.

Another significant period started in 2004 when the city's land area expanded to 138.000 hectares with the inclusion of certain villages within its boundaries, as stipulated by the Law No. 5216 on Metropolitan Municipalities. Finally, in 2014, with the implementation of Law No. 6360, known as the "Comprehensive Urbanization Law," all provincial boundaries were included within the scope of the metropolitan municipality. As a result, the land area expanded to 2.081.500 hectares, approximately 15 times larger than before (Anonymous, 2017).

The effects of urban heat island are felt more and more in Antalya city. The destruction of forest areas for tourism facilities and other land uses; conversion of agricultural lands into urban development areas; increases in building rights granted in zoning plans; inadequate and ineffective use of planning tools and public authorities; insufficient urban open and green areas in relation to the current population and urbanization; lack of energy-efficient building stock; underutilization of public transportation were the main reasons of the heating of Antalya.

Antalya is situated in a location where the typical Mediterranean climate is observed. According to the data from the Antalya Regional Directorate of Meteorology Station (1970-2015), the city and its surrounding areas receive the highest rainfall during the winter months, while the summer rainfall is minimal. The annual average total rainfall in this area exceeds 1074 mm. In Antalya, the coldest month, which is January, has an average temperature approaching 10°C. However, during the summer months, the average temperature exceeds 25°C. The city experiences 6 months of summer days ($T_{max}>25°C$). The maximum temperatures in the city can reach up to 45°C. The duration of sunshine exceeds

10 hours between May and September, but it decreases to around 5 hours in December and January (Şensoy et all. 2016:136).

The excessive rainfall observed during the winter and spring months, as well as the extreme heat and humidity during the summer months, due to the climatic characteristics of the city, lower the quality of life for the residents in terms of climatic comfort. The lack of planning based on climate has resulted in the urban heat island effect, characterized by temperature increases caused by existing structural conditions and land use/land cover changes. This, in turn, leads to increased energy consumption. In Antalya, electricity consumption during the summer months increases by 75% compared to the spring months. The increased consumption of electricity, generated primarily from fossil fuels and hydroelectric/natural gas power plants, contributes to the destruction of natural resources, increased carbon emissions, environmental/air pollution, and the expansion of our ecological footprint.

The present study aims to examine the presence/intensity, effects, causes, and consequences of the urban heat island phenomenon in Antalya and, if present, to develop solutions within the scope of urban and landscape planning disciplines to mitigate its effects.

URBAN HEAT ISLAND (UHI)

Luke Howard (1833) was the first to provide evidence that air temperatures are often higher in a city than in its surrounding countryside (Oke, 1982: 2). The climatic difference between urban and rural areas, known as the "urban heat island," was first defined and entered the literature in 1820 by Luke Howard for the city of London (Yüksel and Yılmaz 2008).

According to Oke (1982), an urban heat island refers to the temperature characteristics of a city or town. It is formed by human-induced changes in surface and atmospheric properties resulting from climatic changes and urban developments. This phenomenon is described as an "island" because the isothermal structure of the air near the surface resembles the contours of islands within the surrounding sea, which have a cooler isotherm structure. An isotherm is a closed line of equal temperature that defines a relatively warmer area of the surface observed in urban areas. The physiographic difference is derived from the similarity between the isotherm contour pattern and the contours of equal elevation on a topographic map. Therefore, the urban heat island is defined as the foundation for temperature differences between rural and urban areas (Yüksel and Yılmaz 2008).

The general characteristics of urban heat islands, as generalized by Oke (1982) and Arnfield (2003:23), have been confirmed by numerous studies. These characteristics include:

- The intensity of the urban heat island decreases with increasing wind speed.
- The intensity of the urban heat island decreases with increasing cloud cover.
- The intensity of the urban heat island is highest under anticyclonic conditions.
- The intensity of the urban heat island is greater during summer or the warmer half of the year.
- The intensity of the urban heat island tends to increase with the size and/or population of the city.
- The intensity of the urban heat island is highest at night.
- The urban heat island effect can diminish during the daytime, and the city can be cooler compared to the surrounding rural areas.
- The urban heat island effect increases the expenditure on heating and cooling.

The most effective way to reduce the urban heat island effect is to increase the use of materials with high albedo, enhance vegetation, increase the number of trees and lakes in urban areas, reduce heat emissions from building clusters, and design urban blocks and buildings accordingly. These strategies have a direct or indirect impact on a city's energy consumption (Parham and Haghighat, 2010:2193).

Measuring Urban Heat Islands

Different methods are used to detect heat islands based on their spatial and temporal characteristics. Surface cover and urban perimeter heat islands are typically identified using thermometers, while remote sensing techniques are employed for surface heat islands. Weather conditions, geographical location, time, period, urban form, and urban functions create distinguishing features.

Multi scale phenomena: The formation of urban heat islands is the result of various phenomena encompassing small-scale processes, such as interactions within human metabolism, and meso-scale interactions, such as atmospheric forces (Parham and Haghighat, 2010:2193).

Observational approach: In recent years, several general observations based on geographic coverage have been made in urban heat island studies. The intensity of the urban heat island decreases with increasing wind speed, decreases with increased cloud cover, and is more severe during the summer season or the warmer half of the year. It tends to increase with urban growth and population growth and is most pronounced at night. However, the above conclusions have contradicted by other studies. These contradictions are related to weakness of statistical analysis to present several physical phenomena (Parham and Haghighat, 2010:2193).

Field measurement approach: In the field measurement approach, the surface temperature of the urban area is typically compared to that of the rural area. This urban-rural comparison is based on the statistical analysis of data obtained from several fixed or mobile stations or station clusters (Arnfield, 2003:15, Parham and Haghighat, 2010:2193). Field measurement was first used by Howard in 1818 for UHI (urban heat island) studies in the city of London.

Thermal remote sensing: With the advancement of sensor technology, the thermal remote sensing of urban heat islands (UHI) has become possible using satellite, radar, and airborne platforms. The resulting data includes surface temperature, as well as other factors such as surface moisture, surface emissivity, surface albedo, incoming radiation to the surface, effects of the near-surface atmosphere, and the influence of surface radiative and thermodynamic properties.

Improvements in spectral and spatial resolution in satellite sensors are expected to provide more information at higher resolutions for urban surfaces at a lower cost. Similar to the field measurement approach, thermal remote sensing can also be used to provide boundary conditions for other UHI models (Parham and Haghighat, 2010:2193).

Local Climate Zones (LCZ)

Stewart (2012) defined local climate zones as regions of uniform surface cover, structure, material, and human activity that span hundreds of meters to several kilometers in horizontal scale. Each LCZ has a characteristic screen height temperature regime that is most apparent over dry surfaces, on calm, clear nights, and in areas of simple relief.

Different surface characteristics such as land use, vegetative distribution, building/tree height and void ratio, soil moisture, and anthropogenic heat flux directly influence the surface-air temperature through the urban-rural continuum. These variations give rise to 16 climate zones within the context of urban-rural continuity (Figure 1) (Stewart 2012:1885).

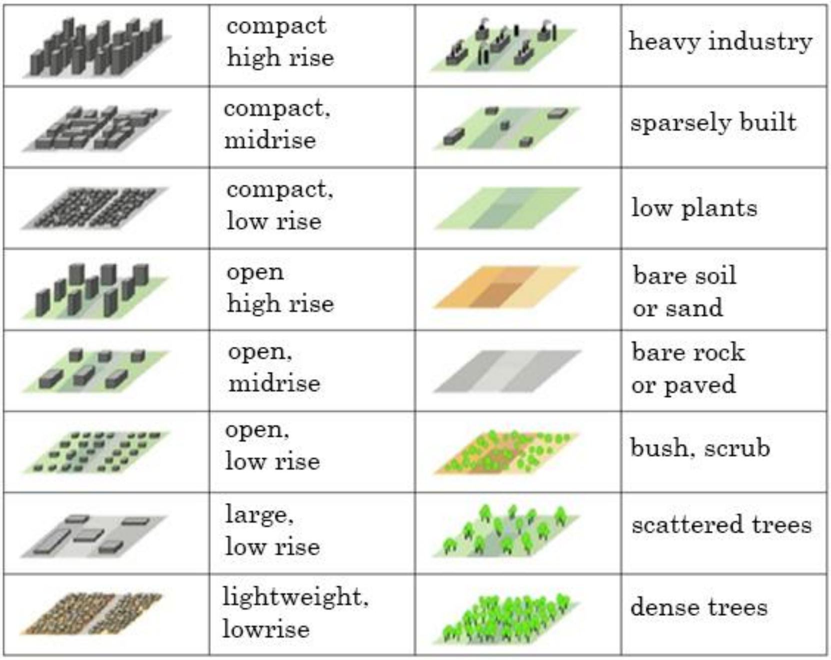
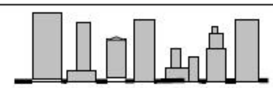


Figure 1: Local Climate Zones classified by Stewart and Oke (2012:1885)

Urban Climate Zones (UCZ)

There is no universally accepted scheme for urban classification based on climatic purposes. However, a good approach to the built components is the "Urban Land Zone" types developed by Ellefsen (1990, 1991). Initially, he categorized the building patterns into three types: attached, detached but close to each other, and detached with significant distances between them. These were further subdivided into 17 subtypes based on function, location within the city, building height, materials, and age. The implementation of this scheme only requires aerial photographs.

Ellefsen's scheme can be used to define urban structure in terms of roughness, air movement, radiation access, and shading angles. Additionally, it indirectly provides information about urban cover, texture, and metabolism because the classes also encompass the type of cover, materials, and degree of human activity. In areas where structural elements are rare and vegetation and natural land cover dominate (such as urban forests, shrublands, or grasslands), bare areas (soil or rock) and water bodies (lakes, wetlands, rivers) are less useful. This scheme combines the groups in Ellefsen zones and adds the measure of the structure related to airflow, shading, and heat island, as well as the percentage of built surface cover associated with surface permeability (Figure 2) (Ellefsen, 2006:10).

Urban Climate Zone, UCZ[1]	Image	Rough-ness class[2]	Aspect ratio[3]	% Built (imperm-eable)[4]
1. Intensely developed urban with detached close-set high-rise buildings with cladding, e.g. downtown towers		8	> 2	> 90
2. Intensely developed high density urban with 2 – 5 storey, attached or very close-set buildings often of brick or stone, e.g. old city core		7	1.0 – 2.5	> 85
3. Highly developed, medium density urban with row or detached but close-set houses, stores & apartments e.g. urban housing		7	0.5 – 1.5	70 - 85
4. Highly developed, low or medium density urban with large low buildings & paved parking, e.g. shopping mall, warehouses		5	0.05 – 0.2	70 - 95
5. Medium development, low density suburban with 1 or 2 storey houses, e.g. suburban housing		6	0.2 – 0.6, up to >1 with trees	35 - 65
6. Mixed use with large buildings in open landscape, e.g. institutions such as hospital, university, airport		5	0.1 – 0.5, depends on trees	< 40
7. Semi-rural development, scattered houses in natural or agricultural area, e.g. farms, estates		4	> 0.05, depends on trees	< 10

Key to image symbols: buildings; vegetation; impervious ground; pervious ground

Figure 2. The simplified Ellefsen classification provides an approximation of the climatic impact abilities of different urban form arrangements (Ellefsen, 2006:10)

STUDY AREA AND DATA

The study area is the administrative boundaries of Antalya Metropolitan Municipality, which is approximately 138.000 hectares. The city boundaries cover five central districts: Muratpaşa, Kepez, Konyaaltı, Döşemealtı, and Aksu (Figure 3). The total population of the central districts of Antalya is 1.496.881 (TÜİK, 2023). The economy of Antalya relies heavily on agriculture, particularly the fertile plains located in the eastern part, as well as its natural and cultural characteristics, which contribute to tourism.

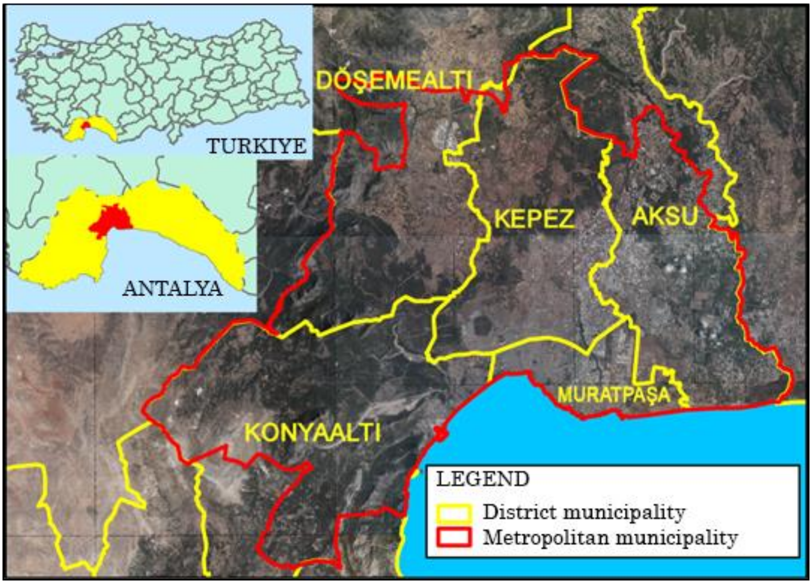


Figure 3. The study area

Satellite images from 1987, 2002, 2006, and 2010 were used focusing on the summer months with the lowest climatic comfort in the city. Surface temperature analysis was conducted using satellite images from 2012, specifically selecting August, one of the two months with the lowest climatic comfort and highest energy consumption in the city due to high humidity and temperature. In addition, three Davis Vantage Pro2 wireless weather stations were installed in different parts of the city to obtain climatic data. Measurement values were recorded every hour, and data was collected from the stations on monthly basis. At the end of 12 months, all measured values were evaluated by correlating them with each other and other relevant data.

The study incorporates a wide range of materials and sources related to each stage in the following order: global warming and climate change, land cover classification using remote sensing techniques, vegetation analysis, surface temperature analysis, sky view factor analysis (SVF), detection of urban heat islands, climate science, meteorology, local climate zones, urban climate zones, energy-efficient design criteria, solar angles, previous studies on climate characteristics of Antalya city and energy-efficient planning in Antalya city, reports, master's theses, doctoral dissertations, scientific articles, unpublished papers, conference proceedings, books, web-based presentations, and internet sources. During the development of the study's climate and energy-efficient planning criteria, several primary sources were utilized. These include the publication "Energy Conscious Design - a Primer for Architects," which was published in 1992 by the European Commission.

METHODOLOGY

This research aims to develop an energy-efficient planning approach for Antalya city in relation to urban heat island effects within the city boundaries. Due to the diverse scales, scope and variables, this study has integrated key studies that have been applied in similar research and used as references, resulting in the development of an original methodology (Figure 4.

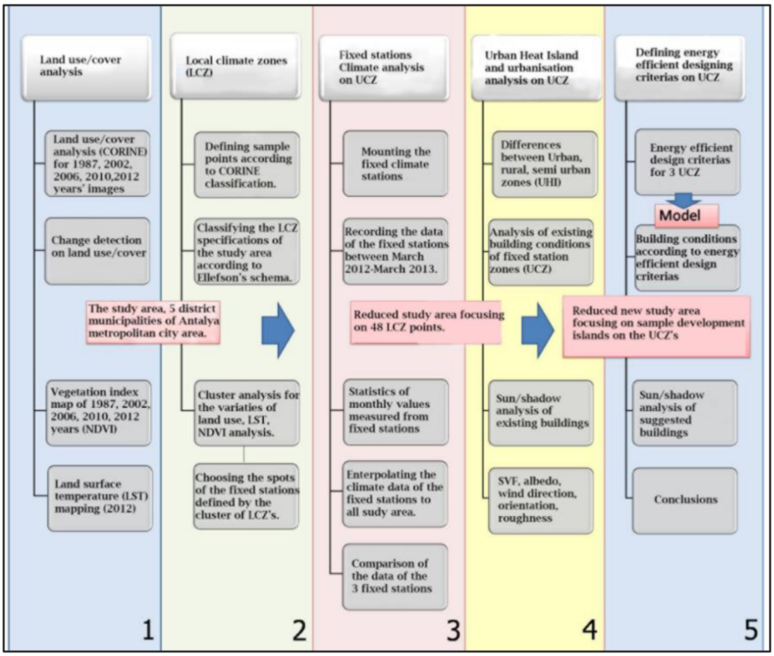


Figure 4. 5 stages of the study as a flow chart of the methodology.

The presence of surface heat islands was examined using Landsat 7TM imagery dated August 2012, by creating a surface temperature map through remote sensing techniques. The reason for using Landsat 7TM imagery is the high spatial resolution provided by the thermal infrared band. The used imagery consists of seven spectral bands, six of which provided surface reflectance data and one provided surface temperature data. The resolution of Landsat 7TM imagery is 30 m in the visible and near-infrared regions, and 120 m in the thermal region. The images were mosaicked, georeferenced, and cropped according to the boundaries of the study area using Erdas Imagine software. An analysis map of surface temperature was created from the thermal infrared band of the Landsat 7TM imagery.

Using the Landsat 7TM imagery, a land cover/land use and normalized difference vegetation index (NDVI) map was created. The changes in land cover/use and vegetation density between 1987 and 2012 were analyzed and correlated with the surface temperature map to investigate the urban heat island effect and formation factors within the boundaries of the five central districts of Antalya city.

The normalized vegetation index values or results obtained by dividing the near-infrared band by the red band provide information about the green vegetation as well as identifying areas with weak or no vegetation. The vegetation index values close to (1) indicate strong vegetation, approaching (0) indicate the absence of vegetation, and when negative, approaching (-1) indicate completely vegetation-free areas. Water surfaces such as rivers and lakes generally have very low vegetation index values. The same applies to artificially created areas by humans, such as residential areas, industrial areas, and road networks. The change in green-covered areas based on vegetation indices derived from satellite images dated 26/08/1987, 24/06/2002, 19/06/2006, and 25/08/2010 has been revealed.

In the second stage of the study, the local climate zones (LCZs) of Antalya city were identified based on the land cover/land use classes according to the CORINE classification system. The Stewart and Oke’s (2012:1886) approach was followed as a basis for developing the local climate zones. 48 points were selected from urban, rural, and semi-rural areas according to the sub-categories of the three main land use types of the CORINE classification. A cluster analysis was performed on the 48 points based on land use classes, surface temperature values, and vegetation index (NDVI) values. The cluster analysis (dendrogram) revealed the presence of three main clusters. These three main clusters were identified as three local climate zones (LCZs), and weather stations were established in these zones for "in-situ measurement”.

The measurement devices were installed in secure public buildings located in the districts of Döşemealtı, Kepez, and Muratpaşa. During the installation phase, necessary permissions were obtained from relevant authorities to ensure the safety of the devices. The stations were positioned at a maximum height of approximately 2 meters from the ground to minimize the influence of surface materials' thermal properties, such as albedo, soil moisture, or thermal characteristics, on the measurements.

The third stage of the study (in-situ measurement approach in urban heat islands) involves investigating the microclimate effect by analyzing the climatic values measured by the fixed weather stations in the selected local climate zones. Statistical analysis was conducted on the recorded measurements, including temperature, wind, humidity, solar radiation, precipitation, and perceived temperature, to examine the basic climatic characteristics (footprint) and differences between the three reference areas where the stations were set up. The measurement results were statistically evaluated using multivariate analysis of variance (MANOVA) and one-way analysis of variance (ANOVA) techniques, both within each measurement parameter on a daily and monthly basis and between the stations. To compare station averages, the Tukey test was performed to determine if there were significant differences among the groups.

In the fourth stage of the study, urban climate zones (UCZs) were identified based on the comparison of measurement approaches used for detecting heat islands. The identification of surface cover and urban perimeter heat islands was done using temperature measurements from climate stations, while remote sensing-based temperatures were used for surface heat islands. The presence of microclimatic differences among these areas was determined through the analysis of surface heat islands and climatic measurements. To assess the heat island effect, temperatures and temperature differences were evaluated in urban, semi-rural, and rural areas where three climate stations were installed. The research involved studying the urban planning conditions, existing urban development, and building heights, building and street surface coverings, sky view factor analysis (SVF), vegetation presence, water presence, function, elevation, vegetation index analysis (NDVI), and surface temperatures generated through thermal analysis, among other factors, to identify urban climate zones (UCZs) based on clusters that exhibit common characteristics.

The temperature values measured at the stations were interpolated to calculate the air temperature values for all 48 observation points in the study area using the "radial basis function" method in ArcMap's geostatistical analysis. The temperature difference (ΔT) between surface temperature and air temperature was calculated for the analyzed 48 points. This calculation indicates the formation of negative and positive heat islands. Additionally, the temperature difference (urban-rural, suburban-rural, urban-suburban) between the measured temperature values in the urban, rural, and suburban areas, where the climate stations were established, was calculated to identify the urban heat island effect.

FINDINGS

Landuse/cover Change

Spatial analysis was conducted to examine the changes in land cover/land use between 1984, 2002, 2006, and 2010 at the CORINE 1 and 2 classification levels to investigate the factors contributing to the urban heat island effect. These analyses aimed to understand the factors that cause the urban heat island phenomenon. Analyzing the spatial and temporal changes in land cover/land use provides valuable insights into the formation and development of urban heat islands.

Between 1987 and 2010, over a period of 23 years, there was an increase of 18.175 hectares in settlement areas. This increase is not limited to areas classified solely as settlement areas but also includes artificially damaged or opened areas resulting from other anthropogenic factors associated with population growth. Over the 23-year period, % 23.5 of total land transformed into urban and rural settlement areas and their associated secondary functions (Table 1, Figure 5).

Table 1. Land use/land cover change in 1987-2002-2006-2010 years.

Level 1	Level 2	1987 (ha)	%	2002 (ha)	%	2006 (ha)	%	2010 (ha)	%
Artificial surfaces	Urban fabric	11381	8,00	18179	13,00	18198	16,80	29556	21,20
	Industrial/transport/etc	6883	4,80	8484	6,10	23574	13,00	21476	15,40
	Sub-total	**18264**	**12,80**	**26663**	**19,10**	**41772**	**29,80**	**51032**	36,60
Forest, Semi-natural areas	Dense forest	62150	45,30	62377	44,80	44548	32,00	44537	31,90
	Open spaces, less vegetation, Sclerophyllous vegetation	14135	10,40	15435	11,20	18025	12,60	12283	8,80
	Sub-total	**76285**	**55,70**	**77812**	**56,00**	**62573**	**44,60**	**56820**	40,70
Agricultural areas	Arable land	**43581**	31,50	**35408**	25,40	**35573**	25,50	**31666**	22,70
Total Area		**138130**	**100,00**	**139884**	**100,00**	**139848**	**100,00**	**139518**	**100,00**

Source: Alpaslan and Ortaçeşme (2020:52)

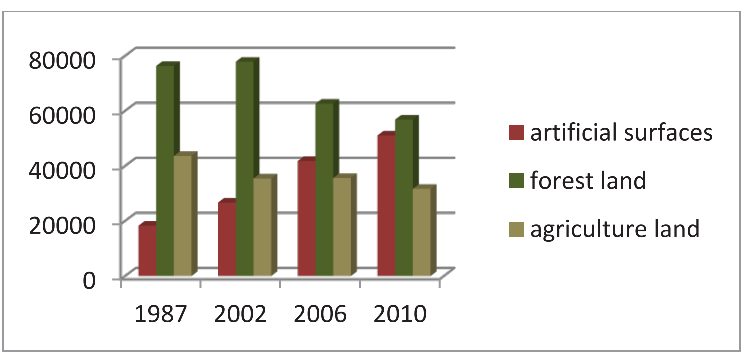


Figure 5. Land Cover Change in Hectares between 1987-2002-2006-2010 years

Furthermore, during the 23-year period, agricultural areas decreased by 11.915 hectares, while forests and semi-natural areas decreased by 20.853

hectares. Between 2002 and 2006, forest areas that were converted into damaged/open surfaces were further transformed into settlement areas along with agricultural areas at a rate of 3% between 2006 and 2010.

Vegetation Index Analysis (NDVI)

In 1987, agricultural areas between Aksu, Döşemealtı, Kırcami, Düden and Boğaçayı branches, with a vegetation density close to 1, showed the highest values. However, in 2002, the vegetation density reached a maximum of only 0.78, mainly seen in the Boğaçayı and its surroundings. In 2006, the vegetation density value decreased further, reaching a maximum of 0.58. However, in 2010, the vegetation density value increased to 0.80. These differences in vegetation density are likely due to the images used for NDVI analysis, where the images from 2002 and 2006 were obtained in June, while the image from 2010 was obtained in August. The high NDVI value in 2010 is observed in the Aksu River basin, which is intensive in greenhouse cultivation.

When the surface temperature map is correlated with the vegetation cover map (NDVI), it is observed that areas reflecting high surface temperatures in the study area, located to the north, have intensive agricultural areas and artificial regions (Döşemealtı). To the east, there are also regions with dense agricultural areas, including the surroundings of Antalya airport (Aksu), where the vegetation density is low (Figure 6).

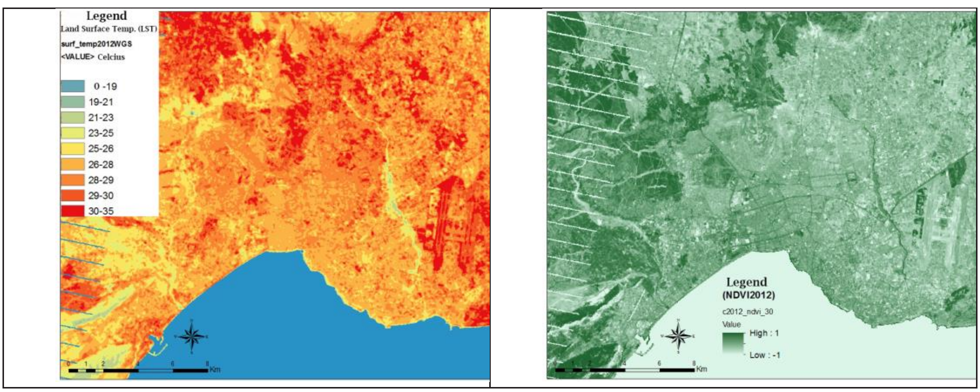


Figure 6. The Land Surface Temperature (LST) map vs NDVI map (Alpaslan ve Ortaçeşme 2020:53)

The coolest temperature range in the study area, represented by the 0-19 ºC interval, is observed in the west and partially northwest of the city in the mountainous areas of Konyaaltı district. The coolest temperature range seen within the city center is most frequently between 23-25 ºC and rarely between

21-23 ºC. Lower temperatures among urban areas are located around water surfaces. It is observed that the green areas within the city cause a temperature decrease of at least 3 ºC.

Land Surface Temperature Analysis (LST)

The surface temperature distributions of the study area were calculated and mapped using Landsat 7 TM imagery, and the values were represented in °C (Figure 7). In the analyzed image, each pixel represents an area of 30x30 square meters. The analysis divided the surface temperature distribution into 10 classes. Each pixel represents a temperature range of 1°C or 2°C. On the map, the pixel value represented by the red color corresponds to the hottest temperature range of 30°C to 35°C.

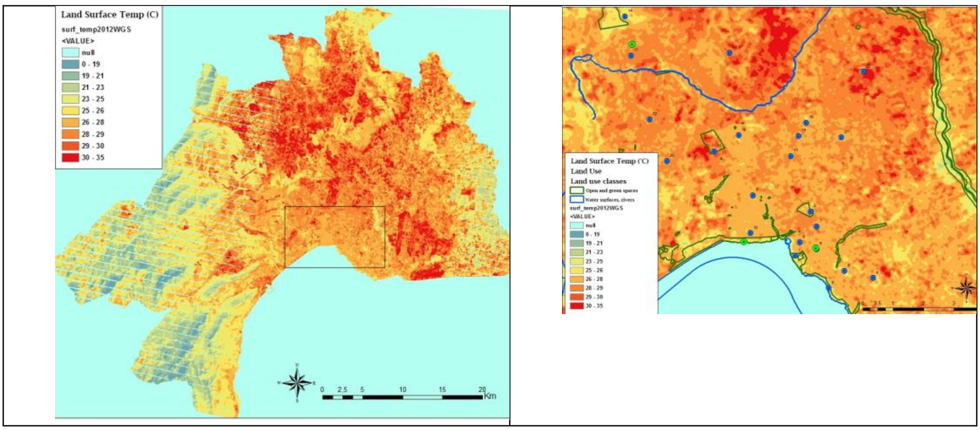


Figure 7. Land surface Temperature (LST) Map of Antalya City (Alpaslan and Ortaçeşme, 2019:34).

The temperature range of 25°C to 29°C represents the reflection results of urban settlements, industrial, commercial, and transportation units, mining sites, disposal and construction areas, and artificial surfaces. For example, in the city center, the temperature value falls within the range of 26°C to 28°C, indicated by shades of yellow and dark yellow. The areas within the city center that appear as light yellow and light green, observed between the yellow, orange, and dark orange colors, reflect lower temperature degrees due to the presence of green areas, rivers, and vegetation along the riverbanks.

Local Climate Zone Analysis (LCZ)

According to Stewart and Oke (2010), each Local Climate Zone (LCZ) represents a unique surface temperature formed by its characteristic geometry and land cover under calm and open sky conditions. These zones are differentiated from each other by surface properties that directly influence high temperatures, such as vegetation distribution, building/tree height and spacing, soil moisture, and anthropogenic heat flux. The urban-rural continuum is explained by a hierarchy of 16 climate zones, each chosen by representing equal specifications of these zones within the research area. Three points were selected for each of these zones, resulting in a total of 48 analysis points. These points are numbered from 1 to 48 for reference purposes.

The 48 points marked and numbered on the Landsat 7 TM imagery using ArcMap software have been associated and grouped according to the 16 land cover classes determined by Stewart and Oke (2012:1885). The table includes the district code to which each point is connected, as well as the class codes that represent the most frequently observed land cover classes within the study area. This grouping was done to simplify the analysis and adapt it to the study area (Figure 8).

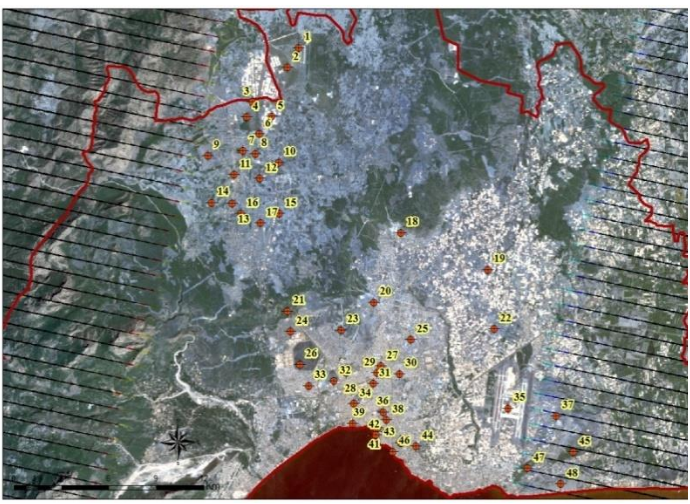


Figure 8. 48 observation points positions in the study area.

In order to examine the relationships between the identified 48 points more closely, hierarchical clustering analysis using the single linkage technique was attempted for grouping. For this purpose, observed values of vegetation index (NDVI) and land surface temperature (LST) related to the points were used. As a result, it was observed that three clusters emerged with a 15% similarity threshold. To investigate the local climate zones at a micro scale, it was decided to establish fixed meteorological measurement stations in three different locations representing the three clusters.

The Land Surface Temperature Analysis (LST)

The descriptive statistics of the surface temperature values for the selected 48 points and the ANOVA results for surface types are provided in Table 2 and Table 3, respectively. The analysis results indicate a significant difference in surface temperature values based on surface type, $F(2\text{-}45)=6.049$, $P<0.01$. In other words, temperature values vary significantly depending on the land cover type. Some surface types are hotter, while others are significantly cooler.

According to the results of the Tukey test conducted to determine the differences between surface types, it was found that the dense residential area ($\bar{x}$=29.02) is significantly hotter than forest and green areas ($\bar{x}$=27.01) and mixed agricultural areas ($\bar{x}$=26.73). There is a significant temperature difference of 2.3°C between urban areas and agricultural and other green areas.

Table 2. The change in mean temperatures according to land use class based on different factors is analyzed using One-way ANOVA

Variable	Factor	N	Mean	s	sd	F	P
Surface Temp.	Mixed agricultural	6	26,733333^{b}	1,79	2-45	6,049	0,005
	Forest and green	13	27,007692^{ab}	2,65			
	Urban, dense residential	29	29,024138^{a}	1,79			

Table 3. The results of One-way ANOVA based on factors for land use groups

Source of variation	Sum of squares	sd	Mean of squares	F	P
Between groups	51,081	2	25,540	6,049	0,05
Within groups	190,016	45	4,223		
Total	241,097	47			

The analysis results also indicate a significant difference in surface temperature based on land cover/use within urban areas ($F(5\text{-}42) = 2.878$, $P \leq 0.05$). In other words, when urban areas are divided into subareas based on land cover, surface temperatures vary significantly. Some urban areas exhibit significantly higher temperatures compared to other urban areas with different characteristics. According to the Duncan test, Group 3 consisting of urban industrial and small industrial areas (mean = 30.00) forms the hottest group, while non-agricultural artificial green areas and urban green areas constitute the group with the lowest temperatures (Table 4).

Table 4. Land use/cover and relation to the land surface temperature

Variable	Urban climate zone (UCZ) clusters	N	Mean	s	Df	F value	P
Surface temperature	Unnatural, non-agricultural green spaces/urban green spaces[b]	13	26,46	2,602	5-42	2,878	0,025
	Mixed agriculture[ab]	9	29,00	2,398			
	Heavy/light industry[a]	3	30,00	1,000			
	Transportation units[ab]	2	28,50	,707			
	urban/dense residential[ab]	8	27,63	1,188			
	urban/less dense residential[ab]	13	29,00	2,082			

Climate Data Collected from the Fixed Stations

The measurement values recorded at different locations simultaneously, at the same hour and minute, throughout one year were evaluated using frequency analysis and multivariate analysis of variance (MANOVA) methods to demonstrate regional-scale climatic differences statistically. In this way, the relationship between environmental differences at the station locations and climate was examined, aiming to determine the influence of climate on the urban fabric and the impact of the urban fabric on climate.

The climatic data were collected from a total of 5 locations, including three climate stations established at specific points as part of the study as well as two stations already established at the Regional Meteorological Directorate and at the Airport. The data obtained from the ground stations were entered into the point database in ArcMap software. The climatic variables of maximum temperature in August, temperature in January, wind speed in August, and solar radiation in August were interpolated to the entire study area using the Geostatistical Analysis method with the "radial basis function" tool. Thanks to this tool, the temperature and wind maps of the 48 observation points are obtained in order to make further analysis such as development analysis to define urban climate zones (Figure 8).

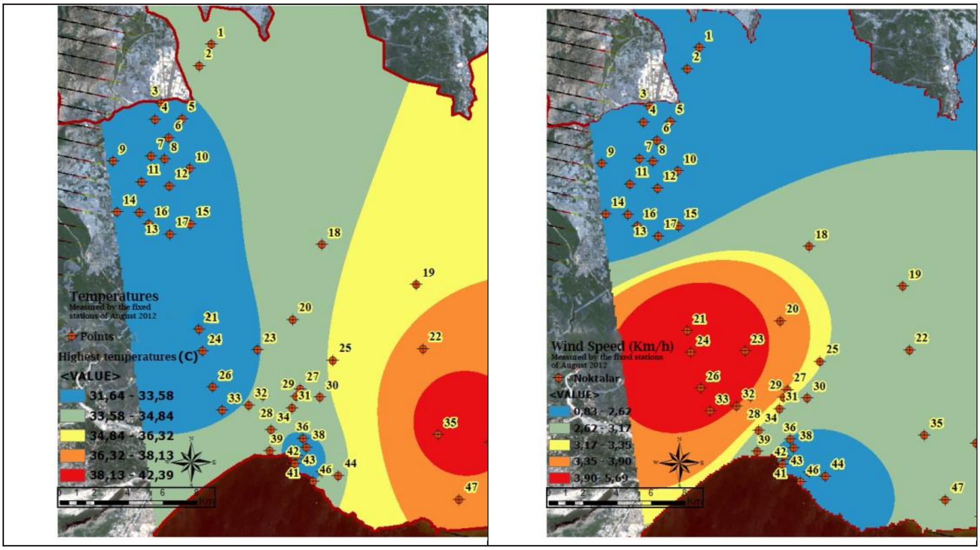


Figure 8. Temperature (Alpaslan and Ortaçeşme, 2019:35) and wind maps at each 48 observation points.

Urban Climate Zone (UCZ)

For each LCZ, urban climate zones were classified based on the urban planning and existing building conditions, SVF (sky view factor), texture and structure analyses, as well as sun-shadow analyses (Figure 9).

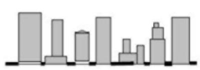
Climate Stations	Definition of Urban Climate Zone (UCZ)	Zoning plan and construction status	Sky view Factor (SVF)	Roughness class	Albedo	Impermeability rate %
Z1- Döşemealtı	A medium-density urban area with high levels of development, characterized by rows or contiguous small apartment buildings with sparse settlement	 FAR:1 5 floors Road profile: 7-10 m.	0.9	7	0.20	65-85
Z2-Kepez	Medium development level: Low-density urban fringe settlements with 1 or 2-storey houses, urban fringes, suburban housing."	 Houses with gardens 1 -2 kat Road profile: 7-8 m.	0.8	6	0.30	35-65
Z3-Muratpaşa	High development: High-density 2-5 storey buildings with contiguous or closely spaced brick and concrete structures.	 BAC/FAC: 0.30/1,50 5 floors Road profile: 10-12 m	0.4	7	0.15	85+
Z4-Antalya City- Turkish State Meteorological Service	High development: contiguous or closely spaced multi-storey buildings.	 FAR:1.35 4-10 floors Road profile: 9.50-12 m	0.5	8	0.15	90+

Figure 9. Urban climate zones (UCZ)

According to analysis Z1 represents a partially developed rural environment in Döşemealtı district. Z2 represents a semi-rural environment characterized by suburban areas and single-story shanty houses within gardens. Z3 represents a densely populated urban environment in Muratpaşa district (Figure 10, 11). Z4 represents the region where coastal influences are observed.

Figure 10. SVF, wind, building and direction analysis of Muratpaşa UCZ (Z3)

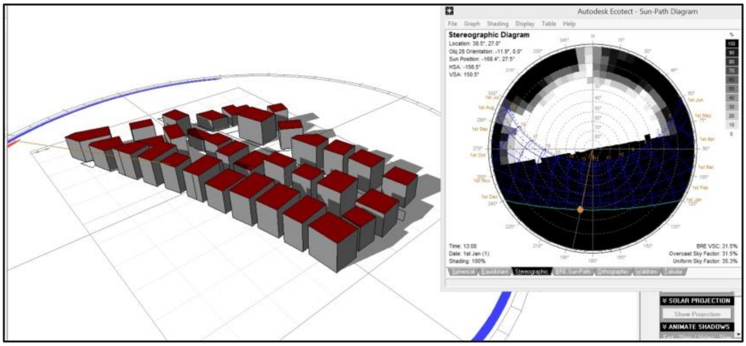


Figure 11. Sun/shadow analysis of Muratpaşa (UCZ-Z3)

DISCUSSION AND CONCLUSIONS

In the land cover/land use change analysis conducted for Antalya city between 1987, 2002, 2006, and 2010, it was observed that during the 23-year period from 1987 to 2010, a total of 32.700 hectares of forest and agricultural land has been converted into urban and rural settlement areas and their associated functions. Artificial areas (settlement areas and areas affected by human activities) have increased by 18%, while forest areas have decreased by 15% and agricultural areas have decreased by 8%.

According to the vegetation density (NDVI) analysis conducted in the same years, in 1987, the agricultural areas between Aksu, Döşemealtı, Kırcami, Düden, and the branches of Boğaçayı showed vegetation density close to a value of 1. In 2002, the highest vegetation density of only 0.78 was observed in the vicinity of Boğaçayı and its surroundings. In 2006, the maximum vegetation density value was 0.58. In 2010, the vegetation density value was 0.80. This difference may be attributed to the fact that the NDVI analysis images from 2002 and 2006 were obtained in June, while the one from 2010 was obtained in August. In 2010, a high NDVI value was observed in the Aksu River basin, where agricultural activities are intense. Over the 23-year period, it can be observed that the areas of Döşemealtı, Kırcami, and the Aksu River basin have undergone partial urbanization and a decrease in vegetation presence, but agricultural activity is still ongoing in the Aksu River basin.

The analysis of surface temperature, which determined the urban heat island, was obtained using the thermal bands of Landsat 7 TM image captured in August 2012, which is one of the hottest years according to the measurements of the Meteorology Regional Directorate. In the study based on surface temperatures, while the city center and its surroundings in Antalya range between 26 ºC and 29 ºC, the temperature range in Aksu to the east of the city and Döşemealtı to the north is mostly between 29 ºC and 35 ºC. Antalya Airport located in the eastern part of the city and Lara Dunes in the administrative district of Muratpaşa also have a temperature range of 30 ºC to 35 ºC, and they are among the areas with the highest temperature reflection.

When the surface temperature map and the vegetation cover map (NDVI) are correlated, the sectors of the study area that reflect high surface temperatures are mainly located in the northern agricultural areas and artificial regions (Döşemealtı) and in the eastern regions where agricultural areas are also concentrated, including the vicinity of Antalya Airport (Aksu). These areas also exhibit low vegetation density. The temperature range of 0-19 ºC, representing the lowest temperature range in the study area, is predominantly observed in the high, mountainous areas in the west and partly northwest of the city, particularly in the Konyaaltı district. The lowest temperature range observed within the city center is the most common range of 23-25 ºC, with rare occurrences of the range 21-23 ºC. Low temperatures observed within urban areas are predominantly found around water bodies. It has been observed that green areas within the city cause a decrease in temperature of at least 3 ºC. The reason for the coastal areas, especially the coastal section of Antalya city center, reflecting lower surface temperatures compared to the rural areas in the north is due to the city's coastal location.

In order to determine the climate zones, the temperature difference (ΔT) between surface temperature and air temperature was calculated at 48 selected points. The areas where the difference between air temperature and surface temperature is highest (with an average of 6 ºC) are predominantly the urban residential areas and urban green spaces in the Muratpaşa region. This indicates that the urban heat island effect in the Muratpaşa region is higher compared to other areas. According to another heat island measurement study, the daily maximum temperature difference between the city (Muratpaşa) and the rural area (Döşemealtı) is 3.80 ºC, while the daily maximum temperature difference between the suburb (Kepez) and the rural area (Döşemealtı) is 2.60 ºC. The daily maximum temperature difference between the city and the suburb is 1.70 ºC.

According to the urban development analysis conducted in the urban climate zones, it has been determined that the Muratpaşa district in the city center has intense urbanization, but it does not allow planning based on energy-efficient criteria while maintaining the density of construction. It lacks a green area system and wind corridors. The density of green spaces is low, and there is a lack of sky view and low albedo. There are many urban canyons, and buildings obstruct each other's sunlight. It has been observed that the orientation of blocks, plots, and buildings does not correspond to the solar angles in the city of Antalya.

In the urban climate zone of Döşemealtı district, which exhibits characteristics of rural settlements, the research revealed the followings: It is located in the developed areas of the city according to the urban plan, and if built according to the zoning regulations, the buildings would obstruct each other's sunlight. The sky view is high, but there is a lack of vegetation. The surface is permeable, but the albedo is low. The wind intensity is ineffective, and the humidity level is lower compared to other regions.

In the development islands within Kepez district, which exhibit characteristics of semi-rural/suburban areas, it has been concluded that the existing situation is positive in terms of orientation, direction, sky view, albedo, vegetation presence, permeability, roughness, and canyon effect. However, currently, urban renewal projects are taking place in this area. Precautions to be taken during or as part of the implementation of the project have been specified.

All these climatic evaluations and urban climate zone assessments have led to the identification of energy-efficient construction criteria based on urban climate zones. These criteria provide guidance for the planning and construction of buildings in accordance with the region's climatic characteristics, solar movements, and energy efficiency principles. Among these criteria are the proper orientation of buildings to maximize solar benefits, optimal sunshade relationships, use of energy-efficient materials, insulation, natural ventilation, and utilization of solar energy and other renewable energy sources. Energy-efficient construction design criteria are determined by considering the region-specific climatic conditions and environmental factors, aiming to support sustainable urban development (Figure 12).

<table>
<tr><th colspan="2">Design criterias</th><th>Döşemealtı (Z1)</th><th>Kepez (Z2)</th><th>Muratpaşa (Z3)</th></tr>
<tr><td rowspan="2">Orientation of buildings</td><td>With the Sun</td><td>Optimum direction: S-E 18°, Favorable direction: S-E 40°</td><td>Optimum direction: S-E 3°, Favorable direction: S-E 19°,</td><td>Optimum direction: S-E 3°, Favorable directions: S-E 19°, S-W 10°</td></tr>
<tr><td>With the Wind</td><td>It should provide ventilation from the prevailing wind direction (SE)</td><td>It should provide ventilation from the prevailing wind direction (N)</td><td>It should provide ventilation from the prevailing wind direction (SE)</td></tr>
<tr><td rowspan="5">Distance between the buildings</td><td rowspan="2">Avoiding the sun</td><td>1 1/2 - 2 1/2 H (m)</td><td>1 1/2 - 2 1/2 H (m)</td><td>1 1/2 - 2 1/2 H (m)</td></tr>
<tr><td colspan="3">The shading ratio is adjusted according to the characteristics of the desired cooling period</td></tr>
<tr><td rowspan="2">For the Wind benefit</td><td>5– 7H<DX (m)</td><td>5– 7H<DX (m)</td><td>5– 7H<DX (m)</td></tr>
<tr><td>Less wind: The distance should be wide.</td><td colspan="2">Humid: the distances between buildings should be wide enough to capture the wind inside the settlement</td></tr>
<tr><td>For the Solar benefit in winter</td><td colspan="3">The shading ratio should be reduced based on the direction that increases sunlight exposure during the winter months and the characteristics of the desired heating period.</td></tr>
<tr><td>Shape of building</td><td>General</td><td colspan="3">-Minimal depth and long facades to make the most of cross-ventilation.
-Unobstructed circulation of air should be ensured within the space with an open plan concept.
-Detached, wide eaved, single-storey buildings with verandas, and multi-storey buildings with balconies can be constructed.
-The total heat gains and losses of buildings are proportional to the size of their exterior surface area.
-The building form should be chosen based on the heat losses/gains per unit area since the building's form, its configuration in the plan, and the texture of its shell affect its performance concerning solar radiation and wind.
-For Döşemealtı: Courtyard compact structures are more suitable. The main spaces should be organized facing the courtyard. Depending on the seasonal use, the window sizes and usage rates on the north and south facades may vary.
-For Kepez and Döşemealtı; Adjacent single to 1-2 storey buildings are suitable. Frequently used spaces should be oriented towards appropriate directions to minimize heat gains and losses.</td></tr>
<tr><td>Exteriors</td><td>Green design</td><td>On the south facade, deciduous tall trees provide shade in summer while allowing the winter sun to enter. The natural ventilation is created between the crown and trunk of the tree.</td><td>Deciduous trees should be planted on the south and west facades, and evergreen trees, which do not shed their leaves, should be planted on the north facade.</td><td>Deciduous trees should be planted on the south and west facades, and evergreen trees, which do not shed their leaves, should be planted on the north facade.</td></tr>
</table>

Figure 12. Energy efficient construction and design criterias for 3 UCZ's (Alpaslan and Ortaçeşme 2020:54)

In the modeled building clusters of Muratpaşa UCZ (Z3), wind ventilation and sunlight exposure are among the most important criteria. Therefore, the buildings are oriented at a 3-degree angle from south to east, and the building forms are kept slim and elongated with an approximate aspect ratio of 1:2. The ground floors of the buildings in this area are designed with voids supported by stilts (Figure 13).

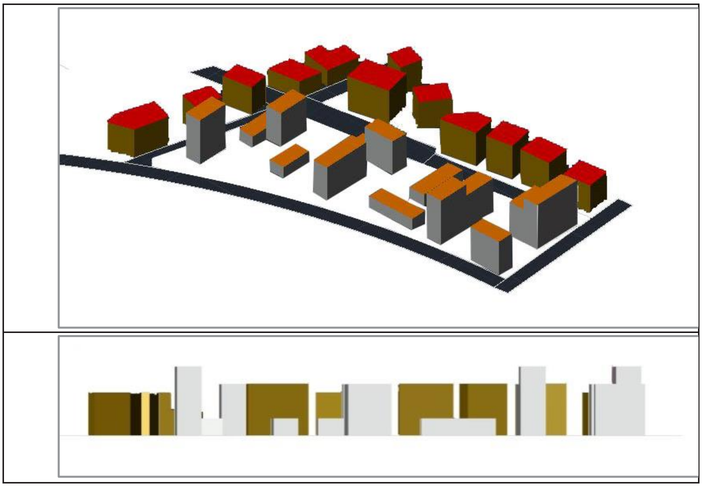


Figure 13. The energy efficient design model for Muratpaşa UCZ (Z3).

In Döşemealtı UCZ (Z1), the orientation of building clusters in the existing development is north-south, resulting in the east-west orientation of building facades. This arrangement helps reduce the indirect heating effect caused by the summer breeze from the south and minimizes solar stress during winter. However, the lack of vegetation does not contribute to cooling in summer or heating in winter (Figure 14).

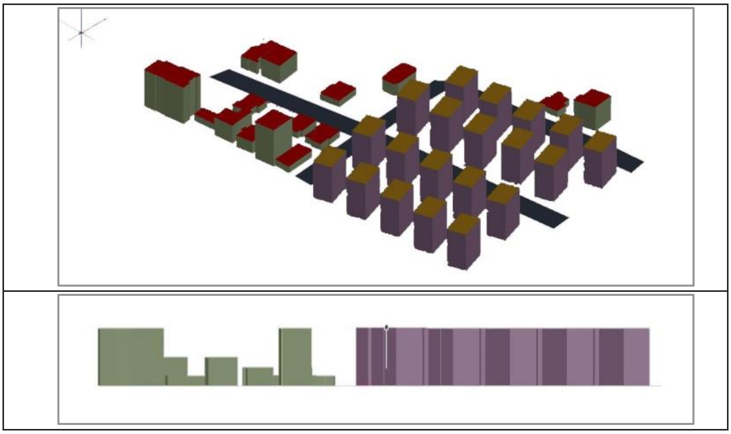


Figure 14. The energy efficient design model for Döşemealtı UCZ (Z1).

One of the most important findings of the study is that despite the cooling effect of the sea, which is Antalya's coastal location advantage, it still exhibits the presence of an urban heat island. The main reasons for the urban heat island extending to the city's outskirts and development areas, and even higher surface temperatures in these areas, are the changes in land cover in the outskirts and development areas, insufficient and isolated green spaces in the city center.

As a result of all assessments, it has been determined that Antalya city exhibits both urban and surface heat island effects, and the presence of the heat island is particularly significant in the city center, Muratpaşa. The existence of the heat island is not limited to the city center alone; it also intensifies over the defined outskirts of the city center, namely Döşemealtı and Aksu districts. High surface temperatures were observed in areas where land use/cover changes occur, especially in areas transitioning from forest to agricultural land or from agricultural land to residential areas or areas being prepared for such transitions.

One of the roles assigned to cities in the implementation of climate change action plans is to plan according to energy-efficient criteria to maintain climate resilience and ecological sustainability. Urban transformation projects are currently the fastest and most effective tool in local governance. Regardless of the reason, urban transformation projects, including urban planning and landscape planning within the scope of adapting the urban fabric to the present day, such as revision of development plans, urban renewal, and health improvement, should be carried out by considering energy-efficient criteria in accordance with the region's climate. According to the urban resilience studies, it is observed that 70 % of the city's building stock is deteriorated, the city's population is rapidly increasing, green and natural areas are diminishing, and the heat island is expanding. Therefore, it is believed that the energy-efficient approach developed in this study will serve as a tool for local governments and designers in implementing the city's energy action plan, contributing to the city's sustainability and resilience against climate change.

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Chapter 2

Requirement Elicitation with End User: A Case Study for Research Laboratory

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ABSTRACT

One important construction project issue is sustaining the designs according to the requirements. Defining the requirement differs due to client and building typology. For some projects, they are elicited before the project stages, and for the rest, they are elicited with the involvement of the architects. For all cases, the proper elicitation of the requirements is vital. End-users have important requirement knowledge for their buildings because of their experience with spaces that will be designed. However, it is hard to capture end-users' knowledge resulting from less technical knowledge, lack of proper frameworks, and insufficient time. This study investigates end-users' involvement in requirement elicitation in an applied process. The process was executed in the design of Kırıkkale University Research Laboratory. The case study is important for requirement management because this building type is also accepted as having complex and detailed requirements. In the study, a theoretical framework is first conducted, and then the design and applied process of the building is presented. The evaluation part explains the major contributions of the applied process.

Keywords: Requirement Elicitation, Knowledge Capturing, End-Users, Research Laboratory

1. INTRODUCTION

Requirement elicitation is an important stage of any construction project. Architectural and engineering designs are made according to the requirements of the process. The requirement of spaces is a set of vital information and statement that rules the design and construction process. These requirements in architecture are mostly commonly treated during architectural programming, as early in the design process (Ozkaya & Akin, 2006). However, working on requirements may differ due to project type, client typology, and delivery methods. In any case, the requirements should be elicited by various capturing and validating methods or frameworks for the project's success.

Problems related to the elicitation of client requirements are, to a large extent, linked to designer-client communication issues in which the design proposal does not reflect the certain requirement of the clients (Haug, 2015). Architects try to design and reflect their thoughts on design in a situation of insufficient consideration of the requirements. To be able to work on construction drawings, utilization of the requirements is needed. For complex space requirements, end-users should be involved in the design process, and communication should be facilitated between them and designers.

The gaps in requirement elicitation and briefing process have been studied and examined widely in the literature. One of the important problems is capturing the demands and wishes of the end-users properly where needed. The research laboratory is a building typology in which the architectural program spaces are affected by the utilization of researchers. Thus, the researchers' (end-user demands and wishes should be captured, validated, and converted into requirements. This study presents an applied process for reuquirement elicitation with end-users. The experience of execution belongs to the design process of Kırıkkale University Research Laboratory. The building was designed in 2017 to create research spaces for existing academicians in the university. Firstly, theoretical framework including briefing, requirement management, and knowledge capturing to conduct the field's definitions, studies, lacks, and problems. Then, the design brief of the building is presented. The applied process is investigated considering the relationship between the project stakeholders and activity diagrams. The evaluation of the applied process and conclusion are conducted in the study. One of the major contributions of the process is that the involvement of the end-users is sustained for requirement elicitation with a proper framework. The separated stages make the communication between project stakeholders clearer and more accurate.

2. THEORETICAL FRAMEWORK

Briefing

The briefing is a process used not only in the construction industry but also in many fields involving various project stakeholders. The briefing is a process of understanding an organization's needs and resources and matching them to its objectives and mission (Blyth & Worthigton, 2010). Thus, as a process, it is vital to identify requirements, objectives and statements, match them at the right time in a clear medium, and validate the outcomes by common consensus. The documentation of the briefing process can be hard to manage and track. Studies show that architects are often dissatisfied with briefing documents (Heintz & Overgaard, 2007). These papers and mediums require essential attention from clients, construction teams, and architects. These documents are sometimes lengthy and comprehensive to provide precise project details. There is a need for the management of client-end user requirements, planning for the instructed cost and time, management of the information and knowledge of project stakeholders, evaluation of the process and project in terms of feedback into the future, and the success of the project, even though it is challenging to develop useful methods and frameworks for briefing where a designer's use is intended.

According to the building's kind, size, and complexity, the brief's development and creation procedure may change. The knowledge management cycle for complex projects may include significantly more information flow and involve numerous multi-disciplinary individuals, necessitating additional obstacles for briefing (J M Kamara, Anumba, & Hobbs, 1999). Barrett listed rule-based and knowledge-based failures about briefing and provided suggestions for improvement (Barrett, Hudson, & Stanley, 1999): (1) brief takers' reliance on experience, information has to be presented in a way that is acceptable to individuals, (2) individual brief taker may be appropriate instead of architect, (3) client should be involved more to provide the necessary checks to ensure the brief is on course, (4) a neutral computer-based expert system may back up the weak areas of professionals. This process may start before the process stage and run after the completion of construction for evaluation as shown in Figure 1. Although it takes a longer view and focuses on the operation's strategic growth goals, prospects, and the possibility of adapting the facility for other purposes, strategic briefing is born out of the current operational demands (Ryd, 2004). Project Brief comprises functional, fit-out, and operational briefs (Blyth & Worthigton, 2010). The post-project briefing is related to evaluation and feedback.

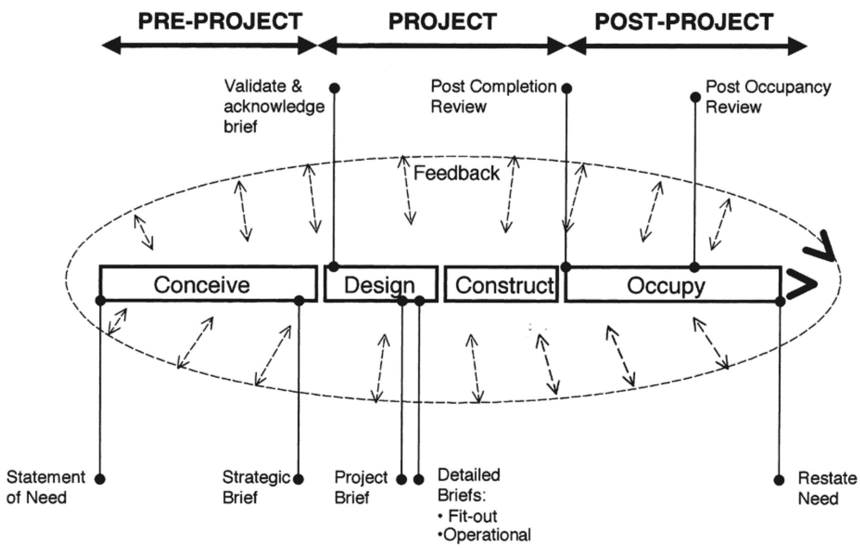

Figure 1 : Stages of Briefing (Blyth & Worthigton, 2010)

Requirement Management

Requirement Management (RM) is one of the important aspects during the briefing term. It is important for efficient construction delivery and challenging completion (Shen, Li, Chung, & Hui, 2004). The terminology used to collect, examine, process, and assess customer demands identifies different facets of the subject. While requirement engineering covers elicitation, analysis, prioritizing, specification, and validation, RM is concerned with documentation, storage, communication, tracking, and traceability (Bray, 2002).

Construction clients seek projects that retain correct designs following their requirements in a suitable amount of time and money. The briefing procedure designed by project stakeholders defines and states customer requests as a client requirement. Due to the ambiguity and complexity of the project brief, the construction sector has struggled to meet these criteria (Shahrin, Johansen, Lockley, & Udeaja, 2010). The problems, guidelines, tools, and methods were summarized in the study of Pegorraroa and Carisio (2017). Lack of communication, objectives and decision clarity, client inexperience, involvement of end-user, and evaluation of solutions for client's requirements could be listed as critical factors.

The requirement knowledge of construction projects should be elicited, refined, validated, and used for the design of the buildings. The requirement eliciting process may differ due to client, delivery method, or building typology.

Knowledge of building project process, site, client, and regulatory requirements is available. To handle the knowledge of the requirements, there is a need for integration and collaborative working across project stakeholders. Types of knowledge about requirements are presented (John M Kamara, Anumba, & Evbuomwan, 2002);

Client requirements

- Site requirements
- Environmental requirements
- Regulatory requirements
- Design requirements
- Construction requirements

The knowledge of space requirements cannot be defined by not involvement of the end-user in many cases. There some obstacles to communicate between end-users. The absence of them, not using the same technical knowledge, insufficient time and client approach may result in the loss of interaction between the designer and end-user. Even if end-user involvement in the briefing process is sustained, a framework is needed to run the requirement elicitation process. This leads to obtaining higher-quality information. Higher quality of information will lead to better communication between stakeholders (Tessema, 2008). This cycle loop allows parties to participate in the process with better performance.

Although there is communication between designers and paying clients, there may be a common language limitation or difficulty in sharing expertise. By better understanding user needs and presenting information effectively, such as through organizational charts, personnel projections, workflow diagrams, visualization methods, relationship diagrams, etc., it may be able to close the gaps (Figure 2).

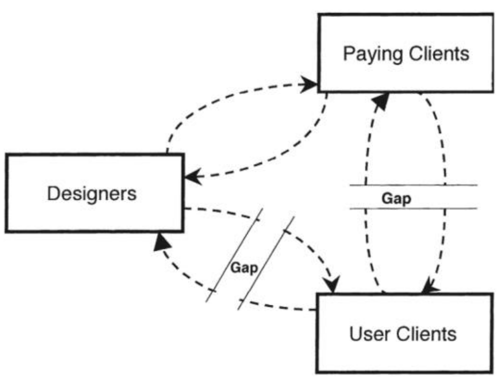

Figure 2 : User-Needs gap (Zeisel, 1984)

Knowledge Capturing

Various researchers did the explanations of the knowledge. It can be addressed briefly in the intersection zone of information, capability, and understanding (Groff & Jones, 2003) for the construction process knowledge inquire all needed stages, types, and resources that can affect the success of design and construction. An important aspect of knowledge processing for the construction industry is its tacit/explicit dimension. Since the transferring, capturing, and converting are affected by this dimension. Tacit Knowledge comes from experience and practice and is hard to formulate. It can be characterized as inexpressible, ineffable, and hard to tell (Polanyi, 2009). In contrast to tacit knowledge, which is personal, context-specific, and challenging to codify, convey, and transfer, explicit knowledge is packaged, readily codified, communicable, and transferable (Kidwell, Vander, & Johnson, 2000). This is important to capture requirement knowledge from end-users since; generally, designers and end-users have no common experience and skills.

The knowledge cycle defines the knowledge creation and sub-processes, which are parts of the whole process that capture, archive, understand and reuse. Capturing is important for gathering knowledge from individuals, groups, or organizations. The construction industry employs knowledge management (KM) tools, principles, and ideas to capture and disseminate knowledge about positive effects on the process. While academics and practitioners design some tools for certain stages of the briefing and construction life-cycle, others are recognized by various industries and used throughout the building process. These tools can be categorized as KM techniques which are non-it tools, and KM technologies which use information and communication technology (Al-Ghassani, 2003). Some of the actual practices on capture, sharing, and reuse of project knowledge can be listed as; post project reviews, brainstorming, communities of practice, training, recruitment, face-to-face interviews, mentoring, text and data mining, knowledge bases, reassignment of people, groupware, case-based reasoning, project extranets, lesson learned tools, observation, repertory grid, meetings, surveys, consensus decision making, concept map, and cognitive map (Al-Ghassani, 2003; John M Kamara, Anumba, & Carrillo, 2003; Pourzolfaghar, Ibrahim, Abdullah, & Adam, 2014; Tan et al., 2010).

The design briefing uses all the sources that provide the inputs for design development when capturing knowledge. The capturing difficulty varies depending on the sources and nature of the knowledge. Implicit knowledge that belongs to an individual or a community requires difficult-to-achieve procedures or technologies. One of the key advantages of knowledge capture in the design briefing is the capacity to elicit and confirm customer needs, which are ideal for building requirements already established in the client's minds. Moreover, the design team can develop high-quality designs if these criteria are clearly defined (Olatokun & Pathirage, 2015).

Research Laboratories

Laboratories are workplaces with instruments and equipment required to conduct experiments and research (Mahmoud, Sanni-Anibire, Hassanain, & Ahmed, 2019). More advanced laboratories must serve students, academics, and researchers than a simple kitchen where experimental observations are made (Cooper & Kerns, 2006). Contemporary laboratories are designed and constructed in a flexible and secure framework for users' needs and objectives.

There are various types of laboratories for different disciplines. A general list is presented as General or Analytical Chemistry Laboratory, High-Toxicity Laboratory, Nanotechnology Laboratories, Engineering Laboratories, Pilot Plant: Chemical, Engineering, and Biological, Physics Laboratory, Controlled Environment Room: Hot or Cold, High-Pressure Laboratory, Radiation Laboratory, Biosafety Laboratory, Clinical Laboratories, Teaching Laboratory, Gross Anatomy Laboratory, Pathology Laboratory, Autopsy Laboratory, Morgue Facility, Open or Team Research Laboratory, Animal Research Laboratory, Microelectronics and Cleanroom Laboratories, Printmaking Studio, Academic Laboratories (Daniel, 2001; Daniel Watch and Deepa Tolat, 2017; DiBerardinis, Baum, First, Gatwood, & Seth, 2013; Dorgan, Dorgan, & McIntosh, 2002). Due to the purpose of utilization, the design and construction criteria have differences in a level.

The spatial designs of laboratory facilities are either modular or open plan: Modular layouts allow for a single-unit laboratory confined by partition walls or a large space that can be subdivided using partitions according to the needs (Mahmoud et al., 2019). The laboratory module is the key unit in any lab facility, and a lab module will coordinate all the architectural and engineering systems (Daniel, 2001). Access and circulation, the generated chemicals and biological wastes by activities, needed thermal conditions, arrangement of furnishing and equipment, health and security, flexibility, compartmentation due to activities, and support services are important issues that must be considered in the design process (Daniel, 2001; Daniel Watch and Deepa Tolat, 2017; DiBerardinis et al., 2013; Griffin, 2005; NRC, 2000).

Academic laboratories include research and teaching labs which Academic research labs can be very similar to those of the private and government sectors (Daniel, 2001). Teaching laboratories at undergraduate levels are different and the laboratories in academic research laboratories. They sustain fundamental services for students. The requirement of academic research laboratories differs due to researchers and the working field. Thus, the needs should be defined and validated. However, Academic labs can generally be classified into the following categories: Biology labs, Physics labs, Chemistry labs, Engineering labs, and Geology labs (Daniel, 2001).

3. DESIGN BRIEF of KIRIKKALE UNIVERSITY RESEARCH LABORATORY

The project is located on the main campus of Kırıkkale University. The land is in the Technology Development Part of the campus. There is a slope from west to east which can result in one level difference according to the locating of the buildings. As shown in Figure 3, the main access to the building is from the west direction, and this direction is designed as a front façade. The 3d render from the front façade is illustrated in Figure 4. The building is separated due to function in two: the office block at the north and the laboratory block at the south. The main circulation and entrance are located at the intersection of these blocks. The laboratories are planned in a modular system that can be organized in the design and usage stages. The service entry is planned at the south part of the building, which has direct access to laboratories. It is supported by independent stairs and service elevators to service the research facilities. The offices are for the academicians and administration of the building. Some offices are planned to use temporarily for the researchers according to their accepted project in this facility.

Figure 5 shows the first level plan, which explains the main spatial organization of the building. Besides, the office has a ground floor with an office and entrance. The laboratory part has three floors: ground, first and second. All level plans are in the same modular arrangement, which differs due to researchers' needs. As a difference, it can be noted that some part of the laboratory' bloack is reserved for building and research services only in the ground plan. The main objective for constructing a new research laboratory building is to bring the existing laboratories together, which are spread in the various buildings of the university. The physical conditions of these spaces should be improved. Also, new research units are planned in buildings with the integration of the university's strategic plans. The building was thought to be around 4.000 m2 in total because of the budget limit. The laboratories related to chemistry, biology, and physics for research were decided to be in pre-project stages. The design of the building was completed in 2017, and the construction will be finished in 2023.

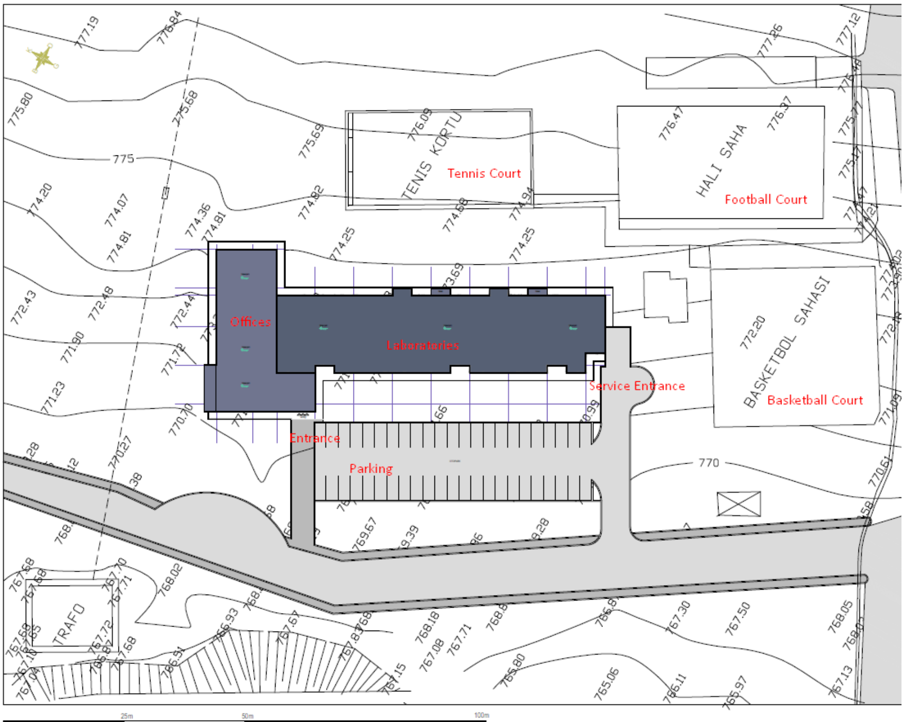

Figure 3 : Site Plan

Figure 4 : Render

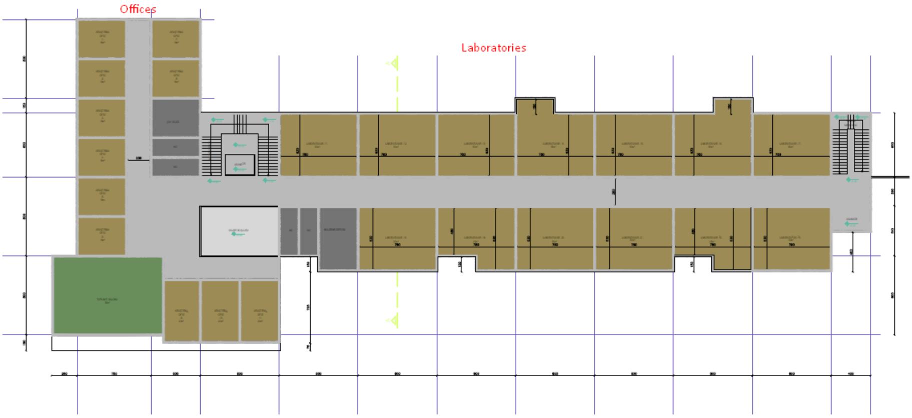

Figure 5 : 1st Level Plan

4. APPLIED PROCESS

The situation of the Project Stakeholders

The project work was executed after a bidding process in which the construction team was absent. After the completion of the project, another bidding project was done for the construction. Thus, in the project stage, there is no relation to the project team as the project stakeholder. Architectural and engineering offices are involved in the design side of the project. For each discipline, the University Construction Work Department's experts were assigned. As an end-user, the involvement of the academicians who would use these facilities was vital. Thus, their participation of them was maintained with their great contribution. The head of the research team stated at the pre-project stage that they would give maximum support to figure out all the laboratories. However, the main problem was to define a procedure and communication medium for those who had no technical knowledge but knew all the working criteria of research laboratories.

Process Description

The process that was used for requirement elicitation is shown in Figure 6. This figure was drawn by the author from minutes of meetings, records process- and documents of room sheets of the project archive. It presents the inferences and learnings from the design study completed in 2017. The process was executed between Turkish People, so all the documents, meetings, and mediums are in Turkish.

Pre-Project Stage: Before the involvement of the designer, the requirements had been asked from the researchers (end-user). The university's (client) controllers refined the general requirements layout and prepared for the definition of an architectural program.

1st Stage: Due to the submitted architectural program, the designer prepared the proposal. Draft plans, sections, and 3d rendering were submitted, and a presentation was executed to the client. Some revisions were done during this stage, and the approved preliminary design was achieved. Laboratories were designed in modular and flexible ways to allow end-user and designers to relocate and arrange the units.

2nd Stage: After the layout approval, the designer prepared technical drawings and templates of the room sheets for each laboratory unit. The end-user submitted the technical drawings in an easily understandable version, including scale and explanations. The room sheets include all necessary information about any laboratory considering furnishing, electrical demands, temperature needs, ventilation requirements, wastes, medical gases, etc. These documents were sent to end-users with an explanation of demands, and they were informed to meet about their work in 3-4 weeks.

3rd Stage: A set of meetings for briefing about the end-users' studies. The main aim is to capture all the requirements by working on the researcher's preparations. All requirements and arrangements of the laboratory units were done and captured in a draft version during these briefing sessions. Individual briefing sessions were executed with different end-users. The cases which were not proper to client statements were tried to solve during the session; if not, they were noted, and latterly related project stakeholders were informed.

4th Stage: The captured knowledge from the briefing sessions is refined and reflected in the architectural drawings with documentation. During this stage, some online and face-to-face meetings were also conducted to solve the remaining subjects. The outcome of this stage was submitted to end-users for their approval.

The approved room sheets and layouts include all necessary information for construction drawings, such as positive pressure demands, medical gases, electrical demands, laboratory separations, types of equipment, and furnishing. Thus, the captured knowledge could be used by both the project authors for completing the construction drawings and the client for controlling and validating the completed drawings. Besides, all project stakeholders agreed to reflect the demands of end-users. During the 3rd stage, approximately 15 different briefing sessions were completed with end-users.

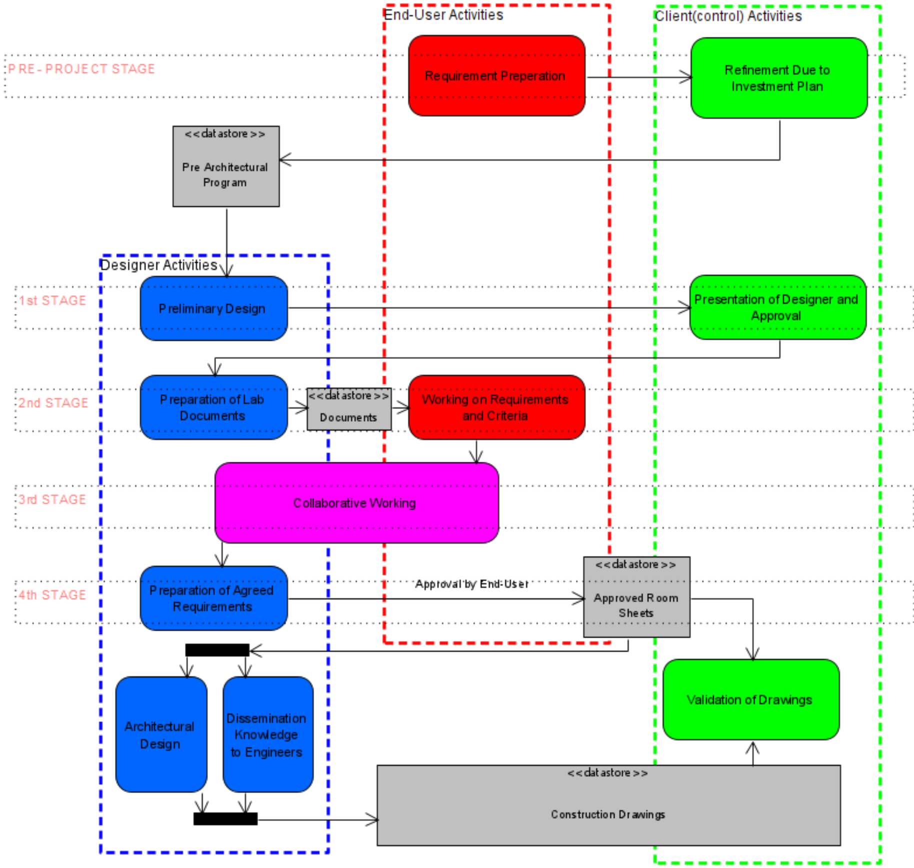

Figure 6 : Overview of the Process

5. EVALUATION of the PROCESS

The architectural design of the building was evaluated in different sessions with the client. Thus, the project could be evaluated against their expectations, site conditions, budget, technical issues, and construction process. Possible conflicts in communication were eliminated by setting separate briefing sessions and stages and recording and validating the outcomes. In the 1st stage, the designer found more working spaces without concentrating on the detailed and complex requirement environment. The modular and flexible laboratory unit design, which the architectural program considered, made the project possible to serve solutions for the demands of the end-user. Besides, the approved preliminary design shaped the boundaries for the building, including space areas, heights, and more than planned wishes during the second and third stages in which the end-users participated. End-users had no knowledge or experience with buildings that could affect the architectural program.

End-users participated in the processes at the expected level. Their knowledge about the requirement of specific laboratories could be reflected in the design. Besides, by conducting briefing sessions, they understood the spaces and could be able to transfer their demands adequately. In this process, the sufficient time that project stakeholders spent were vital. Even if the mediums and documents prepared by the designers were used, elicitation would be impossible without sparing enough time.

One important cycle of capturing any knowledge to elicit requirements is validating them. The collaborative work between designers and end-users had a significant role in capturing and validating the requirement. Because for end-user, it is so hard to examine technical documents for any approval. During this stage, by preparing draft documents and explaining the outcome to end-users by designers, end-user could easily understand the documents submitted after approval. Thus, validation of knowledge was completed, and requirement elicitation with the end-user was successfully executed. The approved documents serve as references for the construction drawings to project authors. Also, they were used by the client for controlling and validating construction drawings.

CONCLUSION

The requirement elicitation process is complex due to project typology, client type, and delivery method. The limitations and lacks can be found in the literature, such as improper framework, the experience level of project stakeholders, involvement of end-users, and insufficient time. Research laboratories complete building in the meaning of managing the users' requirements. Even if there are widely used guides, specifications, and legislations, the spaces and their needs change due to the research objectives defined by the end-users.

This study presents a process for requirement elicitation with end-users from the completed design project as a case study. The architect of the project authors was used to draw the process overview and evaluate the outcomes. As a revealing result, it can be stated that with the proper framework and involvement of the end-users, communication between people with different technical knowledge can be sustained. Besides, the separation of stages due to the need for involvement and the process stage makes the knowledge flow far from the conflicts. The validation of the captured knowledge from the end user establishes a completed requirement elicitation process. One bottleneck of the study is not being able to conduct any post-occupancy evaluation for the building's usage. In parallel to the completion of construction and after a period to start utilization, the evaluation of the applied process should be expanded and validated by actual users.

ACKNOWLEDGEMENT

Thanks to the project stakeholders for participating in the design and construction process.

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Chapter 3

An Evaluation on the Re-Functioning of Malatya Sevserek Han from Seljuk Caravansaray

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ABSTRACT

Anatolia has always been important with its cultural heritage values. Caravanserai and inn structures, which are one of the richest cultural elements of Anatolia, clearly show this importance to us. It is not possible to use the caravanserai structures in accordance with their original function in today's living conditions. It is difficult to transfer the structures that have lost their old functions to future generations with only preservation. It is necessary to present them to the needs of the society and to make them reusable. Because unused structures will become idle after a while. Re-functioning, one of the contemporary conservation techniques, is aimed at eliminating this situation. With the space syntax method used within the scope of the study, it is aimed to bring the building to our cultural heritage by presenting a new function proposal according to the connection value of the spaces.

The Sevserek Han structure, which is considered within the scope of this study, has been made using the spatial analysis of the space syntax method. A new function line routing the result of these analyzes to the path is executed. It is aimed to comply with the limitations of the desired function and to extend the life span with the use of the enclosure. Better protecting the guards, by needing re-functioning, would increase the effort to maintain the protection, protection and re-enforcement frameworks. In addition, this collection of articles, loss of use and the necessity and importance of re-functioning many inns and caravanserai structures that have been closed will be better understood.

Keywords: Caravanserais, Re-functioning, Space Syntax Method, Conservation, Architecture

INTRODUCTION

Throughout history, Anatolia has been a bridge between Asia and Europe due to its geopolitical and geographical location and has hosted many civilizations. As a result of the archaeological excavations and discoveries, Anatolia emerges as an important settlement area where people have lived since the early days. With the Turks starting to settle in Anatolia, the way for the Islamization and Turkification of this geography was opened. The conquest of Anatolia by the Turks is one of the most important events in the history of the world. In the Anatolian geography, with the establishment of the Anatolian Seljuk State, studies were started for the re-development of the region. Turks realized the geopolitical, strategic and topographic importance of Anatolia and they made Anatolia a center of politics, science, trade and civilization again. The Turks; By interacting with the Roman-Byzantine cultures that they inherited from Central Asia and encountered in Anatolia, they created their unique Anatolian Seljuk Turkish architecture and art.

The trade networks that started to develop in Anatolia also necessitated the construction of new routes. Trade networks were expanded with the construction of new caravan routes and the renewal of old Silk and Spice routes. There was a need for structures that would meet the safety and all needs of trade routes and the caravan passengers using these routes. Caravanserai structures were designed to meet the needs of passengers and caravans at that time, and were positioned on trade and caravan routes. Although these monumental structures, which are located at certain distances on the road routes, have lost their original functions today, they can reflect the socio-cultural traces, architectural style, construction technique and features of the period in which they were built.

Today, these historical inn and caravanserai structures have lost their original functions due to many factors such as environmental, economic, social and cultural changes, and many of them remain idle and disappear. The aim of this study is to protect the idle caravanserai structures by increasing the human-space interaction and giving them a function again in accordance with the identity and spirit of the building. As a tool for the protection of historical and cultural structures that have lost their current function, it is aimed to use the building and extend the life of the building by re-functioning. Within the scope of this study, the Sevserek Han structure, which is located in the Battalgazi district of Malatya province and has a bad structural condition, has been discussed. It is aimed to give a new function to the spatial organization of the caravanserai, which has lost its function over time, by using the space syntax method. Space syntax, which is used as the method of the study, reveals the direct relationship and connection between space organization and social structure both graphically and numerically. Thus, by determining the space organization scheme of the caravanserai, it is aimed to give a function in accordance with the way people perceive and use the space.

As a result, it is necessary to preserve the caravanserai structure, which has lost its original functions today, but clearly shows the characteristics of its own period, by giving it a function again. It is thought that opening the caravanserai structures to the use of people by re-functioning will contribute positively to the preservation and transfer of these cultural and historical structures to future generations. Especially in this period when great cultural losses were experienced as a result of the earthquake, the protection of these structures, which reflect the past of people and societies, has increased its importance. It has been expressed by various studies that architecture is the most important factor affecting the emotional and cultural consciousness of people. In this context, we are in a period when we most need these historical cultural assets inherited from our history, culture, and us in these days when everywhere is ruined, devastated and devastated. It will be a light for future generations to restore many historical buildings in the region, such as the Sevserek inn, by giving them a function in accordance with their identity and spirit.

ANATOLIAN SELJUK CARAVANSERAI

The sultans of the Anatolian Seljuk period understood the importance of trade and caravan routes and created new roads in addition to the old trade routes. Trade was given importance by connecting the historical Silk and Spice roads to the Mediterranean and Black Seas in Anatolia. Thus, Anatolia started to develop culturally, socially and economically in a short time. Caravanserai structures were built to meet all kinds of needs of people and animals using caravans and trade routes, such as shelter, accommodation, security, food. For centuries in Anatolia, caravanserai structures continued to function as an important building group. These caravanserai structures, located at certain intervals and in important intersection areas, are the most important examples of cultural heritage that provide information on many subjects such as the social, cultural and architectural style of the period.

Development of Caravanserai Structures

Caravanserais are structures that first emerged with the logic of ribat. It was created to meet similar needs according to terms and conditions. In the process, ribat, inn and caravanserai began to be used in the same sense. The caravanserai structures built by the Seljuks differ in terms of space setup and understanding of architectural art. (Şahin, 2016).

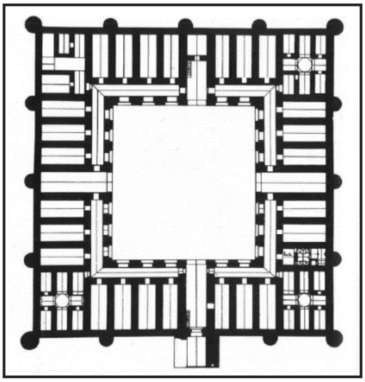


Figure1: Ribat (Cezar, M.,1977)

The architectural style and layout of the Anatolian Seljuk caravanserais were shaped according to the original conditions of the period and the basic needs of merchants, soldiers and passengers such as protection and shelter. For security reasons, the caravanserais were built with solid and massive walls like castles, and were supported with bastions, towers and buttresses to strengthen the building walls. In order to meet the shelter and accommodation needs of the caravans, their animals and belongings, rooms and sections such as a warehouse, cellar, pharmacy, farrier, shoemaker, soup kitchen, masjid, hammam were built. Many caravanserais were built along the route of the caravan routes. This situation varied in spatial planning such as caravanserais, open (courtyard) and closed spaces in different climatic conditions. (Şahin, 2016).

Climate and geographical conditions, the needs of the users, and accommodation were effective in the separation of the Anatolian Seljuk Caravanserais into different plan typologies. For this reason, it is classified into different plan typologies by researchers. Many researchers such as Aslanapa (1989), Karpuz (2001), Erdmann (1965), taking the indoor and outdoor spaces of Anatolian Seljuk caravanserais as measurements;

- 'hall' inns consisting of only closed parts,
- Courtyard inns consisting of only open parts,
- As inns, which consist of both closed and open parts, they divided the caravanserais into three groups in terms of architectural space. (Yavuz, 1976).

Bektaş (1999), on the other hand, differs according to the number of naves of the closed space of the caravanserais; grouped as one nave, two naves, three naves, and five naves (Aslanapa, 1993; Erdmann, 1961; Karpuz, 1995; Bektaş,1999). Researchers such as Yavuz (1976), Aytaç (2002), Günel (2010); They added 'interlocking (concentric)' caravanserais to the caravanserai plan typology and examined the typology in four groups. The same Sevserek Han structure within the scope of this study has a concentric plan typology.

Concentric (Interlocking) Anatolian Seljuk Caravanserai

Anatolian Seljuk Caravanserais have been evaluated according to their spatial configurations; It is divided into three as 'hall' inns consisting of only a closed part, inns with both open and closed parts, and inns with only an open part. However, due to the differences in spatial organization in the process, concentric (interlocking) inns were added to the plan typology as the fourth group (Yavuz, 1976).

Sevserek Han, which is our study area, is among the rare structures in the group of concentric (interlocking) inns as a criterion in classification.

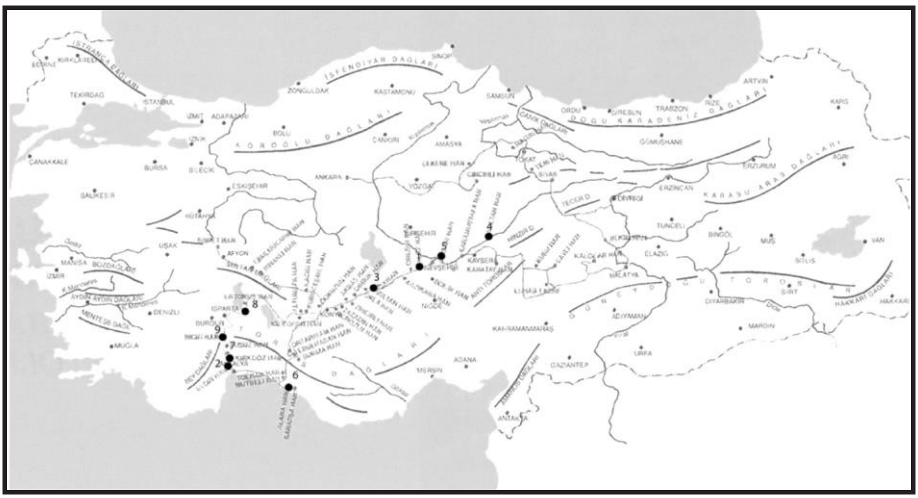


Figure 2: Anatolian Caravan Routes (Bektaş, 1999)

Anatolian Seljuk period caravanserais are generally classified as shown above, although different classification methods are applied. But Yavuz(1976 and 1991); Alara Han, Eshab-ı Keyf Han, Mama Hatun Caravanserai, Sevserek Han, Mirçinge Han and Yerhan are classified in the fourth group as concentric Anatolian Seljuk Caravanserais in terms of plan scheme and space setup. The plan layout of the aforementioned caravanserais, from the center to the outside, the spaces are designed as courtyards, rooms-iwans and service areas-stables. The plan scheme in these structures differs from other caravanserais according to their function. In addition, due to the large number of rooms and the fact that most of the places are reserved for people only, a different classification was needed. Since these caravanserais differ from other caravanserais in terms of features, they have a special plan scheme. Among the concentric structures, which have similar plan schemes with other caravanserai structures, only Alara Han has survived to the present day.

MALATYA SEVSEREK HAN (ÇİFTE HAN)

Malatya has always been a center of attraction and attraction due to its location at the intersection of historical trade and caravan routes, being next to important water resources. For this reason, there have been many wars and conflicts in order to have the Malatya region, and the region has been destroyed many times. Malatya has an important position in terms of its cultural and natural riches. However, it has not been able to preserve many of its cultural and historical riches until today. In this respect, it is very important for us and future generations to preserve and preserve these historical and cultural heritage riches that have survived to the present day.

Malatya City

Malatya province, located in the westernmost part of the Eastern Anatolia Region, is located in the Upper Euphrates basin. Malatya is surrounded by Sivas in the north, Adıyaman in the south, Kahramanmaraş in the west and Elâzığ in the east. The road routes that have been used for centuries with the surrounding provinces have provided the transportation of many civilizations from the past to the present, and the formation of some buildings and building groups has been observed on these routes.

Although settlement was intense in Malatya and its surroundings, especially in the Bronze and Chalcolithic ages, there were also settlements in the Neolithic, Mesolithic and Paleolithic ages (Aytaç, 1998). Malatya, which is a transit route due to its location, contains important roads connecting Mesopotamia to Anatolia (Aytaç, 1998).

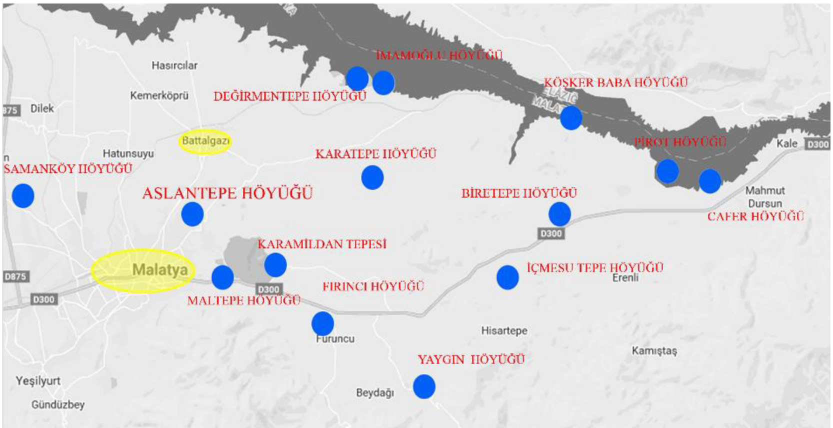


Figure 3: Map showing the settlement in the Malatya region in the historical process

When the inscriptions from the Hittites and Assyrians are examined, it is known that the first settlement started in the mound areas located in the south of Malatya, which is now called Arslantepe. M.S. In the 1st century, the city was moved to the region called Old Malatya today (Aytaç, 1998), (Baykara, 1988), (Göğebakan, 1992). Old Malatya, with its current name Battalgazi, is located 8 km north of Malatya as a district center. In addition, various caravan routes within the provincial borders of Malatya are as follows; Malatya-Elbistan, Malatya-Sivas, Malatya-Divriği, Malatya-Harput, Malatya-Kahta, Malatya-Adıyaman are routes (Aytaç,2017).

The fact that the trade routes connecting Mesopotamia to Anatolia from past ages pass here and that it has areas where various agricultural products are grown has contributed to the social, cultural and economic development of the city in Turkish periods, as well as having these features in every period (Eskici, 2013).

The city, which was under the rule of the Byzantine state until the 12th century, has passed into the hands of the Turks since this date. Since this date, there are artifacts from the Seljuk, Mamluk and Ottoman periods in the city. According to the information obtained from written sources, many religious and civil architectural works were built here; however, the vast majority of these works have not survived until today. One of the losses in the field of cultural heritage is Eski Malatya; Abandoned since the beginning of the 19th century, the city was left unclaimed. As a natural process, most of the monuments in the city have been destroyed by neglect; some of them were completely destroyed in order to use their stones and materials or to make fields. This situation has made it necessary to protect the historical monuments left behind at least (Eskici, 2013).

Battalgazi District

Battalgazi district has a great cultural heritage in its geography in terms of history and archeology. Considering the findings obtained as a result of the studies and the finds unearthed in the excavations, the culture of the district dates back to BC. It has been found to date back to 6000 years. Traces of past civilizations are found in the foundation excavations. Battalgazi district is named after Battal Gazi, a Turkish-Islamic commander and Hero, and is also known as old Malatya. It is located at the intersection of the roads coming from historical Anatolia and the Middle East and on the most used caravan routes. The interaction of Battalgazi with other civilizations extends to Iran and even the Far East in the east, the Caucasus in the north, Çukurova, Mesopotamia and Syria in the south (Malatya Kültür Envanteri, 2021).

The district has been exposed to many attacks in history and has come under the protection of many civilizations. This is because it is a border city in the East. While the district was under the auspices of Byzantium, it was attacked by the Sassanids and changed hands between the Arabs and Byzantines from the 7th century to the 10th century. During the reign of Yavuz Sultan Selim, the district remained under the protection of the Danişment in 1101 and the Anatolian Seljuks in 1105, until it passed under the protection of the Ottomans in 1516 (Malatya Kültür Envanteri, 2021).

There are many historical textures in the district. Foremost among these are the Roman fortifications, the oldest 1224 Old Malatya Great Mosque, and many mosques, tombs and vaults (Kanlı Vault, Nefise Hatun Vault), Silahtar Mustafa Pasha Caravanserai, Şişman Han, Sevserek Han and the medrese ruins. It contains many cultural structures. It also has an intense historical and cultural texture with its many historical buildings and archaeological settlements (Malatya Kültür Envanteri, 2021).

The Location and History of the Sevrerek (Çifte) Han Building

Sevserek Han is located in Tokluca neighborhood of Battalgazi district. It is 6 km from the Malatya-Elazig highway. It is located 21 km southeast of Malatya, 15 km from Malatya. It is approximately 17 km from Old Malatya. Due to the presence of the remains of a similar inn structure in the same village 80 m east of the building, these two inns are also called double inns among the people.

Figure 4: Representation of Sevserek Inn as a Location

From the plan features of the building, it is understood that it is an application of concentric caravanserais of the Seljuk period. Ünal(1979) Alara Inn (Anatalya-Konya) dated 1231, Eshab-ı Kehf Inn dated between 1232-1234, Mama Hatun Caravanserai in Tercan and Yerhan (Erzincan-Refahiye) dated to the end of the 13th century, and Sevserek Inn in the 13th century due to their similarities. It dates back to the first half of the 19th century (Ünal, 1979; Aytaç, 1998).

Regarding concentric inns, Ayşıl Tükel Yavuz has included Mirçinge Inn (Divriği-Arapkir, Divriği-Malatya) in the category of concentric inns in the publications and dated it before 1230 (Yavuz, 1976). All of the above-mentioned inns are thought to have been built in the first half of the 13th century (Ünal, 1979).

Figure 5: Pictures of Sevserek Han from different angles (URL1)

It is understood that together with Sevserek II Han, which is 80 m east of Sevserek Han, they formed an important range during the Seljuk period. In the Ottoman period, these inns ceased to be ranges (Yinanç and Elibuyuk, 1983).

Sevserek Han is one of the seven known caravanserais with concentric plan typology in Anatolia. For this reason, it is very important. In caravanserais, the connection to the outside is generally provided by a single sentence gate. In this work, however, it differs due to the presence of an iwan-shaped front entrance, two side spaces opening to this place, and another space opening directly to the outside. (Aytac, 2017).

Architectural Plan Review

The land on which Sevserek Han was built is inclined to the West, and the building has a south-north direction concentric plan typology. Its short sides are 27.70 m long, and its long sides are 45.40 m long. The east and north facades are 1.40 m, and the west and south wall thicknesses are 1.60 m. Entrance to the building is provided from the 5.50 m iwan on the northern façade (Aytaç, 2017). There is an entrance in the form of an iwan, with the portal pulled in, measuring 5.50 m X 5.50 m.

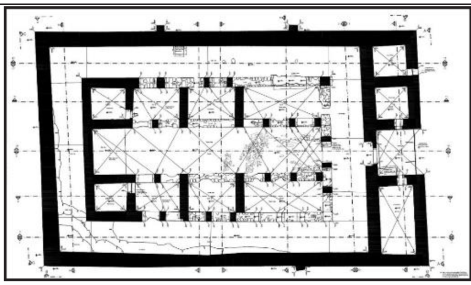


Figure 6: Sevserek Inn - Survey Drawing-Plan (Archive of Protection, Implementation and Control Bureau, [KUDEB], Malatya ,2022)

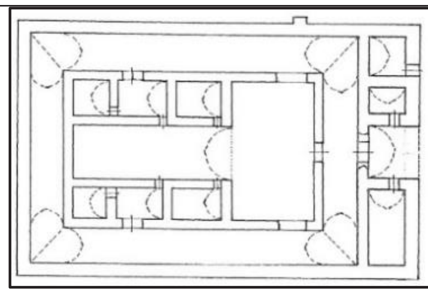


Figure 7: Sevserek Han, R.H. Drawn from ÜNAL (1979).

To the east of the iwan is a space of 8.10 m X 4.60 m, which is thought to be vaulted. The surrounding stones of the door of the place opening to the iwan were removed. There are two rooms to the west of the iwan. The space adjacent to the iwan and measuring 3.80 m X 3.90 m opens directly to the outside. From the entrance hall, the shelter area surrounding the middle spaces of the inn is passed. This place was covered with slightly pointed arched vaults, and it is understood that light flowed from the lanterns placed on the vaults (Ünal, 1979). R.H. The drawings taken from Ünal are taken from the work he did in 1977. He also made a facade drawing. These drawings were also used in our study.

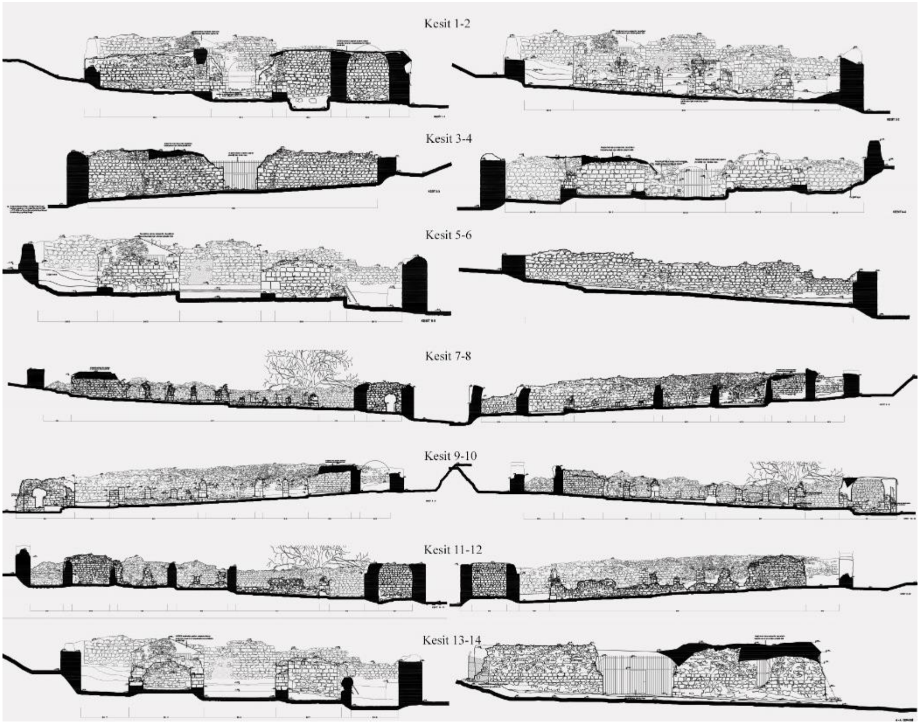


Figure 8: Survey sections of Sevserek Han Building (KUDEB, Malatya, 2022)

The plan of the middle space, whose foundations are visible, is clear. The covering stones of the door and the wall, which provides the passage from the corridor to a small courtyard, were removed. The courtyard measures 19.60m X 9.20m. Behind the courtyard is a long narrow iwan. On both sides of this iwan, there are three spaces of different sizes. The lowest spaces provide access to the spaces in the middle with a door, and these to the shelter in the middle and at the back. It is envisaged that the windows in the middle spaces on the east wing, whose stones were removed, were built to give a passage to the shelter, to control the animals and to benefit from the heat. The spaces towards the courtyard, on the other hand, open to the middle iwan with a door. It is thought that there are four rooms on the northern façade together with the entrance iwan, and six in the middle of the building. The places that are thought to exist are units such as warehouse, prayer room, Turkish bath, kitchen, toilet, independent passenger rooms and cannot be identified. There is a 90X70m buttress towards the western part of the building (Aytaç, 1998).

Figure 9: Sevserek Han shows the main wall and its foundations (URL2)

It was built of cut stone at the corners of the walls and buttresses of the inn, coarse stone forming a regular row on the walls, crushed stone and rubble stone inside. It is understood from the old photographs that the vaults were made of coarse stone. It is seen that they are covered with soil. No ornamental elements were found on the building or on the stones scattered around (Aytaç, 1998).

Figure 10: Images showing the current state of the Sevserek Han building (URL3).

Almost all of the wall covering stones of the caravanserai, which is in a dilapidated condition, have been removed. All of the vaults forming the upper cover have collapsed. Almost all of the exterior walls of the building are standing, and behind some parts of the courtyard walls, there are almost half of the service spaces (Aytaç, 1998). Today, this valuable cultural heritage structure is idle.

MATERIAL AND METHOD

Places where human actions take place and where people realize all their experiences are called spaces (Tumertekin and Özgüç 2002). All the possibilities that the structural elements create without a certain order are called syntax. syntax allows to show spatial similarities and differences (Hillier and Handson 1984). Hillier et al. define space syntax as “a model used in the representation, analysis and interpretation of space” (Can, 2014).

The space syntax method is a space reading method developed at the Bartlett School, University College London with a research group led by Bill Hillier and Jullienne Hanson. All the techniques of this method are described in the book Social Logic of Space, which was published in 1984. It is analyzed by analyzing a space setup with the space syntax method. Since it is supported by figural expressions and graphics, it has allowed us to make inferences about the space and the elements that make up the space (Çil, 2006), (Şıkoğlu and Arslan 2015). David Seamon defines the space syntax method as the most important feature that distinguishes it from other analytical approaches that have emerged recently, as the method used in defining space is based on "people's spatial experiences". Due to this feature, the space syntax method has become a method used by many disciplines, especially architecture, in many countries around the world (Gündoğdu, 2014).

The space syntax method is a technique that analyzes certain features of the built environment on a spatial scale. It helps to define the process of shaping the space and the social structure that makes up the space (Atak, 2009). The space syntax method is a method that defines the indoor organization of cities, building groups, built environment, and interior space at different scales and investigates their interaction with the social structure. The main purpose of this method is to examine the relationship between human movement and perspective and space organization and reveals how spaces affect human actions (Gündoğdu, 2014), (Şıkoğlu and Arslan 2015).

Graphics are a form of visual expression used to express the permeability of a space. These shapes enable to reveal the relationship between the interconnectedness of the spatial spaces in the whole of the building (Hillier, 1996).

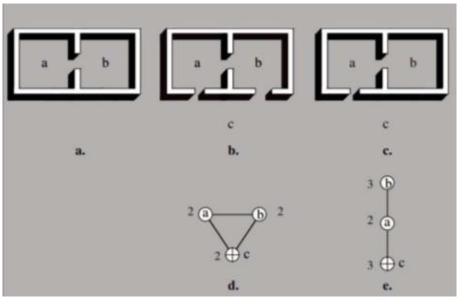


Figure 11: Example of spatial graph (Hillier, 1996).

The graph diagram shows the relationship of each space with other spaces. It shows the degrees of depth of the spaces by showing the connection of each space with the other space. Figure 11 shows how the graph diagram changes according to the different permeability of the spaces in the example. It clearly shows how even a single connection to the space has an effect on the graph diagram.

The letters shown as round in the figure represent the spaces and the lines represent the edges. If there is a connection between a space and another space, its connection is shown with lines. Every time we pass from one place to another, it appears in the graph diagram. Thus, it can be clearly seen how many places to pass through in order to pass a place, using the graph method (Atak, 2009; Şıkoğlu and Arslan 2015).

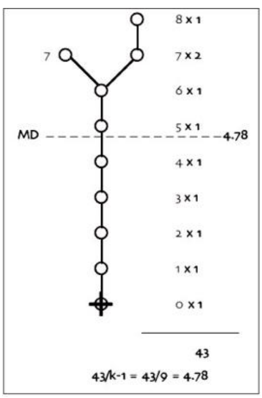


Figure 12: Calculation of the mean depth (MD) value (Czerkauer Yamu, 2010).

Another important concept, Depth Analysis, also known as Mean Depht, is defined as the least number of syntactic stages of transitions between spaces (Atak, 2009). Another concept is the concept of Integration. The concept of integration is a continuation of the concept of depth and is used together. In addition, in order to understand the concept of Integration, the concept of depth must first be known (Jiang & Claramunt, 2002).

The concept of depth is the most important of the relations found in the Space Syntax Method. Depth emerges in the case of passing through a space that has more than one intersection for the space to be reached. If the number of direction changes of the desired place is low, then the depth is called “shallow”, if it has a high value, it is called “deep”. The aim here is to express the relationship of each space in the system with all other existing spaces as a value. The average of the values of all the spaces found reveals the whole, and this provides the opportunity to compare with other systems (Hillier, 1984; Çakmak, 2011).

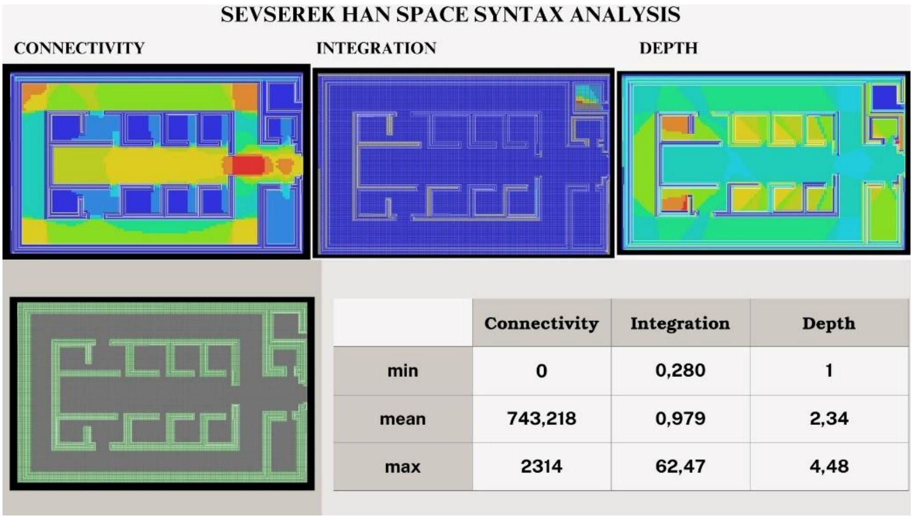
Integration value is a numerical value that expresses whether a place is a part of the system and expresses the integration or heterogeneity of the space. Integration value is obtained with the program run on the computer. The colors expressed by the transition graphic in the program describe the integration value of the spaces. Among these expressions, the red color represents the most integrated spaces of the system. The dark navy blue color shows the most differentiated place of the system, that is, the last accessed place. (Özyılmaz, 2007)

ANALYSIS AND RE FUNCTIONALIZATION OF SEVSEREK HAN

Caravanserai structures are also one of the most important elements of our cultural heritage values. Due to the changing living conditions of the caravanserai today, it is not possible to use them with their first function. However, it is very important to protect these structures and reintroduce them as a cultural heritage to future generations. Thus, it needs to be repaired and restored within the framework of the determined function and reintegrated into the society.

According to the 1964 Venice Statute, the Law on the Protection of Cultural and Natural Assets No. 2863, if a building or a group of buildings is unable to fulfill its original function due to the developing living conditions, one of the ways to protect the building and transfer it to future generations is to design the building in accordance with the needs of the day. function is required. However, while the conservation and restoration technique is applied in re-functioning, the exterior of the building should be preserved as it is, and the interior should be made suitable for the new function with minimal intervention.

In short, an application and intervention should be made in accordance with the identity and spirit of the building and in a way that will cause the least damage to its originality. Based on the principle that today's technology and materials can be used in cases where traditional methods are not possible, suggestions have been made for the building. It has been determined by the researches that Sevserek Han, which is in ruins and in danger of extinction today, could not fulfill its function when it was first built. The building should be given a function that will contribute both to tourism and the regional economy and to contribute culturally and socially to the local people. In this context, it is aimed to analyze the proposed function in accordance with the analysis result.



	Connectivity	Integration	Depth
min	0	0,280	1
mean	743,218	0,979	2,34
max	2314	62,47	4,48

Figure 13: Sevserek Han Space Syntax Analysis

In the context of Sevserek Han's re-functioning, the space-sequence analysis method was used. The space-sequence analysis method is a method that allows the spaces used in architecture or many disciplines to be expressed objectively and numerically. In this context, it is aimed to bring the building to our cultural heritage by making a proposal for re-functioning the spaces of Sevserek Han.

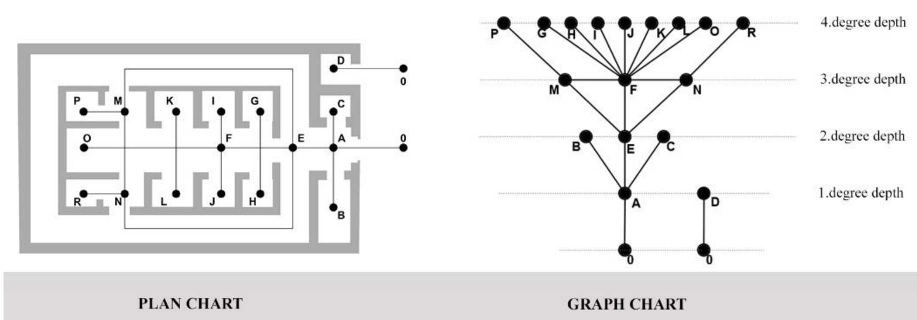


Figure 14: Sevserek Han Graf Diagram

The spaces are named alphabetically with the created graph scheme. With this method, starting from space 0 (zero), space A was first entered and it is understood that this space has a depth of 1st degree. There is a transition from space A to spaces B, C and E, and spaces B, C and E are at 2nd degree depth. There is a transition from space E to spaces M, F and N at the 3rd degree depth. The F space at the 3rd degree depth also has a transition to the M,N spaces and the G,H,I,J,K,L,O spaces at the 4th degree depth. It also seems that there is a transition from space N to space R and from space M to space P.

During the determination of the most appropriate function to be proposed for the building, first of all, the existing volumetric arrangement of the building, which is shown by the graph diagram, is taken into consideration. The functions and spaces required by the new function should be shaped by considering this volumetric order. At this stage, the elements that make up the space should be sensitive to the identity of the building and the place. Otherwise, it would be an extremely wrong practice as some interventions applied to the building are not reversible. The original space layout of the building should be perceived despite the change in function. Within the scope of the study, the Library-Book Cafe was found suitable for the function proposal we prepared as a result of the evaluation of the analyzes made with the space syntax method.

Within the scope of this study, while determining the organization of the space in line with the given function of the caravanserai, an evaluation was made on the value of connectivity and its visual, and the spaces were functionalized.

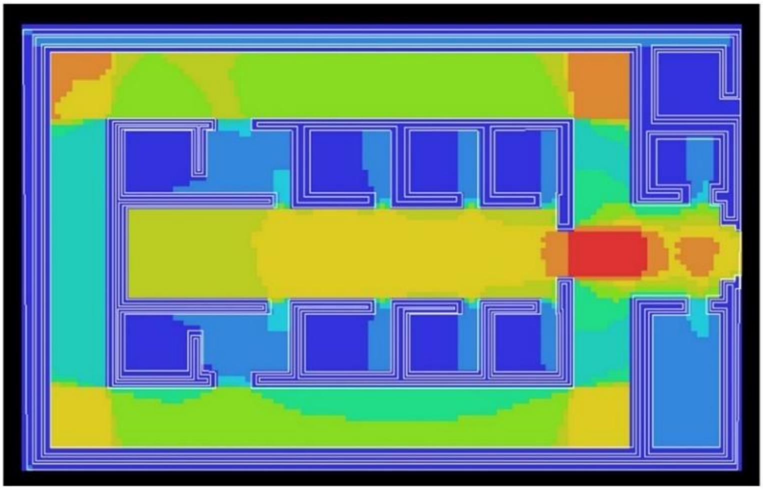


Figure 15: It shows the connection diagram of Sevserek Han structure in computer environment.

Red colors in the connection scheme of the Han structure by loving in computer environment; It refers to areas where integrationon value is high, shallow spaces, social interaction increases, visual connection and communication gain intensity. Navy blue colors are; Deep spaces refer to areas where social and visual interaction is weak and social interaction is low. In the light of these data, the spatial organization of the caravanserai was created in line with the given function.

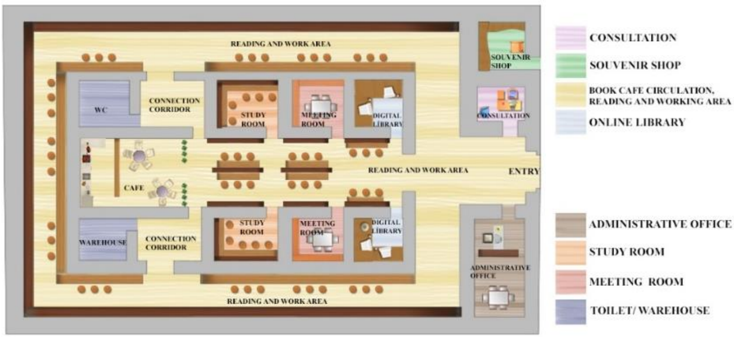


Figure 16: Shows the spatial organization of the library and book cafe function proposal of the caravanserai.

According to the function proposal we have prepared within the scope of the study; The volume, which is located in the building and opens to 0 (zero) space and has the feature of a single space, has been evaluated as a gift shop. It has been proposed to use two different sized spaces right next to the entrance as a consultation and book buying and selling office. It was found appropriate to evaluate the central nave of the Sevserek inn as two separate spaces by approaching the unique concentric plan scheme of the inn with the awareness of preserving and making use of the connection graph. Based on the necessity of these spaces to be semi-permeable, the middle nave has been evaluated as a cafeteria and working area. The deepest spaces in the building were evaluated as WCs and warehouses, and for other spaces, it was proposed to function as a study room, meeting room and online library. In addition, the entire circulation area of the inn is considered as a reading and working area, and it is aimed to perceive every space of the building. In the re-functioning of the building, the function was selected in line with the analyzes made within the scope of our work and the space organization was arranged accordingly. It is aimed to ensure that the building, whose survey measurements are taken, is included in the Restoration program as soon as possible and thus to extend the life of the building.

EVALUATION AND CONCLUSION

Bringing new functions to historical buildings and their sustainability are as important as conservation and restoration works. It is very difficult for the structures that lost their old functions to last for many years with only conservation works. It is necessary to reintegrate these structures into society and to make them workable again. Otherwise, unused structures will soon be idle and disappear. Refunctioning is one of the contemporary conservation techniques aimed at eliminating this situation.

As a result, it is a preferred method for historical buildings that have survived from past years to lose their function due to some reasons and to re-function to meet various needs. Making it functional for different purposes is very important in terms of transferring the building to future generations. While re-functioning, it should be given a function appropriate to the spirit and identity of the building. In addition, the spatial organization of historical buildings by revealing their spatial characteristics and identities paves the way for a more effective and better use of the building. In this context, while re-functioning Sevserek Han, the space syntax method was used, and the spaces were arranged in the light of the data presented. Thus, the spatial organization was made in accordance with the spatial perception and visual-social interaction data of the people who will use the building. At the same time, the re-functioning of the historical Sevserek Han will increase the educational and cultural density of the region. With this study, it is thought that the importance of Sevserek Inn will be better understood. In addition, in the light of this article, it is aimed to better understand the necessity and importance of re-functioning many inns and caravanserai structures that have lost their current function and are no longer used.

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Chapter 4

Design and Application Principles of Vertical Gardens[1]

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[1] This study was prepared based on the Master's Thesis titled "Investigation On The Application And Design Principles Of Vertical Garden According To The World And Turkey Applications", carried out by Erdi EKREN under the supervision of Assistant Professor Şule KISAKÜREK within the Graduate School Of Natural And Applied Sciences of Kahramanmaraş Sütçü İmam University.

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ABSTRACT

One of the biggest problems of this century is urbanization, which causes many environmental problems with negative aspects such as building areas and population growth. The decrease in urban green areas and the increase in environmental problems have led to the development of vertical gardens, which use the help of systems to cover facade walls with various plant species. Vertical gardens not only increase urban green space, but they also serve other purposes such as sound and heat isolation, energy productivity, air quality improvement, heat island reduction, aesthetic occurrence, and a positive contribution to human psychology. In line with these positive effects, the number of vertical gardening applications, which is a method used by professional disciplines (architects, landscape architects, engineers, etc.) in search of solutions to urbanization and environmental problems, has been increasing in recent years. This study was carried out to determine the design and application criteria for vertical gardens. In this context, primarily it has been made a literature review and then vertical gardening practices in Turkey and abroad have been examined in detail. As a result, the design and application principles were determined and suggestions were made.

Keywords: Vertical Garden, Design and Application Criteria, Vegetated Facades, Urbanization

INTRODUCTION

The increasing population and migration from rural areas to cities causes many problems. The increase in the speed of urbanization and the decrease of green areas serve as the foundation of many problems, as well as cause the graying of the cities. The ecological, aesthetic, and sociological contributions of green areas to urban ecosystems are very important. Therefore, the need for green areas increases day by day (Ekren, 2017:52).

Recent studies show that the amount of public green space (parks and gardens) has been decreasing. For example, the amount of green space in London was %38.4 in 2003 but it was %33 in 2013. In the same way, the amount of green space in Hong Kong was %41 in 2012, but after three years it was %40 (Anonymous, 2013; Anonymous, 2015). The reduction in the amount of city green space, as well as their inadequacy in the face of rapidly growing urbanization, increases the need to seek out alternative green areas.

In line with this requirement, studies in order to integrate nature into construction are called "vertical garden". Vertical gardens not only increase green space in cities, but they also serve other purposes such as sound and heat isolation, energy productivity, air quality improvement, heat island reduction, location acquisition, agricultural area creation, aesthetic occurrence, and positive contribution to human psychology (Erdoğan et al., 2009:438; Ottelé, 2011:33; Mir, 2011:39; Kaynakçı Elinç et al., 2013:56; Yüksel, 2013:18). In line with these positive effects, the number of vertical gardening applications, which is a method used by professional disciplines (architects, landscape architects, engineers, etc.) in search of solutions to urbanization and environmental problems, has been increasing in recent years. However, what is important here is to ensure that vertical gardens can be created in line with the design and application criteria and demonstrate their positive functions. The accuracy of the selected vertical green system type, site selection, and application according to the design criteria is extremely important. Vertical gardens cannot be applied to every area, and it is important to determine the correct construction structure of vertical green systems (Ekren, 2018:142).

Within the scope of this study, it aims to determine the design and application principles of vertical gardens. By examining the existing vertical garden samples in Turkey and the rest of the world, vertical garden design and application principles have been formed within the scope of creating sustainable and ecological structures.

MATERIAL AND METHOD

The main material of the study is vertical gardens. To obtain the data related to vertical gardens; books, journals, articles, papers, master's and doctoral theses, and internet resources on vertical green systems, urban development, green building certification systems, energy-efficient use, and environmentally friendly ecological structures were used.

This study, which was carried out in order to determine the application and design principles in vertical gardens, was carried out in three stages. The first stage was the literature review. In the second stage, the components of the vertical gardens and the vertical garden varieties were introduced. In addition, various vertical garden examples were examined. The design and application principles of vertical gardens were determined by evaluating all the data obtained in the third stage. The role of these principles and the parameters affecting them in creating sustainable vertical gardens were determined. For each of the principles, parameters were determined as ecological factors (temperature, precipitation, wind intensity, and direction), structural components, plant species, natural conditions, and plant growth environments. Recommendations have been developed by taking into consideration all the principles set out in the result of the study.

RESULTS AND DISCUSSION

Vertical gardens are the form applied to building facades or walls with the planting design dimension of the traditional garden approach in particular (Erdoğan & Khabbazi, 2013:24). They bring a new understanding to contemporary cities and building culture.

Vertical gardens can be defined as the interior or exterior walls covered with the various plant species in two different ways; pre-vegetated, in other words, “prefabricated modular panel” or in situ applied panels. Vertical gardens are categorized according to the material used in the system. Vertical garden systems can be examined under four different headings as follows (Mir, 2011:8; Örnek, 2011:35; Kanter, 2014:22; Ekren, 2017:52);

Modular system: It is defined as vertical gardens created with plants placed in panels or pots. In this system, drip irrigation is preferred. In addition, in order not to overload the carrier system, the amount of soil is kept low and materials with high nutritional value such as peat and perlite are used.

Foam based system: In this system, the foam-based substrate, which is made of aminoplast resin foam, is mounted to the above carrier profile. Thanks to the special foam structure it contains, this system offers a durable living environment that increases water efficiency for many plant species and climate types.

Mineral wool based system: They are systems created by mounting mineral wool panels on the carrier profile placed on the facade.

Felt layer based system: In this system, the felt material, which acts as a growing medium for plants, also allows for a homogeneous distribution of water. A waterproof insulation material should come to the layer where the felt layer meets the wall.

In this study, vertical garden examples from different parts of the world were examined.

One Central Park (Sydney)

The vertical garden work applied to the skyscraper "One Central Park" is the longest vertical garden application in the world with a length of 166 meters (Figure 1). The skyscraper was designed by architect Jean Nouvel and the vertical garden was designed by Patrick Blanc. The vertical garden includes 190 plant species that grow naturally in Australia and 160 plant species that grow exotically. Some plants in the application are; *Anigozanthos manglesii* D. Don, *Baeckea linifolia* Rudge, *Epacris crassifolia* R.Br., *Hovea elliptica* (Sm.) DC., *Melaleuca hypericifolia* Sm., *Microstrobos fitzgeraldii* (F.Muell) J. Garden & L.A.S.Johnson, *Psilotum nudum* (L.) P. Beauv, *Viola hederacea* Labill (Blanc, 2013).

Figure 1. One Central Park (Sydney) vertical garden application
Source: Blanc, 2013

Los Angeles Downtown Pocket Park

This vertical garden is the longest vertical garden in downtown Los Angeles and is located east of the PacMutual campus (Figure 2). This building is the city's only historical building with LEED Platinum certification. An approximately 25-meter-long vertical garden application was implemented on a modular system basis. A drip irrigation system was used in the application created with plants placed in pot modules (Wang, 2015).

Figure 2. Los Angeles Downtown Pocket Park vertical garden application
Source: Wang, 2015

Europa Congress & Exhibition Centre of Vitoria-Gasteiz

To increase the energy efficiency of the building, a vertical garden of 1000 square meters was applied to the facade of the building (Figure 3). Thanks to this application, a 270% increase was achieved in the energy efficiency of the structure. Aluminum and steel bearing profiles are used for vertical garden applications. Plants were placed in the system without soil. Thanks to the LED lights placed in the application, which has more than 33.000 natural plants, it has a pleasant appearance even during the night (Meinhold, 2014).

Figure 3. Europa Congress & Exhibition Centre of Vitoria-Gasteiz vertical garden application
Source: Meinhold, 2014

Antalya Erasta Shopping Mall

This vertical garden application was implemented on a modular system basis (Figure 4). A drip irrigation system is applied to the plants placed in the modules for irrigation and fertilization. It has the feature of restoring rain and irrigation water with waterproofing. It contributes to thermal insulation by providing cooling in the summer and heating in the winter (Üçok, 2014:42).

Figure 4. Antalya Erasta Shopping Mall vertical garden application
Source: Beceri Muhendislik & Mimarlık, 2012

All research related to vertical garden application examples was examined and design and application principles were tried to be created. The creation of design and application principles is important in terms of the ability of vertical gardens to create the desired effects. In this study, application and design criteria were evaluated under eight headings.

The Selection Criteria For Structural Components Must Be Taken Into Account

Integrity, load-bearing capacity, and ecological factors must be taken into consideration when selecting structural components. In vertical garden structures, the most important consideration is the preservation of the integrity of the structural components that support plants in the vertical environment. Therefore, it is necessary to reduce the risk of rebuilding, which will cause high costs, by using long-lasting insulation materials (Ling & Ghaffarian, 2012:17).

The issue of load-bearing capacity is of great importance to ensure the long life of the vertical green systems to be applied to the facade surfaces.

Considering the capacity of the plants to absorb water, the load per square meter in vertical green systems should be between 11-18 kg (Ling & Ghaffarian, 2012:18). After determining the carrying capacities of the facades that will be applied, it is necessary to take into account the possible wind and snow loads when calculating the load that the systems will form on the facade.

Location Selection Criteria Must Be Taken Into Account

Design purpose, physical structure, ecological features, and accessibility are important factors in the location of vertical gardens.

The design objectives of vertical gardens can be both aesthetic and functional. It can be aimed to improve people's quality of life by having a positive impact on their psychology through aesthetic applications. For this purpose, it will be more accurate to apply vertical gardens to places where people are dense and spend time. In functional uses, vertical gardens can be used for many different purposes, such as noise and image barriers, limiting, separating, highlighting, and concealing elements, as well as energy-efficient use.

Another factor that affects the choice of vertical garden places is the suitability of the area. Factors such as the physical structure of the walls, solar access, and wind flow are important factors in determining site suitability. Determination of the light-receiving status of the application place is important in terms of deciding whether to use the lighting component in the system.

In addition to physically damaging the plants, the wind is very effective in drying the leaves of the plants. Therefore, it should be taken into consideration that the water requirement of the plant species in the vertical garden to be established in areas with high wind intensity will be higher and the irrigation system should be adjusted accordingly. In addition, the possibility of the physical structure of the vertical garden system being damaged by the wind intensity should also be taken into account (Croeser, 2014:18).

Physical features and accessibility are also important in choosing the location for vertical gardens. In terms of physical properties, space capacity and potential, usable wall size, slope and quality of materials, accessibility that provides easy maintenance and construction are all extremely important to long service life.

Plant Selection Criteria Must Be Considered

Ecological factors should be taken into consideration when choosing plants. Temperature, solar access, dominant wind direction, and intensity are ecological factors to be considered in plant selection (Mir, 2011:87; Croeser, 2014:22). The use of natural plant species belonging to the region in vertical garden applications will ensure the best fit for climatic conditions, minimize the risk of failure of the design, and will be an important factor in ensuring the continuity of applications. In addition, the use of natural plant species will be effective in maintaining the ecological integrity of the region by preventing pests and diseases. If it is necessary to include exotic plant species in the applications according to the planting design, it should be investigated whether there are samples in the region and their growth in the current climate conditions.

The purpose of planting design in vertical gardens should be parallel to the aim of the use of the system. In this direction, determining the purpose of planting design is important for the selection of plant species. For example, the purpose of a vertical garden planting design can be a functional purpose such as preventing noise and image pollution, or an aesthetic purpose such as relaxing and emphasizing.

The Selection of Irrigation and Drainage Systems Should Be Done Correctly

Climatic characteristics, plant species, plant growing media, and current state are effective factors in the selection of irrigation and drainage systems.

In vertical garden applications, a drip irrigation system is generally used to transport water and nutrients required for plants. When preparing the irrigation system, it should be ensured that it delivers water and nutrients to all plants. And also, it should be kept in mind that the water requirements of the plants may vary according to the species and the applied facade. Plants' water requirements change because of the evaporation rate according to the facade. In addition, the moisture value and water demand may vary according to the plant growth medium material used.

In vertical gardens, the drainage system can be designed in two ways: closed and open. In a closed system, irrigation water is collected and reused; however, a small amount of water must be drained out in order to control the soluble salts resulting from the evaporation of water and to prevent damage to the system. In the open drainage system, excess water transfers to the existing drainage system of the building (Ling & Ghaffarian, 2012:19).

The Plant Growth Media Selection Principles Must Be Considered

The carrier system, plant species, and plant nutrient content are important factors in the selection of plant growth media in vertical gardens. It is important to choose a light plant growth media to avoid deterioration in the building construction of vertical gardens. The plant growth media must retain the plant nutrients and be in a structure that allows the root growth of the plants.

Maintenance Work Must Be Done On Time And Regularly

In vertical gardens, accessibility is an important factor for timely and regular maintenance. Accessibility must be ensured first for maintenance operations.

In vertical gardens, maintenance operations can be categorized into three groups: plant care, system maintenance, and material maintenance. Plant care in vertical gardens has consisted of operations such as pruning the plants, collecting the damaged leaves, replacing the dried or sickened plants with new ones, replacing the species that cannot adapt to the environment with the appropriate species, controlling the plant food materials, and making the irrigation according to the needs of the plant. Performing all plant maintenance on time will increase the success of vertical gardens (Yeung, 2008:7; Ling & Ghaffarian, 2012:19).

In vertical green systems, plant nutrients are added to the irrigation tank and transmitted to the plants with the help of irrigation pipes. These nutrients are consumed by plants over time, and the nutrients need to be added again with regular maintenance work (Ekren, 2016). Material maintenance is the replacement of damaged carrier profiles or insulation materials with new ones (Yeung, 2008:7). A sample maintenance plan for a vertical garden is shown in Table 1.

Table 1. A sample maintenance plan for vertical garden systems

Component	Material Composition	Expected Life Span (Under Normal Circumstances)	Possible Deterioration	Repair Method	Routine Maintenance Requirement
Carrier Profile	Galvanized Mild Steel (GMS)	> 10 years	Rusting; Fatigue	Replace	NIL
Plant Nutrients	Organic Nutrition Materials	It varies according to the amount of plant nutrients added to the system.	It is consumed by plants.	Refill by fertilization	Fertilization
Plants	Natural Perennial Species	It depends on the frequency and extent of adverse weather.	Various diseases, inability to adapt to climatic conditions	Healing or replanting	Irrigation; Fertilization; Pest Control
Irrigation System	PU hose; Nozzle Timer	> 10 years	Damage; Malfunction	Repair or Replace	Check for any malfunctions.

Source: Yeung, 2008:7

Application Objectives Should Be Considered

In vertical gardens, the application purposes can be grouped under two main headings:

- Aesthetic purposes
- Functional purposes

Vertical gardens play an important role in eliminating the stress of everyday life by addressing people's aesthetic feelings and relieving the negative pressures created by intensive urbanization on people.

The functional use of vertical green systems can generally be grouped under three headings:

- Usage for energy-saving
- Usage for image barrier
- Usage as a noise barrier

Vertical gardens can be considered as a component of an energy-efficient structure design. These systems, which reduce the amount of energy spent on heating during the winter months and for cooling during the summer months, have an important place in ensuring the sustainability of the resources used to generate energy.

Vertical gardens can be used to hide unwanted and uncomfortable images in indoor and outdoor spaces. They are used in the prevention of headlamp lights, which may cause distraction to drivers, especially on highways. In interior spaces, they are preferred for separation tasks. Besides, they can be used for image barrier and the separation of uses in the interiors.

Noise pollution, which is one of the most important problems caused by rapidly increasing urbanization, has many negative effects on human health. The vertical gardens that have included plant material as a biological measure can be used to prevent noise pollution. Evergreen, large and hard-leaved plant species with dense textures should be preferred for noise barrier vertical garden applications (Yılmaz & Özer, 1997:527).

Landscape Design Principles Should Be Considered

Vertical garden design should be based on landscape design principles formed within the scope of basic design criteria. In this direction, practices that have principles such as harmony, balance, unity and contrast, and hierarchy can be implemented (Yazgan et al., 2009:32).

The aim and concept of the design should be determined during the planning phase. Balance and harmony should be created according to basic design principles between the composition of the plant species to be selected and the space. The size, color, texture, and form characteristics of the selected plants should be in harmony with each other for the specified purpose. For example, the principle of contrast in design must be applied to create emphasis or mobility. Repetitive use of species that have the same or similar characteristics in measurement, color, and form may create harmony, but it should be taken into consideration that monotony will be created by using repetition at the extremes (Yazgan et al., 2009:36).

CONCLUSION

With the increase in the rate of construction in cities, open green areas disappear and environmental problems are observed. Vertical gardens, which emerged as a result of the search for solutions to this issue, contribute to both the formation of sustainable cities and the increase in the living standards of city-dwellers thanks to the benefits they provide to the urban ecosystem.

Considering the design and application principles determined within the scope of the study, some suggestions have been developed that will enable vertical gardens to reveal the expected benefits from them at the maximum level. These recommendations are as follows:

- Increasing the plant species used in vertical gardens contributes to biodiversity by creating natural habitats. For this reason, plant species diversity should be increased, especially with natural plant species.
- Considering the application and ongoing maintenance costs, it would be more accurate to select vertical garden application areas from areas where the beneficial features of these systems will be maximized. Applications that will ensure the functional use of vertical gardens should be encouraged.
- Dense-textured plant species should be preferred in terms of successful concealment of structural components and aesthetic appearance.
- It has been observed that vertical garden applications are mostly applied on exterior facades. However, vertical gardens are systems that can also be applied indoors. When these systems are applied indoors, they increase air quality and have a positive effect on people's psychology. Due to these positive effects, indoor vertical garden applications should be expanded.
- Necessary standards should be established for the creation of qualified systems by preparing laws and regulations for vertical garden applications.
- The vertical garden sector should be provided with knowledgeable staff about the principles to be considered and the way to be followed in the design process of vertical gardens.

This study was carried out to determine the design and application criteria for vertical gardens. For this purpose, vertical garden samples from Turkey and other parts of the world were analyzed from every direction. As a result of the study, eight principles were determined. For the sustainability of the ecological, aesthetic, and functional characteristics of vertical gardens, they should be applied considering the design and application principles.

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Chapter 5

An Assessment on Contemporary Mosque Desıgns in the 21st Century

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ABSTRACT

Religion, closely intertwined with people's beliefs, values, and spiritual needs, has persisted since ancient civilizations. Religion has been continued to have a profound impact on people's lives today. This is because religion is closely related to people's beliefs, values, and spiritual needs. Therefore, the relationship between religion and individuals plays an important role in architectural designs.

In the first part of the study, the concept of religion is discussed, the emergence and development of religious structures are described. explanations have been made about polytheistic and monotheistic religions and their religious structures. The mosque structures, which are the research subject of the study, were investigated.

Mosque structures provide a special space for people to worship, experience spirituality, and engage in social interactions. However, with contemporary mosque designs, the dynamics of the relationship between religion and individuals are changing. Hence, the subject of this study is to evaluate the contemporary examples of mosque structures that effectively maintain their influence in today's context.

Within the scope of the study, first, the historical development of mosque structures was examined under the title of " The Mosque Buildings." The differences that occurred in the architectures of mosque buildings due to various cultures and historical periods from 610 AD to the present day were briefly explained. Next, the spatial features of mosque structures were discussed, and the necessary spaces present in all mosque buildings were explained. Subsequently, as a sample for the study, contemporary examples of mosque structures from different geographical locations that participated in the World Architecture Festival were selected. Within the scope of contemporary mosque structures, the following mosques were examined: QASR Al Hosn: Al Musallah, Bioclimatic Mosque of Pamulang Community, Basuna Mosque, Masjed Almajed Endowments Muhammed bin Abdullah bin Ibrahim Almajed, and The Mosque of Light.

Religious structures belonging to the same religion vary according to their regions and societal and cultural structures. However, mosque structures, which are shaped by worship, have many immutable elements within their spatial features. This circumstance shaped the aim of the study. The purpose of the study is to examine and evaluate the interior spatial features of contemporary mosque structure,

Keywords: Contemporary Mosque, Interior Design, Mosque Structures

INTRODUCTION

Religion, closely intertwined with people's beliefs, values, and spiritual needs, has persisted since ancient civilizations. It is known through ancient cities that even in the earliest civilizations, people performed rituals and worship based on their belief systems of that era. The reason for religion dating back to such ancient times is that the act of belief is one of the fundamental needs for humans (Holm, 2001: 71). People have sought answers to existential questions, found meaning and purpose, and attained spiritual tranquility through religion. Religion has been a universal necessity arising from human existence (Bahadır, 2023: 13).

People have had belief systems and religions that catered to their needs since ancient times, and they have developed religious ceremonies and worship practices (Holm, 2001: 71). In this context, it is understood that religion has a significant impact on the formation of societies and cultures. Worship and religious rituals have served as crucial elements that bind people together. In ancient times, religion fulfilled the need for seeking refuge in a superior power in the face of unknown natural events and contributed to the establishment of societies and their political formations (Childe, 1978: 87-94). Because the sense of religion is defined as the sum of common emotions that religious subjects can evoke in people (Bahadır, 2023: 13). Over time, religion has formed values for people living in society and gained the status of a constitution for the community (Mardin, 1997: 47).

In ancient times, people designated natural spaces as places of worship to fulfill the requirements of their beliefs. However, after transitioning to settled living, they felt the need for specific spaces to perform religious ceremonies and rituals (Özel, 1998: 5). With the advent of settled life, the construction of religious structures had been began due to the preference for fixed and enclosed spaces. In this context, the first spatial organization concerning human and religion relations emerged in temples. During ancient times, when polytheistic belief systems were widespread, temples constituted the first examples of religious structures. (Lethaby, 1892: 10).

One of the most significant examples of the first center of belief in the world is Göbekli Tepe. This settlement, dating back to the Neolithic period, contains 20 identified temples. The transportation of heavy stones and large pillars used in the construction of Göbekli Tepe to the area where the temples were built required a labor-intensive effort by a large group of people. In this context, it is possible to suggest that the temples at Göbekli Tepe played a role in gathering a large number of people in history (Öztürk, 2015: 2). However, even before the discovery of Göbekli Tepe, temples belonging to different societies had been considered within the scope of architectural history. In ancient Near Eastern civilizations, temples were initially used on a small scale. From the second half of the 3rd millennium BCE, temples known as "zigurats" showed development (Güngör, 2004: 9). During the Persian period, closed temples were built and used, where sacred fires would burn continuously and where they could perform sacrificial acts (Kimball and Edgell, 1918: 36). In Egyptian history, an area surrounded by body walls was used as a temple. They did not allow individuals they considered non-religious to enter the temple, creating a spatial boundary for the distinction between sacred and non-sacred (Norwich, 1991: 46). Greek temples, on the other hand, had a very simple plan scheme consisting of monuments, yet they required skill in proportion and detail, unlike Egyptian temples, and did not create spatial boundaries (Hamlin, 1909: 54). In Etruscan temples, a shallow and wide cella and a series of columns were used. The plans of Roman temples continued similarly to the Etruscan periods as a result of the religious tradition, which had a lasting impact on shaping Roman temples (Statham, 1950: 77).

Under the scope of Monotheistic Religions, the beliefs include Judaism, Christianity, and Islam. The first and most sacred temple belonging to Judaism was built in Jerusalem by Solomon in the 10th century BCE. Outside the structure, an area had been created where non-Jews could enter. Upon passing through this area, the Women's Courtyard had been reached. Beyond the Women's Courtyard, the Israelites' Courtyard could been accessed by Jewish men. After the Israelites' Courtyard, the most sacred area, the Courtyard of the Kohanim, could been reached, which is accessible only to the holiest individuals. (Türkoğlu, 2003: 20-21). Although there is a single holy temple known in Judaism, they also have religious structures called synagogues for performing their worship. Synagogues, meaning "assembly places," are spaces with diverse architectural contexts and no linguistic unity, but they have many rules to be observed inside (Türkoğlu, 2003: 10). Christian religious structures, on the other hand, are churches. In the Eastern Roman Empire, Christians had religious freedom, and as a result, numerous architectural remnants of religious structures from the Eastern Roman Empire have been found today. Initially, they frequently gathered for worship in private basilicas owned by wealthy individuals. Later, they found large public basilicas suitable for their worship and imitated these structures to build new basilicas. The early Christian architecture in Europe consisted mainly of tombs. With the liberation of Christianity, they adopted the basilica plan type from Roman architecture as their places of worship, and thus basilicas became the starting point for church architecture (Hamlin, 1909: 72-73). As for the religious structures of Muslims, they are mosques. Mosques are places where Muslims collectively perform their worship. Islam, which began with the first revelation to Prophet Muhammad in the Cave of Hira, spread to different geographies and became a religion embraced by people from various cultures. The mosque structures emerged within the scope of Islam have been influenced and developed by different cultures over time.

Religion continues to have a profound impact on people's lives today. This is because religion is closely related to people's beliefs, values, and spiritual needs. Therefore, the relationship between religion and individuals plays an important role in architectural designs. Mosque structures provide a special space for people to worship, experience spirituality, and engage in social interactions. However, with contemporary mosque designs, the dynamics of the relationship between religion and individuals are changing. Hence, the subject of this study is to evaluate the contemporary examples of mosque structures that effectively maintain their influence in today's context.

Within the scope of the study, first, the historical development of mosque structures was examined under the title of " The Mosque Buildings." The differences that occurred in the architectures of mosque buildings due to various cultures and historical periods from 610 AD to the present day were briefly explained. Next, the spatial features of mosque structures were discussed, and the necessary spaces present in all mosque buildings were explained. Subsequently, as a sample for the study, contemporary examples of mosque structures from different geographical locations that participated in the World Architecture Festival were selected. Within the scope of contemporary mosque structures, the following mosques were examined: QASR Al Hosn: Al Musallah, Bioclimatic Mosque of Pamulang Community, Basuna Mosque, Masjed Almajed Endowments Muhammed bin Abdullah bin Ibrahim Almajed, and The Mosque of Light.

Religious structures belonging to the same religion vary according to their regions and societal and cultural structures (Aydın and Uysal, 2012: 352). However, mosque structures, which are shaped by worship, have many immutable elements within their spatial features. This circumstance shaped the aim of the study. The purpose of the study is to examine and evaluate the interior spatial features of contemporary mosque structures.

MOSQUE STRUCTURES

The word "worship" refers to carrying out Allah's commands and engaging in acts of devotion and adoration (Develioğlu, 2009: 401). Among the worship practices in Islam are giving zakat (alms), performing Hajj (pilgrimage), fasting, and offering prayers (namaz). Namaz, one of these worship practices, has played a significant role in shaping mosque structures. Mosques, in general, are religious buildings where believers come before Allah, express their wishes and gratitude, and perform the obligatory five daily prayers (Ateşoğlu, 2007: 95). In the Islamic belief, there is no intermediary between Allah and His worshippers. All worship practices within the scope of Islam continue to be bound by the concept of time. The importance of the namaz prayer is quite significant. It can be performed individually or collectively, with congregational prayers taking place in mosque spaces as well (Stegers, 2008: 46). Mosque structures have been utilized not only for the purpose of namaz prayer but also for religious education, cultural, and social activities. However, while conducting these activities in mosque structures, there are rules that should be followed. Entering mosque structures barefoot, in a state of ablution, with heads covered, and in clean attire is required. Regardless of cultural differences, engaging in activities such as shopping or eating and drinking inside the mosque is generally considered inappropriate (Sargın, 2012: 40).

The place where Muslims collectively perform their worship is called "Mescid" or "Cami," and these terms are often used interchangeably. However, in the early period of Islam, places of worship were referred to as "mescid." Later on, smaller places of worship were called "mescid," while larger ones where Friday and Eid prayers were held were called "cami" (Baltacı, 1985: 225). The number of mescids increased significantly in the early years of Islam. Because Prophet Muhammad's recommendations to the tribes that accepted the religion of Islam included the construction of mescids. In Medina, 20 mosques were built, and around Medina, 40 mescids were constructed. This contributed to the significance of Medina as an important center for Islam (Akın, 2016: 181). The construction of Masjid al-Nabawi, which was built by Prophet Muhammad following the significant event of the migration from Mecca to Medina, marks an important milestone in Islamic history. This mescids holds great significance among all mescids and has served as a model for the mosques built after it, in terms of its functions (Bozkurt and Küçükaşçı, 2004: 281).

In Islamic faith, the intensity of the emotions experienced by the believer's inner world takes precedence over time and space during worship. Within this context, mosque structures should be spaces that evoke and strengthen the spiritual feelings existing within the believer (Aydın and Uysal, 2012:352). Since the time of Masjid al-Nabawi, different cultures that embraced Islam have built mosques throughout history. For this reason, the historical development of mosque structures is explained within the scope of this study. Although mosques are constructed by diverse cultural communities, certain elements of the building remain unchanged due to the requirements of worship. Therefore, the spatial characteristics of mosque structures are discussed as a separate topic.

The Historical Development of Mosque Structures

The historical development of mosque structures, serving as places of worship in the Islamic faith, is closely associated with the emergence of Islam. The architectural advancements in mosque structures have been influenced by the acceptance of Islam by various cultural communities. The architectural development of mosque structures commenced during the time of Prophet Muhammad and had been continuously evolving by the communities that embraced the religion up to the present day (Kulak, 2016:14).

The first example of mosque structures built in societies that embraced Islam was the Prophet's Mosque (Masjid-i Nabawi) located in Medina. The structure had a rectangular floor plan, consisting of three main areas: the mosque area, the zulle area, and the suffe area. The mosque area served for the performance of prayer (namaz), while the zulle and suffe areas were used for religious education and also as residential spaces. The structure was surrounded by walls made of stone and sun-dried mud bricks (kerpiç), and date palm trees were utilized to provide shade from the sun. The rectangular floor plan of the Prophet's Mosque was later adopted for the construction of other mosque structures. This decision was influenced by a hadith indicating that praying in the front row of the mosque carried greater rewards. To accommodate more people in the front row, the rectangular floor plan has been chosen. During the times of Caliphs Abu Bakr and Umar, mosques were constructed with mud brick walls and also served as military camps (ordugâh) (Baltacı, 1985:227-228-229).

The Umayyad period followed the era of Prophet Muhammad and the Four Caliphs. The art produced during the Umayyad rule represents a significant phase in the development of Islamic art. In terms of religious architecture, one important advancement was the development of architectural floor plans. Additionally, they introduced the use of pulpits (minber) in the interior of mosques, creating enclosed spaces for worship and designing courtyards surrounded by porticos. Decorative elements were employed in the interior spaces of mosques, and construction materials such as stone and brick were utilized. One of the most sacred structures built during the Umayyad era is the Masjid al-Aqsa (Al-Aqsa Mosque). It is considered a significant example for later mosque architecture. The layout of the prayer rows (saflar) in the mosque extends perpendicular to the qibla wall (kıble duvarı). Moreover, domes were used as a roofing solution. Furthermore, one of the most important mosque structures from the Umayyad period is the Umayyad Mosque located in Damascus. (Berksaç, 1995:105). This mosque has a rectangular plan scheme measuring 36x37 meters. It consists of three aisles running transverse to the qibla wall and features a dome as the upper covering. Besides the main mihrab known as the Shafi'i mihrab, there are three more mihrabs on its sides. The mosque includes a courtyard measuring 122.5x50 meters, with a central fountain (şadırvan) located in its middle. Three minarets adorn the mosque (Yazıcı, 1995:109). During this period, existing mosques were renovated, and construction of large mosques was initiated as well (Baltacı, 1985:229).

With the transfer of the caliphate from the city of Damascus to Baghdad, significant changes occurred both politically and in terms of art and culture. In Damascus, Islamic architecture was influenced by Late Hellenistic Byzantine art, while in Baghdad, Sassanian art predominated. The Turks, who played a role in the rise of the Abbasids to power, contributed to the emergence of Turkish artistic influences in Islamic architecture. The assimilation of Turkish influences was evident in the Abbasid art, particularly in the architectural plans and decorative motifs. The application of new materials and techniques in architecture gave rise to a distinctive style in mosque structures (Yetkin, 1995:49). During the Abbasid era, brick became a commonly used material in mosque construction. Moreover, the introduction of minarets in mosque architecture started during this period. The pointed arches, a characteristic feature in mosque architecture, also emerged during this era. Among the notable works of the period are the Great Mosque of Samarra and the Mosque of Abu Dulaf (Baltacı, 1985:229).

Another significant period in mosque architecture is the Fatimid era. They initially constructed a building known as Mehdiye/Kayveran Grand Mosque. One distinct feature of this mosque is the projecting entrance gate, which is entirely unique. The mosque has a courtyard surrounded by porticos on all four sides. After capturing Cairo, they built the Al-Azhar Mosque (Berksaç, 1995:237).

The development of Turkish mosque architecture evolved alongside the rise of Turkish States. During the Karakhanid period, which was one of the first to embrace Islam, decorative plasterwork on the mihrab, dome over the mihrab, and the use of brick minarets were introduced. Unfortunately, no surviving mosque from the Ghaznavid period has reached our time. However, written sources indicate that the first wooden mosques were constructed during this era (Baltacı, 1985:230).

During the Great Seljuk period, the initial examples of mosques were based on domed structures. The main space gathered under the dome, and one would pass through iwans to reach the exterior space (Ara, 1988:35). In the 12th century, the Great Seljuks developed mosques in three plan types. The first plan type consisted of a harim (prayer hall) divided into longitudinal sections with a designed area for the mihrab (prayer niche). The second plan type included a mihrab unit and an eyvan (vaulted hall) relationship, with a courtyard to the north of the harim. The last plan scheme is represented by Kufic-style mosques. With the arrival of the Seljuks in Anatolia, the evolving mosque typologies underwent changes. In the first plan type, the area for the mihrab was enlarged, and the design was focused on the harim unit. A courtyard area was added in front of the harim. The second plan scheme incorporated the existing courtyard and eyvan units into the harim area, and a central skylight was introduced. In this period, the spatial unity of the harim in mosque structures was strengthened by the mihrab, while the uniformity on facades was alleviated with the use of monumental doors. Mosques began to use stone as the primary material, with stone decorative elements frequently employed (Güler and Aktuğ Kolay, 2006:89). After the Seljuk period, the Ottoman Empire significantly contributed to and further developed mosque architecture. However, there was a transitional period between the two eras known as the Beyliks period. In this period, mosques featured a final courtyard area and the use of a single dome. Additionally, flat-roofed and wooden-columned mosques were constructed (Baltacı, 1985:231).

After the Seljuks, a transitional period marked the direction of Ottoman mosque architecture. The Ottoman period, which started as a beylik and evolved into an empire, is divided into three phases: the early period, the classical period, and the period influenced by the West (late period) (Kulak, 2016:21). During the early period of the Ottoman state's the mosque of structures, the traces of the Anatolian Beyliks' mosque architecture were a blend of Seljuk period's local construction techniques and forms (Antel, 2012:258). The first group of Ottoman early period mosques falls under the single-unit mosques, characterized by square plan schemes with domes as their main roof coverings, built using brick and rough-cut stone. Multi-unit mosques comprise the second group, inspired by the Great Seljuk grand mosque plan scheme. In the Ottoman era, these grand mosques that were initially built with flat roofs were later modified with small domes on each unit. The last group includes the cross-axis mosques, also known as Bursa-style mosques, combining open and enclosed madrasa plan types. A central open dome was used as the roof covering for the square plan scheme. The last prayer space in cross-axis mosques was divided into five sections, and they typically had one or two minarets (Kuran, 1964;3). During the reign of Yıldırım Beyazid, original mosque designs emerged. Bursa

Grand Mosque was the first example of a modular system, where multiple domes were used for roof covering, leaving the interior design unchanged (Antel, 2012:258). With the conquest of Istanbul, changes in mosque design became evident. Especially, the roof covering system used in Hagia Sophia inspired the Üç Şerefeli Mosque. A combination of domes and semi-domes was applied for the roof covering (Benian, 2011:43). Edirne Üç Şerefeli Mosque was constructed with a T-shaped plan, supported by many pillars and having two aisles parallel to the mihrab wall. It didn't introduce any innovations in mosque typology but was a significant experiment in using a large dome monumentally (Peker, 2012:266). The peak of dome architecture, in terms of technology, planimetry, and structure, during the Ottoman Empire is referred to as the Classical period. This period coincides with the era of Mimar Sinan, who served as the chief architect for 48 years. Mimar Sinan represented his era with three distinct mosque structures: Şehzade Mosque as his apprentice work, Süleymaniye Mosque as his journeyman work, and Selimiye Mosque as his masterpiece (Mülayim, 2009:225-226). The Şehzade Mosque has a square plan with a dome of 19 meters in diameter. Mimar Sinan paid more attention to form than decorative elements in the design, creating a monumental and centralized mosque scheme for the first time. The Süleymaniye Mosque has been features a main space of 63×68 meters and a large dome with a height of 53 meters, supported by pendentives. The large dome was reinforced by two half-domes and two quarter-domes from the north and south (Antel, 2012:59). After Mimar Sinan's passing, the influence of the Classical period continued for almost a century through the architects he trained. Subsequently, the late period of the Ottoman era, influenced by the West, began. A phase of applying European architectural styles in Ottoman architecture took place (Baltacı, 1985:232). One of these styles was the Baroque style, and the Nur-u Osmaniye Mosque exemplifies this influence. With its oval-shaped courtyard and the use of specific forms in ornamentation, the mosque reflects the characteristics of Ottoman Baroque style (Dabanlı et al., 2013:1). In the later periods of the Ottoman Empire, movements towards nationalizing architecture began to emerge. The use of pointed arches and corniced columns, along with the construction of smaller-sized mosque structures, was observed. The Bostancı Mosque, built by Architect Kemalleddin, is an example of this era (Baltacı, 1985:233). After the Ottoman period, the Republic era began. While modern principles were applied in architecture during this period, it didn't significantly manifest in mosque architecture (Antel, 2012:261-262).

With the rapid advancement of technology, contemporary mosque examples are increasing in the field of architecture. In Turkey and around the world, contemporary mosque designs are shaped by different geographical locations, diverse cultural influences, and the light of technology. Contemporary mosque structures exhibit distinct features in terms of plan schemes, decorative elements, and roof coverings. However, there are common elements that must be present in a mosque structure. In the next section of the study, based on the data obtained from the historical development of mosque architecture, the narration of mosque spaces has been carried out.

The Spatial Features of Mosque Structures

Mosque structures have evolved since their inception, taking into consideration the act of prayer. In modern times, various spaces have become integral components of mosque architecture. Therefore, the spatial elements of mosque structures are addressed in this section of the study. These spatial elements are examined in two main categories: exterior and interior spaces. Under the scope of exterior spaces, there are the courtyard, ablution fountain (şadırvan), and minaret. Regarding interior spaces, the elements include the last congregation area (son cemaat yeri), prayer hall (harim), women's gallery (kadınlar mahfili), and within the prayer hall, the mihrab, pulpit (minber), and preacher's platform (vaiz kürsüsü) are located (Kulak Torun, 2016:32-37).

The spatial elements of mosque structures are first addressed within the scope of the exterior spaces, including the courtyard, ablution fountain, and minarets. In large mosques, a courtyard is used to separate the building from the crowded city surroundings. Generally, the courtyard is positioned between the east and southeast directions, considering the qibla direction in Turkish mosque structures. Access to the inner courtyard is provided through a grand door or main entrance gate. The inner courtyard is surrounded by a columned gallery known as a "revak" (Eyice, 1993:56). The ablution fountain (şadırvan) is a place where the act of ablution takes place. These fountains are located in the central area of mosque courtyards and are covered by domes (Kılcı, 2010:219). The plan type of the ablution fountains can be either square or circular. Additionally, these fountains can be constructed with open or covered tops. In modern times, ablution fountains are more commonly found in enclosed spaces, serving as designated areas for ablution along the walls (Durmuş, 2009:47). The use of ablution fountains is particularly observed in areas where Turkish influence prevails (Kılcı, 2010:219). The concept of the minaret in mosque architecture dates back to the time of Prophet Muhammad when a special area named "üstüvane" was used for Bilal-İ Habeşi to climb with a rope and recite the call to prayer (ezan) facing the qibla direction at the Masjid al-Nabawi. However, the first addition of minarets to mosque structures occurred during the Umayyad period. In their early forms, minarets did not have a specific architectural style. Various materials and different designs were used in minarets across various regions and cultures. The usage of minarets reached its most mature and widespread form during the classical period of the Ottoman era (Gündüz, 2020:98). The interior elements of mosque structures include the "son cemaat mahalli" (narthex), the "harim" (prayer hall), and the "kadınlar mahfili" (women's gallery). Narthex area is a section located at the entrance facade of the mosque, typically constructed with a colonnade, where believers who arrive late for the prayer can perform their worship. It also serves to prevent direct access to the main prayer hall. The prayer hall is the main worship area of the mosque. Generally, mosque interiors have a central area called the central aisles with a dome located at its center. The side areas on both sides are called the side aisles (Eyice, 1993:56-57). Women's gallery, is a space in mosque structures designated for women to perform their prayers. It was initially introduced by Prophet Muhammad, who allocated a section at the rear part of the mosque harim for women's use (Aycan, 2013:15). Over time, this concept was further developed in the architectural context of Turkish mosque structures. As an early example, the Beyşehir Eşrefoğlu Mosque has its women's gallery situated above the narthex area (Tanman, 2003:333). In contemporary mosque constructions, the design and allocation of women's gallery areas vary based on cultural differences. In Nepal, there are a few designated spaces for women. In Pakistan, gallery levels are usually reserved for women. In Indonesia, men and women still pray within the same harim, facing different directions, just as in the time of Prophet Muhammad (Tayılga and Demirarslan, 2020:46).

During the time of Prophet Muhammad, he used to stand in front of the qibla wall when performing prayers. After his passing, the surface of the qibla wall was marked with colored stones. Subsequently, specific signs or colors were used on the wall surface indicating the qibla direction, and this led to the formation of mihrabs. The first use of a mihrab can be traced back to the 8th century in a mosque built over the house of Prophet Muhammad in Medina (Frishman, 1994:35). The mihrab, known as the niche that indicates the qibla direction and where the imam stands to perform prayers, is designed as a recess into the wall plane. Due to its special orientation, it is generally adorned as the most embellished part in mosque interiors (Eyice, 1993:56-57). The development of the pulpit dates back to the year 628. During that time, a two-step and one seating place pulpit was built for Prophet Muhammad to lean on a date palm trunk while speaking (Bozkurt, 2020, 101). In the subsequent periods, the pulpit evolved, and during the late Umayyad era, it began to be present in mosques. The pulpit with three steps for delivering sermons was later introduced. the preacher's platform, is a few steps that are built adjacent to the qibla wall or the side wall and are accessed by a staircase, which allows the preacher to ascend (Eyice, 1993:57).

In addition to spatial elements, certain design features are also essential in mosque architecture. The dome, which has been increasingly prevalent, is one of these significant design elements that has played a crucial role in the evolution of mosque architecture. Throughout history, domes have been used in structures belonging to various cultures, but they have particularly stood out as a prominent roofing element in Turkish Islamic architecture. In the classical style of the Ottoman Empire, with the genius architect Mimar Sinan, domes reached their pinnacle and became inseparable from mosque design. Furthermore, the utilization of natural light in mosque structures has been a longstanding practice to create a spiritual impact. Daylight filtering through wall surfaces or dome windows not only facilitates worship activities but also evokes profound spiritual emotions (Durukan, 2017:536).

Mosque structures, representing the Islamic religion, have evolved and continued as architectural masterpieces from the emergence of Islam until the present day. The literature section of this study comprehensively covers the historical development and transformations in mosque architecture. The spatial elements of mosque structures have also been thoroughly elucidated. In the evaluation of contemporary mosque examples, the spatial components of mosque architecture have been carefully examined. This includes elements such as courtyard, ablution fountain, minarets, narthex, prayer hall, women's gallery, mihrab, pulpit (minbar), and preacher's platform. Additionally, the use of domes as a roofings and the strategic utilization of natural light have been taken into account as they have been integral to mosque design since ancient times.

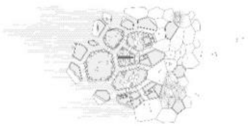
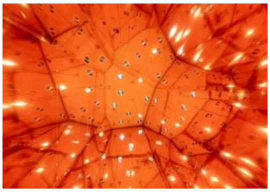
EXAMPLES OF CONTEMPORARY MOSQUE BUİLDİNGS

The emergence and spread of Islam have significantly influenced mosque architecture. Throughout history, societies that embraced Islam and held strong beliefs have played a crucial role in shaping mosque architecture. Mosque structures, which have been synthesized with architectural elements from different cultures, have undergone continuous changes since their initial construction. However, in contemporary times, various factors have come to the forefront in the evolution of mosque architecture. Advancements in construction technology and innovative design approaches have given rise to modern and contemporary designs in mosque architecture.

The subject of this study is contemporary mosque buildings. The sample for the study has been determined based on the World Architecture Festival. The inclusion of the World Architecture Festival is due to its status as a global architecture event, where professionals from the world of architecture come together to share their expertise through seminars and award programs. This festival, which will hold its 16th edition in 2023, provides an opportunity for architects to expand their professional networks and closely follow the latest developments in the field (Url-1, 2023). The mosque structures that participated in the festival from different geographical regions in the last five years constitute the sample of this study. These mosque structures are QASR Al Hosn: Al Musallah, Bioclimatic Mosque of Pamulang Community, Basuna Mosque, Masjed Almajed Endowments Muhammed bin Abdullah bin Ibrahim Almajed, and The Mosque of Light.

QASR Al Hosn: Al Musallah: Al Musallah is located in Al Hosn area in Abu Dhabi. The region is a critical point that narrates the history and modernity of the city. The mosque structure was designed and built by the CEBRA company and was completed and opened for service in 2018 (Url-2, 2023). Although Al Musallah is a complex structure, the study focuses on the mosque space. The mosque's design drew inspiration from the natural geometric shapes that emerged as a result of the region's climate. Additionally, there is a reference to the Hira Cave in the mosque's design. The inspiration from the natural phenomenon was translated into architecture through geometric shapes known as Voronoi. The cluster of Voronoi shapes accommodates various spaces. The outer boundaries of the structure are defined by a void created and accentuated with stone, allowing the natural form to prevail. A water pool is incorporated into the exterior space of the building, creating the illusion that the structure is immersed in water. Glass bridges are used to provide passage between different units over the water pool. Privacy is considered in the interior design. The interior includes an entrance hall, ablution area, and prayer halls for both female and male believers. The prayer halls areas feature a copper-clad fractal design on the ceiling, symbolizing the cosmos (Url-3, 2023). Pendant-like fixtures are used for interior lighting, along with small circular openings in the ceiling designs and reflectors on concrete walls to bring in natural daylight. Concrete is the main building material used (Url-2, 2023). Visuals of QASR Al Hosn: Al Musallah are presented in Table 1.

Table 1: Images of QASR Al Hosn: Al Musallah

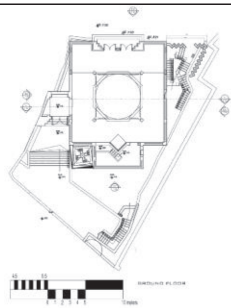
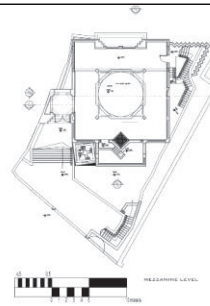
Site Plan	Top View	General View
		
Courtyard	Entrance	Entrance
		
Ablution Fountain	Prayer Hall-Mihrab	Transition to the P.Hall
		
Roofing	Roofing	Roofing
		

References: Url-2, 2023, Url-3, 2023, Url-4, 2023.

Al Musallah structure is designed to be in harmony with the topography on which it is built. It has a polygonal floor plan and is composed of interconnected spaces. Furthermore, the building reflects the history and contemporaneity of the culture it belongs to. The structure does not have a courtyard enclosed by walls. However, it has defined its own space through the boundaries implemented in the landscape design. There is no minaret. The şadırvan (ablution fountain) is incorporated within the interior space. It has a closed floor plan. There is no designated area for the last narthex. Within the mosque's interior, separate prayer halls areas are located for men and women. The mihrab, on the other hand, features a unique design. It is not recessed into the wall; instead, it is customized using different materials on the wall surface. However, in the prayer halls area, the ceiling design takes precedence over the mihrab design. The structure does not feature domes as part of its roofing. Pendant lighting is used in the ceiling design. Additionally, designs have been implemented in the ceiling and wall planes to allow natural light into the interior space.

Basuna Mosque: Located in the city of Sohaj, Egypt, the structure was designed by Dar Arafa Architecture. The mosque was completed in 2019 and opened for service. In the area where the mosque stands, there used to be an old structure that served the village for Friday prayers and funerals for 300 years. However, over time, it suffered structural damage and was demolished. Basuna Mosque was built in its place. The mosque not only serves the Muslim community but also provides a sanctuary for people of all religions. In the new mosque design, the capacity for users has been increased. The structure is situated in a hot and arid region with noisy, dusty, and heavy traffic conditions. To mitigate these unfavorable conditions inside the interior space, a hybrid roof system was applied instead of traditional windows. The main area of the mosque is designed as a square plan covered with a dome. The design of the main dome consists of a grid of concrete beams partially covered with brick pendentives, forming 108 square openings (Url-5, 2023). The main dome is constructed with lightweight sand blocks made in Egypt. The dome surface features a special cut and is adorned with a simple stepped mosaic application. This design allows natural lighting into the interior space through fixed horizontal and operable vertical glass panels, and it also collects rainwater. The dome at the entrance area to make references to the dome of a historic structure. Environmentally friendly local materials were used in the construction of the mosque. The use of sand and limestone blocks reduces the weight of the building (Url-6, 2023). Visuals of Basuna Mosque are presented in Table 2.

Table 2: Images of Basuna Mosque

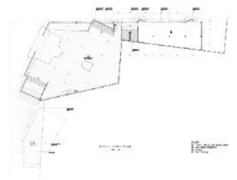
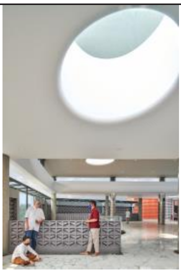
Lower Ground Floor Plan	Ground Floor Plan	Mezzanine Level Plan
		
Courtyard	Entrance	Ablution Fountain
		
Prayer Hall	Mihrab	Women's gallery
		
Roofing	Roofing	Roofing
		

References: Url-6, 2023, Url-6, 2023, Url-7, 2023, Url-8, 2023.

The Basuna Mosque has a square plan typology. It features a courtyard and a minaret. In the courtyard, there is an open and flat plan designed ablution fountain. There is no designated area for narthex in the mosque. The prayer hall and the women's gallery are separately designed, each with their own entrances. The mihrab in the prayer hall is customized with different materials. Additionally, on the left side of the mihrab, there is a preacher's pulpit. The mihrab area features a dome above it. Furthermore, the main dome design has been realized. Natural lighting and ventilation have been utilized.

The Bioclimatic Mosque of Pamulang Community: The mosque located in Indonesia was commissioned to the company RAD+ar by Pamulang University. It was completed in 2020 and opened for service. They stated that the mosque's design focuses on the essence of the religious space rather than a form-based architecture. The mosque structure is not only considered as a place of worship but also as a gathering and resting area. Since it was built in a climate with direct heat exposure and high humidity, it was designed to require minimal maintenance and be self-sufficient. Inside the mosque, indirect natural lighting from solar energy is utilized for approximately 12 hours a day. The facade design provides shading to prevent direct sunlight. Instead of using brick material, brick roster blocks were used to ensure privacy while creating tunnels for light and wind. Additionally, cross-ventilation systems provide thermal comfort in both interior and exterior spaces. Through these methods, natural lighting and ventilation are achieved. The architectural design of the mosque incorporates basic geometric forms. For the roof, green roof sheets were used instead of a dome to reduce heat. The designers of the mosque described adopting a postmodern approach in its architectural design (Url-9, 2023). The visuals related to the Bioclimatic Mosque of Pamulang Community can be found in Table 3.

Table 3: Images of The Bioclimatic Mosque of Pamulang Community

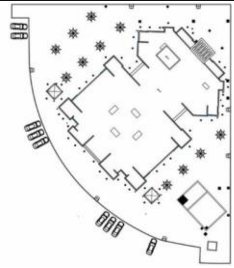
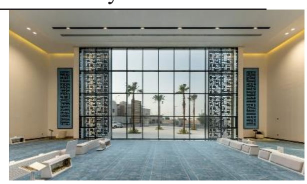
First Floor Plan	Second Floor Plan	Generaral View
		
Courtyard	Entrance	Ablution Fountain
		
Prayer Hall	Mihrab	Women's Gallery
		
Roofing	Roofing	Roofing
		

References: Url-9, 2023, Url-10, 2023, Url-11, 2023.

The Bioclimatic Mosque of Pamulang Community does not have a courtyard bounded by walls. However, there is a landscape arrangement. There is no minaret element as well. The fountain area is designed separately for men and women, located indoors with a closed plan type. There is no space narthex. The prayer area is situated on the first floor. The plan of the prayer area has a polygonal shape, and the mihrab wall is projected outward but not prominently felt from the inside. The women's gallery is designed on the upper floor of the mosque. The mihrab in the prayer area is highlighted and personalized with a different material. The interior design emphasizes the significance of the mihrab. Rooms are located on both sides of the mihrab, which are believed to serve as the pulpit and the preacher's platform. Access to these rooms is achieved through the inner surfaces of the mihrab niche. The mosque's roof is covered with a green roof, making effective use of natural lighting.

Masjed Almajed Endowments, Mohammed bin Abdullah bin Ibrahim Almajed: Located in Riyadh, Saudi Arabia, the structure was designed by Alsoliman Real Estate company. The project was completed in 2022. It is defined as a work that combines local and contemporary practices. The transition to the sacred realm is represented through the light entering from the glass surfaces used in the design. The place of worship area of the building covers an area of 1340 square meters. The minaret is 28 meters long and designed with stone cladding and window patterns. Windows on the walls and roof are used to illuminate the space. The glass surfaces of the mosque are surrounded by geometric patterned shades. The design aims to create a play of light and shadow inside the interior. The mihrab area is formed as a semi-circular niche (Url-12, 2023). The visuals of Masjed Almajed are available in Table 4.

Table 4. Images of Masjed Almajed Endowments Muhammed bin Abdullah bin Ibrahim Almajed

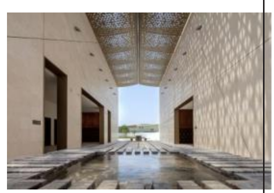
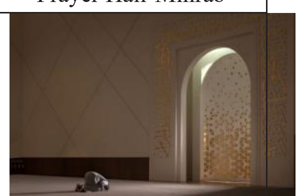
Side Plan	First Floor Plan	Second Floor Plan
		
General View	General View	General Viev
		
Prayer Hall	Mihrab	Prayer Hall
		

References: Url-12, 2023.

Masjed Almajed does not have a courtyard surrounded by boundaries. However, it has a landscape design that gives the impression of a courtyard. The entrance to the mosque is designed in a way that the change in material is noticeable. The minaret is constructed from stone material. The ablution fountain area is designed separately and indoors, distinct from the worship area. There is no designated narthex. The windows in the prayer hall are generously sized, creating a spacious atmosphere. There is no women's gallery in the mosque. The mihrab in the prayer hall is customized and benefits from natural lighting, but direct sunlight is not allowed inside. Geometric patterned shades are utilized to create interesting light and shadow effects within the interior space.

The Mosque of Light: It is located in Dubai, United Arab Emirates, was designed by Dabbagh Architects. The mosque was completed in 2022 and opened for worship. During the design process, the focus was on facilitating prayer rituals in a serene and peaceful environment by controlling natural light. While the overall appearance of the mosque differs from traditional structures, the designers emphasized their adherence to fundamental principles in terms of the plan typology. Separate blocks were allocated for the prayer areas of men and women. Additionally, a third block was designed to house the ablution areas, imam, and muezzin. The two divided areas were then interconnected through canopies in the courtyard, which also serve the purpose of indirectly admitting sunlight into the outdoor worship space. Furthermore the use of double-shell domes allows natural light to filter into the interior. The external facade of the mosque features triangular patterns, creating perforations to enhance natural lighting. The extensive use of natural light aims to provide a gentle ambiance for worshippers. The prayer area is covered with dual domes and constructed with stone as the primary building material. Additionally, the mosque has a separate minaret, designed distinctively from the main volume. The Mosque of Light images can be found in Table 5.

Table 5: Images of The Mosque of Light

Side Plan	First Floor Plan	Geneleral View
		
Minaret	Entance	Courtyard
		
Entrance	Interior Space	Prayer Hall-Mihrab
		

References: Url-9, 2023, Url-10, 2023.

The floor plan of the structure is designed in a rectangular shape. The courtyard surrounds the building from all sides. The ablution area is resolved in a separate block within the structure. There is a minaret. An outdoor area for worship is provided in the exterior space. Although it does not serve as a typical narthex area, it is a space used due to the climate conditions. The prayer hall and the women's gallery are designed separately. The mihrab in the prayer hall is integrated into the wall surface with a protruding design. Natural light is considered in almost every area of the building, and design solutions are implemented accordingly. Surface designs, dome usage, and the roof tructure used to connect spaces in the courtyard all take into account the presence of natural light inside the interior space.

SPATİAL EVALUATİON OF CONTEMPORARY MOSQUE STRUCTURES

In the evaluation section of the study, the general characteristics of mosque structures were initially examined. The construction dates, locations, floor plans, roofing systems, natural lighting designs, and construction materials of mosque structures were taken into account. The construction dates and locations of mosque structures are significant due to their belonging to different geographical regions. Considering that mosque structures belong to different cultures and their features will be compared, it was considered important to analyze these data collectively. Mosque structures share common spatial elements. However, as described in the literature, there are accepted variations in their floor plans, roofings, and natural lighting designs. The presence of domes in the roofings was investigated. The implementation of natural lighting within the interior spaces was identified in the context of individual structures. Therefore, these features were further examined in detail. The conducted analysis is presented in Table 6.

Table 6. Examination of General Characteristics of Mosque Structures

	Al Musallah	Basuna Mosque	Bioclimatic Mosque	Masjed Almajed	The Mosque of Light
Year of Construction	2018	2019	2020	2022	2022
Location	Abu Dhabi/Al Hosn	Egypt/Suhaj	Indonesia/ Pamulang	Saudi Arabia/ Riyadh	United Arab Emirates/ Dubai
Plan	Polygon	Square	Polygon	Square, Rectangle	Square
Construction Materials	Concrete	Brick, Lightweight Sand Block	Brick Roster, Concrete	Concrete	Stone
Roofing	Flat	Dome	Green Roof Membrane	Flat	Dome
Natural Lighting	Ceiling, Wall	Ceiling, Wall	Ceiling, Wall	Wall	Ceiling, Wall

The mosque structures included in the sample were constructed within the last five years, between 2018 and 2022, in different countries. Three of the mosques have a plan layout based on basic geometric forms such as square and rectangle, while two have a polygonal plan shape. Two of the mosque structures were built using concrete as the construction material, while one was made of stone and the other two were constructed using bricks. However, one of the mosques utilized lightweight sand blocks as a local material, while another one employed local brick roster material. The roofings of the structures also vary; two mosques have domes as their roofing solution, while the others have flat roofs. Notably, one of the mosques with a flat roof used green roof membrane considering climate conditions and self-sustainability. The utilization of natural light in the interior spaces was considered an important aspect in all mosque designs. In one of the mosques, natural light is introduced solely through the wall surface, while in the others, it is achieved through both the roof and wall surfaces.

Following the general characteristics of the structures, the spatial features were examined. The analyzed spatial attributes consist of the spaces described and discussed within the scope of the literature. The evaluation conducted is presented in Table 7.

Table 7: Evaluation of The Spatial Features of Mosque Structures

	Al Musallah	Basuna Mosque	Bioclimatic Mosque	Masjed Almajed	The Mosque of Light
Courtyard	+	+	-	+	+
Minaret	-	+	-	+	+
Ablution Fountain	+	+	+	+	+
Narthex	-	-	-	-	+
Prayer Hall	+	+	+	+	+
Women's Gallery	+	+	+	-	+
Mihrab	+	+	+	+	+
Pulpit	-	-	+	+	+
Preacher's Platform	-	-	+	+	+

There are examples of structures where the courtyards are enclosed with walls. In this context, there are 2 mosques with courtyards. In the other two, the courtyard is perceived through the use of different materials and landscaping. One mosque example does not have a courtyard; however, the surrounding landscaping behaves like a courtyard in terms of its location. Three mosques have minarets, while two do not. All mosques have a fountain ablution area. Regarding the ablution fountains, their plan types, locations, and the separation of men and women are features that differentiate them. Four mosques have enclosed ablution fountain areas, and among these, three have separate ablution fountain spaces for men and women. One mosque has an open ablution fountain space. The usage of a designated narthex was not observed in the mosque structures. In one mosque, it was mentioned that due to climatic conditions, prayers are sometimes conducted in open areas. Although not precisely a narthex a similar approach is adopted. The main prayer hall is present in all mosques, while the women's gallery is absent in only one mosque. The mihrab is found in the prayer hall area of all mosques. The pulpit is present in three mosques, and the pulpit platform is found in three mosques. However, cultural differences may lead to different functions for similar mosque features.

CONCLUSION

Religion is a concept that has shaped human existence since the beginning of time and has continued to remain relevant through the ages. It still holds great significance in the present century as it fulfills the needs of individuals and influences their way of life. In today's world, there are various religions, each with its own followers. This study primarily focused on polytheistic and monotheistic religions, discussing the religious structures required by these faiths and their historical development. The specific subject of this study was mosque structures belonging to Muslims, delving into their historical evolution and spatial characteristics.

Islam, which has spread across a vast geographical area, has been embraced by diverse societies with different cultures. Contemporary mosque designs, realized with advancing technology and construction techniques, constitute the sample of this study. Particularly, the exploration of contemporary mosque designs from various cultural backgrounds has been considered as a significant area of investigation. Therefore, the mosques that participated in the global event, World Architecture Festival, within the last five years, have been selected as the sample for this study. The examined structures are as follows: QASR Al Hosn: Al Musallah, Bioclimatic Mosque of Pamulang Community, Basuna Mosque, Masjed Almajed Endowments Muhammed bin Abdullah bin Ibrahim Almajed, and The Mosque of Light.

The general characteristics of mosque structures, their construction dates, locations, floor plans, construction materials, use of roof structures, and utilization of natural lighting have been examined. The following conclusions have been drawn from this investigation:

- QASR Al Hosn: Al Musallah was constructed in 2018, Basuna Mosque in 2019, Bioclimatic Mosque of Pamulang Community in 2020, and both Masjed Almajed Endowments Muhammed bin Abdullah bin Ibrahim Almajed and The Mosque of Light in 2022. All structures belong to the 21st century.
- QASR Al Hosn: Al Musallah is situated in Abu Dhabi/Al Hosn, Basuna Mosque in Egypt/Suhaj, Bioclimatic Mosque of Pamulang Community in Indonesia/Pamulang, Masjed Almajed Endowments Muhammed bin Abdullah bin Ibrahim Almajed in Saudi Arabia/Riyadh, and The Mosque of Light in the United Arab Emirates/Dubai. The geographical diversity of these mosque structures reflects various cultural influences.
- QASR Al Hosn: Al Musallah and Bioclimatic Mosquehave polygonal floor plans, while the others have square and rectangular floor plans. Although there is no consensus on this matter, all structures utilize basic geometric forms in their floor plans.
- As for the construction materials, QASR Al Hosn: Al Musallah and Masjed Almajed Endowments Muhammed bin Abdullah bin Ibrahim Almajed used concrete, Basuna Mosque used bricks and lightweight sand

blocks, Bioclimatic Mosque of Pamulang Community used bricks roster material, and The Mosque of Light used stone. Basuna Mosque and Bioclimatic Mosque employed local materials.

- There is no uniformity in the use of roof structures among the mosque buildings. Only Bioclimatic Mosque and The Mosque of Light feature domes in their designs.
- There is a consensus among the mosque structures regarding the utilization of natural lighting within the interior space. They have incorporated daylight through the ceiling and wall planes. Only Masjed Almajed has focused on using wall planes to bring natural light into the interior.

The spatial analysis of the mosque structures focused on the outdoor spaces such as the courtyard, minarets, and ablution fountains as well as the indoor spaces including the narthex, prayer hall, women's gallery, mihrab, pulpit, and the preacher's podium. The findings of the evaluation are as follows:

- The use of courtyards is evident in Basuna Mosque and The Mosque of Light, where traditional walls demarcate the area. The other mosque designs do not explicitly define the courtyard boundary, yet they incorporate a sense of it through material differences.
- The use of minarets is not present in QASR Al Hosn: Al Musallah and Bioclimatic Mosque. In the other structures, minarets are incorporated with unique designs specific to each mosque.
- All the mosques have incorporated ablution fountains. Bioclimatic Mosque stands out with a single, open-plan fountain, while the majority of the others feature enclosed fountains, indicating a prevalent use of covered fountains in mosque designs.
- The use of narthex area is not present in the structures. It is known that The Mosque of Light utilizes an open space for this purpose. The usage of narthex area demonstrates a decreasing trend in contemporary structures.
- The prayer hall is present in all mosque structures, serving as the central space for worship.
- The women's gallery (kadınlar mahfili) is absent in Masjed Almajed, which can be attributed to cultural differences.
- All the mosques have a mihrab within the prayer hall, and each mihrab has been individually customized.

- Minbar and preacher's platform are not separet each other used in the mosque structures. Minbar or preacher’s platform have not been detected in Al Musallah and Basuna Mosque. However, their absence may be due to cultural variations, as these elements can be realized through different design solutions while serving the same function.

The study confirms that mosque structures exhibit both similarities and differences among various cultures. Floor plans, roof designs, and natural lighting arrangements emerge as key elements contributing to the diversity of mosque architecture. Particularly, floor plans consisting of fundamental geometric forms such as square and rectangle are observed to be common, along with the prevalent use of flat roofs. Furthermore, variations in building materials are also evident, with the usage of concrete, stone, brick, and locally sourced materials being influenced by geographical locations and construction cultures. When examining the spatial characteristics of mosque structures, elements such as courtyard usage, minarets, and fountain designs are considered significant. Mosques with courtyards showcase diversity through environmental arrangements and material distinctions. The enclosed designs of ablution fountains and separate designs for men and women indicate that these structures are focused on their social and cultural functions. Analyzing the interior features of mosque structures, areas like the main prayer hall, women's gallery, mihrab, pulpit, and preacher's platform are examined. It is determined that these spatial elements may exhibit cultural variations in usage; however, noticeable differences in their functions are not observed.

As a result, this study has been a crucial step in comprehending the spatial characteristics of mosque structures and evaluating the similarities and differences among mosques from diverse geographical and cultural backgrounds. The diversity in mosque architecture reflects the richness of architectural heritage and cultural variety. It is hoped that this research will shed light on future investigations and architectural designs.

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Chapter 6

The Impact of Advances in Laminated Wood Technology on Architectural Design and Sustainability

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ABSTRACT

The basic principle of sustainability can be said to be leaving a more livable world to new generations by using resources efficiently. In this context, the durability, reuse and recyclability of building materials are among the important parameters for a more livable environment. Natural building materials are more environmentally friendly than non-natural building materials. Wood, which is used as a raw material in the construction and furniture industry, does not harm the environment during its production, use and recycling. In the life cycle of buildings, the dismantling, reuse and recycling of building elements significantly reduces the amount of waste. The modularity of building materials can also provide an important advantage, allowing additions or removals to be made in the structure. Fossil fuels are generally used in transportation and the lightness of building materials has a positive effect on carbon emissions. In reinforced concrete structures, the hardening time of the concrete has to be waited. Therefore, the production of wooden structures is relatively faster. Structural wood and laminated furniture parts produced with lamination technique are superior in terms of mechanical and aesthetic properties. Laminated beams and boards can be produced in a wide variety of sizes. Wooden laminated structural elements can be produced in various forms such as arches, trusses and columns. As a result, wood lamination technique has provided flexibility in architectural design. Pyramids, geodosic domes, vaults, which could not be built using solid wood in the past centuries, can be built due to developments in lamination technology.

Keywords: Architectural design, environmentally friendly building materials, laminated wood, sustainability, wood technology

1- INTRODUCTION

Why Wood Material?

Wood is regarded as the primary renewable resource crucial for a future sustainable bio-economy. In the construction sector, where it has been traditionally utilized, wood has recently gained significance as a sustainable substitute for steel and concrete. Furthermore, it serves as the foundation for innovative bio-based functional materials.

Wood is a preferred choice in architecture for a multitude of compelling reasons. First and foremost, it stands out as a renewable resource, and when harvested responsibly, it can become an environmentally sustainable building material. Sustainable forestry practices ensure that trees are either replanted or allowed to naturally regenerate, significantly diminishing the environmental impact.

Beyond its eco-friendly characteristics, wood brings a unique blend of aesthetics and functionality to architectural designs. Its warm, natural, and timeless appearance appeals to architects and designers alike, offering a canvas for a broad spectrum of architectural styles. Moreover, wood can be left exposed to elevate the visual allure of both interiors and exteriors.

Practical advantages also come into play. Wood's innate insulating properties make it an excellent choice for thermal regulation. Wooden structures tend to excel in energy efficiency, which translates into cost savings for heating and cooling in buildings. Furthermore, wood's relatively lightweight nature simplifies transportation, handling, and on-site work during construction. This agility in assembly also translates into reduced construction time.

Designers find wood particularly appealing due to its versatility. It can be easily cut, shaped, and formed into various sizes and forms, facilitating intricate and innovative architectural concepts. Wood readily pairs with a wide array of finishes and treatments, allowing for endless creative possibilities.

In terms of structural integrity, wood boasts remarkable strength, especially when engineered or laminated. When properly treated and maintained, it can withstand various loads and environmental conditions.

Beyond the physical attributes, wood contributes to the health and well-being of occupants. It has been associated with improved indoor air quality and psychological comfort, emitting fewer pollutants into the environment, thus fostering healthier living spaces.

From an environmental perspective, wood possesses a lower carbon footprint compared to materials like concrete and steel. Its production typically demands less energy and results in fewer greenhouse gas emissions.

Wood also demonstrates adaptability. Wood structures are known for their ease of renovation and adjustment to changing needs, reducing the necessity for demolition and new construction.

Lastly, wood holds cultural and historical significance in many societies. Integrating wood into architectural designs can establish a meaningful connection between a building and its cultural and regional context.

While wood offers a plethora of advantages, its suitability hinges on project-specific requirements, local building regulations, and environmental considerations. Architects consistently weigh these factors when determining whether wood is the ideal primary building material for a given project.

Laminated wood material exhibits several advantageous characteristics in contrast to other structural materials. These attributes encompass its status as a natural substance, its ability to provide thermal, acoustic, and electrical insulation, its ease of manipulation, its aesthetically pleasing appearance, and its high strength-to-density ratio (Bozkurt and Erdin, 1997). Wooden materials are not confined solely to use in wooden constructions but are also prevalent in the furniture sector and various industries (Obata *et al.*, 2005; Priadi and Hiziroglu, 2013). Thanks to its exceptional properties, wood maintains its significance across a wide range of material applications, boasting nearly 10,000 applications as a primary raw material source (Ors and Keskin, 2001; Khalil *et al.,* 2010).

The increase in the world population, global warming, and epidemics have brought new approaches to architecture. Healthy living spaces and sustainability have become more important design parameters than ever before. Advances in technology have also been effective on wood materials. Thanks to the wood lamination technique, wood which is among the oldest building materials, maintains its importance today.

Progress in Laminated Wood Technology

The development of wood lamination technology has presented architects with a wide range of new possibilities to design more complex and unique structures. Wood lamination paves the way for creating durable, aesthetically appealing, and structurally diverse buildings by combining different layers of wood. It is an attractive material in terms of energy efficiency as it provides excellent thermal insulation, which can reduce energy consumption in buildings. Therefore, it can be utilized in the design of sustainable and energy-efficient structures.

Wood lamination is considered a sustainable material, aligning with principles of sustainable forestry practices to contribute to the preservation of forest resources. Wood lamination technology can be employed in both modern and traditional architectural design applications, allowing architects to create structures that harmonize with various styles and periods.

With its high potential for durability and structural performance, wood lamination is well-suited for constructing large openings, intricate forms, and unconventional buildings. Additionally, it can be engineered to enhance its fire resistance, a critical aspect of building safety.

Furthermore, the natural and warm appearance of wood lamination adds aesthetic appeal to architectural designs. When used in interior and exterior applications, it can yield visually striking results.

Wood is a sustainable construction material sourced from a natural and renewable reservoir, boasting minimal carbon emissions during production and reduced energy requirements. To safeguard its sustainability, it is imperative to explore alternative wood sources, assess waste management in composite wood production, engage in conscientious tree harvesting, and implement effective afforestation initiatives (Binggeli, 2008). With appropriate resource management, the world has an abundant supply of wood at its disposal (Cankal and Sakar, 2021).

In contrast to many other nations, the utilization of wood as a structural component remains relatively uncommon in Türkiye today. To diversify its application in construction, it is possible to manufacture composite wood materials with enhanced strength through various methodologies, facilitating the production of wood materials in desired dimensions and configurations. Historically, wood has found extensive use as a construction material, serving various purposes such as furniture, beams, columns, walls, roofs, doors, and windows (Cankal and Sakar, 2021).

Due to the fibrous and heterogeneous nature inherent to natural wood, even basic loads can induce complex stresses within the material. The lamination process aims to mitigate the adverse effects of natural growth patterns, striving to create a more homogeneous material. Utilizing lamination technology, it becomes feasible to produce structural elements with dimensions that might not be suitable for manufacturing using reinforced concrete or steel from wood. Lamination entails bonding two or more layers of wood, whether sourced from the same tree or different trees, using adhesive. This technique enables the utilization of lower-quality or recycled wood that would otherwise be unsuitable for use. In recent years, thanks to advancements in production and design, laminated wood has gained widespread acceptance as a structural material in tall and multi-story buildings (Colak and Degirmentepe, 2020).

Laminated wood finds application in various domains, including bridges, racetracks, ship components, load-bearing elements in wooden houses, stairs, ceilings, walls, and floors in wooden structures, as well as in schools, mosques, and shopping centers. Its attractive appearance, aesthetic appeal, and ease of processing make it a preferred choice. It is also favored indoors as a joinery profile and serves as an ideal roofing material (Insapedia, 2022). Figure 1 illustrates the stages of the lamination process for laminated wood material, while Figure 2 provides examples of its application areas (Falcon Timber, UK).

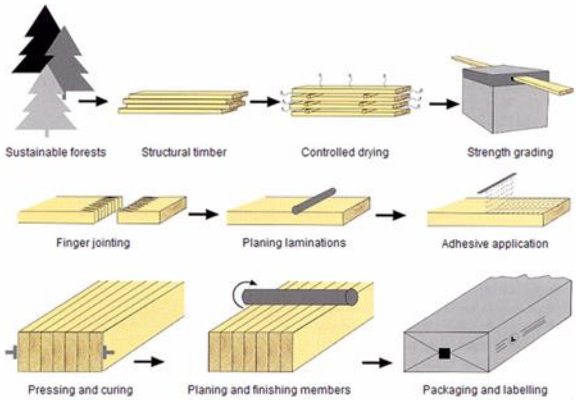

Figure 1: Lamination Process (Glulam Limited) (URL 1)

Figure 2: Application areas of laminated wood material URL 2 (Falcon Timber, UK).

Wood Technology and Global Warming

The Earth maintains a temperature conducive to life, courtesy of the natural greenhouse effect. Greenhouse gases play a crucial role in creating a warm environment by preventing the escape of infrared rays generated from the collision of solar rays with the Earth into space. The Earth's atmosphere primarily comprises 21% oxygen, 78% nitrogen, and 1% other gases. Within this 1% category of other gases lie the greenhouse gases that are of concern in the context of global warming. Naturally occurring gases like water vapor, carbon dioxide, ozone, methane, and nitrous oxide serve to stabilize the Earth's temperature. Without this greenhouse effect, it has been estimated that the Earth's surface temperature would plummet to around -20 °C (Houghton, 2001).

However, since the Industrial Revolution, the elevated atmospheric concentration of carbon dioxide has intensified the greenhouse effect. Consequently, infrared rays that should dissipate from our planet into space become trapped within it. This phenomenon leads to a discernible increase in surface temperatures on Earth (Maslin, 2004).

In this context, both global warming and the forest ecosystem exhibit a highly dynamic structure influenced by numerous factors. Forests are not merely entities susceptible to the repercussions of global warming; they also constitute one of the elements influencing the dynamics of global warming. It is well-established that forests play a pivotal role in mitigating global warming through their capacity to sequester carbon, store organic carbon, and participate in the carbon cycle, involving both the tree canopy and the various life forms inhabiting the ecosystem (Flavin, 1990). Consequently, the degree of impact forests have in the face of global warming and climate change is a critical factor that can directly impact the acceleration of global warming (Canli, 2010).

Sustainability

The notion of sustainability generally entails "the capacity to maintain a situation or process indefinitely" (Dictionary, 2022). In the realm of architecture, sustainability encompasses practices such as efficient energy utilization, the reuse of construction materials, recyclability, and a commitment to preserving the natural environment.

Another facet of sustainability involves the ability to perpetuate the Earth's natural cycles and productivity for future generations (Chapin *et al.*, 1996). Regrettably, many scientists expressed concerns that the world's resources have reached a critical depletion point (Turner, 2008). From this perspective, achieving sustainability necessitates utilizing natural resources at a pace that allows for their spontaneous regeneration.

Sustainability is a multifaceted concept, extending its reach into various aspects of life. It is not confined to a single definition, as it intertwines with numerous vital activities. Examples include sustainability in forestry, wetlands, urban planning, agriculture, and architecture, among others, rendering sustainability a complex and extensively discussed concept (Yavuz, 2010).

This study primarily delves into the realm of sustainable architecture. Within this context, sustainable architecture aims to create structures that prioritize the utilization of renewable energy sources, embrace environmental friendliness, and consider energy efficiency, materials, and location, all while safeguarding the health, safety, and well-being—both physical and psychological—of occupants. Ultimately, it endeavors to provide enduring comfort and productivity, not just for the present generation but for those who follow. To achieve this, the study explores the sustainability of architectural designs employing wood-based materials as alternatives to traditional wood materials.

TRADITIONAL WOOD BUILDING MATERIAL

General Description of Wood

Wood is typically described as a botanical entity characterized by foliage interconnected to the ground through its root system, featuring a lignified and timber-appropriate core enveloped by a substantial bark layer. Throughout the annals of history and across diverse cultures, wood has been ubiquitously employed as a naturally occurring construction material, adeptly serving a myriad of purposes.

The Use of Wood in Architecture and its History

Wood, a naturally occurring material, has found extensive use throughout history, evolving from rudimentary shelters to contemporary structures characterized by advanced construction techniques. Its wide-ranging utilization can be attributed to several factors, including its ease of manipulation, inherent adaptability to various needs, and eco-friendly composition. Furthermore, as technological advancements continue to reshape the construction landscape, wood's properties as a building material have been continually refined and its significance in architectural design accentuated.

In diverse regions of Turkey, the utilization of wood and associated construction methods exhibit considerable variation, encompassing applications spanning entire edifices to individual building components. Simultaneously, Turkey boasts a rich architectural heritage deeply rooted in wood, spanning typologies such as residential houses, bridges, and mosques, each employing distinct wood utilization techniques (Yucel, 2018). Notably, historical landmarks like Konya's Beyşehir Eşrefoğlu Mosque (1299), Samsun's Göğçeli Mosque, Kastamonu's Town Village Mahmut Bey Mosque, Afyonkarahisar's Ulu Mosque, and Ordu's İkizce District Laleli Mosque (1560-1600) stand as exemplars of wooden architectural mastery, their histories spanning centuries (see Figure 3).

a) b)

Figure 3: Wooden architectural heritage mosque examples a) Konya Beyşehir Eşrefoğlu Mosque, 1299 (Turkey Culture Portal, 2018), b) Ordu İkizce District Laleli Mosque, 1560-1600 (Ordu Culture and Tourism Directorate, 2018).

Moreover, contemporary applications underscore wood's entrance into 21st-century construction with enhanced technologies and strengthened structures. In a noteworthy development, a Japanese timber company revealed plans in early 2018 to erect a 350-meter-tall, 70-story wooden hybrid skyscraper by 2041 (see Figure 4-a). Further demonstrating the possibilities of wood, the 18-story Brock Commons Tall Wood House, equipped with a wooden hybrid structural system, was successfully completed and opened for occupancy in Vancouver, Canada, in 2017 (see Figure 4-b). Going back a bit, the nine-story residential complex known as Murray Grove, constructed from wood in 2009 in London, England, represents a pioneering instance of a wooden apartment conceived and executed through cutting-edge technology (see Figure 4-c) (Yücel, 2018).

a) b) c)

Figure 4: Examples of multi-storey wooden structures a) 350 m high hybrid skyscraper to be built in 2041 in Japan (Sumitomo Forestry, 2018), b) Dormitory Building, Canada Vancover (Brock Commons Tallwood House (Acton Ostry Architects, 2018), c) Timber apartment, Murray Grove, 2009, Hackney, London, (Waugh Thistleton Architects, 2018).

ADVANCES in LAMINATED WOOD MATERIAL TECHNOLOGY

Glued Laminated Timber (Glulam) can be defined as wood material that is bonded together using lamination techniques or as wood material formed through layering. It involves arranging four or more layers of laminated wood material in a straight or curved configuration parallel to the longitudinal axis. The lamination process enhances the quality of the material by eliminating defects, resulting in a product that surpasses solid wood in terms of quality. Laminated wood, created from solid components, not only boasts exceptional flawlessness but also possesses a heightened aesthetic appeal due to the utilization of wood materials with varying thicknesses and colors in laminated floors (Keskin and Togay, 2004).

The lamination technique permits the application of a variable number of layers, different tree species and sizes, as well as variations in layer and shape thicknesses. The nomenclature for wooden laminated elements differs depending on the thickness of the layers employed. In the construction industry, for instance, large-sized laminated wood elements like beams, columns, and arches are typically crafted using solid wood materials with thicknesses ranging from 25.4 mm to 50.8 mm. Such laminated wood material, characterized by these specifications, is commonly referred to as "GLULAM" (Glued Laminated Timber) or "MICROLAM" (Hoyle and Woste, 1989).

It's worth noting that laminated boards and structural beams produced using lamination techniques should possess an appropriate moisture content that corresponds to the environment in which they will be utilized. For outdoor applications, the humidity level should be maintained below 19%, while for indoor use, the moisture content of laminated wood materials should not exceed 16% (Karayılmazlar *et al.,* 2007).

LAMINATED WOOD MATERIAL AND SUSTAINABILITY

Sustainable materials are those that have no adverse impact on the environment or human health. This attribute can be attributed to their minimal energy consumption over their entire life cycle. Within the realm of sustainable architecture, building materials hold a significant role in influencing a structure's energy consumption, as well as the preservation and utilization of natural resources, and overall environmental well-being (Brundtland, 1987). When considering the sustainability of wooden building materials, it becomes evident that these materials exhibit a higher level of environmental friendliness in both their production and utilization when compared to alternative building materials. Table 1 demonstrates that wooden building materials have a relatively low carbon footprint during their production.

Table 1: The amount of carbon released and stored in the production of building materials (Erdil, 2018).

Material	Carbon Emitted (kg/t)	Carbon Emitted (kg/m^3)	Stored Carbon (kg/m^3)
Timber	30	15	250
Steel	700	5320	0
Concrete	50	120	0
Aluminum	8700	22000	0

In light of these considerations, the pursuit of environmental and architectural sustainability becomes imperative, given the minimal carbon emissions associated with wood and wood-based materials. Furthermore, the significance of employing wood materials is escalating in response to the diminishing reserves of fossil energy resources worldwide. Examining developed nations such as Canada, several countries in Central Europe, Australia, and Scandinavian countries, notably the USA, it becomes evident that the utilization of wood and laminated wood materials is widespread, spanning both historical and contemporary constructions (Cankal and Sakar, 2021).

SUSTAINABILITY PARAMETERS IN LAMINATED WOOD

One of the escalating contributors to the intensifying global climate change is the release of greenhouse gases into the atmosphere during the production processes associated with the products we commonly use. With existing policies and industrial practices, attaining a sustainable future remains an implausible proposition. In response, the United Nations has called for achieving "Net Zero" emissions by 2050. The concept of Net Zero entails implementing measures to curtail carbon emissions or offsetting these emissions by investing in projects that remove an equivalent amount of carbon from the atmosphere. Effectively realizing the Net Zero objective necessitates a comprehensive overhaul of our production methods, work practices, and lifestyles.

According to a 2019 report by the OECD, steel and cement production were responsible for a substantial 12-14% of annual carbon emissions in 2018. Conversely, data from Breakthrough Energy indicates that the buildings we inhabit account for approximately 7% of global CO2 emissions. When considering these statistics, it becomes evident that increasing the utilization of wood within the construction materials sector would significantly bolster the battle against climate change (Mesail, 2022).

CONCLUSIONS

In conclusion, advancements in laminated wood technology are breaking down the barriers in architectural design, opening up possibilities for crafting truly distinctive spaces. A wide array of geometric structures, including geodesic domes, traditional domes, pyramids, vaults, and more, can now be realized in large, single-span structures such as theaters, concert halls, educational institutions, and product display/sales venues. By fabricating large-scale elements within controlled environments and implementing one-to-one designs with solid modeling, construction projects can achieve exceptional quality and flawless finishes on-site.

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Chapter 7

Interferometric SAR Technique in Remote Sensing and GIS Based Planning Studies

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ABSTRACT

Introduction

SAR systems have a wide range of uses thanks to the high resolution they provide. It has a very wide usage area, especially in all weather conditions and in situations such as day/night location detection and ground surveillance. It is a preferred system in situations where high resolution is required, such as terrain profiling, detection and tracking of ground vehicles. As another usage area, observation of agriculture, forest and glacier areas can be shown in order to take precautionary measures against a problem that may occur in the future. Finally, three-dimensional terrain profiling is also possible with Interferometric SAR technology (Carver et al., 1991; Carrara et al., 1995; Chen et al., 2001).

Polarimetric SAR, is a concept used to indicate the electric field vector direction of a polarizing electromagnetic wave. The electric field vector direction can be horizontal (horizontal, H) or vertical (vertical, V). Radar receiver and transmitter antennas are designed in this direction. Therefore, the radar polarization is determined in accordance with the polarizations of the receiving and transmitting antenna. Accordingly, there may be four different radar polarizations: HH, HV, VV and VH. For example, it can be understood that the transmitting antenna of a radar with VH polarization generates electromagnetic wave with vertical polarization, while the receiving antenna detects electromagnetic wave with horizontal polarization. A radar can have a single polarization, or it can have several polarizations together. Such radars are called multi-polarization radars. Usually research radars have multiple polarization. When a radar sends an electromagnetic wave with a certain polarization to any object or surface, the polarization and intensity of the scattered wave may vary according to the characteristics of the surface. Since this change will also affect the radar image, it is possible to understand the features of the surface from the image. These properties of objects are defined as polarization signature. Polarization signature is a concept that shows the changing properties such as intensity and polarization of echoes reflected back from an object illuminated by an electromagnetic wave with a certain polarization (Stimson, 1998; Dapueto, 2015).

Each object has a unique polarization signature. The polarization signature, radar frequency, and angle of view vary depending on the falling angle and polarization of the transmitted wave. It also changes according to the geometric structure of the object, its direction, reflectivity and atmospheric properties. In this way, it is possible to define and classify the radar image obtained (Irak, 2009; Akabalı, 2002).

Interferometric SAR, the amplitude of the signal reveals the back-reflectance of the target, while the phase information is a value determined by the distance from the target. Interferometric SAR obtains altitude information by using the difference in phases of corresponding pixels in two SAR images. While the working principle of the Interferometric SAR technique is shown in Figure 1, the altitude information corresponding to the obtained phase difference is shown in Figure 2. Therefore, the phase of an image is meaningless on its own.

Unlike conventional SAR methods, the Interferometric SAR technique provides the opportunity to measure the third dimension of the target by using the phase information as well as the amplitude of the signal reflected back from the target. For this reason, it is mostly used to map the topography of the earth or to observe the topographic changes that occur in a particular region. These systems are mostly mounted on space platforms. In the interferometric SAR technique, phase information is obtained by comparing two different images obtained from the same region. There are two different ways to get different images. The first of these is the comparison of images obtained by a space platform passing through the same topography region at two different times, and this is called repeat-pass interferometry technique.

In this technique, it is assumed that there is no significant change in the region in the time interval between two different image acquisitions. The second is the comparison of images obtained simultaneously from different perspectives by positioning two different space platforms at a certain distance from each other, and this is called single-pass interferometry technique (Irak, 2009; Kutoğlu et al., 2014).

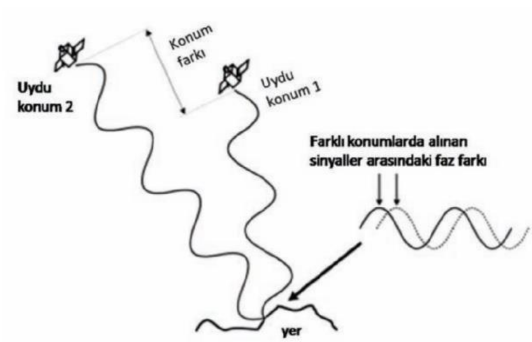

Figure 1. Interferometric SAR Technique Working Pattern (Irak, 2009)

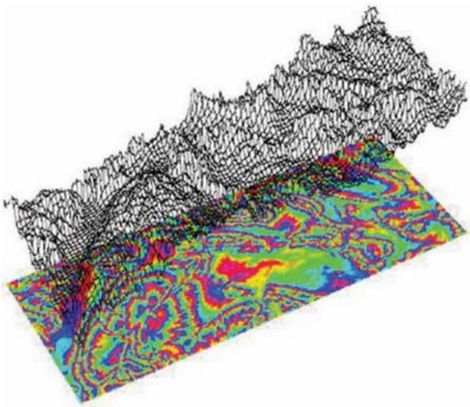

Figure 2. Obtaining Altitude Information from Phase (Irak, 2009)

Basic Principles:

Radar Signals: Satellite radars emit electromagnetic waves to the earth and these waves are reflected on the surface. The phase of the reflected signals contains information about the structure, topography and deformations on the surface.

Comparison of Reflected Waves: The phases of the signals obtained from radars observing the same region during two separate satellite passes differ depending on the changes in the earth. These differences are analyzed using radar interferometry.

Differential Interferometry: Differential interferometry is used to measure the differences between two satellite passes. This process helps to monitor surface deformations, crustal movements or structural changes (Rignot, 2008).

Application Areas:

Generating Digital Elevation Models (DEM): Radar interferometry is used to generate high resolution digital elevation models to create the topography of the earth. These models provide important information in GIS applications, map making, and terrain analysis.

Deformation Monitoring: Radar interferometry is used to detect deformations in the earth. It is an important tool in monitoring events such as earthquakes, volcanic activities, crustal movements and mineral extraction.

GIS Applications: Remote sensing data is used in geographic information systems and provides important information in this field. Radar interferometry is an important data source in GIS projects to identify ground changes, monitor land use and analyze urban development (Rondeau-Genesse, 2016).

Interferometric Studies

Şengün and Kılıçoğlu (2005), in their work, the recent InSAR (Interferometic Artificial Aperture Radar) method; they stated that it started to develop rapidly in areas such as ground observations, coastal area movements, soil changes, sensitive topography changes, snow-water changes and measurements, use of wetlands and hydrological studies.

Aydöner and Maktav (2006) analyzed the changes in urban land use areas caused by the big earthquake that occurred in Kocaeli region in 1999 by integrating various temporal and spatial image sets with satellite and ground data. In the first study of the analysis studies, displacement events and deformation formations were examined and the changes that occurred before and after the earthquake were analyzed. In order to make the changes sensitive and measurable, the Interferometry method was used with the help of SAR images, and the images of the same area taken on different dates were created as an interferometry data set by creating double data sets. These data sets were provided on different days and months in time. In the other phase of the study, new settlement suitability analyzes were carried out with the MCA method, taking into account different situations such as geological formations, deformation events, soil impact, the relationship of the main transportation networks with the settlements in the city of Kocaeli. The resulting data were interpreted according to the situation of the region and the city.

Kutoglu et al. (2014) aimed to review the change of radar interferometry method for monitoring the security of port shelters and similar structures in coastal areas with their study. They aimed to fully examine these changes by supporting them with the literature studies conducted with the radar method-based interferometry method. Within the scope of the study, coastal structures in Zonguldak city center were monitored using two TerraSAR-X datasets. According to the examination and evaluation results of the sensitive changes, it was determined and revealed that the fishing shelter in the region was deformed by the displacements on land, and the newly built port was subject to a settlement apart from the land movement. By using X and C band datasets on the Radar, it has been stated that it provides a great opportunity to detect high sensitivity and changes in coastal areas and has a serious resolution capacity.

Battal et al. (2016) emphasized that our natural and natural resources are of great importance in our social life, and stated that remote sensing data sets are actively used to detect them, monitor the changes that occur, and manage the resources in the conservation area. In this study, it was aimed to determine the coastal-side line changes of Lake Eber between the years 2015-16. As the study materials, Landsat 8 OLI multi-band satellite data and Sentinel-1A SAR data from April 2015-16 were used. In order to perform accuracy analysis on these two different data sets used, the area of the lake was obtained by drawing vector forms by hand and comparisons were made with the help of uncontrolled classification results. Between 2015 and 2016, error rates were measured as 0.64% and 0.75%. It has been stated that the emergence of such sensitive values reveals the importance of using the Interferometry method.

Lievens et al. (2019) examined space data and radar systems in their comprehensive study, especially on the contributions of C band-sourced data sets to direct results in detailed and sensitive measurements. Within the scope of the study, especially the snow depth and water resources were evaluated with this perspective. It was emphasized that accurate snow depth observations are of critical importance in the evaluation of water-related resources. It has been stated that approximately one billion and more people rely on the melting of snow in the northern hemisphere and the water coming from the mountains located there.

Despite this, it was emphasized that there are important deficiencies in the depth measurements of the snow coming from the mountains, in remote sensing. A study is presented that demonstrates the ability to map snow depth in the northern hemisphere using the Sentinel-1 Radar dataset. An empirical change detection approach at 1 km^2 resolution was used in northern hemisphere mountains. With the measurement, evaluation and analysis data made in approximately 4000 regions, Sentinel-1 radar measurements, spatial variability between and within mountain ranges and differences within the year were provided. Snow depths in different regions between 2017 and 2018 in the US Sierra Nevada and European Alps are presented within the scope of the study. With the Sentinel-1 continuum, up to 2030 and beyond, these findings provide a basis for measuring snow depth. The long-term vulnerability of snow-water resources, especially in mountainous regions, to climate change is also stated within the scope of the study.

SAR (Synthetic Aperture Radar) Data Set

The overall SAR system can be summarized as shown in Figure 3. The raw SAR data obtained from the SAR sensor is sent to the data preprocessing unit along with the data obtained from the motion sensor. Here, primary level shake compensation is performed on the raw data before the image is created. Afterwards, the preprocessed data is transferred to the image processing unit to obtain a focused SAR image. The image processing unit is the unit where residual shake compensation is made, the resulting raw image is better focused, noise reduction processes are made and the image is ready for target detection and classification. Finally, the image evaluation unit is the unit where target detection and classification is done, and application-oriented information is transferred to the user (Carrara et al., 1995; Soumekh, 1999; Chen et al., 2001).

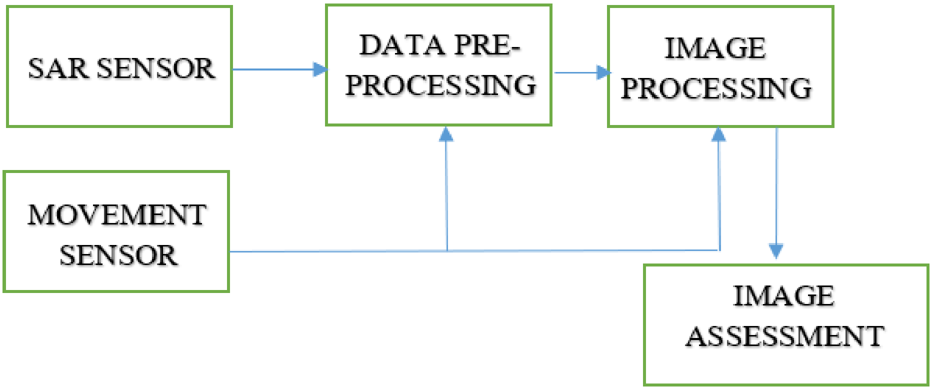

Figure 3. General SAR System Diagram

SAR systems can provide high resolution in the flank direction, which standard radars cannot provide in practice, with data collection method and data processing algorithms. In addition, due to the synthetic aperture method it uses, the platform shake must be compensated in order for the image to be focused. Finally, SAR systems are widely used in military and civilian areas thanks to the high resolution advantage they provide (Soumekh, 1999). The characteristics of the main space-based sar systems that are currently active are given in Table 1.

Table 1. Characteristics of Major Space-Based SAR Systems with Current Activity (Lillesand et al., 2015)

Launched year	Satellite	Country	Radar Band	Pol.Mode	Visual Angle	Resolution, m
2007	TerraSAR-X	Germany	X	Dual	15-60^{O}	1-18
2007	COSMO-SkyMed 1	Italy	X	Quartet	20-60 ^{O}	1-100
2007	COSMO-SkyMed 2	Italy	X	Quartet	20-60 ^{O}	1-100
2007	Radarsat-2	Canada	C	Quartet	10-60 ^{O}	1-100
2008	COSMO-SkyMed 3	Italy	X	Quartet	20-60 ^{O}	1-100
2010	TanDEM-X	Germany	X	Dual	15-60 ^{O}	1-18
2010	COSMO-SkyMed 4	Italy	X	Quartet	20-60 ^{O}	1-100
2012	RISAT-1	India	C	Quartet	12-50 ^{O}	1-50
2014	ALOS-2	Japan	L	Quartet	10-60 ^{O}	1-100
2014	Sentinel-1A	ESA	C	Dual	20-47 ^{O}	5-40
2016	Sentinel-1B	ESA	C	Dual	20-47 ^{O}	5-40

Radar backscattering from ice depends on the ice's dielectric properties and spatial distribution. In addition, factors such as ice age, surface roughness, interior geometry, temperature, and snow cover also affect radar retroreflection. X-band and C-band radar systems have proven useful in determining ice types and ice thickness associated with extraction (Wynne et al., 1998).

ESA's Sentinel-1A/1B satellites distribute data in the C-band in single or dual polarization, covering mid to high latitudes. The Sentinel 1 satellite was first launched in 2014 and later in 2016. This rapid data distribution is designed to support operations such as ship tracking, sea ice monitoring, oil puddle detection, snow ice dispersal, flood and uncontrollable natural disaster response, and other time-critical applications (Heady and Child, 1994).

Sentinel-1A SAR satellites have a C-band (5.405 GHz) imaging feature system that can operate in 4 different specific modes with different resolutions and scan widths. Imaging modes for Sentinel-1A satellite systems are 5 meters resolution and 80 km long strip-map mode; It includes an extra-wide scan mode that delivers 40 m resolution data at a scan width of 400 km and a single pass interferometric mode with both satellites working together sequentially to obtain interferometric data at a scan width of 250 km at a resolution of 20 meters (Table 2) . Its temporal resolution is stated as 6 days (Rignot et al., 2008).

Table 2. Sentinel-1A Imaging Modes (Sentinel 1 Team, 2013)

Mode	Scanning Width (km)	Resolution (SLC) (m)	Resolution (GRD) (m)	Polarization H (Horizontal) V (Vertical)
Strip Map (SM)	80	5*5	23*23	HH+HV, VH+VV, HH, VV
Interferometric Wide Swath (IW)	250	5*20	20*22	HH+HV, VH+VV, HH, VV
Extra-Wide Swath (EW)	400	20*40	50*50	HH+HV, VH+VV, HH, VV
Wave-Mode (WM)	20*20	5*5	-	HH, VV

Many programs and support program add-ons are available for processing Sentinel-1A SAR images. In this context, ENVI and MATLAB programs draw attention first. In addition, there are many JAVA supported add-on programs that have been applied in previous studies. The most frequently used ones are ESA (https://www.esa.int) supported; It is included as Science Toolbox Exploitation Platform (STEP) and Sentinel Application Platform (SNAP). In order to obtain the data set, Sentinel Data Hub (Sentinel Data Center) connected to the same platforms can be used (Campbell, 2002). Within the scope of the study, SNAP and a supporting program, SNAPHU, were used in the steps of interferometric processes (Sanchez-Lazano et al., 2013).

Interferometry Application Phase:

Based on the area boundaries determined as the study area, it is possible to determine the snow thickness in the region by applying the interferometry method (Figure 4) with the help of SAR Radar data sets and satellite data taken from different heights of the same region at the same time. There are several stages of performing the interferometry method. First of all, the Sentinel-1A SAR dataset was downloaded from the Copernicus platform with the desired features and made ready for use for analysis. In order to use the data received with the Sentinel-1A satellite and make it ready, some processes are applied. These operations are carried out by SNAP with its short name, Sentinel Application Platform, which is developed for Radar satellites and is especially used in studies on Sentinel data, which has its own toolbox and can produce a generally accepted output data in many studies on this subject. The data set is exported by using the SNAPHU section for the phase opening process of the data obtained in the analyzes carried out, and after the phase opening process is performed with the support of the CYGVIN64 software program, the result data is transferred back into the SNAP program using the SNAPHU section.

Interferometry Analysis Steps

Data set supply and data control

After obtaining the Sentinel-1A data set, the files were called in pairs for the interferometry method. The general values of the data in which the same area was shot on different days in the relevant months were checked. “Track” values must be the same so that all data used can be taken from the same piece.

Interferogram graph generation and image pair call-up

After checking the general information of the data and making the data sets with equal Track values from the same piece ready for use for interferometry, the first and second images were selected by creating an interferogram graph.

Area determination for interferometry analysis

In the TOPSAR Split section, one of the VV or VH polarizations is selected and the area to be analyzed by interferometry is determined by separating it to cover the area to be treated in the next step.

Selection of Digital Elevation Model for binary interpolation

In the Back-Geocoding section, the DEM that we will use within the scope of the study and required for binary interpolation is selected. STRM3 data is selected as DEM data for interferometry study. With the determination of this data set, binary interpolation selection was made. In order to see error rates and jumps, “output deramp and demod phase” application was made.

Integration of data set

Another important step for integrating the selected data is the TOPSAR Deburst section. In this section, it is ensured that the binary data set can be of the same integrity by selecting the VV or VH options. At the end of all these processes, the data is made ready for interferometry and the process is started.

Phase filtering process for image cleaning

There is an effect called speckle noise, which is unique to the images obtained with the SAR technique. This is because raw data has a complex structure. Because each pixel contains more than one reflective object or target, the phases are randomly distributed due to the reflector. This can cause objects to weaken or strengthen each other's reflections. Statistical interference between these objects adds a mottled appearance to the SAR image and makes detection difficult (Irak, 2009). “Goldstein Phase Filtering” is applied to get rid of this effect on the data.

Phase Unwrapping

The “Phase Unwraphing” phase of the study is again one of the most important and critical phases. For the "Phase Unwraphing" process, which is not included in the SNAP program supported by the Java Program used, the data set was first exported and phase unfolded in the CYGWIN64 software program. Then, the new data set was transferred back to the SNAP environment.

Geometric Correction and Terrain Correction (for image corrections after phase unwraphing)

Geometric distortions occurring in the new phase expanded SAR data obtained are corrected by using DEM data with “Terrain Correction” within the scope of “Geometric Correction” support and a map projection data is produced. Within the scope of the study, SRTM3 (Dozier and Painter, 2004) DEM data was used in the geometric correction process and the data set was produced in the WGS84-UTM projection.

Generating Data and Checking Coherence Values

After all these stages were completed, the image that was among the sub-images of the data set, which was formed under the name of coherence, was selected and the consistency values of the data were checked. Areas close to 1 are defined as the areas that overlap most in some aspect of the signal. These areas are the areas with the highest success rate. They are defined as the places where the correlation difference is clearest. Within the scope of the study, the areas with the highest consistency values were taken into account when looking at the snow thickness.

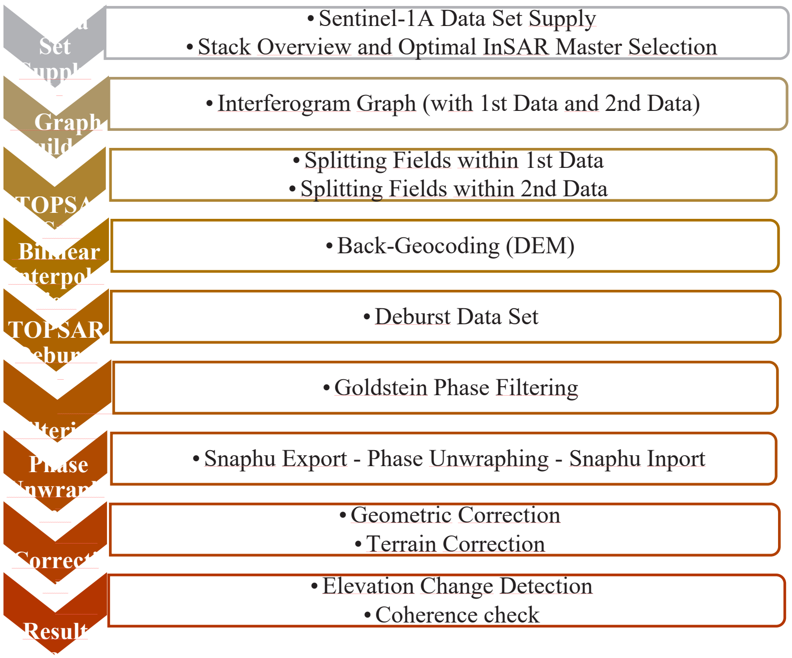

Figure 4. Interferometry Method Flow Chart

Interferometry Application Example

Within the scope of the study, which is located within the borders of the Seyhan (Upper) Basin and is considered as an example of interferometry application, the areas previously determined for suitable winter recreation areas and ski resort center are tested with the interferometry process in order to test the snow thicknesses and to understand the snow potential in those regions more clearly. Snow thickness variation was demonstrated in two regions with a single image set for the study (Figure 2).

These regions were previously named GCP 1 and GCP 2. Performing the interferometry process by using the entire downloaded image set causes both a decrease in accuracy and an increase in processing volume. For this reason, the relevant fields were used by narrowing them according to their potential importance. The reduced and newly created data set covers two suitable areas determined by the MCA method. More accurate results were obtained in the analyzes made in this way.

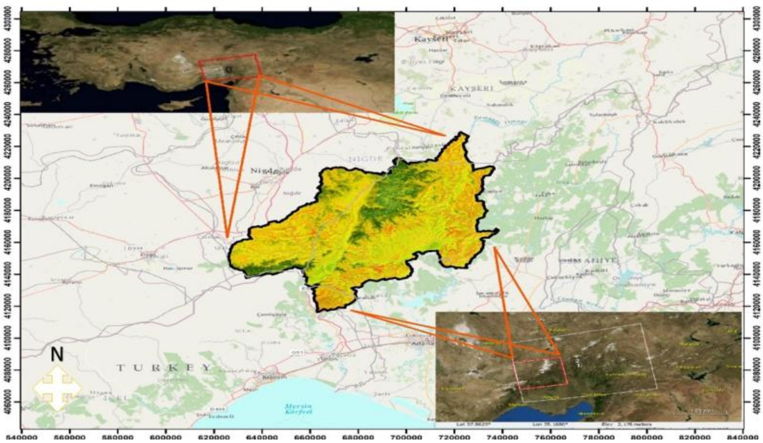

Figure 5. Radar Interferometry Analysis Areas

As a result of the interferometry process performed to examine the 12-day change using the dates of 18-30 December 2016, the snow thickness change in the first of the suitable areas (GCP 1) was determined as 90 cm, and the change in the second area (GCP 2) was determined as 39 cm (Figure 6). It was observed that the coherence values of the appropriate areas analyzed were close to 1 and the maximum value reached up to 0.924 (Figure 7).

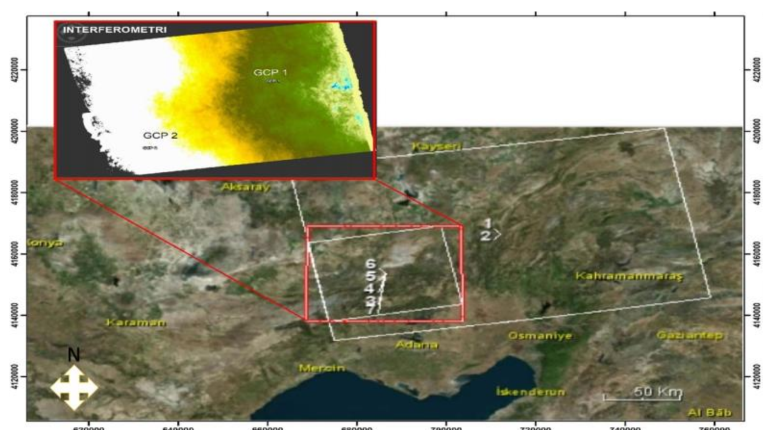

Figure 6. 2016 December Interferometry Process

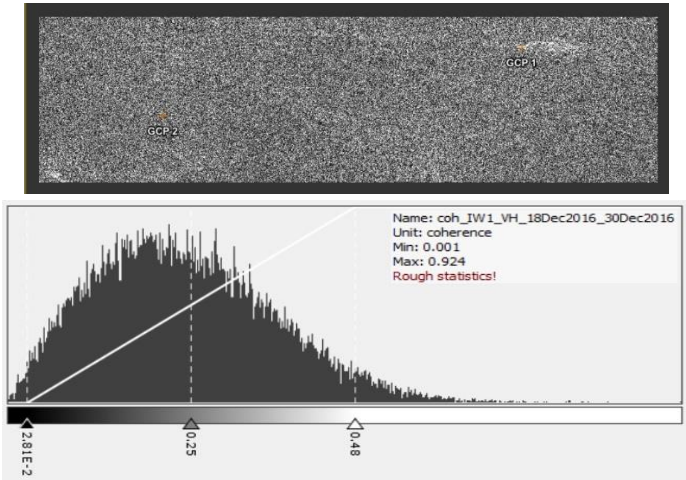

Figure 7. December 2016 Coherence Values

As a result of the interferometry process performed to examine the 12-day change using the dates of 11-23 January 2017, the change in snow thickness in the first of the suitable areas (GCP 1) was 68 cm, and the change in the second area (GCP 2) was 23 cm (Figure 8). It was observed that the coherence values of the appropriate areas analyzed were close to 1 and the maximum value was up to 0.894 (Figure 9).

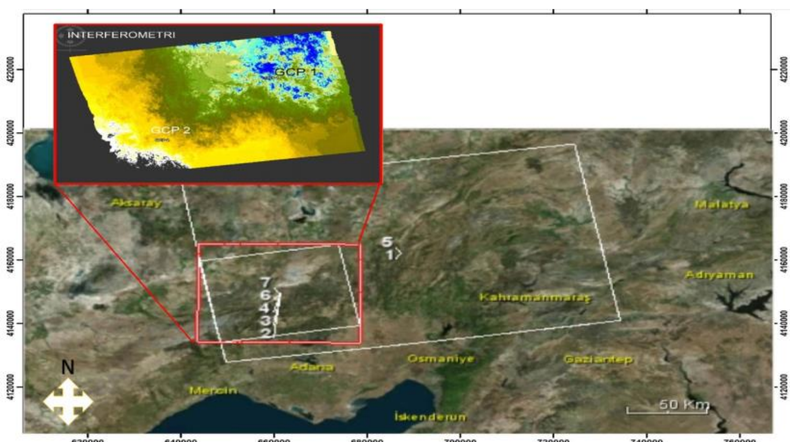

Figure 8. 2017 January Interferometry Process

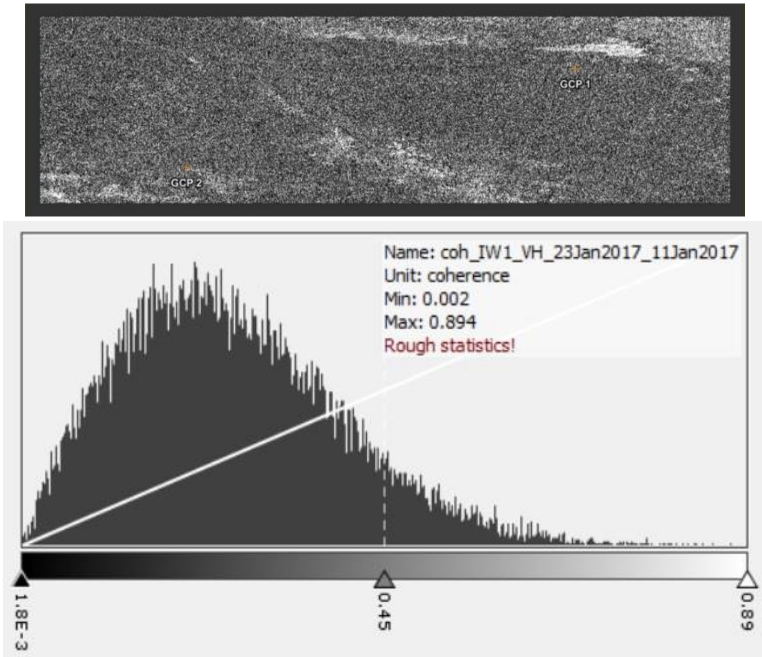

Figure 9. January 2017 Coherence Values

As a result of the interferometry process performed to examine the 12-day change using the dates of 01-13 December 2017, the snow thickness change was determined as 21 cm in the first (GCP 1) area and 13 cm in the second area (GCP 2) (Figure 10). It was observed that the coherence values of the appropriate areas analyzed were close to 1 and the maximum value was up to 0.98 (Figure 11).

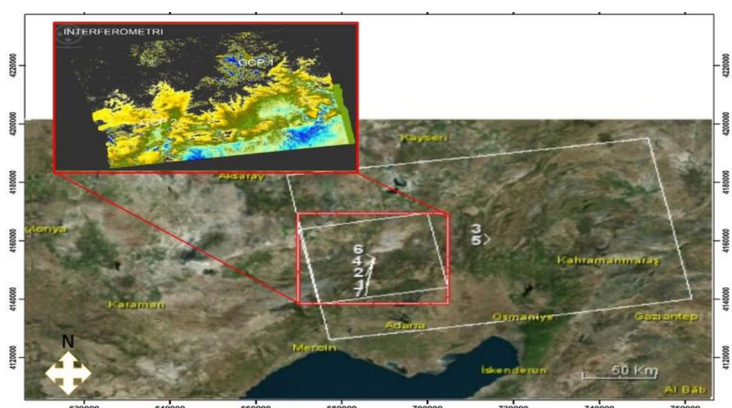

Figure 10. December 2017 Interferometry Process

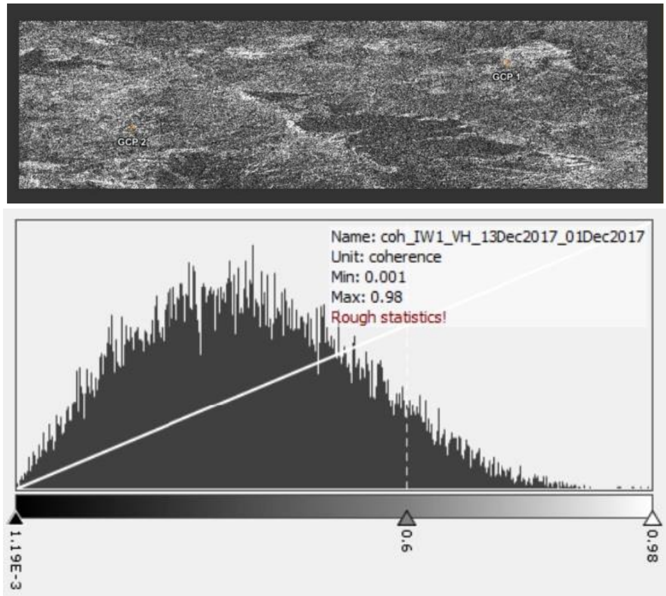

Figure 11. December 2017 Coherence Values

As a result of the interferometry process performed to examine the 12-day change using the dates of 08-20 December 2018, the snow thickness change was determined as 20 cm in the first of the suitable areas (GCP 1) and as 12 cm in the second area (GCP 2) (Figure 12). It was observed that the coherence values of the appropriate areas analyzed were close to 1 and the maximum value increased up to 0.955 (Figure 13).

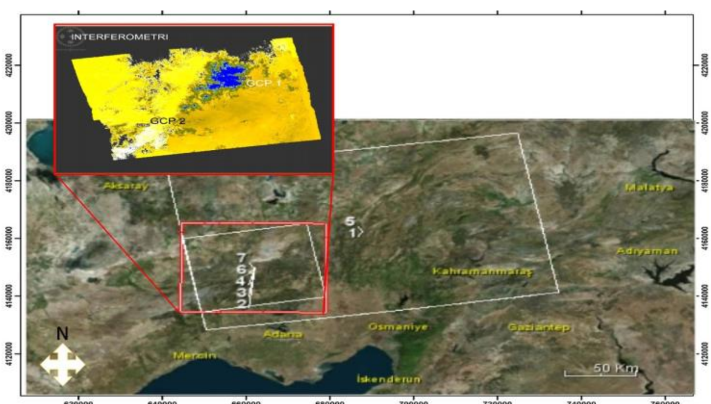

Figure 12. 2018 December Interferometry Process

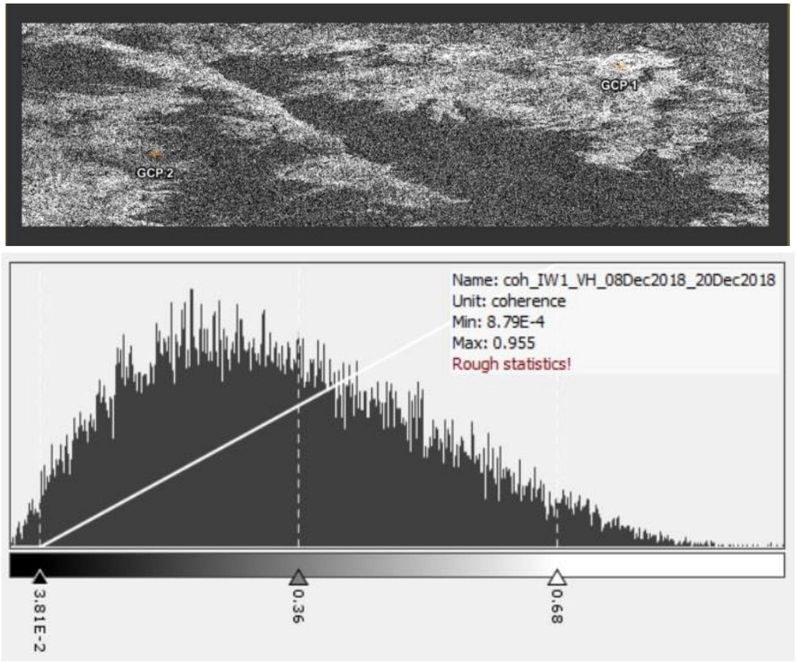

Figure 13. December 2018 Coherence Values

Within the scope of the study, suitable areas for the location of the ski slopes that could be used for the establishment of ski slopes by using MCA methods were mapped and named as point (GCP 1 and GCP 2) and put forward to be tested by interferometry method. With the help of radar data sets of the detected areas, the snow thickness in the winter period was determined by the interferometry method and the permanence of the amount of snow in the area at a regular density and volume was tested. The snow factor, which is the most important component for winter recreation activities, was tried to be evaluated in all aspects with the result data produced. Thus, in the Seyhan (Upper) Basin region, which was determined as the study area, the ability of the interferometry method to produce precision accuracy was also used while making suggestions for the creation of winter tourism infrastructures by determining suitable areas for winter recreation activities.

Conclusion

As a result, radar interferometry is an important tool in the field of remote sensing and geographic information systems. It can be used to create high-resolution digital elevation models and monitor deformations on the ground, providing valuable information in a variety of applications. In the case studies, it was determined that the ground data and interferometry showed consistent results. Thus, it has been determined that similar studies can be used in different regions and can be used as a safe mapping method by testing with radar. It has been determined that the studies to be carried out with RADAR datasets in Remote Sensing systems, especially in difficult terrain and topography conditions, will contribute to the issues of overcoming both temporal and physical conditions. It is stated that this interferometry method used will make a significant contribution to the process-based mapping of the components to be tested in large areas within complex structures and to test the accuracy of the result data.

When the advantages of using the Interferometric SAR technique in planning studies are put forward;

Monitoring the deformation of the earth's surface: InSAR can monitor the deformation of the earth's surface with high precision. It can be used to detect changes at a local or regional scale caused by natural disasters such as earthquakes, volcanic movements, crustal movements and depressions.

Infrastructure monitoring: InSAR can be used to monitor the deformation of cities and infrastructure facilities. Remote monitoring of structures or dams is important in detecting potential security threats and assessing the health of the structure.

Agriculture and forestry: InSAR can provide information on the overall health and growth of farmland and forests. The changing growth rates of agricultural products and forests are important for monitoring water resources, determining environmental changes and sustainability.

Topographic mapping: InSAR can be used to create high precision digital surface models (Digital Elevation Models, DEM). This is important for mapping in mountainous areas, rural areas and remote areas where topographic data is lacking.

Monitoring of water resources: InSAR can be used to monitor changing levels of groundwater levels and lake surfaces. This is important for the sustainable management of water resources and for preventing water crises.

Monitoring of ship traffic: InSAR can be used for monitoring the sea surface. Tracking the movements and activities of ships provides valuable information for maritime safety and coastal management.

Earthquake and disaster predictions: InSAR can contribute to the monitoring and forecasting of earthquakes and disasters. Monitoring crustal movements and deformations can help predict future earthquakes and natural disasters.

All these advantages have increased the use of InSAR in planning studies and made it an important tool in various industries. However, it is also known that InSAR needs appropriate satellite data, calibration processes and analytical methods to obtain accurate results.

Acknowledgement

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Chapter 8

Reflection of Cold Light on Architectural Spaces

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ABSTRACT

1- INTRODUCTION

Despite the developing technology, fireflies are cold light sources that have not been artificially imitated for thousands of years. The most striking feature of fireflies is that they emit light at short intervals. This event occurs as a result of some chemical reactions occurring in their bodies. A substance called luciferin is secreted from special cells at the lower end of the abdomen of fireflies. When luciferin reacts with a high percentage of oxygen, it turns into another substance. As a result, light is emitted from the part where the cells are located. The flashing rhythm of the lights depends on the type of firefly. In Figure 1, the firefly breeding area is seen.

Figure 1: Firefly breeding area (URL-1)

The scientific explanation of the light they produce as cold without loss of energy is explained by photogenic cells inside a transparent layer called "cuticle" and light reflective layers resembling car headlights. The luciferin substance produced in the light organs burns gradually with plenty of oxygen. While this chemical incident creates light, the slowly occurring oxidation completely transforms the chemical energy into light.

For example, in Thailand at night, it gathers around trees on the riverbank and flashes more than 100 times a minute, creating the impression of artificial lightning. Or, the lights and brightness of fireflies in Jamaica can give the appearance of a large-scale forest fire from meters away. It is known that doctor Williams Gorgas, who had to operate on a soldier who was injured during the war in 1898, completed the operation when the lights went out while the operation was going on, thanks to the light emitted by a firefly in a jar.

This light is called cold light in the scientific world. The use of cold light has started to gain importance today. Although cold light can be used in devices with certain percentages in technology, artificial light production has not been fully achieved yet. The used cold light, which can be partially imitated by organic LED (OLED) light systems, is used in skin beauty and skin rejuvenation processes. In the medical field, it is also used as cold light in endoscopy devices and ultrasonic devices (Cengiz and Cengiz, 2018:Cengiz et al. 2015:Eren et al, 2015).

Biomimicry, the idea of being inspired by nature, has inspired Korean scientists. OLED performance has been significantly improved by imitating the nanostructures of fireflies with scientific studies. Compared to bioluminescent insects, fireflies are among the most productive and brightest insects. By imitating this situation of fireflies with asymmetrical microstructures and longitudinal nanostructures, OLEDs were produced thanks to polydimethylsiloxane. Firefly types are seen in Figure 2.

Figure 2: Types of fireflies (URL-2, URL-3)

COLD LIGHT EFFECT IN SPACES

The eye, the most developed and most adaptable organ of the human body, experiences and perceives life at thousands of lux brightness levels in daylight. The eye organ continues to perceive the world, its environment, and living things even on a moonlit evening. For this reason, the eye's superior adaptability carries people's perception level between pure darkness and light to a relative and subjective dimension. Although lighting is tried to be defined rationally and measurably with its “luxury” value, cold light contributes to the perception of space in the process ranging from traditional lighting to cold lighting.

Cold light can be defined as a new element compared to traditional light sources. This new element creates different effects on spatial and vital perceptions. Point light sources such as fire, sun, and traditional lamps have been used by people for years. Buddha left a one-way mark on people by creating permanent perceptions. Today, the surrounding objects and spaces are illuminated by point light sources. However, when the space is illuminated with non-point (linear, curvilinear, planar) different, that is, cold light sources, the effect of the lighting on the space will have a very different effect.

- Cold light is form-independent. With cold light sources, it is possible to create portrait landscapes in which more free point, pixel-based, linear, curvilinear, planar, and organic forms can be designed, apart from the forms conditioned by the point and centripetal principle. For this reason, the change in the form of light opens up a new way for light to become a building element in the space and change perceptions.
- It has decoration ergonomics. Cold light sources have much smaller dimensions than conventional light sources. Therefore, it is easier to integrate into the architecture. This feature takes the perception of space to a different dimension by improving the use of concealed lighting and integrated lighting in space lighting. Here, the feature of the light to be used to beautify the living spaces is important. Choosing the wrong color as part of the cold light will cause the whole decor to appear in a different color.
- It has tactile properties. While light used to be an intangible object, it has become a new practice to touch a light source and sit on a lighted bench with cold light technology (OLED), which emits much less heat. Light has become touchable, even wearable. Today, with the concept of "wearable devices" (wearable light), people have also become a part of spatial perception.
- It has the capability of modularity. Modularity is a very basic concept in space design. Traditional light sources have served space design with limitations in terms of modularity. Cold light sources, thanks to their multidimensional modularity, can be processed like a building element and integrated into materials to create repetitive surfaces and volumes.
- It has a multi-color feature. People have studied the environment and space in a color temperature range from warm white to cool white, experiencing fire and sun for centuries. Cold light sources allow various colored surfaces to be illuminated with different colored lights in spaces. This color technology, which offers unlimited combinations, should be used with the principles of color science. Because the mixture of colors causes the eye to perceive a different color. Colors created in OLED cold light are shown in Figure 3 (URL-4, URL-5).

Figure 3: OLED - colors created in cold light (URL-4, URL-5).

- It is the closest light group to daylight. Scientists have always worked to provide the colors closest to the color spectrum of daylight. Compared to traditional light sources such as incandescent, halogen, and metal halide, cold light technology (OLED) has much more advanced features to achieve this goal. Today, the birth of concepts such as Mood Lighting and Human Centric Lighting is based on the relationship between the hormonal and vital cycle of human health and daylight.
- It interacts with its environment. Although light has been used with the relationship of light and dark in human life until today, light can be used as a design element in space. In this way, different perceptions can be added to the space with the interactive and programmable feature of the light. In today's conditions, where sensors and light sources interact with human life, light creates moving and living perceptions in human life. The biggest reason for this development is that cold light (OLED) sources have electronic infrastructure suitable for fully digital control.

COLD LIGHT PERCEPTION

In the process of recognizing the new generation of light sources, both designers and end users have started to compare this new experience with their old habits. Although people are open to innovations, when they start to experience innovations, they begin to question their old comforts and habits.

While people are taking advantage of the lighting advantages in the transition to halogen, compact fluorescent, and incandescent lamps, they have started to compare the color temperature of halogen light and the distribution of fluorescent light visually and sensorial (Arpacı et al. 2018:Efe and Varhan, 2020, Doğruer and Can, 2022). New-generation cold light sources have started to shape these habits with the technology that will re-establish these habits with halogen or fluorescent light sources. Today, the conversion process of lighting to cold light continues. If the perceptual effects of cold light are examined;

- Depth and dimensional effect analysis: Cold light sources have characters that will strengthen and differentiate the multidimensional perception of the space. Being decentralized and form-free is used as a new approach in architectural lighting design.
- The shading effect is a more critical issue for cold light sources. The shadow effects of non-single-point cold light sources need to be controlled with the right optics. Otherwise, perceptual confusion and visual pollution may occur, such as the formation of many gradual shadows that the human eye is not accustomed to. The depth-dimension effect and shadow in architecture can be seen in Figure 4.

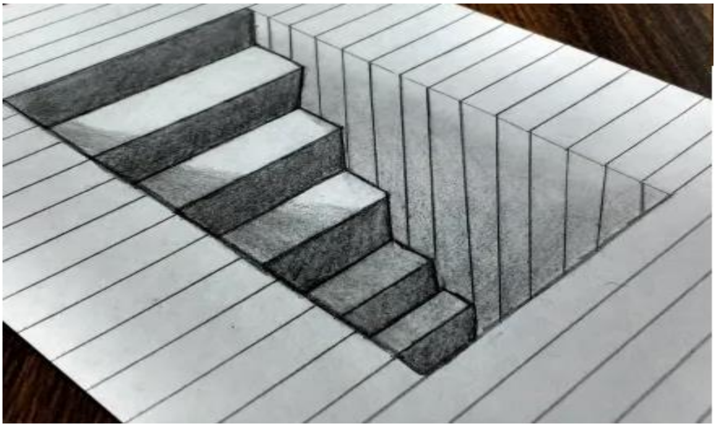

Figure 4: Depth-dimensional effect and shadow in architecture (URL-6)

- Cold light according to daylight: As a result of controlling cold light sources with computers and daylight sensors, the brightness and feel of the space can be managed by adjusting the brightness level and color temperature adaptively during the day in buildings such as offices and hospitals.
- Glare Control requirement: Cold light sources with better quality light properties than conventional light sources need to provide glare control with the right optical design. This factor is a visual element that directly affects the comfort perception of the space.
- Accurate Detection of Textures and Colors: Cold light provides more accurate detection of textures and materials with various designs, optics, and typologies. Differences in the color temperature of light sources and versions with high color rendering help to perceive colors more accurately. In addition, cold light sources and special chips provide a more dominant and effective perception of certain colors.

- Perception of Hierarchy: Depth, planes, and levels are important in perceiving orientation and technology in the perception of space. Features such as changing the color temperature of light, dimming, illuminating different colors, and having light distribution at different angles and forms can improve these perceptions.
- Contrast and distribution in cold light: If the environment is generally bright or dark, that is, if there is a homogeneous light distribution, this type of lighting is called low contrast lighting. If the difference between dark and bright spots is clear, it is called high-contrast lighting. Deciding how much contrast to have in a lighting application will depend on the effect you want to create. Low-contrast homogeneous lighting is generally preferred in terms of visual comfort in indoor and outdoor lighting. High-contrast lighting can be used in architectural lighting applications. Low contrast creates a calmer, more relaxing, and fun atmosphere, while high contrast creates a more mysterious and striking effect. In the architectural design of the space, the factor that the light affects the perception and function the most is contrast. Therefore, the visual concept used to describe the forms and objects in space as a whole or independently is defined by the concept of uniformity at the other extreme. Thanks to the cold light, it is possible to design the contrast and uniformity factors in a balanced way with different technologies.
- The feeling and ambiance effect in the space: The use of lighting layers in architectural lighting design is also available in the traditional method. Cold light technology enables each lighting layer to be controlled independently and dynamically, allowing us to program and design color, illuminance level, and color temperature values parametrically in the space. In Figure 5, it shows the effect of light on the space in terms of feeling-ambiance and contrast-dispersion.

Figure 5: The effect of light on the space in terms of feeling-ambiance and contrast-dispersion (URL-7)

DISCUSSION AND CONCLUSIONS

Cold light can inspire designs that strengthen the perception of space and create new experiences in architectural lighting design.

Cold light establishes various relations with the building elements it comes into contact with, through the shadow that is the opposite, and takes its place in the created visual composition. While cold light plays this role, the semantic identity it assumes affects the shape of the space elements and the properties of the material used. Cold light is an element that complements the design process and is needed in the shaping of the space. The quality and quantity of cold light in an architectural space is a major factor in people's feelings, communication, and behavior with the environment, as well as giving meaning to the space.

Thanks to the ability of cold light to produce color, it allows the color of a surface to affect many different color tones. With various color tones, different aesthetic experiences in the space are offered to the service of the user. These new experiences break the monotony and create an interesting and aesthetic appearance.

While experiencing a space, the perception of it and the feelings about the space are related to the way cold light is used in the space. The aesthetic effect created by cold light in the space is an important element to be considered in terms of integrating with the general character of the space.

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Chapter 9

Slow City Urban Identities: A Comparative Study On Public Spaces of Seferihisar and Trani

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Abstract

The formation of Slow City (Cittaslow), which is defined as a kind of sustainability movement, aims to preserve the collective memory, to protect the city, and to maintain the repetition that makes a space a home and the healthy relations between the people who keep the home alive. In this context, it would be appropriate to say that the formation is a kind of cultural sustainability movement. Negativities brought about by the rapidly developing and changing world leads to the creation of urban areas that are unidentified, uniform and have neither connection with the past nor the future. According to this concept, the main purpose of the research is to analyze to what extent the cultural identities of the cities under the scope of Slow City are read through the urban texture. At this point, as a research area, a comparative analysis study is carried out on the first Slow City of Turkey, "Seferihisar" and on the other hand, "Citta di Trani" from the country where the mentioned formation was born. For the comparison of the two cities mentioned, the criteria that are effective in the formation of urban identity are taken as basis. As the research areas are selected from two different countries, two different cultures' approach to the formation is revealed.

Keywords: Slow City (Cittaslow), Urban Fabric, Urban Identity, Public Space.

Introduction

With modernism and globalization, the world has met the concept of speed. This concept reshaped local culture, heritage, and identity of small towns. In the fast-paced cities of the overall world; the relation between space and identity is confused, cultural attitudes and urban fabric become homogeneous. Fast-paced cities are facing loss of their traditional heritage and cultural identity in urban and public spaces.

The Cittaslow is an act despite the similarity of towns caused by globalization and the fast world. Cities, like all systems in social life, are similar to each other by moving away from their local characteristics. Cittaslow is a kind of ecological and humanitarian movement that preserves local and traditional culture and promotes comfort and enjoyment in life. The Cittaslow movement aims to protect the local characteristics of cities without losing their own identities. It is based on the conservation of sustainable and ecological characteristics that exist in conventional formation of towns.

The Cittaslow movement represents a feasible model for alternative urban development that is particularly sensitive and sensitive to the complex interdependencies between local identity, environmental protection and quality of life goals.

This study analyses the Slow City movement from the perspective of cultural identity in public spaces. This movement as an appropriate urban model is especially sensitive and responsive to the complex interdependencies between the goals of life quality, environmental protection, and local identity.

This research examines the Slow City movement as an alternative approach to regain cultural identity of urban public spaces. From this point of view, “Seferihisar” as an example of Cittaslow in Turkey and “Citta di Trani” in Italy are examined as case studies. Cittaslow is preferred in connection with varied purposes such as improving the quality of urban life, avoiding the disadvantages of globalization, preservation of urban identity, sustaining the ongoing regional development, creating the awareness of being in relation with social, economic and environmental values of cities. In terms of relation between cultural identity and urban fabric, Cittaslow is a means which could be used to reveal different aspects of cities from others. Within this scope, this study discusses Cittaslow in Seferihisar and Trani in terms of public spaces.

Evolution of Cittaslow Movement

Slow Philosophy

Cities, the products of man's greatest virtue, are "placeless" spaces that, as a result of modernization, are kept at the forefront of speed and consumption due to the rule of their assistance of thoughts. With the effect of modernization, where speed and consumption are at the forefront, cities have become “placeless” spaces. The terms “fast” and “slow” are briefly the spelling of the philosophy concerning to life and existence beyond mentioning the rate of change. The word “speed” is used in the meaning of busy, controller, aggressive, hasty, analytical, stressed, superficial, impatient, active and caring; the amount over the quality. Slow is the opposite of speed that means calm, attentive, open, quiet, intuitive, non-fussy, patient, and thoughtful and situations that favors quality over quantity. In the age of globalization, social and cultural structures experience radical changes from the local culture to universal culture by ignoring the traditional values.

Slow ideology is growing rapidly as a powerful grassroots movement. There are many independent slow-thinking events all over the world, but they are not really related to Slow Food or Cittaslow. Regardless, this grassroots way of thinking movement is indicative of a general dissatisfaction with the pace of life and a lack of value, with an increasing preference for quantity and speed. Slow Food has become the most visible manifestation of the emerging slow theory.

The slow in "Cittaslow" refers to the concept of taking the time to succeed with quality. Nonetheless, the people of Cittaslow do not live at a slower pace.

Slow Food

Carlo Petrini founded the Slow Food movement in 1989 in Bra, Italy. Cittaslow is firmly associated with Slow Food in both theory and practice. Slow Food was presented as a method of preserving locally grown products, traditional cuisine, and the cultural associations that go with them. It started as a result of the growing popularity of fast food restaurants in Italian cities and towns. Those fast food restaurants were seen as addressing a foreign concept to the Italian way of life. Not only were the brands unfamiliar, but the way of life associated with fast food was also unfamiliar. Carlo Petrini predicted that fast food and fast food culture would take over Italy. As an immediate reaction, he founded Slow Food.

In his book, Carl Honoré noticed that Slow Food "represents all that McDonald's doesn't: natural, local, seasonal produce; passes traditional recipes from elder to younger ones, farming which able to continue over a period of time; productions which made by traditional way, slow-paced dining with family and friends".

Cittaslow has made Slow Food a philosophical point of reference. Slow Food has established a link between food, regional farms, and traditional cuisine and socio-cultural sustainability. Slow Food and Cittaslow's collaboration has created significantly more urban space to promote regional products and educate people about the importance of regional and traditional foods.

Slow Food became a rousing foundation for Cittaslow, as the fundamental methods of reasoning of Slow Food were then applied to urban environments. Cittaslow, which is run on a municipal level, has a different hierarchical structure than Slow Food. Regardless, the two are linked by shared goals and the fact that they live in many of the same places.

Slow Food and Cittaslow have both recently been depicted as movements. This is an exceptional city association, pushing forward with a common interest that encompasses borders, cultures, and city identities.

The Slow City (Cittaslow) Movement

In 1999, Paolo Saturnini (Mayor of Greve in Chianti) founded Cittaslow with the mayors of Orvieto (Stefano Cimicchi), Bra (Francesca Guida), Positano (Domenico Marrone), and the President and Founder of Slow Food. Saturnini recognized the need to keep up with the characteristics and qualities of smaller urban areas. He predicted that, in the long run, urban communities would suffer as they grew into massive global cities with no local connections. Overall, urban areas will become "everywhere communities" by losing the soul of place that has distinguished them for a long time. "Cities, on the whole, are becoming uniform; they are losing their character and sense," Saturnini observes.

Cittaslow's mission is to protect the quality of life, which is an essential component of every city's sense of place, in an environmentally sustainable manner. The underlying ideology is to recognize and encourage the resources and lifestyles that have traditionally shaped each city district's character. According to Cittaslow's pillar, it is the point at which these characteristics are supported, advanced, and sustained that civic regions are protected from essentially turning out to be more instances of everywhere societies. Revive the soul of place also recreates contact with actual environmental factors and ties with the territory, which have historically been the foundation for local life.

The certification of cities includes 72 requirements for quality, subdivided into 7 macro areas. These 7 chapter titles consist of Energy and environmental approaches, infrastructure policies, quality of urban life strategies, agriculture, tourism and tradesmen policies, hospitality, awareness and education policies, social cohesion and partnerships.

The Cittaslow criteria include programs for environmental sustainability, preservation of local culture and enriching the social aspects of urban life. Cittaslow aims to preserve and maintain the existing identity of the old cities and to seek a holistic environment with slow city identities while recognizing the development of new cities.

Urban Identity in Slow City (Cittaslow)

Urban public spaces are the places where human as people interact, come together and socialize as a composite complex. These places as the center of interaction, diversification and transition between people who lives communally. Halprin defines "city" as a community that human as a social entity live, work, enjoy and encounter with the others, in other words participate in social life (Taylor, 1979).

The identity of urban space is also tied to the lives, experiences, and activities of its inhabitants which inseparably evokes a sense of belonging and rooting. Moreover, urban areas as the places where people could interact with each other's, identifies themselves and the others are important to discuss in context of identity.

The term "urban identity" was coined to describe the chaotic, disordered, and damaged cities that result from the process of urbanization. According to Wiberg , the profile and the image of a city which could be considered as the urban identity are shaped in a long time. As designers and planners agree in the "science of urbanization", the physical, social, cultural and historical structure of every city are the reasons which has been defined as "urban identity". Therefore, each city had to restructure depending on its identification features such as cities' own skeleton, way of life and architecture.

Formation of the spatial identity requires the mixture of whole qualities shape the city such as local traditions, cultural level, geographical content and the historical accumulation. For that reason, while we are analyzing urban identity, the people living there and the physical, public and economic structure of a city should be thought as a whole.

There are physical, socio-cultural, functional, spatial and economic values of cities and dwellers which are important for developing an urban identity. These attributes which shape the structure of urban identity could be defined as below;

1. Historical Components: The cities that "have not lost its quality of being old" are the ones which protected their historical and cultural values. The qualities of the physical environment, historical places, their habits formed by local culture which determines the identity of certain areas. The new element and technological advances that will be added to the city should be appropriate with the texture, color and styles of these valuable components.

2. Geological-Topographic Structure: The city's identity is also influenced by physical factors such as its geographical and topographic structure, climate, and hills and plains. Topography influences the location of the city in the region, as well as economic and cultural structures. Whether the city is located on a highland, waterfront, or lowland, all of its structural and architectural specifications are impressed. Environmental components such as form, color, and pattern shape and develop topography and climate characteristics. Some cities' identities may be determined by their geographical properties, such as Istanbul's Bosporus and Venice's waterway.

3. Relation with Water: The other important element that affect the economic structure is water and the irrigation facilities depending on sea products. The water factor also causes the city to be formed more differently than the others. The formation of the city determines its urban identity.

The climate that has a big role in the configuration of physical and urban identity of city, also related directly with water. On the other hand, water always affects people’s mood positively and could be an effective psychologically element.

4. Flora and Fauna: These two items as the significant physical components are effective factors on both locations of the city and also urban identity. Flora and Fauna affect the urban identity and economic structure in a positive way.

5. Public and Cultural Structure: The underlying foundation of traditions and a sense of belonging is culture. The urban characteristics features are formed by political, religious, artistic freedom and democracy, scientific knowledge, and objectivity. The elements that comprise urban identity are public structure, cultural relations, community educational level, and people's attitudes. Outdoor public structures such as streets, main roads, and urban squares reflect the community's, cities’, and citizens' historical cultural values.

6. Economical Structure: The cities identity depends on the economic activities, level, source and distribution of income. Same time the cultural, social and geographical effects form the economic structure which is one of the substantial elements of urban identity.

7. Recreation and Entertainment: The variety of social and cultural activities and individuals and groups as users creates a remarkable public place which exhibit the urban identity. Therefore, urban public places such as squares, streets and parks are the best places to reflect urban identity.

8. Technological Level: Globalization, innovations and technological developments have made the change of the city as a spatial and social area inevitable. The atmosphere created by this change also affects the concepts of urban identity and urban culture.

These features which combine, define, and highlight the city establishes the urban identity. The structural facts help to determine an image or an identity of a city. Urban identity is a notion which is not physical but can be related to physical, social, cultural, historical and economic features of the city. To understand the impact area of the urban identity, it is needed to grasp all the influencing features.

Public areas as the significant elements of urban structure is the place where people practices to socialize and coming together. The economic, political and socio-cultural and historical values are the main arrangements factors of public realms. Changing modern society, urban transformation, globalization and migration transformed public places and urban identity. These factors present both opportunities and threats to small cities' national cultures, heritage, and identity.

In this respect, the reflection of the Cittaslow philosophy on the public places gives important clues about how the idea of Cittaslow is internalized or not. Cittaslow has an understanding of urbanization that reveals the local identity and sense of place. However, in the imagination of the public space, it is important to multiply the spaces and arrange them according to common sharing.

The aim of the Cittaslow movement is to offer a high quality lifestyle against the loss of identity as a result of the monotonous lifestyles of the globalizing world and the loss of identity as a result of the loss of social, historical and cultural values.

The conditions caused by globalization and modern life in cities cause the loss of historical, local and traditional values. As a result, these areas become less appealing to live, work, visit, or invest in, and international tourism provides fewer economic benefits and may have more negative consequences.

Public Space Approach in the Slow City

As Hough states, “identity in the urban center is based on the continuity of the built environment. Public spaces are used as a means of creating urban identity, including streets, local public markets, parks, public squares. These open and public areas are where people interact with the city, environment, and their neighbors. On the other hand, public spaces play a critical role in urban structure and urban life.

According to Heidegger (1958), urban spaces which became ordinary and lost their identity are “placeness” spaces. Globalization, which affects social and economic life, has caused people who are in constant interaction in today's world to resemble each other. Cities, like all systems in social life, have begun to resemble each other by moving away from their local characteristics. Therefore, this rapid change and assimilation process has caused the loss of identity and cultural values in public spaces. On the other hand, Public spaces that reflect the physical, cultural, historical and socio-economic characteristics of the city should be thought and designed by embodying the values of local identity. The diversity of activities and users creates a remarkable public space which could be the best place to define and understand urban identity.

In this sense, “Cittaslow movement” is one of the alternative views to improve the life quality in the cities and creating more sustainable life systems and so on, developing the social relations in urban fabric and public places.

The Cittaslow snail symbol, that carries the historical values on its back emphasizes the importance of urban culture. Being cities that still contain the historical city structure alongside modernity is the most important feature of the Slow Cities. The historical city squares, streets, traditional marketplaces and religious buildings as a cultural heritage are defined as public urban cities. These Public spaces can be thought as the junction between people and the city, which conveys all of the economic, political, social and cultural elements.

Therefore, the philosophy of Slow City, could be able to find expression on different surfaces of the city, the life style of the local residents and the relationship between people and space.

On the other hand, the understanding of public space in Cittaslow, is handled within the scope of the reproduction and arrangement of public spaces that provide common sharing. Urban streets are at the forefront of areas whose functionality has been destroyed in the process of modernization and globalization, but in slow cities, it is highly regarded as it emphasizes locality. These spaces which enable people to come together, socialize and spend time, have been rearranged within the framework of the slow city approach. For example, implementations such as closure of certain city squares or streets to vehicular traffic at certain times of the day or indefinitely have led to the rethinking and revival of traditional public spaces in many slow cities.

In the Cittaslow criteria, the most important goal is to regain the public space in favor of the residents of the city in line with the economic, social, cultural and tourism values.

In this study, the public space understanding of the Cittaslow was examined with examples selected from two different countries in order to see the original urban approaches applied in the Cittaslow. In this context, the public spaces of the cities of Seferihisar (Turkey) and Trani (Italy) were compared and evaluated in line with the urban identity and slow city criteria discussed in the previous section.

METHOD

In this study, the urban identity characteristic which related with Cittaslow criteria is analyzed in order to evaluate cultural identity of urban fabric in Seferihisar and Trani (Table 1). Afterwards, the interaction with urban identity features reveal that public spaces in slow cities is the most important feature for Field observations. Photo analysis and data collection methods are used to confirm how urban identity characteristics are reflected on Slow City and the interaction between cultural identity and public space.

Table 1: The relation between urban identity features and Cittaslow criteria

URBAN IDENTITY FEATURES	CITTASLOW CRITERIA
1. Public and Cultural Structure	Infrastructure policies
2. Historical Values	Preservation of the historical values
3. Relation with Water	Energy and environmental policies
4. Recreation and Entertainment	Quality of urban life policies
5. Economic Structure	Local products

In this context, Seferihisar, which is the first Cittaslow of Turkey, and Trani in Italy are selected as case studies due to their regional, formal, and climatic similarities .

Seferihisar

Seferihisar is a little coastal town and a locale of Izmir area on the Aegean shoreline of Turkey with a populace of 30.890. The town, with a surface area of

355 km2, is encircled by the Aegean Sea from the south and southwest, Urla locale from the north and Menderes area from the east. The urban settlement today creates at the western and southern seaside fragments and the northern Izmir highway direction. A way off of 45 km from Izmir, Seferihisar can be reached from Izmir on two routes by highway. The focal point of Seferihisar is a way off of 40 km to the Adnan Menderes Airport in Izmir. The old Greek settlement of Ephesus and the area of Selçuk can be reached effectively as ancient venues.

Citta di Trani

Trani is a historic fishing port in Puglia, Southern Italy, located on the Adriatic coast between Bari (43 kilometers north) and Barletta (7 m high). It is on Italy's mainline railway network, so it is easily accessible from the Puglia Region's main cities. In 2014, the city's population was reported to be 56.000 people. The nearest airport is Bari Palese Airport, which is only a few miles from Trani. Trani's tourist attractions include lanes to wander down and harbor views to admire. The Cattedrale di San Nicola Pellegrino, which dominates the seashore from a spectacular position at the water's edge, is a must-see in Trani.

The aim of this study is to evaluate the urban identity features of public spaces in Seferihisar and Trani as listed in Table 1, which is given above. In the following, the existence of the chosen principles is proven for the coastlines of Seferihisar and Trani by means of photo-analysis, observations, data collection and earlier researches (Figure 1).

Figure 1. Location plans of Seferihisar and Trani

FINDINGS

Assessment of Urban Identity Principles in Seferihisar and Trani

Public and cultural structure

Seferihisar: The city which is known to have existed for 4000 years, has hosted different cultures and religions throughout history. Therefore, this diversity of the city body has enriched the its culturally and socially values. This richness is felt both in the cities public spaces and the lifestyle of the local people (Figure 2).

Figure 2. A sight from public areas in Seferihisar

Izmir's Seferihisar district, which was waiting to be discovered as one of Turkey's holiday destinations, rising its trend with the advertisements and promotional activities made after becoming a slow city. The fact that Seferihisar is close to the airport and the city center, having 13 blue flag beaches, has caused the district to become a frequent destination growing without disturbing its natural beauties for tourists who love coastal and history tourism since 2016. Therefore, the tourism sector has undertaken almost the entire economy of the district.

Trani: The port marked the first expansion of the city outside the city walls and the start of the construction of large religious complexes, starting from the Cathedral and extending to the West, dedicated to St. Nicholas the Pilgrim, which began in 1099 on the site of the older church of Santa Maria. This information mentioned for the first time in a document dated 1035. At the same stage, both the complex of San Giovanni della Penna to the east and the church of the Templars (or All Saints) at the bend just west of the port, was erected.

Moreover, the port's importance for the pilgrimage to Jerusalem was demonstrated in the second half of the 12th century by the Jewish traveler Binyamin of Tudela, who crossed Europe from Navarra in Spain to Baghdad between 1159 and 1167. In his travel book «Sefer ha-Massā'ōt», written in Hebrew and later published for the first time in 1593, «all pilgrims traveling to Jerusalem due to the convenience of the port gather at Trani», describing the city as “great and beautiful”. In this instance Trani hosted a big Jewish community with four synagogues, two of which still survive today among the oldest in

Europe, the Scola Nova and the Scola Grande .Today, it is possible to live the history as mentioned above in the streets and buildings of the city (Figure 3).

Figure 3. Views from streets and squares in Trani

Historical values

Seferihisar: Seferihisar is a historic town. The earliest settlement is Teos, which is thought to be a Carian city founded by Cretans fleeing the Achaeans in 2000 B.C. Sığacık Castle, which dates back to the Seljuk period, is well-preserved despite the ravages of time, nature, and innovation. Following the devastating earthquakes, it was rebuilt, first by Aydınoğulları and then by the Ottomans. After Piri Reis recognized its importance in the Aegean Sea, it was re-established by Parlak Mustafa Pasha at the request of Sultan Suleiman the Magnificent, with stones brought from the Teos ruins (Figure 4).

Figure 4. Historical values of Seferihisar/Teos and Sığacık Castle

Trani: Urban topography is a complex set of purely aesthetic values related to the extraordinary natural conditions of the basin and the relationship between it and the main monuments of the city, as well as historical and cultural elements over centuries. Trani in Puglia, Southeastern Italy Like many other towns in this region, even had an ancient rural occupation in Longboard and Byzantine times; At this time the city emerged with the urban form of a castrum, which is still well known today and probably corresponds to the ancient Roman settlement .

The city of Trani, which was home to a vital minority Jewish population during the late Middle Ages, has only buildings left today to provide evidence of its former existence. Trani has a beautifully preserved medieval core and a distinctive Giudecca (Jewish quarter) with streets, houses and synagogues. Other essential elements in this setting are the churches and castle of Trani (Figure 5).

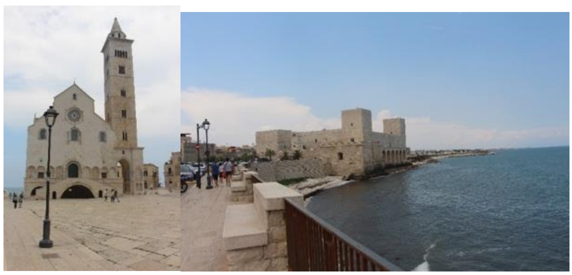

Figure 5. Historical values of Trani/ Cathedral of Trani and Svevo Castle

Relation with Water

In both case studies, being an old fishing town with marina, beaches, sea products and ancient sites strengthen the relation of these cities with water. So we can see a unique combination of nature, history and architecture in these cities.

Seferihisar: Seferihisar's 49.5 km long coastline is an important factor causes to participate in the union of Cittaslow and makes it the city with the longest coastline in Turkey (Figure 6).

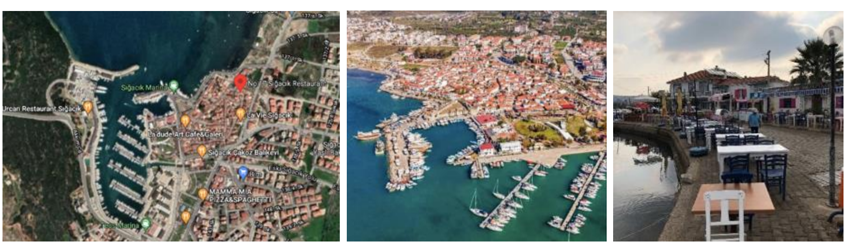

Figure 6. The relation of Seferihisar with water

Trani: The historian Raffaele Colapietra describes the essence of Trani as a dialectic “between land and sea, agricultural recall and the shipping profession, on a common platform for trade and exchange.” The origins of the town of Trani are based on a fundamental topographic fact, that is the presence of a large bay, suitable for a harbour settlement, in close relationship with the land behind. The urban history of Trani is strictly related to its natural basin on the Adriatic Sea. Moreover, almost all the big monuments of the city – from the Castle, to the Cathedral, to the main palaces looking on to the harbour, up to the monasteries of Carmine and San Domenico – are in direct relationship with the sea (Figure 7).

Figure 7. The relation of Trani with water

Recreation and Entertainment

Seferihisar: The famous mandarin and olive festivals are Seferihisar's strong points. In Sığacık, there is a Teos Çamlık Recreational Area, which includes the Zeibek folk dance, which is performed at the Dionysus Festivals in Teos. In addition to being a Cittaslow member, Seferihisar has urban projects such as improving castle streets, using the same type of furniture such as chairs and tables in cafes, and constructing new small fish restaurants near the coastline. Projects such as the Sığacık Producer Market and Women's Labor House have been launched to support local productions and products in Seferihisar (Figure 8).

Figure 8. Views from Seferihisar Streets and Recreational Areas

Trani: The coastline and city square (festivals, live concerts, local market, and fish market), cafes, restaurants, and the garden of the Villa Comunale are recreational areas for different activities in Citta di Trani. Villa Comunale which is constructed in 1823, was accomplished, directly overlooking the sea on the site of the "Canneto", between the Carmine and Santa Croce .

Restaurants, squares, green areas and playgrounds on the coastal line feed local people and visitors both socially and culturally. Two large squares on the seashore are actively used with different functions.

By setting up temporary stages, squares host a sports event one day and turns into a giant concert venue the next. It is used as areas where people meet and spend time, especially on weekends. Similarly, the main street on the coastline of the city is turned into a different venue by being closed to traffic during festivals and celebrations (Figure 9).

Figure 9. The usage of public spaces as recreational and entertaining areas

Economical Structure

Seferihisar: Agriculture has an important role in Seferihisar’s economy. Agriculture is still the occupation of the generality, even though the share of service sector is increasing frequently. It can be asserted that after being Cittaslow member, Seferihisar has increased the efforts to protect local life style.

Seferihisar Municipality, which transformed the old municipality building into a local market prohibited the entry of outside products into this market, in order to protect local producers and to offer natural and healthy products to the public and enabling local producers to sell their products directly to the public .Seferihisar Municipality organizes “Seed Exchange Festivals” in order to protect local producers, to instill awareness of healthy product consumption in consumers, and to provide new and large market opportunities for these domestic and healthy products.

Seferihisar's economy is based on agriculture, fishing, and olive products, mandarin and goat tulum cheese called Armola. Additionally, after joining the Cittaslow network, tourism has started to provide more income (Figure 10).

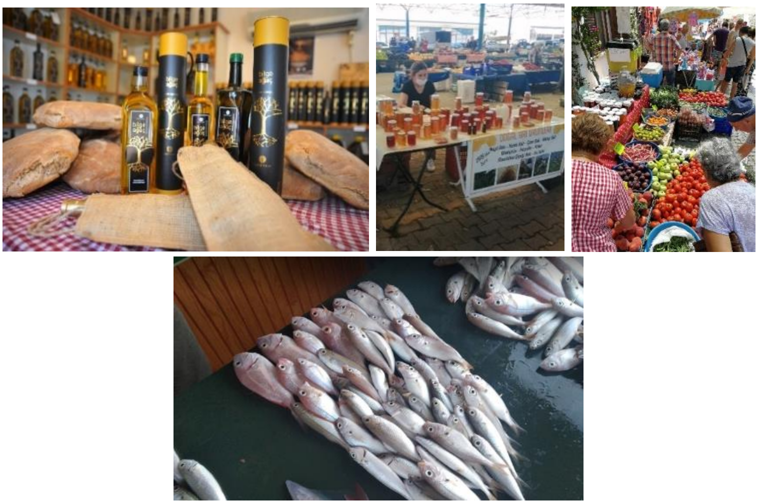

Figure 10. Local Products of Seferihisar

Trani: Benjamin of Tudela, who passed through Trani around 1166, mentioned the city's role as a center of mercantile activity for the entire region. According to Benjamin, Trani's position as an Adriatic port, was the key to its economic prosperity. Citta di Trani stands out with its wines (especially moscato), olive oil and quarries stone, and these local products play an important role in the city's economy and touristic development(Figure 11).

Figure 11. Local markets of Trani

Marble is exported to Switzerland and Germany. There is also a furniture industry and some fishing. The other vicinity of Trani grows figs, almonds and grain which are also profitable articles of trade (Figure 12).

Figure 12. Local Products of Trani

A city's identity is a very comprehensive unity that affects the city's image, which constantly evolves over long periods of time and emerges accordingly. To be able to use the city we live in for the benefit of society, urban planning must be done with a sense of city identity in mind. In this context, the cultural image and urban identity features along with Cittaslow criteria preserve cities' identity, character, and historical characteristics (Table 2).

Table 2: Comparative Analysis of Seferihisar and Trani

Comparative Analysis of Seferihisar and Trani				
	CITTASLOW CRITERIA	URBAN IDENTITY FEATURES	Seferihisar	Citta di Trani
1.	Infrastructure policies	Public and cultural structure	should improve characteristics of the public areas	has improved characteristics of the public areas
			should create public, private and semi-private areas	has diversity in public, private and semi-private areas
2.	Preservation of the historical values	Historical values	has a serious cultural accumulation but should evaluate	has a serious cultural accumulation and more preserved
			has recognition and development of the historical values	has recognition and development of the historical values
.	Energy and environmental policies	Relation with Water	has a strong relation with physical environment and public behavior	has a strong relation with the physical environment and public behavior
			has a strong unity of city and nature	has a strong unity of city and nature
.	Quality of urban life policies	Recreation and Entertainmen t	should improve the way people live and quality of life	has more improved the way people live and quality of life
			should create new functions in public spaces	has multi-functional usages in public spaces
.	Local products	Economical Structure	has increment of socio-economical structure	has more developed socio-economical structure

Discussion

Urban identity could be defined as the impression that historical, environmental, socio-cultural and spatial values create on its inhabitants. On the other hand, urban identity of slow cities has a dynamic structure, susceptive to every change on before and after joining Cittaslow network. Public and cultural values are related to historical, social, economic and environmental elements. In this study, the relationships and interactions between these changes forming the public, cultural, social, economic and environmental and historical structure are examined between Seferihisar/ Turkey and Citta di Trani/ Italy as defined below (Table 3).

Table 3: Comparative Analysis of Seferihisar and Trani before and after being Cittaslow

		BEFORE SLOW CITY	AFTER SLOW CITY
TRANI/ ITALY	1.	Open public areas (green areas, squares, streets) as recreatinal spaces and social activities	Open public areas as recreatinal spaces and social activities
	2.	Preservation of the historical values and buildings	Preservation of the historical values and buildings
	3.	fishing village and sea products	fishing village and sea products
	4.	Local market and local economy	Local market and local economy
	5.	Local cafes and resturants	Local cafes and resturants
	6.	-	Bed & breakfast hotel concept
	7.	Bicycle tracks and recreation areas	Bicycle tracks and recreation areas
	8.	Local products (wines (particularly moscato), olive oil, figs, almonds and grain, stone quarries, Marble)	Local products (wines (particularly moscato), olive oil, figs, almonds and grain, stone quarries, Marble)
	9.	-	-
SEFERİHİSAR/ TURKEY	1.	Has a serious cultural accumulation but should evaluate	Has a serious cultural accumulation and evaluated
	2.	-	Improving castle streets
	3.	-	Constructing new small fish restaurants
	4.	-	Bicycle tracks and recreation areas
	5.	-	Local Sığacık producer market
	6.	-	Women‟s Labour House.
	7.	-	Seed bank (local sustainability)
	8.	Partially Preserved	Preservation of the historical values and buildings
	9.	Partially Local economy	Improved local economy

As stated in Table 3, Trani appears as a city with a slow city feature even before it joined the Cittaslow movement. This situation is completely related to the general urban identity, culture, social and historical values and consciousness of the country. On the other hand, Seferihisar revived most of its inherent cultural and social features after gaining slow city identity. That is why determination of city identity is important in the assessment of urban life.

According to all these data; at the point of enforcing the urban identity, it has been revealed that public spaces should feed the user not only culturally but also socially and economically. The slow cities network which aims to enforce public spaces in cultural, social and economic aspects; sustains and necessitates this situation with its criteria.

In this sense, the movement, which is in an effort to create a conservation awareness, calls for its members to return to their essence. At that point, the role of municipalities is vital. A management that analyzes the city and society correctly and determines the needs; ensures the increase of economic power by producing effective projects.

At this point, while the cooperation of the administrators and the local people is important, the resources of the city are valuable in the realization of the application.

On the other hand, it is also important how much the two selected cities adopt the idea of a slow city. The fact that the infrastructure which supports this idea is found in the foundations of European cities significantly affects the success of the formation.

Conclusion

Urban identity is a notion which is not physical but can be related to social, cultural, historical and economic features of a city. In this study, urban identity and its components is researched in light of Cittaslow criteria.

Speed and globalization are two concepts in today's world that cannot be evaluated separately. Living with time and technology in the modern world becomes a lifestyle. At this point, Cittaslow movement has emerged such a way of life that identity and culture of "city" are preserved and advocated. This movement is a way of life that protects and advocates the cultural heritage and quality of life in the scale of local city.

The Slow City movement, as a new trend in the world, has been shaped despite the developments in technology and fast life, aims to closing the roads to motor vehicle traffic, using renewable energy sources, natural, local and organic products to strengthen the city's economy. Consequently, a Slow City is a new notion with its nostalgic and simple life style and its preservative approach towards historical and cultural assets. In this context, it is critical to create city identities and images that take into account all of the natural and cultural values of our living environments that have survived to the present day. To be able to use the city we live in for the benefit of society, urban planning must be done with a sense of city identity in mind.

The Cittaslow movement as a holistic and interdisciplinary approach, aspires to sustain the local identity, and keep away from the disappointment that cause cities losing their urban existence which have been homogenized in the global world.

Seferihisar and Trani's analysis revealed the implications of being a Cittaslow on current and future planning policies, projects and approaches and their sustainability. Becoming a Cittaslow has perceptibly changed cities to be more respectful of the environment, nature and people. Distinctive planning approach and policies have been skillfully developed to make a place rather than a constructed urban form simply meaning the social construction of the place. The Cittaslow movement is not only about the past, but also about preserving the present and the future.

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Figure References

Table 1-3: Authors archive, 2022.

Figure 1: https://www.google.com/maps/place/Seferihisar

https://www.google.com/maps/place/76125+Trani,+Barletta-Andria-Trani+ili,+İtalya, 2020

Figure 2-3: Authors archive, 2021.

Figure 4: https://gezicini.com, https://it.pinterest.com/pin/451485931368224995/?lp=true, 2020

Figure 5: Authors archive, 2021.

Figure 6: https://www.google.com/maps/place/Seferihisar, 2022. Authors archive, 2020.

Figure 7: https://www.google.com/maps/place/Seferihisar, https://www.onemag.it/trani-limperdibile-meta-della-puglia/, Authors archive, 2022.

Figure 8: Authors archive, 2020.

Figure 9: Authors archive, 2020., https://www.traniviva.it/notizie/piazza-quercia-una-magnifica-balconata-sul-porto/, 2021

Figure 10-11-12: Authors archive, 2022

Chapter 10

Integrated Use of Multiple Design Approaches in Contemporary Public Space Design

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ABSTRACT

The research question of the study focuses on how macro and micro design criteria can be used in contemporary public space design. In this context, the aim of the study is to produce a system that will enable the most effective use of macro and micro design criteria in contemporary public space design. The scope of the study consists of the works and related statements of the leading figures who are decisive in the definition of publicness and contemporary figures who play a role in carrying this concept to the future. The method of the study is literature research. Through literature research, the works of leading figures and contemporary figures who played a role in carrying this concept to the future are listed, examined, evaluated and compared. The original value of the work is decisive in terms of producing a model in which macro and micro design criteria can be considered together in publicness. In the findings of the study, it is seen that macro and micro design criteria form interrelated and feeding lines in contemporary public space design. From this point of view, the feedback systems in the proposed model and the way the related themes support each other gain importance. When all these are evaluated together, the model proposed as a result of the study offers a holistic feedback mechanism that overlaps with the main concerns of both past pioneering public figures and contemporary public researchers' new studies.

ÖZET

Çalışmanın araştırma sorusu, makro ve mikro tasarım kriterlerinin çağdaş kamusal alan tasarımında nasıl kullanılabileceğine odaklanmaktadır. Bu bağlamda çalışmanın amacı, çağdaş kamusal alan tasarımında makro ve mikro tasarım kriterlerinin en etkin şekilde kullanılmasına aracılık edecek bir yaklaşım sunmaktır. Çalışmanın kapsamını, kamusallık alanında önde gelen isimler ile bu kavramın geleceğe taşınmasında rol oynayan çağdaş isimlerin çalışmaları ve ilgili açıklamaları oluşturmaktadır. Çalışmanın yöntemi, literatür araştırması yoluyla kamusallık kavramının mekansal bağlamda geleceğe taşınmasında rol oynayan çağdaş isimlerin eserleri listelenir, incelenir, değerlendirilir ve karşılaştırılır. Çalışmanın bulgularında, makro ve mikro tasarım kriterlerinin çağdaş kamusal alan tasarımında birbiriyle ilişkili olduğu ve birbirini beslediği görülmektedir. Buradan hareketle, önerilen yaklaşımdaki geri besleme sistemleri ve ilgili temaların birbirini destekleme biçimi önem kazanmaktadır. Tüm bunlar bir arada değerlendirildiğinde, çalışma sonucunda önerilen yaklaşım, hem geçmişin öncü kamusal figürlerinin hem de çağdaş kamu araştırmacılarının yeni çalışmalarının temel kaygılarıyla örtüşen bütüncül bir kamusal mekan geliştirme perspektifi sunmaktadır.

Keywords: Publicness, urban architecture, urban design, urban space

1. INTRODUCTION

Contemporary spatiality problems brought about by the reflection of publicity on space are known as one of the most fundamental problems of today's architecture. These issues are considered valuable not only in terms of architecture, but also in terms of enabling intersections and diversifying the user experience. The information packages used to deal with the themes of publicness together were formed by layered schemes presented by the theoretical figures that draw the basic framework on this subject. These schemes contain many resolution mechanisms that include many different compromise, conflict and chaos situations, including possible hybrid situations and encounters in near future scenarios. It is seen that the first figures working on publicness developed their works based on basic variables such as power, property and freedom. In this process, it is understood that solidified themes such as centralism, nobility, silence, and autonomy draw a framework that emphasizes rationality against publicness and renders it unquestionable in terms of irrational values. This situation proves that it is not possible to explain today's complex public relations with the methods offered by the public approaches in the past studies. Therefore, incorporating contemporary studies into the public sphere, researchers' feeding on both past and future themes in a way that creates a historical path will yield more fruitful results for urban and rural users. In this respect, it is important to provide sufficient and necessary grounds for the exhibition of differences with the definitions of competitiveness, combinationism, imitation of nature, giving priority to private initiatives, antirationality, reasonable pluralism, representative-literary-political public, narcissism and community, which were discussed in previous publicness studies. In addition to these basic components, the intersection areas of harmonious and incompatible associations, the questioning of absolute homogeneity, the problems created by limited central power, hybrid processes based on the classification of the majority, the reflections of the concepts of being reasonable and rational in the public sphere, social differences made clear by nobility, the experience of being special increases and decreases. Sub-headings such as the determination of times, the dissolution and reconstruction of bourgeois publicness, unconditional self-view, the contribution and damage of immediacy to privacy may not be evaluated together in all cases. Undetailed publicness studies may be insufficient to represent alternative workspaces, specialized regions, and insufficiently identified sensitivities. The role of contemporary approaches is understood at this point and it seems that contemporary themes should be used to connect traditional themes. As seen in the example of Bonnet Springs Park designed by Sasaki, the fluidity and continuity of the transitions between layers are of great importance in terms of the values that determine the quality of publicness. This situation contains many clues that publicness should be developed with a set of strategies aimed at creating a language between different sensitivities and reducing visible boundaries (Image 1).

Image 1: Bonnet Springs Park / Sasaki,
photo by Jeremy Bittermann, ArchDaily

2. URBAN NEEDS AND LAYERS OF PUBLICNESS

Before making the main spatial implications of publicity, it is important to make a comprehensive list of the operational needs of the public. This list is among the most important factors that determine the formation parameters of the spaces and the interaction between the individuals that make up the public. Walters and Brown's (2005) inferences regarding the decisive role of virtual realities in the identity of public sphere gain importance when contemporary publicness approaches are elaborated in the context of layers and examined in relation to near future predictions. Treating traditional cities as a collection ground helps them both to be evaluated as open museums and to be used as a base for integrating contemporary exhibition mechanisms. In addition, it is understood that the public space is not only an exhibition space but also an area of interaction for people, not a choice but a necessity. Walters (2007) describes form-based codes, signs and type plans, connections between urban and provincial components as punctuation marks that directly associate publicness with themes such as contemporary art, artificial intelligence, and virtual reality.

While Elliott (2010) touches on the communication dimension of publicness, he draws attention to the need to develop communicative action through openness and continuity of discussion. There are many public figures who see the implications of the limitlessness of actions that can take place in a public space as a danger and threat to urban security. When these studies are evaluated together, it should be understood that the studies that consider the streets as social areas are actually a scenario study on the combination of transportation planning and transportation types. Similarly, in all the studies focusing on streets, it looks at approaches that reinvent streets as social spaces and considers approaches that enable pedestrian-oriented traffic solutions to be evaluated together with public transportation. All approaches that evaluate traffic solutions on the basis of gradation in public transport achieve high degrees in publicness score and provide large and efficient solutions by integrating differentiated urban groups into urban and rural life. In the example of Rodda Lane Intervention by Sibling Architecture, it is seen that presenting a physical installation where different user groups can be located by creating different public clusters that are not separated from each other by borders provides great efficiency in terms of circulation of users. The controlled intertwining of age and action-oriented spatial differentiations is among the factors that increase the quality of publicness (Image 2).

Image 2: Rodda Lane Intervention / Sibling Architecture, photo by Peter Bennetts, ArchDaily

Any public installation that is intended to be realistic can be described as successful in that it actually responds to potential intersections rather than to previously planned expectations. Current developments and unexpected spatial outcomes should represent the degree of difficulty that the public space can easily meet. One of the most striking examples of the vehicle-pedestrian relationship is related to the finding that the feeling of shelter increases at the points where there is a communication breakdown. Crankshaw (2012) mentions that large areas adjacent to pedestrian paths reduce the sense of shelter. As the sense of shelter for pedestrians increases, the desire to stand still decreases and the number of public spaces where pedestrians can move increases. On the other hand, the ratio of cars and the sidewalks surrounding them is fed by the public movement, and the frequency of stopping and moving points in the public movement determines the width of the sidewalks surrounding the highways and the level of support for the sense of shelter. Just as the awnings of commercial units protect pedestrians on the pavement from the effects of the season and offer them more public spaces, parked cars change the character of pedestrian lines and create a new public language there. Building facades and trees that highlight the pedestrian-vehicle separation also contribute to the characterization of the pedestrian public space. The fact that the public space is the most important reflection of urban culture (Hou, 2010) can be explained by the fact that plazas, markets, streets, temples or city parks are centers of civic life for urban residents. Offering different architectural solutions for gathering, socializing, resting, festivals, demonstrations and protests, provides a layered public space usage for the users of urban and rural life, and mediates the development of new spaces where users with different sensitivities can engage in collective production. Liberation spaces that fit this definition can contain important elements of civil architecture, as well as work as an open-air museum where the collective outputs and personal memories of a city can be viewed. In the design process of V-Plaza Urban Development conducted by 3deluxe Architecture, each design space works as an independent “open-air liberation space”. This situation offers flexibility to meet both autonomous spaces and collective productions that support visual communication (Image 3).

Image 3: V-Plaza Urban Development / 3deluxe Architecture, photo by Norbert Tukaj, ArchDaily

Since the way each public space relates to each other will be different, before a public space is designed, the whole of the relations it has established and will establish with its environment should also be analyzed. These relationships can refer to the dynamic nature of urban life by pointing to numerous new combinations and mediate the resolution of new complex problems. The fact that public spaces host not only informal conflicts but also official regulations and organizations shows that schemas related to the public also work as urban binders for design solutions. Simpson, Jensen, and Rubing (2017) emphasize that collective decisions must be made so that individuals can reshape their urbanization processes, while emphasizing that in order for the city to be positioned as an area of liberation, it must be able to accommodate historical or conceptual contradictions. At this point, the concepts of "democratic opposition", "social dynamism" and "political dynamism" should be mentioned. Public activities that will emphasize that the change of the individual is less likely to change the city than the change of the city is considered as a part of this view. This change is a complex process in which the built environment is also an important determinant. Mentioning that successful architecture is one of the most important intermediaries of ensuring a strong interaction between members of the public, Gehl and Svarre (2013) remind that public life has many different forms even in one day. Streets, alleys, buildings, squares, even telephone poles, which are considered as part of the built environment, affect the movement in the everyday character of public life. For this reason, it is important to consider public life as comprehensively as possible in terms of actions. Sitting, walking, cycling, spending time on balconies, entertainment in street theaters or cafes are all part of a common whole in this context. Publicness should be considered not only as a positive or negative signifier describing the psychological state of the city, but also as a concept that represents a complex and multifaceted life. Even if the aesthetic features of the urban space serve to naturalization in a ostensible way, the capitalist urbanization processes also disintegrate this process. The network of relations established on a micro-scale on a street corner presents a different image from the descriptions of the macro-scale created by globalism. At this point, Aurigi (2016) states that communication is the most important component of livability in an era where being technologically excluded is the most damaging. The ability to stay with flow is considered more important than many other skills, and it is thought to be an output of public communication processes. Topics such as progressivism in local governments, adequate development of residences, abundance and diversity of commercial units also have an important place in the elections. In the example of "Manifesto Market Andel", the design process of which was carried out by CHYBIK + KRISTOF, progressivism is shaped around the principle of permeability between layers. This is emphasized by the conscious display of the permeability between different spatial prisms (Image 4).

Image 4: Manifesto Market Andel / CHYBIK + KRISTOF, photo by Studio Flusser, ArchDaily

When defining the success and strength of a public space, its ability to deal with weaknesses is evaluated rather than its ability to get rid of weaknesses. However, weaknesses can easily be left out because of their rigidity, which is incompatible with the needs of publicity. The "weak" are easily eliminated from the system, and this elimination causes them to lag behind the competition in terms of technology over time. Technological deficiencies lead to communication deficiencies, and a publicly deprived space becomes less desirable with each passing day. McQuire (2010) also considers publicness in urban life as a product of fragmentation through the metaphor of assembly and reads it as the primary condition, not the condition of alienated modern urban-industrial life. Similarly, Minkenberg (2014) mentions about the politicization of urban space, that architecture is a symbol of national identity and the role of architecture in the identity construction of the individual. Kellett and Carcia (2013), on the other hand, explain with examples that cities work as interconnected nerve centers and become increasingly complex as a result of globalization processes. Cities that represented privilege in the past are today perceived as economies that need to be with us to stay afloat. The fact that agricultural economies have been replaced by knowledge economies is changing the understanding of publicness. Aschwanden and Wallraff (2017) point out that in the urban area surrounded by rapidly and continuously expanding networks, architecture and its products also work as pop culture objects. In the example of K-Farm conducted by Avoid Obvious Architects, it is very important that the elements indirectly related to sustainability, developed with the help of ecological processes, go beyond being pop culture elements and turn into display elements that can be truly experienced and benefited by visitors (Image 5).

Image 5: K-Farm / Avoid Obvious Architects,
photo by Imagennix (Scott Brooks), ArchDaily

All these connections and needs can be placed in a meaningful urban framework by revising contemporary publicity sensitivities and reinterpreting public stereotypes from the past. Suburbs provide an effective illustration in this regard. Repressive suburbs are replaced by flexible and unexpected intersections, while private settlements reinforce their autonomy. In this context, an ideal of permanence that ignores current needs requires constant effort and the cost of living in the moment increases day by day. The fact that the city, like nature, works as a secondary shell for human beings is not sufficient for it to copy nature's human-friendly features. In order for such a similarity to be addressed, sensitive concepts must be adopted by the masses. Dellenbaugh, Kip, Bieniok, Müller, and Schwegmann (2015) talk about a certain configuration of prevalence as the basic condition of publicness. He mentions that the abstraction of the field is essential in order to open up the different field conceptions to discussion. The inhabited space is much more important than the uninhabited space. Micro spaces can help to make far more comprehensive social implications than macro spaces. At this point, although the duties of the social commons push them to be more defensive, it should not be ignored that a single regulation mechanism can also mean a standardizing publicness. Considering the sensitivities of contemporary figures, it is seen that the public sphere can neither be directly tied to a set of rules nor be left to its own devices. Follow-up and schematics are indispensable for the breakdown of their processes. It is therefore essential that the actions of domain users are taken into account. Since the action appears as an output of needs, it is not manipulative, allows for mathematical breakdown and can be compared. Studying activity in the public sphere enables the creation of comprehensive schemes for designing physical solutions. Related to this issue, in the example of Haoxiang Lake Park conducted by eLandscript Studio, it is seen that the urban design element included in the current urban flow is included in the city with a fluid and intricate form formation so that the participants can be included in the area by offering a comprehensive circulation scheme (Image 6).

Image 6: Haoxiang Lake Park / eLandscript Studio, photo by Yong Zhang, ArchDaily

3. APPROACHES BASED ACTIVITY VIA SPACE

Activity in the public sphere presents a holism that lists all the processes that trace and give meaning to the action in the plan and section. This holism makes it possible to match different action groups over time and to evaluate the areas based on their prominent identities in terms of activities. The activities of people in the public sphere are divided into three (Gehl, 1996). These are listed as individual-mandatory activities (going to work, school, etc.), individual-optional 14 activities (walking, cycling, etc.) and social activities (activities based on social sharing with others). Activities are the most easily detectable physical outputs of preferences. Therefore, it is important to follow the activities and convert them into texts for the evaluation of public spaces. Carmona (2010) cites Montgomery's emphasis on the subject. For Montgomery, the key for an urban area to be considered "successful" is that it responds with a balance to the operation in a complex setup and to the unity of different levels and layers. Such as diversity in land uses, ratio of independent businesses, presence of evening and night activities, presence of street markets, their size and specialties, presence of meeting places providing different types, prices and quality, presence of areas including gardens, squares and corners, people watching and cultural animation programs. The realization of activities, mixed land use models, different land sizes and property values, contemporary architecture that provides various building types, styles, designs, an active street life, the existence of active street facades are the basic elements of this order. In order to reduce the principles of Gehl and Montgomery to a framework in which publicness in the open space can be developed through VBK and PSO, an analysis has been made by considering the differences between macro-micro design principles and the above criteria that can be adapted to publicness in the open space have been evaluated. The Little Island Park example conducted by Heatherwick Studio + MNLA provides a good example of how the differences between macro-micro design principles can be used in the same design. The project, which responds to macro expectations by creating a route that is the continuity of urban axes, also includes many autonomous experience points that can make sense of the micro-scale user experience (Image 7).

Image 7: Little Island Park / Heatherwick Studio + MNLA, photo by Timothy Schenck, ArchDaily

4. FINDINGS

Looking at the macro design and the relations between the elements, it is seen that the components are respectively centralism and connectedness, visual access, thresholds and entrance doors. Looking at the micro-design and the relations between the elements, it is seen that there are two basic components as comfort and relaxation areas. In this context, prominent, passive and active interaction areas are also important. While watching and being watched gain importance in passive interaction areas, this situation is handled through exploration and exhibition in active interaction areas. The diversity in land uses, mixed land use models, different land sizes and property values are excluded from the design elements evaluated at the study scale. The absence of a macro-element suitable for development at the scale of the work requires addressing the connectors between macro-elements. These elements will be considered in the next section, under the headings of Centralization and Connectivity, Visual Access, Gates and Thresholds. Varna (2016) emphasizes that Brown defines the public space as “spaces, roads and streets as well as empty spaces, borders and marginal spaces”. What is common at this point is the efficiency of the physical functioning of the public space (physical configuration). The three indicators that provide this efficiency are centralization, visual access, thresholds - entrance doors (Varna, 2016).

Strategically well-positioned areas have more potential for different social groups to come together in terms of time and space. Hillier (1996) emphasizes that a well-located space should be centralized and connected. If the design of the space is weak in terms of centralism and connectivity, it will not make sense in terms of publicness even if the user density is high. In this direction, it is necessary to examine the activities and behaviors. To examine the activities, to create a flow chart regarding the diversity and change of the activities exhibited in the area; to make a breakdown of the behaviors means to define the area in more detail by associating the diversity and change of the behaviors exhibited in the area.

Varna (2016), who stated that Loukaitou-Sideris and Banerjee (1998), who looked at the public plazas of Los Angeles, emphasized that they followed an approach that applied the approaches of “introversion” and “planned compartmentalization”, these plazas came to the fore with the prevention of visual access and emphasizing the state of being special. adds. From the outside the building gives some clues but is isolated from the street. Nearly all emphasis on accessibility at street level has been removed. At the main entrances, it is seen that entrance doors suitable for the approach used in parks are used. The plaza is almost invisible from the outside, it becomes camouflaged, which makes it difficult to distinguish. This example provides extracts that allow comprehensive inferences to be made in terms of the impact of visual access on publicness. There are three key elements that need to be addressed in order to make the necessary inferences about visual access. These items were evaluated as closers, openers and gaps in the study. Shutters, items that create visual access interruptions in the opening; openers, elements that create visual accessibility in the enclosure; voids are considered as areas where visual access can be provided with wide openings.

Thresholds and entrance doors can complicate the physical accessibility of a space. These can be symbolic and passive as well as physical and active. It may not be directly exceeded because they are subject to some constraints. Thresholds are also important as they are decision points. Represents the visible/invisible constraint line that defines the action area as primary. Doors and fences are not only physical barriers, but also control measures. The entrance gate is the most important of the decision-making points on this restriction line.

At this point, Carr (1992) touches on important micro design elements. Considering the relationships between the elements and the experience of the element under the title of micro-design, the micro-elements suitable for development in the context of the study are listed as follows: Presence of evening and night activities; existence, size and specialization of street markets; the existence of meeting places with different types, prices and quality; Contemporary architecture that provides various building types, styles, designs, realization of activities such as people watching and cultural animation programs, an active street life, the presence of active street facades. The micro elements that are unsuitable for development in the context of the study are the proportion of independent enterprises and the point experience areas of gardens, squares and urban corners. Considering the criteria, it is seen that the dimension of liveliness (animation) stands out as a micro-design criterion, similar to the use of the physical configuration dimension as a macro design criterion in optimizing publicness in the open space. Vitality refers to the practical response to human needs in public spaces.

DISCUSSION AND CONCLUSION

When the topics evaluated for the preparation of questions to be asked to public space users are handled with a holistic view, it is seen that physical configuration in the macro design heading and vitality in the micro design heading are discussed. Along with these steps, the nine main steps form the structure of questions for users. Sub-headings, deepened by the definitions of Varna (2016) and Carr (2010), centralism, connectedness, closures, openers, gaps, gates, fences, environmental factors, physical factors, social and psychological factors, natural factors, artificial factors, monitoring, being watched, roads, intersections, borders, thresholds, decors, diversity, change, activities and behaviors. When all these are evaluated together, it is seen that a result has been reached by evaluating the micro and macro design criteria together. Micro and macro design criteria provide feedback mechanisms that feed off each other and mediate the mutual feeding of supporting processes at different scales in the public resolution of design.

In this context, considering the difference and contribution of each experiment in terms of each other, it is understood that the design elements should be supported by creating intertwined work flow charts, not diverging from each other. In this direction, it should be ensured that the boundaries of the public space are determined, the basic user profile of the public space is established, the development of special strategies for this user profile, the pre-determination of auxiliary crisis solutions, cooperation with local governments and the distribution of flow charts between all subjects who play a direct role in public design to all managers. If these solutions are realized, publicness becomes a concept that is quickly grasped and experienced by family members of different ages and sensitivities, as well as by managers and employees, and is realized with a contemporary approach.

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