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# Emotional Design



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## Editorial

Aliye Ahu AKGÜN • *Editor*

Finally, we are going out. Lockdown has slowed down and leads us to enjoy the moments outside in summer.

Be aware that the landscapes you are enjoying have the power to heal. So, before choosing where to go, keep an eye on the paper entitled “Healing landscape: How healing parameters in different special organization could affect user’s mental health?” by Razmara and her colleagues. Stressing the healing capabilities of urban parks in Iran, this paper evaluates the parameters affecting and mainly strengthening the quality and livability of urban parks as healing landscapes. They show that various parameters such as geometric design, visual communication, water elements, and the furniture and the activities had the power to increase the quality of healing in Persian urban parks.

The potential positive effects of green areas and nature, especially in urban areas on the psychology is great. However, turning this potential into power can be achieved by planning. Tafahomi and Nadi, with their paper entitled “The transformative characteristics of public spaces in unplanned settlements”, explore the transformative specifications of public spaces in unplanned settlements. They conclude that private spaces are transformed into semi-private spaces depending on socio-economic conditions, while public spaces are privatized. Thus, planners and policymakers should take this transformation into account.

The socio-economic situation and the spatial quality also play an essential role in designing public spaces. Nezami and Asadpour, in “Social capital and the spatial quality of neighborhoods: Parameters, indicators & strategies” offer a four-parameter model for creating and supporting the public realm and resident participation in the physical space management and construction, increased presence of citizens in public and open spaces, and appropriate distribution and location of functions and amenities.

Depending on the climate, the search for a green space may differ by region. Therefore, in hot and dry climates, the innovative solutions for green space appear as green roofs. For example, Fezzioui and Benaichata, in their article “Green roofs

under hot and dry climate in south-west of Algeria: Study of the implementation conditions”, addresses the realization of green building to transform a desert city into an ecological and green one as a solution to the water problem. According to their results, green roofs help decrease the number of hours of discomfort and the cooling energy use compared to the green facades.

The spatial characteristics of common areas are fundamental to identify lifestyles and daily routines. Significantly, while turning from space to a place in time, historical roots affect daily lives. Therefore, Samman, in the article entitled “Axis of succession and axis of intention of time: Unpacking temporal dynamics of colonial space in Jerusalem”, explores the impact of colonial urban planning on the temporal dynamics of the colonized people. The article explains how colonial policies deeply affect the temporal dynamics of the daily lives of the colonized people, creating loops of temporal episodes that affect the essence of perception of time, its organization and management, and their adopted lifestyle.

The common space, i.e., urban parks, urban green areas and public spaces, affects children’s daily lives and perceptions at most. Therefore, their participation in the built environment design is crucial. Ensarioğlu and Özsoy, in “Children’s participation in built environment design: The case of “Play Without Barriers” project”, discusses the effects of built environment education on young participants while introducing a brief explanation of an educational model named “Play Without Barriers” (PWB).

The participatory design offers an incredible spectrum of alternatives and parameters, yet the decision-making phase is always the most challenging phase of the design process. Palabıyık and Alkılınç, in their paper entitled “Developing a web based software for the evaluation of architectural designs”, offer a decision support system to solve complex problems.

Nevertheless, it is not always a designer’s decision to remake the house’s interior. It is the inhabitants’ decision as well. Cordan and Aktan, in their article “Determination of Syrians re-making home interiors through visual research methods: The Sultanbeyli case”, explores how displaced Syrians living in Sultanbeyli, Istanbul, Turkey, are remaking their home interiors.

Social, cultural, and behavioural codes have an essential role in home remaking processes and practices with the supportive relationship between people and their living environment on developing a sense of belonging and place attachment.

The attachment to a place or to belong somewhere passes through feeling comfortable and having functional interiors. Lighting comes to the scene as the identifier of individuals' behaviour. Avcı and Memikoğlu, in their article entitled "Evaluating effectiveness of LED and OLED lights on user visual comfort and reading performance", analyze the effects of different illuminance levels of the light-emitting diode (LED) and organic light-emitting diode (OLED) lights on user visual comfort and reading performance. They offer a recommendation on the preferred illuminance level for LED and OLED light during a reading performance.

The open spaces shape the daily lives within the time they exist, while the transformation of the built environment depends on the daily routines. Costa and Rosado, in their article entitled "Vernacular architecture in the south of Portugal: The history of Mértola's houses from a rural to an urban landscape", explore the permanence and change in the traditional architecture of southern Portugal, adopting the town and landscape of Mértola as a case study. They conclude that the architectural specificity, in both contexts, is subordinate to the same processes of historical change, which nevertheless acquire a circumstantial dimension.

Şahin and Şener in their article "A review on changing housing approaches and media contents in Turkey: 1930-1980 period", show how historical change and circumstances have an impact on housing approaches in Turkey through the media contents from the 1930s to the 1980s, based on the attitude of the media to guide society, which changes in parallel with the dynamics of each period.

To decide between to protect or to transform the historic built environment is quite difficult. Akpınar and her colleagues in their article entitled "Urban protection

and renewal dilemma: İzmir Mezarlıkbaşı" aims to present the difficulties of dealing with the conservation, renewal, and regeneration for heritage areas in the historic core of İzmir, Mezarlıkbaşı, Kemeraltı, as well as to discuss the intrinsic physical qualities, dynamic characters and diversity of community groups with a view of new spatial agenda.

The life duration to adopt and create the built environment remains at the heart of the shape and its grammar. Hussein and Ismael, in their paper entitled "Regenerating traditional houses facades of old Mosul city by Shape Grammar", explore the design of the traditional dwellings in the old city of Mosul by design parameters of the organization of architectural elements in syntactic characteristics, restricted by topological, geometrical, and dimensional relationships that responded to social, technical, and environmental requirements by the use of shape grammar.

The geometry, occupants and the roots in time shape designs in the built environment. Designs should consider the possible risks with which the regulations impact the design and construction of the built environment. In their article entitled "Investigation on evacuation scenarios according to occupant profile in mosques through different fire regulations", Yaman and Kurtay, focusing on the fire risks, investigate the evacuation scenarios. Regulations provide the minimums while the occupants' profiles are the actual determinant of the evacuation success.

Summer has already arrived. Now is the time to relax. In Turkey, tea is the key to quench the thirst, preferably drank with a tulip-shaped tea glass. Erol and Leblebici Başar, in their paper entitled "Analysis of the Turkish tulip-shaped tea glass's emotional design features using Kansei Engineering Methodology", identify the emotional design features of the renowned tea glass. They conclude with a model based on the relationship between the feelings of people and the design features.

*Take your drink and sit back. Enjoy our July 2021 issue.*

*Stay healthy, stay safe!*

# Healing landscape: How healing parameters in different special organization could affect user's mental health?

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## Abstract

Studies on the relationship between landscape and health show that the inherent attraction of humans to nature and presence in these spaces causes mental peace and improves mental and physical health. Thus, the therapeutic landscape approach could be useful in healing. Healing landscapes reduce stress and improve people's mental health. So, applying healing design parameters in open urban landscapes strengthens the quality and livability of urban space and enhances the tendency to make optimal use of nature. The study was carried out in urban parks and the Persian Garden. The therapeutic landscape approach with emphasized on differences between these two cases did use. This study aims to evaluate the parameters affecting the quality of the healing landscape in two urban landscapes with different spatial structures (Persian Garden and Urban Park) in Iran. Therefore, landscape healing quality factors collected and classified in emotional, cognitive, behavioral, and social effects. The research method consists of both quantitative and qualitative techniques. Data collected through questionnaires, interviews, and field observation. Results indicate that the cognitive parameters in the Persian Garden and the behavioral and social parameters in the urban park affected the healing quality of these landscapes. Geometric design pattern, visual communication, using water, and vegetation increase connection with nature; additionally, psychological safety through night lighting and clarity of the space can be efficient in promoting the healing of the environment. In social and behavioral parameters, quality of public spaces, appropriate furniture, legibility, and a variety of activities are valuable in the quality of healing.

## Keywords

Healing landscape, Persian garden, Spatial organization, Urban park.

## 1. Introduction

Stress and neurological crises, which are rooted in environmental factors, are the source of many diseases and their resulting damage in the form of illness, aggression, crime, and other social harm (Altman, 1975, p.179; Nili, 2013, 66). The results of recent research in the field of environmental psychology, concerning environmental science and perception, suggest that responding to human needs such as relaxation, thinking and contemplating, and self-improvement can reduce stress, mental and physical health of the individual, and promote community. So the proper presence of nature in one's life can also reduce many psychological, physical, and social pressures (Kabiri & Balilan, 2015, p.5). The use of healing landscapes is a way to reduce stress and nervous tension and create peace, regain strength or restore health (Divandari et al., 2016, p.26; Abdollahi et al., 2015, p.26).

In natural settings can be provided by places such as urban green spaces, parks, and gardens in cities where opportunities for contact with nature are available (Pazhuhanfar et al., 2018, p.79). Iran has a valuable cultural and natural heritage called the Persian Garden, which has healing landscapes. As described the Persian garden, Pop writes: "A Persian Garden is a place of inner peace and comfort as well as contemplation and reflection. It is a place to purify the tired soul of a human, to make the human psyche fresh and smooth. Undoubtedly the impact of such gardens cannot be ignored" (Pop, 2009; Divandari & Esmatian, 2016, p.21).

From the Qajar era, the tradition of designing the Persian garden has changed, and in the design of some green spaces, they have created surfaces with curved and symmetrical lines. In the image of Europeans, such spaces called parks. The scientific definition of a park, it is a public and urban space that seeks to provide healthy air and improve the environment and the need to create a natural and healthy place to spend leisure time with the idea of returning to nature in cities (Sultanzadeh, 2003, p.91). Although

garden and park are different, these are relevant in most of the features now, so the link between these two kinds is crucial for enhancing performance in such spaces (Nabizadeh et al., 2018, p.96).

It seems that the performance of healing parameters in parks and gardens (with different spatial structure) is different, and the healing characteristics of the urban landscape in Persian gardens and urban parks are different. Therefore, the theoretical foundations of this research are based on the writings of "Gessler" landscapes with a therapeutic approach (healing perspectives) (Gesler, 1992). Then the performance of parameters affecting the healing quality of the landscape evaluated in 4 parts: emotional, cognitive, behavioral, and social in Persian garden and urban park. To investigate this hypothesis, the research seeks to answer the following questions.

1. Are there differentiating healing indicators in the different landscape spatial structure?
2. How does the spatial structure pattern of the landscape (Persian Garden and Urban Park) affect the healing performance of the urban landscape?
3. Which healing indicators affect the best in the garden and which in the park?

## 2. Literature review

Human communication through the five senses provides an opportunity to experience the environment. Healing landscapes, regulated senses purposefully. The healing landscapes awaken the Human senses and eventually balance the five senses (Nili et al., 2013, p.68). Clare Cooper, stark, and Marni Barnes (1999), in their book, "Healing Gardens: Therapeutic Benefits and Design Recommendations" discovered, the primary history of healing gardens (Fairchild, 2011, p.13). On the other hand, many studies have focused on healing and its influencing factors, including theoretical research. Each of the studies considers factors affecting healing, which summarized in Table 1. As far as we know, there are no studies on the parameters differences performance in two types of landscape structure.



**Table 1.** Research background research on healing landscapes.

Research fellow	Mac Dowell, 1998	Stark, 2013	Stigsdottir, 2005	Ushoricultura therapy association, 1995	Nili et al., 2012	Abdullahi et al., 2015	Shahrad, 2012	vappa, 2002	Sadler, 2007	Kaplan, 1995	Mumtaz, 2017	Ulrich, 1999	Cooper Marcus & Barnes, 1999-2007
Preserving the spiritual space character		✓	✓					✓					
Provide relief from stress:ful environment/ psychological comfort		✓	✓	✓				✓	✓	✓			✓
Sense of control - accessibility				✓			✓				✓	✓	✓
Displaying life cycle		✓	✓					✓					
Privacy-Self-awareness			✓					✓			✓	✓	✓
Social support			✓	✓			✓				✓	✓	✓
Distribution of different plant species		✓	✓		✓	✓					✓	✓	✓
Minimizing ambiguity		✓	✓	✓	✓	✓		✓			✓		
Familiarity/ provide memorable features				✓									✓
Provide positive distractions		✓				✓	✓					✓	✓
Encourage physical exercise and movement					✓	✓	✓				✓	✓	✓
Emphasis on nature (Rock, wood, wind, sound, etc.)	✓												✓
Use the healing power of Water	✓	✓	✓		✓								✓
The use of art and increasing the spirit of the place	✓												
Offer different types of activities				✓			✓						✓
Encourage wildlife in the environment	✓	✓	✓					✓					✓
Creative use of color and light	✓												✓
Inviting Input for Visitors	✓							✓					
Create a sense of respect and support for nature		✓	✓										
Stimulating and using the senses		✓	✓	✓			✓	✓					✓
Spatial variation					✓	✓			✓	✓			
Fascination of place									✓	✓			
Compatibility - understanding different social group users and their needs				✓					✓	✓			✓
Minimize undesirable ambient noise					✓								

### 3. Theoretical framework

#### 3.1. Healing and healing landscapes

According to the World Health Organization, seventy percent of human physical illnesses caused by stress and neurological crises (Shahcheraghi, 2010, p.33). Mental health in today's stressful world is a move that can be achieved by urban planners and environmental designers. Healing involves a broad field that does not certainly refer to treatment. Preferably, it applies to a general process of healing that considers the human mind and body together. According to Marcus and Barnes's (1995) theory, healing is the liberation of physical symptoms, illness, and trauma. It is one of the factors for nervous pressure reduction, which increased human comfort (Nili, et al., 2013, p.39; Fairchild, 2011, p.13). Landscape spatial organization can make people feel relaxed. Gardens and landscapes called healing landscapes designed to improve people's mental health and create a pleasant feeling. (Polat, et al., 2017, p.37). "The healing garden has existed for medieval patients as part of the healing landscape. The goal of the healing garden designers is to create an environment for soul

awareness, strengthening the human body, and conclusively the recovery of the body and the mind's intrinsic power. When healing is not possible, communication with nature can bring out mental relaxation for a person. This concept peaked in the 1700 decade in the Romanticism era" says Spriggs. (Spriggs et al., 1998; Ramyar, 2011, p.81). The healing landscape concept first introduced by geographic health researchers to define a place for health and wellness. The "healing perspective" term used to achieve physical, mental, and intellectual health (Velarde et al., 2007; Jiang, 2014). Since the relation of a healing garden with human, it can stimulate the senses and relieves stress. Continued presence in such places can arouse the patient's mental and physical well-being (Momtaz, 2017; Shahcheraghi, 2010, p.259). Healing is a feature that promotes mental health, relieves stress, and increases recovery. And have been used for landscapes that improve comfort and preserve human health (Williams, 1999). A healing garden "... Used as a tool for treatment: as places to relieve pain, to help the patient struggle for orientation and balance. This is a place that calms and

relaxes and thus encourages the body to think about recovering themselves” (Spriggs et al., 1998, p.7; Anderson, 2011, p.54).

### 3.2. Persian garden as a healing landscape

The impact of healing gardens on visitor health stems from the experiences of the garden and its content (Abdollah et al., 2015, p.330). The Persian Garden Becomes an Entity by Creating a Place through the Relationship between Environment and Human (Khoshouie, Alborzi, 2010, p.406). According to the studies done in the Florence Charter, the constituting characteristics of the Persian garden classified into two categories, natural elements (plant, water, field form) and artificial elements (main building, porch, wall, and garden accessories). While identifying and describing these parameters, they evaluate the effect of these parameters on the individual's health in the two types of urban and suburban gardens of the Qajar era (Nili et al., 2014, p.171). The initial structure of Persian gardens based on a geometrical quadripartite division with a pavilion in its intersection. The general idea of this formation based on the pre-Islamic Iranian division of the earth into four quarters, which may have been inspired by the geometrical motifs of Mesopotamia and Sindh Valley civilizations (Massoudi, 2009; Farahani, et al., 2016, p.3). Persian gardens have the most significant roles in the Iranian landscape, formed by the climate, culture, politics, security conditions, and other features. These factors have affected the Persian garden's appearance. Water use in a variety of forms such as fountains, springs, and so on. The sound of water draws people's attention away from the stressful environment and will have a direct impact on the human psyche. Water's symbolic meanings such as life, radiance, cleanliness, light, immobility, and movement create a great feeling and improves mental comfort in the garden (Khoshouie & Alborzi, 2010, p.412; Göker, 2017, p.661). Throughout history, the Persian garden has tried to create a quiet place by stimulating the five senses. The place to presence of man in space in this world (Khoshouie, Alborzi, 2010, p.406). Involving the five

senses of humans, organic products, and herbal remedies; the healing role could consider for gardens (Khalilnezhad, & Tobias, 2016, p.13). In the Persian garden, plants located for various purposes such as shading, usefulness, and ornamentation of the garden (Mahmoudi Nejad et al., 2006, p.74; Khoshouie & Alborzi, 2010, p.412). Persian gardens consider as healing gardens or health landscapes because plants with fruit or edible plants are one of the principles in designing healing gardens (Nikbakht, 2004). Plants and flowers were not only planted for the sake of beauty and fragrance, but also they used as part of a healthy diet and in perfume making (Ruggles, 2008; Khalilnezhad, & Tobias, 2016, p.11). Apparently, as well as in terms of architecture and urban planning, parks have seen in Iran since the Qajar era. The term “park” has been coming into the Persian language from the French one, so it seems that it is one of the Qajar monarch's achievements from their frequent trips to France. Since then, Park as one of the modern civilization sign has taken place in Iran's urban development plans (Nabizadeh et al., 2017, p.96)

### 3.3. Introducing landscape healing parameters and indicators

This concept incorporates all areas related to environmental design. In environmental psychology and landscape architecture, there are different views on how healing gardens work. According to Ulriuch's (1991) studies, the healing effects of the natural environment are due to the revival of emotional centers in the limbic brain system and Humans are comfortable in the natural environment (Ulriuch, 1991) so at the beginning the emotional aspect of the healing landscape are important. After that desirable communication between humans and the natural landscape is the basis of the cognitive healing process. This process seeks people to behave in the environment. The cognitive function requires high energy, and the brain may be affected by high pressure. This theory indicates that man has different kinds of attention; self-conscious and unconscious (Kaplan, 1989). Nature is a set of features and elements that draws one's unconscious attention. New fac-



tors are discovered without bothering humans (Hartig et al., 1991). Nature can balance one's ability and control over oneself (Lwarsson, 1997). And affect one's response that relates to the behavioral aspect of the healing landscape. Bill Moyers adds social healing to landscape healing criteria. He believes that under no circumstances can one be separated from everything and everyone (Moyers, 1995; Nili et al., 2013, p.169). According to the definitions provided by theorists and what mentions above, Figure 1 shows the resulting indicators in four categories: emotional, cognitive, behavioral, and social. This figure shows the theoretical framework of the present study.

There have been numerous studies on the healing landscapes that each has provided criteria and Parameters. In the following, we will offer the healing landscape indicators of each parameter specified in most researches.

Emotional parameters of healing landscapes are such as:

- Provide positive distractions: Nature draws human attention or fascinates people. This directed fascination which is controlled by the operating system, makes human relax and causes negative thoughts to replace with positive ones (van den burg, 2010)
- Stimulate and use of five senses: Sound, sight, and smell in the environment are external stimuli that are directly identified by the conscious mind (cooper Marcus & Barnes, 1999, p.88 ; Shahradi, 2012, p.10). Smooth and favorable landscapes quickly arouse one's emotions and imply effective in relieving one's stress (Nili et al., 2014, p.171).
- Encourage wildlife: Animals and birds are directly attracted to garden plants. The birdsong, and along with the sound of the wind among the trees, create a beautiful melody in the garden (Jafarnia et al., 2006). This nature orchestra sweeps away the daily stress and tension (Sad, 2003).
- Prevalence of green materials: Green planets effect on reducing the psychological fatigue of the residents. Green planets effect on re-

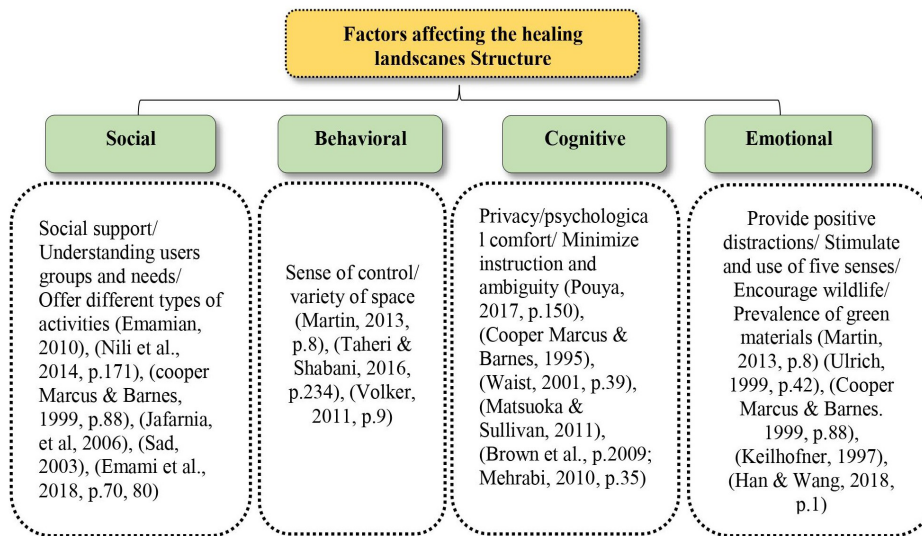
ducing the psychological fatigue of the residents. (Emami et al., 2018, p.70).

Cognitive parameters of healing landscapes:

- Privacy: Researches indicate that people prefer natural, spatially open areas for passive activities like as; sitting, thinking, and watch the landscape, nature, or other people (Pouya, 2017, p.150). Therefore in locations where cultural and ethnic groups, favor visiting in large, extended family groups, sub-space needs implemented the privacy of those who wish to, be alone do not intrude upon (Cooper Marcus & Barnes, 1995).
- Psychological comfort: Mental health is a mental state characterized by health and emotional well-being, lack of anxiety and disturbing life symptoms, and the capacity to build a satisfying relationship with others and to compare with the stresses and inconsistencies of life (Waist, 2001, p.39). Mental peace achieved in different ways. Studies show that exposure to natural elements designed to be effective in relieving stress and reducing mental fatigue (Matsuoka & Sullivan, 2011). Environmental features can help to enhance mental health by providing a higher level of social support experience. (Brown et al., 2009; Mehrabi, 2010, p.35).
- Minimize instruction and ambiguity: People need a degree of sophistication and mystery that will provide them with challenging opportunities. Amounts of complexity create a sense of worthlessness and ordinariness of space. (Kaplan & Kaplan, 1982). However, numerous studies show that abstraction in design does not well tolerated by persons who are ill or stressed. Identifiable features and garden elements incorporated into the design. Abstract art in the facility and garden has been often unsuitable (Mitrione & Larson, 2007, p.3).

Behavioral parameters of healing landscapes:

- Sense of control: Sense of control is an individual's perception of his or her own ability to have power over



**Figure 1.** The conceptual model of research.

what they do (Martin, 2013, p.8). People with a sense of control experience less stress, and the ability to cope with it, and are healthier than those with less control (Taheri & Shabani, 2016, p.234).

- **Variety of Space:** The variety of spaces gives the audience a variety of experiences, and creates a variety of landscapes to see, hear, smell, and touch all of the natural elements that enhance a certain kind of positive emotions and reduce stress (Volker, 2011, p.9).
- **Social support:** Social support is the perceived emotional help individuals receive through interacting with other people (Martin, 2013, p.8). People who receive a higher level of social support are usually less stressed and have better health than those who are more isolated (Ulrich, 1999, p.42-43; cooper Marcus & Barnes, 1999).

Social parameters of healing landscapes:

- **Understanding users groups and needs:** Understanding how people see their surrounding environments and how they react to it is one of the most crucial factors of therapeutic design, in another word, what individuals observe, and how they interpret (Cooper Marcus & Barnes, 1999, p.88).
- **Offer different types of activities:** Men are at heart, an active creature and activity are healthful in it. If he

has a chance to use his body and mind in the pursuit of pleasurable and meaningful occupations, he feels rewarded (Keilhofner, 1997). Physical activity and relationship with nature are promoting both physical and psychological health and well-being (Han & Wang, 2018, p.1).

#### 4. Research method

The present study is applied research. The methodology of this study is analytical, and the descriptive data have been collected by the use of researcher-made questionnaires, in addition to field observations and interviews with space audiences.

For investigating the characteristics of spatial Structure in Persian garden and urban Park and Assessing the differences in the performance of healing parameters in these two cases, qualitative analysis and T-test used respectively. Then Comparison of healing parameters and characteristics in Persian garden and urban Park Was shown with the Mann-Whitney U test. Qualitative evaluation of the effectiveness of the healing landscape in cases evaluated by Interview.

The results of the interviews have also examined the environmental factors affecting the healing of two samples of Persian garden and urban park with two different organizational patterns the survey developed in two descriptive and multiple-choice sections. Descrip-

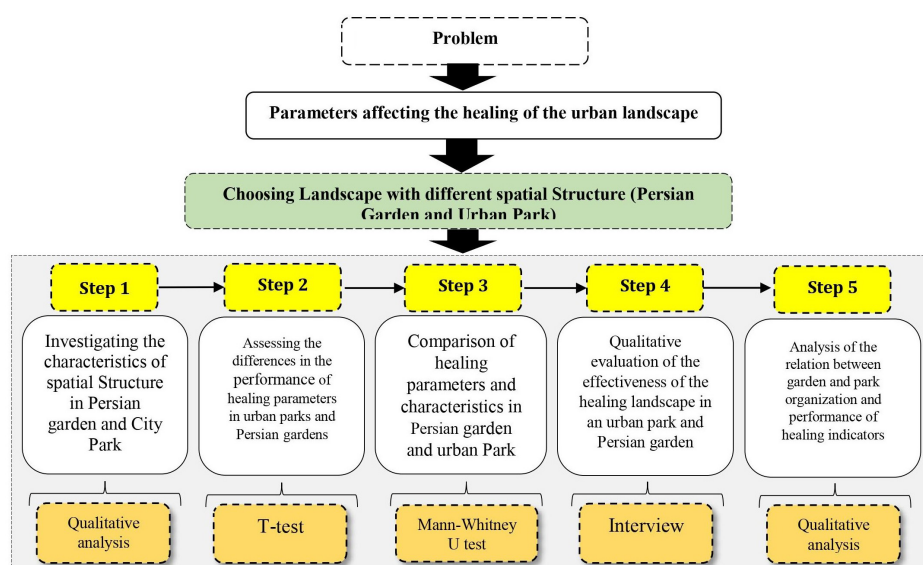


Figure 2. Research process.

tive questions mainly interviewed, and multiple-choice asked on a five-point Likert scale. The statistic sample was the users of Eram Garden and Azadi Park in Shiraz, Iran. A total of 80 questionnaires completed in Eram garden and 128 in Azadi Park. The content validity of the questions confirmed by experts and its reliability assessed by Cronbach's alpha test (alpha coefficient 0.91). According to Cronbach's alpha, the correlation between the items is high and the research model considered to be desirable. Together with all these methods, the relationship between garden and park organization and performance of healing indicators in them analyzed.

## 5. Results and discussion

### 5.1. Step 1: Investigating the characteristics of spatial structure in persian garden and city park

Urban parks have environmental benefits, such as air and water filtration and the reduction of urban heat islands. Urban green spaces also encourage physical activity and social integration by providing spaces for urban residents (Jeon & Hong, 2015: 100). Urban planners emphasize that landscapes play an important role in providing social and psychological benefits to urban residents (Cheung & Jim, 2019, p.2). Urban parks and green spaces widely used to help human well-being and quality of life (Chiesura, 2004). Parks founded on various scales and spatial

structures (geometric, organic, combination of both, etc.) in modern cities. Azadi Park built on 22 hectares of land in Shiraz opened in 1966. This park has an urban function and its unique privilege obtained in multiple functions including recreational, social, and educational activities. Azadi Park has an almost organic and coherent form that enhances its functional diversity and appeal. The extent of the landscapes and the dominance of the natural space make the presence of nature perceptible (Moradian et al., 2019, p.119). It is a place for citizens and also travelers and have various functions as physical, functional, and semantic. Various areas such as the religious-cultural Complex, Library, Playgrounds, Sports Facilities, Café, artificial Lake, Green Spaces, Birdhouse, Various Elements, etc. also attract people of all ages and genders.

The geometric structure of the Persian garden formed in two main ways, one is to create three parallel extensions along with the garden and the other is to consider two main axes perpendicular to each other and, then divide the garden into squares that have regular divisions (Shahcheraghi, 2010, p.43). The general pattern of most Persian gardens consists of a rectangular space with four intersections with streams and routes. In addition to the influence of Persian beliefs, the most common irrigation system known as a factor in





**Figure 3.** From left to right -the space structure and area of Azadi Park and Eram Garden in Shiraz.

forming the geometric structure of the garden (Naghizadeh, 2013; Mahmoudi Farahani et al., 2016, p.3). The Persian Garden is a space that, by combining architectural and natural structures such as water and plants, embodies a dreamy and imaginative meaning (Shahcheraghi, 2010, p.41).

The Persian garden has elements such as a pavilion, row of trees, plots, and water. The Eram garden, from the Seljuq era, was erected at the request of Atabak gharcheh, the Fars governor in the sixth century (Aryanpour, 1365, p.308). This quadrangular garden with an area of 110380 square meters, defined by a row of trees on its periphery, and it has a major longitudinal axis in the structure by the row of tall trees. It has the fountain, and the middle ponds as well as the kiosks and buildings on it (Alai, 2009, p.8). The emergence of water in a variety of forms: Across a row of Cypress, an atmospheric passage through the main pond and large pool (Nili et al., 2013, p.34). It now used as a botanical garden. This garden consists of spaces, including a gem museum (in the middle of the garden), a traditional café, and photography and handcraft booth, a fish pond (attached to the main Eram garden area), sitting areas, walkways with shade trees and more. Figure 2 shows the area of both sites.

According to the presented analyzes, it seems that the existence of spatial hierarchy, the geometric, and symmetrical pattern of the Persian garden is one of the factors to minimize ambiguity.

The geometric pattern in the Persian garden brings balance, symmetry, and simplicity; it also makes it possible to walk in the garden without confusion and feel more relaxed. The location of the pavilion on the main axis and in front of the fountain has led to a better understanding of the environment and the positive experiences of the audience in Eram Garden. It also works as a sign on the path, helps people finding direction, and can reduce ambiguity. Figure 3 shows the area and spatial organization of the Eram Garden (as an example of the Persian Garden pattern) and Azadi Park (as an example of an urban park). These two samples selected with different regular and organic geometric organizations to identify the healing qualities of the landscape.

## 5.2. Step 2: Assessing the differences in the performance of healing parameters in urban parks and Persian gardens

To examine the hypothesis the Kolmogorov-Smirnov test used to determine whether the data distribution was normal. According to table 2, the decision criterion (sig) for all indicators is (0.000). In other words, the distribution of this sample is normal. Therefore, an independent T-test used to investigate this hypothesis.

Based on the above test and sig (2), which is at a significance level of less than 0.05, it claimed that with a 95% confidence, there is a meaningful difference between the performance of

healing parameters among Azadi Park and Eram Garden. And the parameters of Eram Garden were more effective than Azadi Park. Therefore, this garden has been able to get closer to its healing role.

### 5.3. Step 3: Comparison of healing parameters and characteristics in Persian garden and City Park

Effect differences of landscape healing parameters in Azadi Park and Eram Garden verified by an independent T-test. The different performances of various parameters in the Persian garden and urban park examined. For this purpose, the Kolmogorov-Smirnov test used to determine whether the distribution of data in the four behavioral, cognitive, emotional, and social parameters as normal. According to this test, the decision criterion (sig) for all indicators is more than (0.05). By accepting the null hypothesis, there is no reason to reject “the sample has a normal distribution” in other words, the distribution of this sample is normal. Therefore,

an independent T-test used to investigate this hypothesis. According to Table 3, considering the gap between the average difference in the garden and park, the performance of cognitive parameters in the garden and the function of social and behavioral parameters in the park was better. There was no significant difference in the performance of emotional parameters, so these act similarly in the healing quality of the Persian garden and urban park.

To examine the healing indicators in the three social, behavioral, and cognitive parameters, the Kolmogorov-Smirnov test used to determine each indicator data normality distribution. Due to the abnormality of the distribution of data related to the indicators, the Mann-Whitney U test used to investigate the second hypothesis of the research. To measure the influence of each healing parameters between the park and garden, the average rank of each parameter used in two sites. According to Table 4, the average rank of the cognitive parameters, and all its

**Table 2.** T-test for two independent groups in the park and garden.

T-test for Equality of Means							Levene's Test for Equality of Variances		parameters
95% Confidence Interval of the Difference		Std. Error Difference	Mean Difference	Sig. (2-tailed)	df	T	Sig	F	
upper	lower								
-0/00546	~/041518	0/10681	~/020336	0/04	202/053	-1/904	0/001	12/353	Healing Landscape

**Table 3.** Independent T test.

T-test for Equality of Means							Levene's Test for Equality of Variances		parameters
95% Confidence Interval of the Difference		Std. Error Difference	Mean Difference	Sig. (2-tailed)	df	T	Sig	F	
upper	lower								
1/08406	0/79355	0/17878	-43/881	0/016	192/641	-2/454	0/017	5/864	
-0/23626	-0/76248	0/13268	-0/49937	0/000	202/142	-3/764	0/001	12/900	
1/02473	0/30997	0/18024	0/66735	0/000	204/112	3/703	0/129	2/347	
0/10585	-0/34547	-0/11381	-0/11981	0/295	204/112	-1/053	0/586	0/299	

**Table 4.** Average of healing factors in garden and park.

Sum of Ranks	Mean Rank	Site	Healing indicators	Healing parameters
6900.48	53.91	Azadi Park	Social support	Social
4332.00	54.15	Eram Garden	Understanding users groups and needs	
7663.36	59.87	Azadi Park		
4019.20	50.24	Eram Garden		
7845.12	61.29	Azadi Park	Offer different types of activities	
3343.20	41.79	Eram Garden		
6933.76	54.17	Azadi Park	Sense of control	Behavioral
4296.80	53.71	Eram Garden	variety of space	
6312.96	49.32	Azadi Park		
4947.20	61.84	Eram Garden	Privacy	
5907.20	46.15	Azadi Park		
5372.00	67.15	Eram Garden		
5785.60	45.20	Azadi Park	psychological comfort	Cognitive
5372.20	67.19	Eram Garden	Minimize instruction and ambiguity	
6635.52	51.84	Azadi Park		
5408.80	67.61	Eram Garden		

Healing landscape: How healing parameters in different special organization could affect user's mental health?

**Table 5.** Mann-Whitney Test of healing parameters in garden and park.

Sig.	Z	Wilcoxon W	Mann-Whitney U	Indicators	parameters
0.03	-2.132	3304.500	1026.500	variety of space	Behavioral
0.940	-0.075	2.148E3	1130.500	Sense of control	
0.005	-2.945	3.474E3	996.000	Minimize instruction and ambiguity	Cognitive
0.000	-3.593	2.984E3	772.000	psychological comfort	
0.001	-3.457	3.092E3	814.000	Privacy	
0.001	-3.211	1.672E3	851.000	Offer different types of activities	Social
0.002	-3.006	3.408E3	1130.500	Understanding users groups and needs	
0.969	-0.039	3.612E3	1.334E3	Social support	

**Table 6.** Interview with users of garden and park.

Healing Parameters	Healing Indicators	Environmental Parameters	Eram Garden	Azadi Park
Social	Social Support	Quality Of Collective Spaces		•
		Quality Of Furniture Arrangement	•	
		Quality Of Night Lighting	•	•
	Considering Social Groups And Their Needs	Accessibility	•	•
		Facilities And Services And Functional Diversity		•
		Variety Of Activity	•	
	Different Activities	Gender Domination	•	
		Active Experience Of Nature	•	
		Access Facilities		•
		Variety Of Activities		•
		Quality Of Collective Space		•
		Variety Of Uses	•	
		Visual Communication	•	
Cognitive	Privacy	Territorial Segregation (Semi-Public And Public)	•	
		Visual Communication	•	
		Lighting Quality	•	
	Mental Peace	Visual Communication	•	
		Physical And Psychological Supervision And Safety	•	
		Preserve Environment Privacy	•	
		Green Materials	•	•
	Minimize Ambiguity	Use Signs And Guides, Proper Navigation, Legibility	•	
		Coherence and Integration	•	•
		Using Different Materials		•
		Associating Meanings And Emphasizing Collective Memory		•
		Spatial Hierarchy And Symmetry	•	
		Clarity Of Space In One's Mind	•	
Behavioral	Sense Of Control	Proper Location Of Entrances		•
		Variety Of Access Routes (Permeability)		•
		Visual Connection With Different Points	•	
		Use Guides And Signs	•	
		Diversity And Flexibility	•	
	Variety Of Space	Variety Of Green Materials	•	
		Diversity Of Forms (Design)		•
		Uses Centralization	•	

related indicators in Eram Garden is higher than its value in Azadi Park. Eram Garden's cognitive parameters increase its healing quality. In contrast, the average rank of social and behavioral parameters in Azadi Park reported more. Regarding the research hypothesis about the difference of the healing parameters in the Persian Garden and the urban park, according to Table 6, the

Persian garden has a more select performance in the cognitive indicators than the Azadi Park.

According to Table 5, the indicators of each parameter are at a significant level of less than 0.05. There is a notable difference between parameters indicator (except the sense of control and social support) in Azadi Park and Eram Garden.



#### 5.4. Step 4: Qualitative evaluation of the effectiveness of the healing landscape in an urban park and Persian garden

After examining the effect of healing parameters and parameters on two case studies, the causes of differences in their performance in the garden and park investigated. The analysis of healing in gardens and parks as part of the city's landscape depends considerably on space users. So in the second stage of the survey, the semi-constructed interview technique used to extract the positive and negative factors affecting the quality of each of the healing characteristics. For this purpose, 30 garden and park visitors randomly selected. To create two-way dialogue between the researcher and the interviewee, we asked questions about the reason to be in the place, expectations from this environment, and positive and negative characteristics from their point of view. So the role of the researcher in gathering information minimized. After conducting the interviews and based on the content of questions, the approved parameters of the interviewer extracted. Table 6 shows the classification of environmental parameters based on the modality and performance of each parameter. As can be seen in this table, the parameters of healing (social, cognitive, and behavioral) have differences in two samples studied, and Eram Garden has more environmental parameters to increase healing in individuals.

- The social parameter of healing in design parameters such as the quality of collective spaces in both samples is appropriate, but the lighting at night needs improvement in Azadi Park. Accessibility is proper in both garden and park examples, but due to the public and urban space of the park, the variety of services needs to be more. On the other hand, in Eram Garden, due to the diversity of green materials, there is a chance for an active nature experience. Visual communication in Eram Garden is also more effective in healing since the regular spatial organization, and the line of sight created.
- In the cognitive parameter, psychological safety and preserving

privacy in Eram Garden has led to mental peace for people. The use of guides and signs and legibility has also been efficient in minimizing ambiguity in the healing of the Eram Garden. On the other hand, due to the symmetry and the spatial sequence of the Eram Garden, the integrity of the environment is more elevated, so by creating clarity in people's minds, it will help reduce spatial ambiguity and then promote peace in the individual.

- In the behavioral parameter, the variety of pathways in Azadi Park provides the opportunity of experiencing space. It has improved people's sense of control over their surroundings. In the Eram garden, the sense of control more enhanced by signs and visual connection.

#### 5.5. Step 5: Analysis of the relation between garden and park organization and performance of healing indicators

- Eram Garden has a regular geometry and fence specific spaces. The quality of lighting and visual communication with different places, physical and psychological supervision and safety, territorial segregation, preserve environmental privacy, has led to higher mental peace and privacy gained by individuals. The legibility of space, its coherence and integration, spatial hierarchy, symmetry, and clarity of space in one's mind (by minimizing ambiguity in the environment) also improve cognitive healing. The use of guides and signs enhances the diversity and flexibility of the space, along with the variety of vegetation, the focus of the uses, and the sense of control. The quality of public space, night lighting, accessibility, gender dominance and diversity of activity, and active experience nature are among the items that, with emphasis on social support, provide a platform for various activities among different social groups in Eram Garden.
- The regular geometry in the environment increases the legibility of the space, and due to a much perception of the environment, it raises people's peace of mind.

- Azadi Park has an organic and non-linear organization. It creates more complexity in the audience's mind and increases ambiguity. But more spatial diversity and the lack of defined spaces and the flexibility of most spaces have enhanced the sense of control in the area. On the other hand, the proper location of the entrance, the variety of the access route (permeability), and the diversity of Forms strengthened the social aspect of the healing landscape of the park. The quality of the collective space and quality of furniture arrangement, facilities, and functional diversity provide a sense of social support and the place for various activities toward the majority, which affects social healing. The greatest cognitive healing impact in park landscape is related to the existence of green vegetation, the use of different materials, spatial coherence, Associating Meanings, And emphasizing Collective Memory in space.

According to the mentioned factors, in general, the following strategies can be used to strengthen the healing qualities of the cityscape:

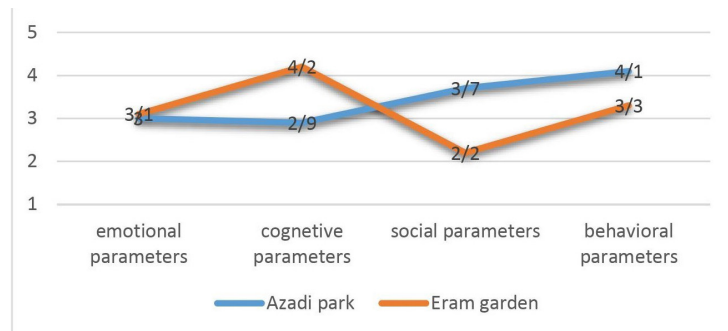
- Familiarity with space and its memory could create a sense of calm in the audience of a space. The scent is a trait that affects a person's subconscious and, while recalling memories, triggers a reaction to space, and creates positive feelings and peace in the person. Besides, the presence and appearance of water in various forms could also enhance the sense of peace in the audience.

- The privacy gained in a space increases with a regular organization and more mental peace.

- Organic and curved patterns reduce space legibility due to the complexity of the environment and cause more ambiguity and reduce peace of mind.

- Spatial and functional differences provided a great platform for various activities that allow the audience to hold different alternatives, so it increases the sense of control.

- Spatial diversity can attract population and increase social interactions.



**Figure 4.** Compare between healing parameters in Persian garden and urban park.

## 6. Conclusion

The beneficial effects of nature on human mental health, as well as the need for human nature to feel close to nature, have made the design of green spaces in today's cities an effective way to promote mental health. The healing perspective, through communication with the human senses through various senses, heals, and reduces daily stress.

The green space designed in Shiraz as a Persian garden and an urban park, so it is essential to study the criteria for landscaping in these two types of spatial organization, to provide solutions to improve the healing effect of the city's green landscape. As a kind of landscape architecture, the Persian garden is one of the most well-known gardening styles in the world, which has played an essential role in designing urban green space in geographical states. Parks, as a natural environment in the heart of cities, also play a significant role in creating a proper relationship between citizens and the natural environment.

Mental peace of the individual is expressed in various ways by the criteria of a healing perspective, and their effects revealed in the form of emotional, cognitive, behavioral, and social healing. All senses are active in the process of perceiving the environment, so they pay attention to all aspects of space and visual, perceptual, and functional categories. so it is necessary to define design details of elements (decorations, variety of materials, colors, etc.) along with the generalities of space (continuity, Confinement, etc.) In general, the performance of Eram Garden is better in terms of cognitive healing than Azadi Park, and in contrast to Azadi Park, it has a better performance in behavioral and social healing indicators.



However, the majority believes that they feel more relaxed in the Eram Garden, which confirms the undeniable value of cognitive parameters in the healing of landscapes. Therefore, using the regular pattern of designing the Persian garden as a healing perspective has been very efficient in the cognitive part.

Also, creating Perspective and Visual Communication, using Water in different shapes, and Variety of Vegetation increases Nature Communication. On the other hand, creating psychological safety through night lighting and routing and clarity of space can be design items that are effective in raising the quality of the healing environment. In the social and behavioral part, which has some purposes in common, enhancing the quality of collective areas, proper furniture, legibility, and variety of activities in the space can be efficient in the quality of healing.

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# The transformative characteristics of public spaces in unplanned settlements

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## Abstract

This research aims to explore the transformative specifications of public space in unplanned settlements. The neglected state of some urban specification, particularly urban spaces is one of the current problems in cities undergoing rapid urbanization. Public spaces in unplanned settlements manifest the resultant of the socio-economic condition in a specific context. The research employed the qualitative method and techniques such as unobtrusive observation, photography, mapping, and graphical analysis to collect, analyze, and interpret the data. The findings reveal a dynamic system of reproduction of the public spaces based on the mass-space proportions and private-public relationships with temporary, portable, and assembled components with low quality in the area. In this regard, the transformative character of the public spaces could categorize in four types including de-form, less-form, soft-form, and anti-form spaces. The result of the research reveals that although there is a process of changing the private spaces to semi-private, paths and open spaces are more vulnerable under the pressure of users to privatize the spaces. The results of this research could help the policymakers and designers for real insight into the public spaces in unplanned settlements.

## Keywords

Mass-space proportions, Public-private relations, Public space, Unplanned settlement.



## 1. Introduction

Rwanda locates in East Africa, where encompasses a total area of 26 338 square km, with the population of approximately 10.5 million, and a density of 340 inhabitants per square km, which a proportion of the population in Kigali lives in poor condition in inner-urban areas (MININFRA, 2015). In recent years, Rwanda is characterized by rapid urbanization (UNDP, 2008; MININFRA, 2015) similar to other countries in Africa (UNDESA, 2014). In fact, inhabitants in slum areas are more than 70 percent of the total population in some countries (UN-Habitat, 2003a) and informality is the increasing trend in most cities in the world (Gilbert, 2004).

Studies highlight the informality as part of the rapid development in African cities. For example, the study theorized that the urbanization in African cities takes the place in the absence of the industrialization (Bryceson, 2014) and African cities tend to follow their own pattern of growth (Buckley & Kallergis, 2014). Therefore, the rapid urbanization results in some problems such as poor infrastructures, environmental pollution, insufficient transport system, informality, lost spaces, and even may damage the identity of the city (Dringelis, Ramanauskas, Povilaitienė, & Mačiukėnaitė, 2015).

In addition, studies identify informal settlements with different perspectives such as contextual adaptation (Rapoport, 1969), people as infrastructure (Simone A., 2004; Simone A., 2010), a result of the informal economy (Roy, 2005), adaptation to the condition (Pieterse E., 2010), the meaning of the public realm (Sebina & Koma, 2015), and as a contemporary component of cities (Avni & Yiftachel, 2014). Despite UN-Habitat defines informal settlements such as slums as a manifestation of the physical, spatial urban poverty and intra-city inequality (UN-Habitat, 2014), neither all parts of slum areas include low quality of life, nor all slum dwellers are always poor (Roy, 2005). Notwithstanding, to call the slum areas either as an unplanned, informal or unofficial settlement (Huchzermeyer, 2011), the current condition of these areas can indicate vibrancy, activities,

and social interaction in the context with many deficiencies, challenges, and misunderstanding. Therefore, it seems the comprehension of the public space in the context of unplanned settlements would formulate a new perspective.

The studies also mentioned that informality is so wide including informal of job, market, and economy such as semi-formal, quasi-formal, or informal, which is rooted in the formality (Roy, 2005; AlSayyad, 2004). In detail, formal political, economic, and financial processes and procedures include deficiencies, which create opportunities to set up an informal business, job, services, or production. For example, part-time, home-based, street-base, and ruin-area-base of jobs, products or services are part of informality to serve both informal and formal part of the society (Simone A., 2004). For this reason, Oldfield argues that the substance, process, and procedure of the economic and political powers configure both formal and informal areas (Oldfield, 2014). Seemingly, the public space attributes take the place in both physical and nonphysical specifications that Roy calls in terms of the mapping of unmapped spaces (Roy, 2004), which refers to documenting of the area that never mapped in detail. Therefore, the concept of the public spaces in slum areas is related to informal (Simone A., 2003; Roy, 2005) specifications such as small size, recycle and cheap materials, and integrated components, in contrast to formal spaces presenting large size of space, artificial and decorative materials, and clarity in the urban functions and land use (Moughtin, 2003).

Some of the studies also theorized that neoliberal and postmodern approaches influence the insufficient urban development. For example, Sideris and Banerjee mention that the priorities of the development in some cities orient toward the rich and developed parts in terms of a postmodern development approach (Sideris & Banerjee, 2007). In detail, the modern style of planning was comprehensive, inclusive, and integrated as the total design (Lang, 2005) based on the welfare state. However, the planning and design are segmented, separated, and individualized based on private investment,

banking finance, and international consortium in a neoliberal government with a postmodern approach (Sideris & Banerjee, 2007). This process creates a gap for marginalized users to get access to public services to establish unofficial relationships to cover this gap (Simone A. , 2003). In this regard, the necessity of life directs users to innovate different ways to encounter the deficiencies in the built environment in an uncertain condition, particularly political decisions, social movement, and urban economy (Simone A. , 2014), and public activities in the public realm (Habermas, 1991).

It means that the users face a range of changing in the political, social, and economical condition, which influences daily life without active participation. This uncertain condition forms the living areas with temporary materials although those forms become gradually part of the urban components, which is called as the “grey spaces” (Avni & Yiftachel, 2014). In a detailed study, Simon advocates the structure of placemaking in terms of the composition of “places, people, actions, and things” in the slum areas (Simone A. , 2004, p. 409). The physical and mom physical aspects of the public spaces are categorized in terms of the mass-space proportions and public-private relationships in the architectural and urban design respectively (Madanipour, 1996; Moughtin, Cuesta, Sarris, & Signoretta, 1999; Lang, 2005). In fact, the term mass refers to the architectural elements that occupy spaces particularly constructed elements and spaces include open areas, which the public-private relationships take the place in the mass-space proportions.

## **2. Argument on the character of public space in unplanned settlements**

There are wide ranges of studies on the public space that carried out through different approaches. For example, public spaces were defined as the result of urban configuration to demonstrate the reality of urban life (Carmونا, Heath, Oc, & Tiesdell, 2003). Madanipour also described varieties of public space in the paradoxical specification based on the experiences in the world.

He stated urban design approaches for public space design including the scale or level, productive or procedural, one or multidisciplinary activity, visual or monumental, spatial or cultural, public or private, and objective-rational or subjective-expressive process (Madanipour, 1996), or something mixed from those aspects. Furthermore, other studies emphasized the importance of function, location, and size (Woolley, 2003), either familiarity, legibility, distinctiveness, accessibility, comfort, safety as qualities in urban spaces (Burton & Mitchell, 2006), or physical forms such as streets and squares (Moughtin, 2003).

By contrast, Oliver criticized that some definitions on the architectural productions are less clear and he advocated the cultural aspects, materials, and form of productions by people could explain the essence of spaces (Oliver, 2006). His interpretation refers to those constructed forms in daily life as a spontaneous public space than an architectural production by government. In addition, the study of Robinson reveals a new understanding of cities in the global south, which poverty and informality are an integral part of urban development (Robinson, 2014). In this kind of society, public space is produced by either social or political power (Schmid, 2008) that informal space refers to social aspects; however, formal spaces represent political factors.

Simone reveals a mixed system of formality and informality in the working, ethnical relation, and neighboring in Jakarta (Simone A. , 2015). The informality also refers to “shadow groups” who try to survive in a defective system of the urban job markets by their own innovation (Simone A. , 2010). In this process, the residents change the physical form of urban areas by temporary or permanent intervention to modify the area based on their needs in daily life (Simone & Fauzan, 2013). Hence, this self-managing (Simone A. , 2003) of spaces creates a systematic network of relation and cooperation for the shaping of the urban form out of the architectural standards of the western countries (Jones, 2009). In other words, people change the urban form through their own interventions to transform the city into a personalized form.

In addition, Simone theorized that although redevelopment process represents the accumulation of financial and political powers to make the city legible for the specific group, the ruined spaces have acted as a possible potential to run other activities for marginalized people (Simone A. , 2004). In this regard, AlSayyad and Roy argued that the physical productions of informal spaces have been the inseparable part of informal markets, jobs, and economy (Al-Sayyad, 2004; Roy, 2005). Consequently, the informal economy is also produced by physical forms of construction as informality (Bayat, 2004). Miraftab criticized that the models of development of the global north do not work in Cape Town due to deficient urban institutions under the neoliberal urban policies (Miraftab, 2007). Thus, users construct their own individual, family, and neighbor interpersonal relationships to tackle problems in the lack of efficient urban institutions (Simone A. , 2008).

In detail, Khan and Pieterse (2004) concluded that increasing process of urban slum areas may demonstrate the problematic decision-making process in the surrounding of big cities in Asia, Africa, and Latin America. They discovered that the main reason is derived from the poor process of democratization, institutionalization, and constitutionalization under the shadow of the metaphor, ritual, and rhetoric of urban policies. Additionally, they summarized that the destitute people attempt to settle in the urban peripheries to take advantage of being a citizen in the whole cities regarding those unclear policies in the developing countries.

For this reason, Sticzay and Koch criticized urban design projects without diversity based on some models from developed countries (Sticzay & Koch, 2015). In fact, those public spaces projects were unrelated to the context (Pieterse E. , 2013). Therefore, the concept of public space becomes an artificial prototype in the absent of the cultural values than part of the context in informal areas. More importantly, inhabitants of slum areas are also involved in both formal economic system and informal activities in open spaces (Bayat, 2004). Therefore, street, valley, and open space play a significant role in providing op-

portunities for informal activities in the shadow of formality (AlSayyad, 2004).

Nevertheless, the study revealed that policymakers advocated the idea of irregular, chaotic, and physically dysfunctional forms in unplanned settlements to provide the legitimacy for governmental interventions to relocate officially (Pieterse e. , 2008) the marginalized and deinstitutionalized groups (Bayat, 2004). This approach has also affected theoretical studies by replacing the slum terminology with other words such as unplanned area and unofficial settlements (Huchzermeyer, 2011). However, it is of great importance to take into consideration African cities, city-ness, and poor settlements in the context and people perceptions (Pieterse E. , 2010) to recognize inhabitants as the main actors of community development (Pieterse E. , 2013).

### 3. Methodology

The methodology of research was grounded on qualitative methods (Groat & Wang, 2002; Miller, Dingwall, & Morphy, 2004; Neuman, 2006). The method was applied to analyze behavioral patterns and activities of users (Goulding, 1999) and graphical analysis based on reality, observability, and testability (Kattoppo & Sudradjat, 2015).

The applied techniques consisted of the unobtrusive observation (Bonnes & Bonaiuto, 2002) and site analysis (Groat & Wang, 2002; Moughtin, Cuesta, Sarris, & Signoretta, 1999), photography (Georgoula, Stamnas, Patias, Georgiadis, & Fragkoulidou, 2013; Sebina & Koma, 2015; Tafahomi & Nadi, 2016), and sketching and mapping (Laseau, 2001; Groat & Wang, 2002; Deming & Swaffield, 2011; Regis, 2003; Sperlregen, 2003; Tafahomi & Nadi, 2020). These techniques provided a set of data based on systematic and consistent contextual elements and behavioral activities to recognize elements and activities in the public space (Carmona, Heath, Oc, & Tiesdell, 2003). The data for the analysis included the mass-space proportions and public-private relationships similar to places, people, actions, and things (Simone A. , 2004); hence, the data were interpreted in the analytical redrawing process (Mugerauer, 1995; Groat & Wang, 2002; Regis, 2003; Sperlregen, 2003).



The data collection took the place on dry seasons between February to March and June to August 2017 and 2018 with a weekly plan in the early stages of the research, and then monthly, seasonal, and occasionally based on the checking the process development. Despite the fact that photography was not a normal activity in the area, some photographs were shot to exemplify the data grounded on the ethical requirements. The visiting arranged with some of the students, visitors, and other experts in mornings and afternoons.

Two sets of the data were collected for the analysis including physical and non-physical elements in terms of space and activity. The space referred to the architectural elements for analysis including both temporary and permanent components such as buildings, setbacks, front-ages, and courtyards. The activity included the public-private relationships based on the behavioral patterns of the inhabitant in the spaces in the daily life. The final stage was when all available data were analyzed, diagrammed, interpreted, and reinterpreted through overlay technique (Laseau, 2001; Moughtin, Cuesta, Sarris, & Signoretta, 1999). The graphical technique was recommended through sketches, schematic drawing, and diagram (Laseau, 2001) to illustrate the data through the analytical matrix tables to represent all data based on analysis, illustration, and interpretation (Charmaz, 2006; Mugerauer, 1995; Mugerauer, 2014; Roy, 2014).

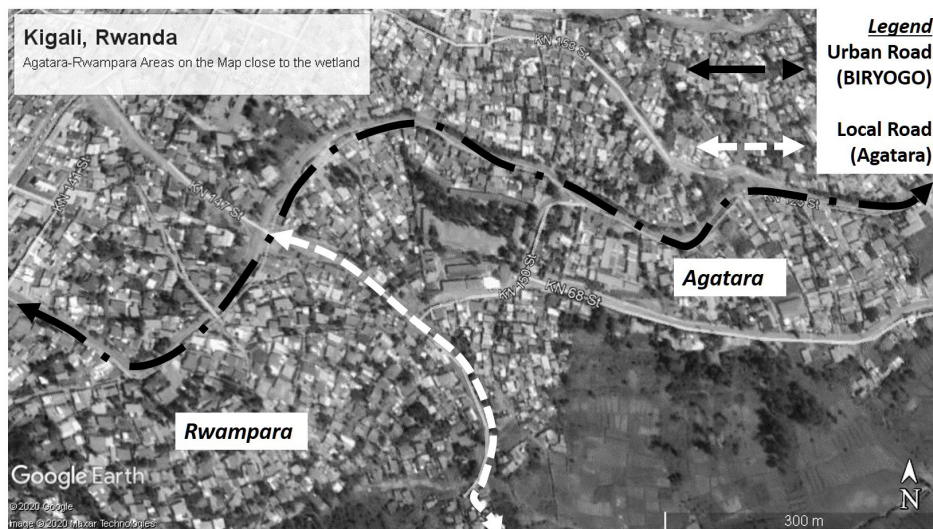
The research faced some limitations and constraints. First, the research, observation, and photography were carried out based on the dry seasons particularly June, July, August, and weekly visiting including weekdays and weekends in daytime activities. Therefore, this study may have missed the possible effects of the raining seasons, nighttime and nightlife activities in the area. Second, the research focused on the observation of behavioral patterns, temporary and permanent elements. However, the range of the changes was dramatic based on seasons and possessions. For example, it was observed that football field, courtyard, shop, and open space converted into maize farms, gardens, storages, and house respectively. Third, in-depth-interview with

users could have released much more priorities, trends, interests, and challenges, which users faced. Finally, the research also did not incorporate the ethnographic inquiries relating to the origin of the inhabitants to discover any possible effects of specific pattern, technology, or space arrangement, which residents may apply those as an adaptation process in the area.

#### 4. The cast of the study

Kigali as the capital of Rwanda situated right in the heart of Rwanda, and has a total population of 1.2 million (OZ, 2007), with the rising level of immigration from rural areas to the city, which means more than 45 percent of the current population of Kigali are immigrants. Biryogo is one of component parts of Nyarugenge district in the city, which includes Agatara area as an unplanned settlement. The connected road between Agatara and Rwamapra was constructed between hillsides and wetland as a public space (Figure 1).

Agatara area includes “5821 population, 27.62 hectares, 1292 household, with 211 density person per hectares”, Rwampara area “6198 population, 26.24 hectares, 1585 household, with 236 density person per hectares” (MINIFRA, 2016, p. 8). The report reveals, “80 percent of the populations are under 40 age, with a deteriorating condition (largely of mud and wood with iron sheet roofs)” (MINIFRA, 2016, p. 9). The report highlights “both formal and informal business activities thrive in the area with traders dealing in new and second-hand clothes, groceries, spare parts for vehicles, motor-bikes, electronic etc. Other sources of income include transport business e.g. motor-bike taxi and sale of food-stuff” (MINIFRA, 2016, p. 11). Although the report mention less about the social background of the population, the rapid urbanization process in the city (OZ, 2007) implies that they are majority immigrant from village parts. The central road (shown in Figure 1) represents public activities, which from the hillside to wetland, the dwelling houses and buildings become temporary and unplanned. The road called the Agatara road in documents (MINIFRA, 2016; Rapid Planning, 2017).



**Figure 1.** The main path as the public space in Agatara.

#### 4.1 Results

Data analysis consisted of the mass-space proportions as the morphology and the behavioral patterns in terms of public-private relationship in the area. Tables of type of space and activity demonstrated important data in the area (Tables 1 and 3). The column of graphical illustration presented the spatial relations of space and activity. All data were converted into a diagrammatic sketch to represent the relations based on the analytical diagram. Hence, those diagrammatic sketches illustrated the position of each space and activity attributes in the context. The logic of the diagrams was constructed based on the location, position, and form of the mass-space in the area.

In detail, according to the survey, all buildings were included one floor on the ground without any architectural or design characteristic and generally as a housing production. Buildings were changed into other small activities such as a retailing shop, repairing shop, and restaurant or bar, or farm-storage house. Therefore, the main character of the area was a self-planned neighborhood with limited functions or varieties in both form and space.


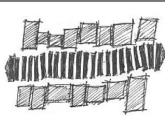

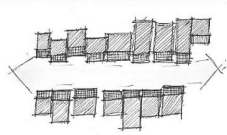

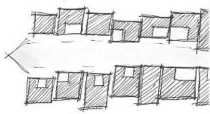

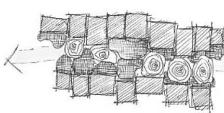

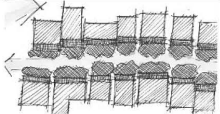

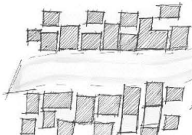
The table of space was classified into six categorical attributes including path, frontage, adjacent, possession outward, setback, and courtyard based on the existing form of mass-space proportions (Table 1). Additionally, data of the activity part was clas-

sified into three main parts including accessibility, services, and recreational activities based on the behavioral patterns to present public-private relationships (Table 3). All typology of space and activity were included an exemplified image to represent the concept. All images were converted into the graphical analysis to interpret the relation between mass-space and private-public by diagrammatic sketches. In addition, to highlight and distinguish the specification of data in the unplanned settlement and other areas in the city, a comparative table designed to explain the differentiation (Tables 2 and 4).

#### 4.2. Research findings

Findings are organized in interpretative parts including tables and figures. First, the results of the graphical analysis are converted into the interpretive-illustrative diagram to conceptualize the relationship between different typologies of both space and activity. In detail, the analytical framework is grounded on the public-private relationships for activity and the mass-space proportions for space in the area. In this structure, it is attempted to conceptualize the position of both space and activity items in the frame of private-public and mass-space to illustrate the common trends. The conceptualized frame is supported by a descriptive column to clarify the interpretation of the trends in detail in the area.

**Table 1.** *Type of the space.*


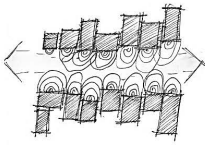

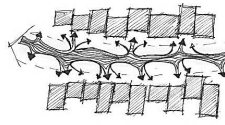

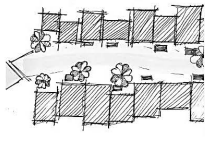

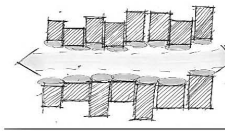

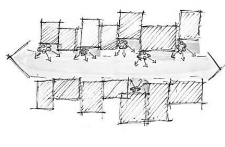

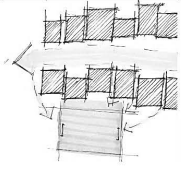
Type of Space	Characteristic of Space	Example	Graphical Analysis
Paths	Public, open, temporary occupying, Accessibility		
Frontages	Semi-private Tends to extend the private area into public areas		
Setbacks	Semi-private		
Possession Outwards	Semi-private, semi-public		
Adjacent	Develop the private space into public area		
Courtyards	Semi-private, semi-public		

**Table 2.** *Comparison of type of the space in the unplanned settlements and city areas.*

No	Title	Specification in the slum areas	Specification in the city
1	Paths are	penetrated with linear or antenna shape for access to the fabric	part of the urban network to circulate inhabitant movement
		mixed on all activities	clear based on the classification and hierarchy
		mixed people and vehicles	The relationship between of the vehicles and pedestrian are clear.
		The road is the main public activity.	The road is tools for access to public activities.
2	Frontages are	sheltering for comfort	Decorative with beautifications
		additional parts to the inside	extension of the inside to outside
		Full of varieties based on the desires and ideas	Similar based on the laws and urban policies
		For sitting and storing	For sitting and presenting
3	Setbacks are	semi-private and semi-public	Private and semi-private
		For more public activities	For more private activities
		Just cutting of the mass	Decorative
		Formless	Based on the urban policies
4	Possession Outward are	Occupying by users in public areas	Forbidden or limited
		Flexible, temporary, and varied	Strictly controlled
		Multi-proposed areas	Not exist
		Depended on the time and events	A calendar base activities
5	Adjacent Areas are	Manged by interpersonal relationships	Based on the community or state permission
		Determined by the occupying of the land	part of the public road, walk side, or frontage
		Developing by elements in the site such as tables, desks, or carriages	Filled by the greenery or urban furniture
		Used for the small businesses	For public services
6	Courtyards are	Developed by the function of buildings	Distinguished by differentiation form buildings
		Varieties of forms, sizes, and shapes	Based on the building codes
		Intersection between buildings, plots, and walls	In the plot for the building
		Uncompleted form and flexible	Solid form of design
		For public activities	Private and semi-private activities



**Table 3.** *Type of the activity.*

Type of Activity	Characteristic of Activity	Example	Graphical Analysis
Accessibility	Passing		
	Access		
Service Stations	Public, tend to Privatize spaces		
Recreational Activities	Sitting, Watching		
	Gaming Grouping,		
	Football in the lost spaces, social activities		

**Table 4.** *Comparison of type of the activity in the unplanned settlements and city areas.*

No	Title	Specification in the slum areas	Specification in the city
1	Passing activities are	Connection of the area to outside	Part of the urban network structure
		Based on the pedestrian, bicycle, and motorbike	Based on vehicles
		Necessity activity in the main road	Optional activity with varieties in other roads
2	Access activities are	the ability of accessibility houses, restaurants, shops, farms, and the logistics to transport the goods and equipment	the ability of accessibility houses, public services, commercial, and transport
		Flexible form of access pattern to the plots	Fixed form of accessibility
		Changeable form access based on the behavioural pattern	Fixed form of accessibility
3	Service Stations are	Flexible forms, patterns, and locations	Fixed based on the landuse plan
		Based on the daily need in the streets	With varieties of need in the buildings
		Limited in small scales of activities such as airtime umbrella, motorbike station, and money transfer desks.	Varieties of sizes and scales based on the functions and activities
4	Recreational Activities are	Including passive activities such as stopping, sitting, and watching in the road	Including passive activities in the designed public spaces such as parks, open spaces, and public spaces
		Including active recreational such as chatting, listening to the radio in the road	Including active recreation those took place in the clubs, restaurants, and coffee shops
		Including social gaming such as football, traditional gaming and playing in the ruined areas and farms	Including those activities took place in the clubs, gyms, open spaces, or playgrounds

Table 5. Findings on the space components.

Type of Space	Graphical Analysis	Interpretative Diagram	Description
Paths			Paths take place in the public parts as most commonplace for activities also occur in open parts of the land. The forward-backward of the mass deformed the paths based on the public-private interests in the space to shape a de-form space.
Frontages			Frontages depended on the Mass and extended the concept of the building to the open part of the spaces. So, frontages created personal less-form spaces in continue with the mass, which they are neither space nor mass.
Adjacent Area			Adjacent areas are after frontages, where those spaces were inseparable from the mass and functions that owners used to continue the activities with flexible form of soft-form spaces with some temporary or permanent materials.
Possession Outwards			Possession of spaces was started from the mass parts and continued to the public space part. The size and scale of getting possession were depended on the conventional relations as activities. Therefore, these spaces resisted to be formed. Indeed, they have been an anti-form than a formed space.
Setbacks			Setbacks invited spaces into the mass with private or semi-private functions such as restaurants, shops, or small business as a de-form space. Therefore, this changing of the building deformed private space and activity to adapt with a new function of public activities. The function of the setback normally followed homogeneously with the function of the buildings in private space.
Courtyards			Courtyards were spaces that more private. They may be separated by walls or surrounded by mass. They controlled by ownership or groups of ownership. Those semi-private activities take the position in the courtyard spaces such as storage, restaurant, or small business. Therefore, these spaces have been under forming, re-forming and de-forming to adapt with the need.

Table 6. Findings on the activity components.

Type of Activity	Graphical Analysis	Interpretative Diagram	Description
Passing			Passing just happens in the most public part of the paths. The passing activity take the position through other activities those take place in the adjacent area of the buildings such as vendors, services, and possession outwards, therefore, the passing pattern is deformed based on the multi-factors.
Accessibility			Accessibility was more permeable than passing due to penetration into frontage, adjacent and possession outward of spaces. Therefore, the accessibility contained a flexible form of spaces based on the vibrancy of users. The accessibility characterized with less-form specification in the areas.
Portable selling Services in spaces			Portable selling services such as airtimes selling, motor taxi stations, hackers, and salesperson included tendency to possess the spaces in the public part. Therefore, these activities followed trend to privatize open spaces but flexible by the time and location. Therefore, this occupying of spaces changed the location in the space to create some soft-form of forms in the area.
Sitting and Watching			The sitting and watching took place in public spaces or with a visual corridor to the public space. It is also located in the adjacent and frontage of mass with varieties of pattern, time, and user to make a less-form pattern of activities in the area. If this activity took the position in the setback or courtyards, it normally was divided from public with temporal screens.
Gaming			Gaming as part of recreational activities took place in close of the mass parts to create privacy for the activity. Therefore, frontage, adjacent, setback, and courtyard could be used for gaming to form more soft-form of spaces in the area.
Social Activities (Sports)			Social activities, ceremonies, and sports took place in the open spaces with a large-scale size in the surrounding area of the living, working and passing. Those activities were flexible based on the users, events, and times to resist to be formed in specific shape, size, or pattern of activities. Therefore, those social activities revealed an anti-form of spaces in the area.

**Table 7.** Overlaying of attributes of the space and activity.

Items	Overlaying of the Attributes	Description
Items of Space		According to the overlaying diagram, major parts of the space's attributes take position in the space-public part of the diagram. They are open, flexible, and common. However, owner of the land controls frontage, so the level of private effects and interventions in the frontages were higher. Setback and courtyards were either part of the plot or surrounded by, and so the level of the mass and private activities were higher than public-open. In the public-mass was not any public building in the area.
Items of Activity		Gaming, sitting, and watching were most relevant activities with the buildings and mass part in the area. Other activities took the position in the public-space. Sports activity other gathering also took the position in the private areas such as frames or gardens but a layers back of the main path. Despite the restaurants and some small business took the position in the mass-private area, those were not in the public-open spaces activities, so did not affect directly on the public space activities.
Overlay space and activity		Based on the analysis, major part of the activities took the position in the public-space part of the diagram. Space and activity in the space-public and mass-private were supportive or advantage-taker from activities in the public-space part. In addition, those activities in the public-space part were more causal and daily-life activities, free or less payment base, than in private-mass or private-spaces.

Diagrams in Tables 5 and 6 illustrate the passing and accessibility activities found in the open spaces and paths. It supports that the quality of the activities is depended on the quality of the open spaces such as size, continuity, and connectivity. In addition, the quality of physical and non-physical components in the space such as the shelter, frontage, setback, or possession outward influence the activities of users in the public spaces such as passing, accessibility, and behavioral sitting. In detail, Tables 5 and 6 also demonstrate four spatial attributes including de-form, less-form, soft-form, and anti-form of space and activity, which are inextricably intertwined to create those attributes.

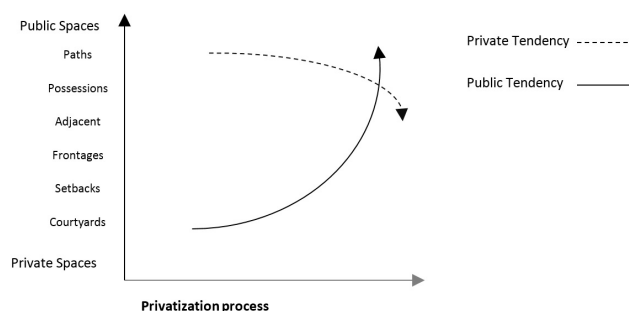
The de-form spaces include at least a basic form but faced with deforming processes due to some changes gradually in the structure, size, and pattern grounded on the intervention of users. It means that the de-form spaces

**Table 8.** Arrangement of forms.

Indicator	Space	Activity
<b>De-form</b>	Paths Setbacks Courtyards	Passing
<b>Less-form</b>	Frontages	Accessibility Gaming Sitting and Watching
<b>Soft-form</b>	Adjacent Areas	Portable selling, Services Stations
<b>Anti-form</b>	Possession Outwards	Recreational Activities

represent those derived forms of the mass-space proportions grounded on the need, claim, or general tendency of users as behavioral patterns. For example, the passing and accessibility activities are changed frequently based on users' interventions such as changing the setbacks and courtyards to restaurants and storages to adopt new semi-private activities.

The less-form spaces represent



**Figure 2.** *The general trends in public and private relationships.*

those extended forms of the constructions in the frontage, sides, or adjacent areas of buildings, which are attached to private spaces as an uncompleted form of space and activity. The less-form spaces reveal that the constructed form is not a completed form in the area, rather than, they are completed by flexible size, dynamic interaction, and incremental elements gradually such as expending the shelters and verandas, extending frontages and terraces, facilitating of accessibility, or sitting areas as a favorite haunt.

The soft-form spaces take the place next to the private parts, which requires fewer materials or fixed elements in the space. Those activities form a flexible, mobile, and intermittent space. For example, portable selling service stations with a handcart, daily and weekly market of vegetable and fruit by vendors with baskets, and on-street sellers with or without boxes and tables create varieties of spaces with soft-form of spaces; however, with clear side effects of the behavioral patterns and sense of place.

Finally, the anti-form spaces resist being formed by hardscape materials in the open spaces. These spaces form based on the behavioral patterns to maximize the efficiency of the public realm in open spaces such as gaming, recreational activities, and occasional ceremonies such as a wedding.

Table 7 reveals the components of the tables of space and activity to represent conceptual relationships of each item. The table demonstrates a concentration of both space and activity components in the public-space segment, which reveals the trends of inhabitants for public activities. In addition, Table 8 represents both Tables

5 and 6 with a new structure to illustrate the relationships based on space and activity specifications.

In a summary, Figure 2 conceptualizes the interaction between public and private based on the space items in the unplanned settlement. In fact, although some of the items integrate with semi-private activities such as frontage, courtyard, and adjacent areas, this tendency is limited to building as mass part of the structure. However, the privatization of the public spaces is common trends in the area. This diagram just conceptualizes the general tendency in terms of the finding of the research; however, the clarification of the accurate relationship between each variable will require further research.

#### 4.3. Discussion

Results of the study identified that paths encompassed the public spaces in the unplanned area for passing, accessibility, and social behavioral patterns in terms of the public realm (Tables 5 and 6). The results of the research approved public spaces in unplanned areas in terms of street-based (Moughtin, 2003) as the social location (Schmid, 2008) with the procedural, public, and cultural specifications (Madanipour, 1996; Moughtin, 2003; Woolley, 2003). It was also similar to the findings of Simone based on the modification process of open spaces to transform the spaces for neighbors on a local scale (Simone A., 2008). Results of the research showed the mass-space proportions and the public-private relationships were flexible, temporary, and transformative in the unplanned settlement.

The research also observed a synchronized paradoxical challenge between the tendency and resistance for privatizing of public spaces based on the economic interests, territories, and ownership. Despite the specifications referred to the unclear economic system (UNODC & UN-Habitat, 2011), integration of informal, semi-formal, and formal economic activity appeared in the area (Simone A., 2008; Simone A., 2003). In detail, the form and function of open spaces were depended on the continuous process of



occupying, changing, and extending the mass-spaces proportions in the area. As the result, the spaces were not fixed in the form and function, however; in a process of transforming to generate adaptable forms based on the public-private relationships similar to the findings of Simone (Simone A. , 2015). In fact, ordinary people materialized those spaces with their own interventions as a self-managing (Simone A. , 2003) on a small scale, short time, and with a limited number of users to meet their need in the space particularly frontage, adjacent, and setback similar to studies of Mirafteb and Simone (Mirafteb, 2007; Simone A. , 2008).

Four specific attributes of space including the de-form, less-form, soft-form, and anti-form revealed that the spaces were transformed by interventions of users in the area (in Tables 5, 6, 7, and 8). This study revealed that the users transform the environment to their needs although this result challenged the study of Dringelis, which he focused the process for the creation of lost spaces and disappearing the identity in the location (Dringelis, Ramanauskas, Povilaitienė, & Mačiukėnaitė, 2015). In fact, the results indicated that the informality was part of transformation the mass-space proportions to improve livability in uncertain conditions in the area similar to precedents studies described in (Simone A. , 2004; Sticzay & Koch, 2015).

This study exposed that the public space was depended on the open parts of the paths in the area. However, both soft-form and less-form spaces tended to transform the public spaces in favor of private activities. This trend observed in the small scales of the construction, assembly, and flexible forms of shelters in the spaces, similar to the observation of Simone in Jakarta (Simone & Fauzan, 2013). However, the anti-form areas resisted privatizing the public part based on private-public relationships. In fact, the behavioral patterns of the users reshaped the urban form through the public-private relationships within the context beyond all architectural standards those reflecting the critical point of view of Jones (Jones, 2009).

The results verified that users struggling to change their conditions by changing the spaces through some small interventions, with available materials, in the micro scales (Table 5 and 6), which was in the same alignment with the results of Pieterse (Pieterse E. , 2004; Pieterse E. , 2010; Pieterse E. , 2013). Therefore, the public space in the case study was a contextual concept like the idea of Rapaport (1969) and findings of Pieterse (Pieterse e. , 2008), in contrast to the definition of UN-Habitat (2003a) and the western model of urbanization. Nonetheless, the public spaces encountered the privatization for informal business and activities in the area. Thus, the protection of public spaces required collective wisdom in an institutionalized mechanism as Khan and Pieterse recommended (Khan & Pieterse, 2004).

Furthermore, this study revealed a current style of self-construction to redesign the area based on the physical and nonphysical facility, accessibility, and possibility in an uncertain circumstance (Parnell, Pieterse, & Watson, 2009) to respond to their own need (Pieterse E. , 2013). Apparently, the informality was an unfit label from the outside, particularly the formal system (UN-Habitat, 2012). In this regard, the idealized pattern of the development (Pieterse e. , 2008) was replaced with a realistic pattern in the socio-spatial context (Bayat, 2004).

## 5. Conclusion

The concept of public space faces a paradigm shifting in the unplanned area as a common discourse, which this concept is under development with further studies. In fact, it is expected to consider the public space as a regenerative phenomenon in unplanned areas through a dynamic system of re-assembling of spaces by users in the uncertain context.

Public spaces are an essential part of the common lifestyle in the informal context. In fact, those spaces namely includes de-form, less-form, soft-form, and anti-form spaces, represent transformative characteristics of public spaces. The form is not only resulted from physical and fixed elements but also includes temporary, portable, and assembles components. This creates flexibility,



mobility, and adaptability between the mass-space proportions and the public-private relationships.

The spaces such as path, setback, and frontage are considered the practical components with a temporary structure to provide some facilities and services for users. Consequently, these small public spaces support the chain of demand and supply for both users and activities. Therefore, in the absence of a large amount of investment, effective policies, and well-organized institutions, users adapt the public spaces to their need to create the minimum quality of the social life. These activities form multilayers of behavioral patterns including either passive social activity such as sitting, stopping, and watching or active social activity such as chatting, gaming, and drinking.

Nevertheless, public spaces encounter serious privatization, particularly in un-designed areas based on the lacks the basic benchmarks such as the sidewalk, street furniture, and trees. In addition, the public spaces in the unplanned areas require more support through facilities, urban services, and financing for the paving, sewage, and hygiene to support the daily life of the inhabitants. Therefore, it is of great significance that designers, politicians, and developers take into consideration a dynamic approach for intervention in the mass-space proportions and the private-public relationships in upgrading, designing, and redeveloping.

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# Social capital and the spatial quality of neighborhoods: Parameters, indicators & strategies

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## Abstract

Although there is extensive literature on the issue of social capital, studies that focus on the social issues of residential neighborhoods complain about a lack of socio-physical relations in planning and design strategies. Since social capital is one of the effective paradigms for creating social sustainability, its dimensions and parameters in neighborhoods remain questionable. This study aims to propose a model for increasing social capital in residential areas and suggest strategies and design criteria based on it. With this issue in mind, the present study applies a qualitative approach. In an attempt to identify the components and indicators of social capital, this paper primarily focuses on the developments of social capital. Then based on the analysis of theoretical studies, the development of social capital indicators are defined in residential neighborhoods. As a result, the components of social capital are categorized as a) social networks, b) common values, c) norms, and d) trust. Our final four-parameter model consists of “social participation and interaction” (social dimension) and “place attachment and spatial equity” (physical dimension) based on literature review in neighborhood studies. Based on the stated parameters, planning strategies and design criteria are recommended as “creating and supporting public realm” (social interaction), “resident participating in the physical space management and construction” (social participation), “increasing the presence of citizens in public and open spaces” (place attachment), and “appropriate distribution and location of functions and amenities” (spatial equity).

## Keywords

Social capital, Residential neighborhoods, Social capital indicators, Spatial quality, Neighborhood sustainability.



## 1. Introduction

Today, the design of residential neighborhoods does not take into account the sufficient community-based approaches that affect citizens' social capital. Traditionally, "the urban neighborhood has been defined as an urban space where residents share a communal bond built upon local communities and social networks" (Mahmoudi Farahani, 2016, p.369). According to this definition, the importance of neighborhoods' social-physical structure should more than ever be considered. In other words, planners should attach more importance to social capital as a mechanism for achieving social inclusion and social cohesion (Flint & Kearns, 2006) in the structure of a neighborhood planning. Residents' failure to participate in social events, lack of local amenities and facilities, and citizens' anti-social behavior drive attention to neighborhoods with a social construction (Reiner, 2003). The gap between the environmental components and social activities in neighborhoods will ultimately lead to the lack of public-gathering and a sense of not belonging to the place. Therefore, social capital could act as a useful strategy to link social-physical factors together. The ordinary design usually neglects social capital. Furthermore, social bonds and social interactions that directly affect lifestyle and the built environment modalities have been overlooked.

Although the contemporary design policies in residential areas intend to establish residential satisfaction, assuming models for social interaction and facilitating pleasant experience (Wang & Wang, 2016), a comprehensive model of social capital in residential neighborhoods need to take practical steps in planning and design. In this study, the social capital parameters in residential neighborhoods are defined, and consequently, recognition and explanation of the design policies and strategies to improve social-physical dimensions in residential neighborhoods are considered. Moreover, according to the stated purposes, this study is aimed at taking a new look at these questions: (a) What changes have taken place in the concept of so-

cial capital over time? (b) Which components or parameters of social capital affect the physical-social construction of residential neighborhoods? And (c) What are the appropriate design criteria or strategies by the concept of social capital?

The present research applies a qualitative approach and consists of four steps; the first step focuses on the conceptual developments of social capital and its role in neighborhoods (literature review). It makes an attempt to provide a critical look into social capital as a concept and establish a logical framework. The second step is based on the analysis of the social capital theories. In this step, the social capital parameters which affect the physical and social dimensions of residential neighborhoods are elaborated. In the third step, a proposed model is offered to help form a logical structure by its linkage to the social capital dimensions and components. Finally, planning strategies and design criteria are accordingly recommended.

## 2. Social capital (background & literature review)

The origins of the term social capital go back to Hanifan (1916), who emphasized, in his discussion of community centers, the importance of community involvement revival for the continuity of democracy and development (Tavassoli & Mousavi, 2005). Hanifan emphasized the link between social capital and social relation so that social capital is considered to be hidden inside of the social relations (Ejtehad, 2007). One of the important scholars who dealt with the concept of social capital in urban sociology is Jane Jacobs (1961) in her famous book entitled 'The Death and Life of Great American Cities'. She considered social capital as a result of social networks which form some parts of residents' daily life, such as the ordinary interactions between neighbors in a region (Jacobs, 2013; Tonkiss, 2015). Following Jacobs, numerous researches measured and evaluated social capital at the neighborhood scale. For instance, in Temkin & Rohe's (1998) study, social capital was highlighted as an influencing component of neighborhood dynamics and stability. Selman (2001) in



an article entitled 'Social Capital, Sustainability, and Environmental Planning' stated that successful participatory approaches based on social capital resources might lead to neighborhood sustainability. As Bashar and Bramley (2019) evaluated, poverty and proximity of living in the neighborhood act as important factors in promoting the components of residents' social capital. One of the practical studies in this field is Butler & Robson (2001) that surveyed social capital, gentrification and neighborhood change in London. Comparing three neighborhoods in south London, they connected the improvement of institutional and environmental infrastructures to the improvement of these neighborhoods, which results in the merging of cultural and social capital together. Another study in Britain by McCulloch (2003) stated that neighborhood structural attributions, such as population density and housing stability, affect social capital. In Scotland, a study conducted by Flint & Kearns (2006) revealed that creating high-quality environments in the development and management of social housing will enhance social capital, ultimately leading to social interaction and a sense of belonging.

In addition to Britain, numerous studies were carried out in the Netherlands. The research directed by Kleinhans et al. (2007) is notable in evaluating the two restructured neighborhoods in Rotterdam. They analyzed the relations of social capital and urban regeneration in improving the physical quality of urban neighborhoods and the citizen's social well-being. Another research by Dekker (2007) identified that social capital and neighborhood attachment were effective concepts in increasing resident's participation. Ethnic diversity also tends to be important in resident participation. For instance, Vermeulen et al. (2012) in their research in Amsterdam found out that ethnic variation acted as a contributing factor to the lack of local social networks. In another research, Hoogerbrugge and Burger (2018) examined the relation between neighborhood social capital and residents' life satisfaction in Rotterdam. The results of this study indicated a significant relationship between social

cohesion and life satisfaction. The investigation on the impact of social capital on the residents' satisfaction and a positive perception of neighborhood quality by Kleinhans (2009) in two reconstructed areas showed that newcomers to the neighborhood have relatively high levels of social capital.

Considering many studies in social capital, Wood & Corti (2008) classified the relationship between social capital and the physical environment in three domains: First, Macro-level is the first category of contextual trends studying subjects, including crime, violence, neighborhood stability, and community adaptability capacity. Second, Meso-level explores the relationship between social capital and neighborhood characteristics and design, such as walkability and access to amenities. Third, Micro-level examines neighborhood-specific features to generate possibilities for social interaction, engagement in groups and activities, quality of the neighborhood and maintenance of a private and public environment, access to nature and greenery, and finally feelings of safety.

According to this classification, many papers investigated micro or macro-level issues in residents' social capital. For instance, Browning (2009) explained the downside of social capital as negotiated coexistence, property crime, and disorder in urban neighborhoods, arguing that increased network communication enhances the interaction between residents and according to studies in Chicago's neighborhoods this will reduce the impact of public monitoring and reduce crime. Kelly et al. (2010) reviewed the impact of social capital on violence. The results of their research in Mexican-American neighborhoods suggested that attention to social capital such as efficacy could improve a neighborhood's social-physical conditions. The role of citizen behavior in forming social capital was also measured. Cho and Kang (2017) pointed out that neighborhood social capital had a significant role in the behavior patterns of individuals in public or private environments. From their point of view, social capital could be achieved by the characteristics and quality of the social relationship between individuals.

The impact of environmental design factors on social capital was also discussed by researchers. For instance, Hanna et al. (2009) investigated social capital and quality of place in a small town. The results indicated that the characteristics of the spatial organization were directly related to the rise of social capital. The spatial elements can also support social capital by facilitating networks and developing the socio-economic opportunity. Mazumdar et al. (2018) identified a significant relationship between social capital and the built environment. In their survey, they concluded that the impact of neighborhood design features and the accessibility of facilities were positive on the social capital and negative on the neighborhood density. Muzayanah et al. (2020) examined the role of urban form in the formation of social capital in Indonesian cities. The results of their study indicated that the urban form could influence the parameters of social capital. They noted in the findings that in high residential density areas the level of social capital indicators was relatively low.

In addition to the aforementioned studies, Iranian scholars have also conducted many pieces of research on social capital that could be categorized into two different levels of scale: city and neighborhood. For instance, Honarvar et al. (2015) evaluated the components of social capital in the Iranian city based on the analysis of Old Persian texts. Referring to city evaluation, social networks were considered as a key component of social capital that influenced other components, so that the impact of these social networks could be observed through “inter-neighborhood links” to “reinforce cooperative norms” and “trust.” Mohseni Tabrizi & Aghamohseni (2011) in the city of Mahalat examined the role of social capital on urban development. They estimated the high level of social capital among citizens and the possibility of further urban development.

Adhami Sayadmahaleh (2014) explaining the role of public spaces and their relation to social capital. This study, conducted in the city of Amol, concludes that strengthening public spaces acts as a factor in improving the “qualitative level of social capital” and

ultimately “urban development”. Habib et al. (2013) also measured social capital in urban structures with an emphasis on public space in Tehran. The results showed that public places in the city could promote social capital in a structural and cognitive dimension. Indicators such as “feelings of security”, “trust”, “social participation”, “socialization” and “amount of interaction” can be used to evaluate social capital in the urban structure.

Barati & Yazdan Panah Shah Abadi (2016) evaluated social capital in promoting the quality of life for residents of the new City of Pardis. They emphasized the significant relationship between social capital and subjective quality of urban life. In this regard, we can point to the study of Vatankhah (2014) who emphasized the meaningful relationship between the promotion of social capital and the components of urban space quality. As well as in the neighborhood scale, Rastbin et al. (2012), in their studies in the Jolfa neighborhood in the city of Isfahan, confirmed the relationship between environmental quality components and the levels of social capital indicators.

The study by Mozaffar et al. (2013), pointed to the direct relationship between sociability and social capital. Rezazadeh & Selseleh (2010) suggested the establishment of local social and physical capital led to sustainable neighborhood development, thereby improving the quality of life of neighborhood residents. In contradiction, Alizadeh et al. (2014) found, in an analyzed case study (informal settlements, old/central, and planned neighborhoods in Sanandaj city), that high levels of social capital did not improve the environmental quality of the neighborhood.

Nevertheless, as the literature review also suggests, most studies specifically measured social capital indicators in urban planning and urban designing just by considering dimensions such as social interaction or social participation. However, there is a theoretical gap which only suggests the limited indicators of social capital in studies, whereas the scope of social capital is beyond the above-mentioned indicators. In this paper, we investigate the dimensions of social capital as a whole phenomenon.

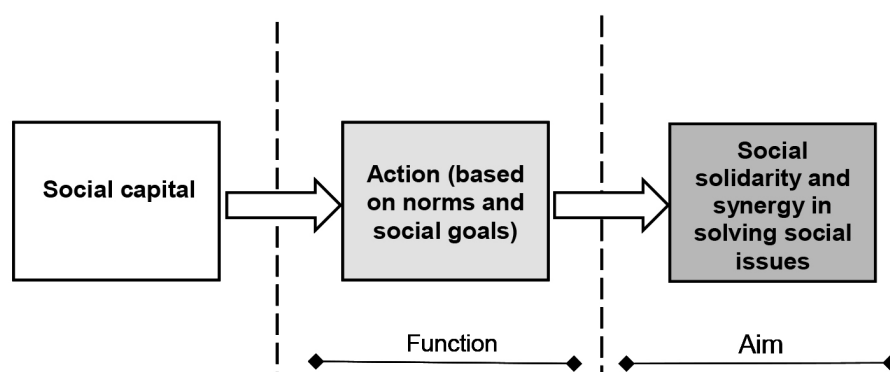


Figure 1. Aim of social capital.

### 2.1. Dimensions of social capital

Social capital is a paradigm that can combine across different disciplines and provide a framework in which the social environment characteristics of individuals are measured (McClain, 2016). Social capital is a result of communication between citizens and is, in effect, a potential that helps citizens through cooperation and participation to achieve shared goals (Stolle, 2003). In the meantime, communities will achieve desirable social goals in which factors and components of social capital are considered (Krishna, 2002).

Social capital emerges in a sustainable network of social interactions and can be defined as a change in the social structure whereby social actors will reach their goals (Rydin & Pennington, 2000; Lin, 2001b; Bridger & Alter, 2006). More specifically, the position of each individual or group in the social structure is their asset; that is, social capital (Burt, 2000 & 2005). In a prevailing conclusion, it could be stated that social capital seeks a public benefit, and it would be seen as a public good that supports targeted behavior in the community (Collier, 2002; Arneil, 2006; Fukuyama, 2007; Ejtehadi, 2007).

In general, it can be stated that social capital performance is action based on common social norms and goals, whose purpose, in principle, would be increasing synergy and solidarity among community members to solve social problems (Figure 1). In other words, social actors behave according to a purposeful action that has a collective interest and a common value, and ultimately one can expect the reproduction of social capital. Therefore, social capital has a function based on

goals and values that focus on social issues such as solidarity and synergy.

In the literature on social capital, four major approaches could be identified. The first approach refers to a critical or the Marxist subject in social capital theory, which is reflected in Bourdieu's theories. The second approach is the subject of the economic or the rational thread in social capital, which has been the subject of much discussion from Coleman's point of view. Although the third approach focuses on sociologists such as Lin and Portes, who point to the level of interaction and relationship between actors together in achieving social resources. The fourth approach is a political and democratic thread in social capital that is reflected in the writings of Putnam and Fukuyama (Grootaert et al., 2004; Lewandowski, 2008, p. 30).

Bourdieu (1980, 1986) and Coleman (1988, 1987) have more systematically introduced the term social capital. They considered social capital as a way of organizing social influences and emphasized the intangible character of social capital (Portes, 1998; Castiglione et al., 2008; Häuberer, 2011; Nanetti & Holguin, 2016).

The concept of social capital in the Coleman and Bourdieu approaches had two key dimensions. Primary is the structure of the relationship between individuals, which had been embedded in social networks and allows a person to access resources. In this frame, features of social participation becomes clear. The second considered the sources of social capital in a way that increasing access to these resources could lead to the individual benefit and ultimately improve the quality of

life (Portes, 1998; Healy & Hampshire, 2002; Arneil, 2006; Koniordos, 2008). Bourdieu considered the social capital generation based on frequent relationships of the people in social networks, which will increase the mutual recognition and awareness of each other (Koniordos, 2008). For Coleman, this relationship is shaped by the collective essence of social capital and by factors such as trust, expectations, and mutual obligations amongst individuals (Castiglione & et al., 2008; Nanetti & Holguin, 2016).

Another scholar in this field is Putnam; He considered the main purpose of the social capital concept as to strengthening social cohesion (Putnam, 2013). Putnam emphasized social networks of commonly beneficial relationships (DeFilippis, 2001). In his interpretation, networks of public engagement lead to neglecting social gaps (Putnam, 2013). Social capital due to democracy is a “civic virtue” that could be generalized to society. Social capital would be thought of as a source rooted in social networks, which was created by mechanisms such as shared norms and trust (Burt, 2005; Kayahara, 2006; Lin & Erickson, 2008; Nanetti & Holguin, 2016).

Portes (1998) claimed that the “heuristic power” of social capital comes from “consequences sociability”. Field (2013) defined social capital as the link between individuals and the importance of shared values such as trust. “The key issue here is that social capital serves as a possible resource that can increase people’s capacity for achieving their goals by ensuring the cooperation of others” (Field, 2005, p. 6).

As a quick summary, Table 1 presents some other viewpoints of the main key theorists from Marx (1916) to McClain (2016). In this table, the definitions of social capital are classified based on two structural and cognitive approaches by applying Uphoff’s (2000) division. Uphoff divided social capital into two “structural” and “cognitive” dimensions; the structural dimension refers to “relationships” and “networks” and the cognitive dimension rely on intangible mental factors such as shared values and behavioral norms (Colletta & Cullen, 2002; Groo-

taert & Bastelaer, 2002). The structural approach in Table 1 refers to the tangible features resulting from the relationships that have emerged in social networks, and the cognitive approach refers to mental elements such as values, trust, beliefs, and so on. This distinction is based on the main emphasis of key authors and theorists on the definitions given in Table 1.

Three general issues can be deduced from these definitions. First, some of the social capital definitions act as the base for achieving a collective goal, whether political, economic, or social. Second, what has changed in the definition of theorists over time is the usage of this concept as to how it can be employed to solve social problems and social development (Grootaert & Bastelaer, 2002; Dhesi, 2000; Fukuyama, 2001; Krishna, 2002). In this respect, social capital is often represented in a positive aspect. Third, social capital is a process-oriented phenomenon. Some scholars consider the formation of this process as the result of cognitive forms such as norms and trust (Donati, 2014; Fukuyama, 2001; Brehm & Rahn, 1997), while others consider it as the structural attributes of social relationships and networks (Häuberer, 2011; Woolcock & Narayanan, 2000; Rose, 1998).

## 2.2. Components of social capital

The constitution of the social capital is dependent on cultural and social context (Krishna & Shrader, 2002; Young, 2014). As such, in addition to defining the content of this concept, we need to have contextual components for measuring social capital (Lin et al., 2001). Theorists and scholars in this field have put forward several components, among which we can identify four main categories that are common in the literature review of social capital: (a) social networks, (b) shared values and norms, and (c) trust, each of which will be discussed below.

### 2.2.1. Social networks

They are the resources by which possibilities would be afforded to create social benefits (Meyerson, 1994). In fact, networks facilitate social participation and communication (Lin,



**Table 1.** *The social capital concept from the key theorists' viewpoint.*

Author/s	Year	Definition of social capital	Approach
Marx	1867	Capital in Marx's theory has a social meaning; since the production and creation of capital requires a process in which relation and social activity play a central role (Mousavi & Shiyani, 2015; Lin, 2001b; Häuberer, 2011).	Structural
Schiff	1992	Social capital can be defined as the set of elements of social structure that affect relationships among people and are inputs or arguments of the production and/or utility function (Schiff, 1992, p.160).	Structural
Burt	1992-2005	The benefits of social relationships that are achievable in the structure of social networks are defined as social capital. Burt regards social capital as the capacity available to individuals and groups that provides an opportunity to use other types of capital (Burt, 2005).	Structural
Newton	1997	Social capital may be understood and defined in terms of (a) norms and values (b) networks, or (c) consequences-voluntarily produced collective facilities and recourses (Newton, 1997, p.575).	cognition
Brehm & Rahn	1997	Social capital is an aggregate concept that has its basis in individual behavior, attitudes, and predisposition (Brehm & Rahn, 1997, p.1000).	cognition
Sandefur & Laumann	1998	The theory of social capital investment is based on advantages, rather than forms; social capital is dependent on the goals of social actors and can create the capacity to achieve individual and collective goals and interests (Sandefur & Laumann, 1998).	Structural
Rose	1998	People-to-people relationships form the core of social capital issues; social capital is the result of investing in formal and informal social networks that individuals use to allocate benefits or services (Rose, 1998).	Structural
Serageldin	1998	Social capital refers to the institutions, relationships, and norms that shape the quality and quantity of an individual's social interactions (Aguilar & Sen 2009, p.425).	Structural
World Bank	2000-2001	Social capital is a strategy to eliminate social problems and reduce poverty. The World Bank views social capital as a stimulus for economic development (Grootaert & Bastelaer, 2002).	Structural
Dhesi	2000	Social capital is largely inherited from generation to generation. It evolves through repeated interactions, which permit the buildup of trusts and norms (Dhesi, 2000, p.202).	Structural
Woolcock & Narayan	2000	Woolcock and Narayan discuss social capital in the context of economic development policy. Social capital is based on the relationship between individuals at different levels of society that enables them to act collectively (Woolcock & Narayan, 2000).	Structural
Lin	2001	Social capital is a shared asset based on individual relationships and has an interactive character that encompasses the collective benefit of individuals (Lin, 2001a; Häuberer, 2011).	Structural
Fukuyama	2001	Social capital is an "informal norm"; promoting social capital contributes to economic growth and the stability of democracy (Fukuyama, 2001).	cognition
Krishna	2002	Social capital is the potential derived from 'quality among relationships' within society and the goals of 'collective action' are reciprocal and beneficial (Krishna, 2002).	Structural
Paxton	2002	Social capital requires (1) objective associations among individuals, and (2) associations of a particular type-reciprocal, trusting, and involving positive emotion (Paxton, 2002, p.256).	Structural
Manderson	2010	Social capital has proven a strong concept in explaining the productive effects of relational and affective ties, explaining and enabling community inclusion, collective identity, and mutual support (Manderson, 2010, p.233).	Structural
Häuberer	2011	Social capital is a phenomenon resulting from social relations that depend on social structure (Häuberer, 2011).	Structural
Donati	2014	Social capital can be generated through trust, cooperation, and interaction that arises between people in society. Social capital is the product of public good relations (Donati, 2014).	cognition
McClain	2016	Social capital refers to the consideration of networks and the relationship between individuals (McClain, 2016).	Structural

2001b). Social networks are one of the main pillars of social sustainability and act as a medium for social capital transfer (Gandelsonas, 2010). Unger

and Wendersman (1985) categorized social networks created in a neighborhood as contributing to individual well-being and quality of life so that



the merging networks are the context for social interaction between neighbors in the neighborhood area (Unger & Wandersman, 1985).

### 2.2.2. Shared values and norms

Norms are the base for understanding people's behavior in their social environment (Giddens & Birdsall, 2015). Norms act according to the social structure and the interests of the individuals. In principle, the agreement of individuals on norms and values provides a common context for synergizing activities (Coleman, 1988; Graeff, 2009). In other words, shared norms provide the capacity to achieve coordinated collective action (Nanetti & Holguin, 2016). Shared values and norms in a positive sense are the acceptance of diversity and common understanding among members of society (Piran, 2013). Shared values and norms are cognitive components that can act as a bridge to social organization and social order among people. It may be argued that social capital is readily available in homogeneous societies, but the role of diversity and variety should also be clarified. Diversity can shift the behavior among social actors to a social gap and enable social groups to act so as to solve social problems. Giddens and Bardsal (2015) state that in a homogeneous society, there is a possibility of conflict between values. Cultural diversity that conflicts with shared values and norms can be seen as a factor and an opportunity to change societies.

### 2.2.3. Trust

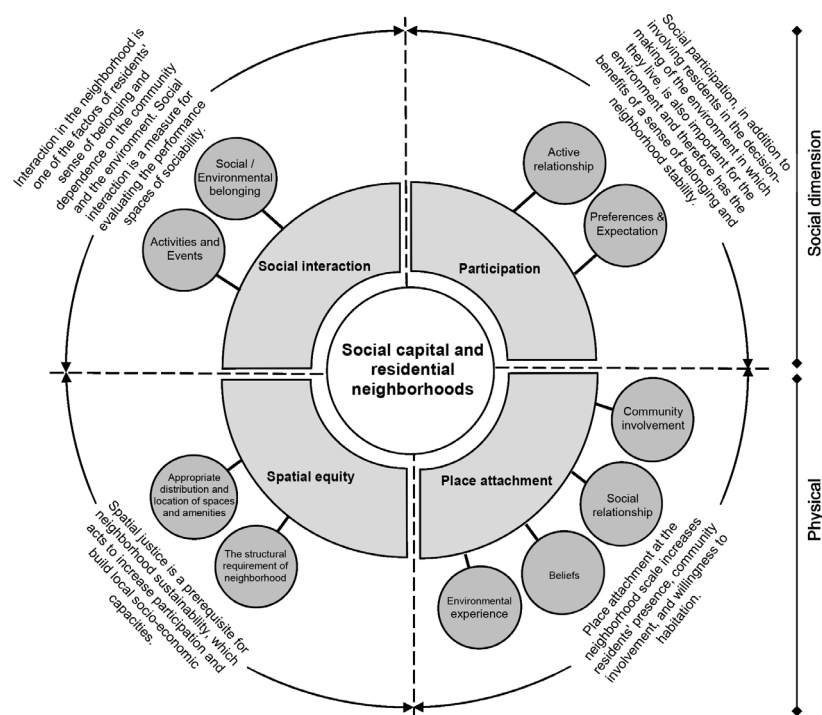
Trust is a way that people adapt to their social environment (Mironova, 2015, p.122). The high degree of trust could permit a wide variety of social relationships (Fukuyama, 1995, p.27). Trust among citizens improves when cooperation takes towards a specific goal (Ostrom & Ahn, 2009). The sense of trust connects public and private boundaries and stabilizes social relationships (Evans, 1996). In neighborhoods, the trust will provide an environment where neighbors could easily communicate with each other and behave in ways that promote beneficial social interactions (Temkin & Rohe, 1998).

## 3. A model for social capital in residential neighborhoods

The physical environment is a reflection of the actions and behavior of users, which results in place-making according to its constitutive criteria. Therefore, the concept of social capital could be considered as one of the approaches that provide a dynamic and continued interaction between the physical dimension and social aspects. Furthermore, it will bring about place-making. Figure 2 proposes a model as a solution to promote social capital in residential neighborhoods. This model can be a basic guide for researchers, professionals, and city policymakers. By using this model and adapting it in different urban environments and conditions and different cultures and climates, it is possible to achieve a base for comprehensive and holistic decisions in social capital in residential areas. The parameters presented in this model are important for the physical-social dimensions because, in the residential neighborhoods, the co-existence of these two dimensions next to each other has been neglected. In this regard, perhaps this proposed model could also be considered as a breakthrough in the design and planning of neighborhoods.

By analyzing the concepts and components of social capital and its dimensions in urban studies, four parameters, namely a) social interaction, b) social participation (social dimension), c) place attachment, and d) spatial equity (physical dimension) are presented in this suggested model. These expressed parameters somehow imply the components of social capital. For example, trust, which is one of the basic components of social capital, could be redefined in the social interactions and participation of citizens that have emerged in urban space and the public realm. Beneficial social interactions will not practically emerge without effective trust between residents. In other words, trust forms the basis for the formation of social interactions or even social participation in a joint issue that pursues the public interest.

The indicators of social capital or any social action need a context for expression, but this context must have conditions. Perhaps the component of spatial



**Figure 2.** A Model for developing social capital in residential neighborhoods.

equity and place attachment according to the criteria that will be addressed further in its definitions is the most appropriate expansion of the relationship between social-physical dimension that will achieve the reproduction of social capital in residential neighborhoods. It seems that in place attachment and spatial equity, the indicators of social capital are among the driving principles. Shared values and social relations in networks lead to the connection of people with place, and wherever the conditions are physically and socially equal and balanced for people in society, the level of this connection will increase. In fact, the intervention and preference of people in the community to improve the condition will increase due to the importance of the environment.

In the model (Figure 2), it should be stated that the social interaction component is based on social activities and events that provide a common context for residents to communicate in the environment and on the other hand, the component of social interactions will be strengthened due to the environmental and social dependence of residents in a sociable environment. It should also be noted that the component of place attachment requires the community involvement and social interaction of

people in a neighborhood. If a person's positive experiences of the environment as well as common beliefs and values of individuals shape by the place attachment, the two dimensions of participation and social interaction may also be strengthened. Ultimately, neighborhood sustainability may increase along with the mentioned dimensions.

This proposed model considers the social participation component to have two main features. The first is to establish active communication between residents and the second is the potential capacity to meet residents' preferences and expectations. These two characteristics can lead to the belonging and stability of people in the neighborhood. Through participation, residents find themselves involved in the process of improving and organizing neighborhood developments. Finally, the component of spatial equity presents the needs and expectations of residents from the environment that encompass them. The base for spatial equity is firstly the appropriate distribution of services and facilities and secondly meeting the structural requirements of the neighborhood such as public spaces, open spaces, etc. In addition to providing the above-mentioned items, this provides a context for the growth of

community involvement and social interactions, which also includes the ability to activate the economic potential of the neighborhood.

### 3.1. Social interaction

Social interaction, as a key parameter, provides the opportunity for improving the cohesion of the local communities as well as encouraging residents to come together for dynamic and participatory activities. On the one hand, the efficiency of social interactions by building a different level of neighborly relationships in “social control” and “social cohesion” has been approved (Browning, 2009). On the other hand, social interaction is an indicator of the social networks in the physical and social environment. Wherever the environmental parameters strengthen to empower the sociability of residents, there will be the possibility to upgrade any of the social capital indicators. The social relationships between neighbors increase the level of trust and help them achieve their common goals.

Social interaction is also a process of purposeful behavior of residents in a place shaped by informal everyday relationships, collective activities, and local events. The possibility of these behaviors at the neighborhood level provides the potential for local social networks to be more strengthened. It would be expected for the residents to support each other in resolving social contradictions and facilitating positive social actions. Relationships between residents in the place can develop the possibility of dependency and belong to the physical environment in which they live. It could be stated clearly that the characteristics of the place where the residents interact within would be restored in line with their needs and activities. Finally, the interactions between the residents constitute a network of relationships that lead to residents occupancy, bonding them with the place. In this respect, it is important to add the physical factors to make places more sociable, where the residents have a visit, meet, leisure and daily activities. Social interactions play a central role in place making, both affecting and influencing the conditions of the place.

### 3.2. Participation

Participation is a factor in the development of neighbors' communication so that active communication could be considered as a participation measurement. Social participation enables people to trust the environment in a sustainable network of relationships. Residents' participation in shaping the public and semi-private spaces of the neighborhood is a mechanism that can manage the preservation and verification of these places. Participation is a key factor in the evolution of public spaces (Hoskyns, 2014).

Social participation, in addition to recovering and modifying the physical environment, will also enable residents to be more stable and sustainable. Furthermore, residents' participation in the neighborhood plays a decision-making role in constructing and shaping the physical environment. Participatory planning, designing, and policy development in the neighborhood will improve the professional's ability in achieving environmental quality simply because the participatory approach takes into account the preferences and expectations of the residents. Besides, citizens in cooperation with each other may find their expectations objectively and can be expected to have a sense of belonging to their neighborhood and wish to participate in preserving it.

### 3.3. Place attachment

Place attachment is a cognitive and behavioral relationship among the people and places (Brown et al., 2012). Desirable environmental characteristics in terms of physical and social dimensions lead to place attachment over time. The neighborhood becomes more meaningful to the inhabitants through activity and social interaction, and likewise, the connection with the place takes shape. From the viewpoint of Kleinhans et al. (2007), high levels of place attachment will indicate (re) production of social capital among residents. Local groups and community centers are factors in facilitating attachment to the place. These social networks will expand the residents' awareness and cognition of the environment (over time) and will increase the level of residents' communication.

The public realm and behavioral territory which arises at the level of a neighborhood are a clear example of individual bonding with the environment. The public realm, like open spaces, in addition to providing social benefits such as attending events and activities for individuals, strengthens the social sense among individuals (Woolley, 2003).

Indicators such as neighborhood relations, community involvement, and residential satisfaction attach the neighbors to the place. More than the physical features, the social processes define the concept of place attachment, a process that supports and revitalizes public characters in a neighborhood. Beliefs, one's mental experiences of a place, social events, collective memories of symbols and signs will indicate the overlaps of social processes in place and lead to the place attachment. The spatial organization based on cooperation will preserve and reinforce important public places. It will increase residents' level of joint actions and environmental desirability. One becomes attached to a place wherever social-physical attractions are brought together in an environment. In other words, people become attached to the place when they experience the sense of being in place and perceive the place as their own.

### 3.4. Spatial equity

Spatial justice is followed by the "social justice array", a concept that directly depends on the perceived quality of the living environment. As can be assumed from Kunzmann (1988), the goal of "spatial justice" is to have "equal access" to local service and spaces. Equal access of people to urban spaces, especially public spaces, as stated by Gehl (2015), is a democratic dimension of social sustainability. Spatial equity increases a neighborhood's "socioeconomic capacities" as well as people's social participation. Spatial equity, like participation, pursues the common expectation of its inhabitants and focuses on equitable behavior within the community. In other words, the extended users' social activities, as well as the power of public intervention (sharing expectations), would be another outline of social support. Spatial equity will guarantee

local social capital development. Spatial equity is a process-oriented term. This process shapes the neighborhood structure over time through the collaborative interaction between residents and experts. The balanced combination of services and infrastructure at the neighborhood level, in addition to absorbing population, supply the presence of residents, so the possibility of communication and environmental satisfaction will also increase. In a macro view, spatial equity, in addition to having a structural perspective, possesses a cognitive dimension. Spatial equity indirectly compares the perceptions and experiences of people from other places as opposed to the conditions in which they live. Thus, wherever the dwelling qualities are evaluated from the perspective of residents in a desirable and equitable neighborhood, spatial equity would be reflected in it.

These four mentioned parameters in general form an integrated and interconnected cycle, in which users' presence remains as bases for social relationships and social network performance. Therefore, the main structure of this model is based on organizing social processes in residential neighborhoods and tends to be a solution for promoting social capital.

As can be seen from the findings of the study so far, the key structural parameters derived from the components of social capital and social network communication have been accurately or inaccurately studied before in residential neighborhoods. It should be noted that local social networks could be supported by the creation and development of places that promote civic activities and respect the goals of residents. These parameters have a basic structure and are indistinguishable from each other in such a way that their interconnections with the design and planning goals provide neighborhood sustainability and quality of life in both physical and social dimensions.

### 4. Planning strategies and design criteria

Strategies and designing tactics based on the parameters of participation and social interaction, place attachment & spatial equity can be stated as follow:



a) The strategies of creating and strengthening a public realm to achieve social interactions should be adopted. Public realms in neighborhoods are a socialized and valuable environment in terms of establishing social relationships that create vitality in the neighborhood. Providing and emphasizing the public realm in strategies can create a two-way interaction. On the one hand, it provides an area for residents where part of their daily life takes place, and in the meantime, it is possible to solve problems related to the conditions of the neighborhood through collective interaction. On the other hand, the public realm in residential neighborhoods can serve as a gateway for the presence and communication of other people living outside the neighborhood.

According to the mentioned strategy, appropriate design criteria can be expressed to ensure social interaction. Designing open spaces in the neighborhood, connecting the public realm with the main pedestrian axis and accessible networks, forming active frontage, homogeneous mixing land-use in the neighborhood, as well as the visible public spaces, improves the sociability and security of residents in the built environment. Designing and facilitating community spaces such as neighborhood centers, local parks, playgrounds, cycling paths, sports clubs, religious buildings, etc. will also provide twenty-four-hour social activities for residents and amazingly improve the opportunity for social occasions and events.

Lack of planning for the establishment of the masses at the neighborhood level will not only create visual unity but also prevent the visibility of public spaces and ultimately the lack of effective communication between residents in a neighborhood. Therefore, the emphasis on motion sequences and visual corridors that reinforce the public realm can be design criteria that indirectly affect social interactions.

b) The strategies for residents' participation in the management and construction of physical space may target the participation component. Part of the adopted strategy refers to

the transfer of neighborhood management to its residents which addresses the concerns of residents in the care, maintenance, and improvement of public-semi-private realms and open spaces of the neighborhood, and the part has to do with the participation of residents in the construction of new physical spaces from the planning to construction stage. Each mention of these sections will increase the potential for participation between residents. As this study declared criteria, such as creating connections between designers and residents for considering their expectations and preferences in the design process, the residents' decision making about abandoned public spaces as well as developing collaborative strategies for tenants to increase the level of participation, will increase the residents' willingness to attend and habit the neighborhood.

c) The strategy should consider the place attachment parameters to increase the presence of residents in the public realm and open spaces. Public realm and open spaces are the connection point that attracts residents due to the activities defined in it. When these areas are socialized, residents' interaction and community involvement can occur, and in addition to providing satisfaction, attachment between residents and the neighborhood can be imagined over time. Applying tactics such as involving residents in the development and construction of places as well as increasing residents' relationships in public and semi-private spaces is aimed at achieving place attachment. If neighborhood programming bases its foundation on the residents' lifestyle, designing and revitalizing local landmarks, creating focal points in the neighborhood, and paying enough attention to the local architecture, then it would be possible to prepare strategies that increase the level of sense of belonging to the neighborhood.

d) The strategies for proportional distribution and location of spaces and services are crucial for spatial equity, the balance between activities and the appropriate distribution of areas and places in addition to forming the structure of a neighborhood.



It provides a suitable context for the development and growth of the other three components of social capital. Spatial equity is a mechanism for organizing the physical changes of the neighborhood and provides residents with maximum access to amenities (over time).

Planners and designers should pay more attention to set an appropriate space between public and residential zones. They should try to prepare more pedestrianizing neighborhoods, linking pedestrian networks to public spaces, provide proper access to public transport, and consider essential infrastructure and appropriate services in the physical environment design. These can all indicate a high level of spatial equity. It should be noted that even on a more limited scale, spatial equity would be achieved by creating retail outlets such as coffee shops and street shops in the neighborhood. In addition to meeting the requirements of residents, the local economy will thrive. Furthermore, eliminating inappropriate land uses that may cause basic changes in the neighborhood in long and short periods may have a positive impact on shaping neighborhood spatial equity. Flexible spaces that provide the future development of the neighborhood, in addition to inducing a dynamic quality to the neighborhood, may be able to meet the requirements of neighborhood spatial equity over time according to the socio-economic context.

## 5. Conclusion

Social capital is a paradigm that has a public character and pursues community interests based on their goals and behavior. Trust, common norms and values, and social relations that arise through these components in social networks can be considered as sources of social capital. The richer these resources are among the members of a society, the more able individuals will be to achieve more social capital. Social capital is also a factor in social life as well as a kind of public synergy in solving social issues. Social capital may also be considered as one of the main factors in a society's urban (re)development, a capital that is built on a variety of sustainable relationships in society. Central findings of this

study support Putnam's theoretical view of creating social networks to generate social capital. Based on the structural aspect of this approach and attention to social processes in the environment, urban designers and planners can provide a framework for developing social capital. Applying the social capital approach in residential neighborhoods can be considered as a solution that, in addition to responding to social problems and dimensions, provides a capacity that has an impact on the quality of physical space.

Social capital parameters in planning and designing neighborhoods stay in line with the preferences of the residents' public interests. Access to social capital resources in neighborhoods will have outcomes such as life quality, social solidarity, and sustainability. The present study divides social capital parameters in residential neighborhoods into physical and social dimensions, including social interaction and participation (social dimension), place attachment, and spatial equity (physical dimension). The parameter of interaction and social participation in neighborhoods, in addition to strengthening the connection and stability of residents with their place, provides an opportunity for residents to meet their needs and expectations from the physical environment around them. Place attachment can be viewed as a scale that is the result of combining social-physical processes side by side. In other words, social attractions and activities along with environmental characteristics connect people with place. But spatial equity in the proposed model is regarded as a key parameter that achieves socio-economic potentials in residential neighborhoods. In fact, spatial equity provides adequate access for all residents to the spaces and services required by the neighborhood.

It should be noted that urban studies researchers have more seen the parameter of interaction and participation to achieve social capital, and they have less dealt with place attachment and spatial equity. However, in this study, by analyzing the data from the concept of social capital and its components, the four parameters mentioned together have formed an integrated process to promote social capital, and therefore

the parameters have an internal relationship with each other. The proposed model can be considered in two ways. First, this model provides a better understanding of the concept of social capital and its promotion in residential neighborhoods. Second, given its parameters, the proposed model can be a structural solution to eliminate the physical-social deficit of residential areas. It can be clearly stated that each of these parameters is directly related to the elements of social capital (social networks, common values and norms, and trust). Therefore, it should be emphasized that raising the level of each indicator means developing social capital. The model of social capital introduced in this research is also based on these four main pillars and can be a basic premise for theoretical and practical work. As it is obvious, measuring each of the parameters is required to examine it directly in the cultural, social and physical context of residential neighborhoods because the conditions of each context to strengthen and use social capital indicators will be different.

Therefore, further studies focusing on these parameters may employ the concept of social capital and its impact on the physical environment and can measure and evaluate neighborhood satisfaction. Considering the challenges that arise at the community level is likely to further highlight the concept of social capital and its parameters. For instance, the current pandemic of the coronavirus (Covid-19), affecting urban spaces, social interactions, individual social distance and in general residence lifestyles especially in neighborhoods and communities is one of the most important issues in social capital studies in years ahead. Perhaps it is critical that the concept of social capital and its parameters be revised or manipulated to suggest a more practical solution in future.

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# Green roofs under hot and dry climate in south-west of Algeria: Study of the implementation conditions

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## Abstract

The Algerian Sahara occupies over 80% of the Algerian surface. Green roofs and facades will contribute to transforming the desert into ecological green cities. This work addresses the possibility of realization of such green buildings under the climatic conditions of the Saharan cities of Algeria by highlighting the need for gray water irrigation in order to overcome the water problem in these arid regions. A collection of different native and non-native plants that can be planted in hot arid climate by carrying out bibliographic research on their applications in other regions and climates is presented. *Carpobrotus acinaciformis* is the most recommended, among the succulent species plants, for its great success in the study area. Regarding herbaceous plants, the basil, rosemary and canna are best adapted to the harsh climatic conditions. A chemical analysis of grey-water was conducted to examine the feasibility of reusing generated water from domestic activities. The results show that slaked lime can be added to purify water, and filtration on sand is recommended. Furthermore, simulations were carried out using TRNSYS to analyze the cooling effect of green roofs and facades compared to conventional roofs. The results show that green roofs help significantly in decreasing the number of hours of discomfort and the cooling energy use compared to the green facades.

## Keywords

Desert plants, Green roofs, Greywater, Hot and dry climate, Simulation.

## 1. Introduction

The building sector is a great contributor to global energy consumption; it is responsible for approximately 40% of the total annual world consumption. The massive magnitude of energy consumption in buildings is for cooling and heating (Tushar, Bhuiyan, Sandanayake, & Zhang, 2019). Building envelopes are one of the most challenging and interdisciplinary components of a building (Perini & Rosasco, 2016). An efficiently designed building envelope improves comfort and reduces energy needs. In recent decades, green roofs are widely built in several countries around the world as an innovative concept that increases the sustainability of buildings and cities. Previous studies have shown the role of these vegetated envelopes in the improvement of building energy efficiency (Jim, 2014), the mitigation of urban heat island effect in sequester carbon dioxide and reduction of air pollution [(Perini, Ottel , Giulini, Magliocco, & Roccotiello, 2017) ; (Nagase & Dunnett, 2013)], aesthetics reactions (Jungels, Rakow, Allred, & Skelly, 2013), enhancement of the biodiversity and reduction of habitat losses (Coma et al., 2017) and decrease urban noise pollution ((Jungels et al., 2013); (Coma et al., 2017)). In addition to the aesthetic impact on the urban landscape, green roof systems also called an ‘eco-roof’ or roof garden are an impressive remedy for creation of more green areas. Numerous investigations have studied the performance of vegetated buildings in different climate zones. Some authors have shown the effectiveness of the green roof in hot summer in the Mediterranean climate (Cristina M. Silva, Gomes, & Silva, 2016); (Cristina Matos Silva, Flores-Colen, & Coelho, 2015)). However, other authors have indicated that the effect of these envelopes is more significant on heat flux in summer than in winter, a conclusion that was also proved by (Cristina M. Silva et al., 2016) for mild climate (Cristina Matos Silva et al., 2015). The most important points in all these results is that the impact of these green roofs on the heating and cooling needs and on the variation of

the temperature varies with the season, the region, and the climate ((Jaffal, Ouldboukhitine, & Belarbi, 2012); (Coma et al., 2017)).

Water is an essential element in the success of vegetated envelopes; for this reason, xeriscape landscaping and xeriscape plants, which require less water and maintenance, have been successful recently. Some studies are focused on the presentation of plants which can intervene in these designs for certain regions (Sari & Kara ah, 2015).

The use of green roofs will depend on the properties of the plant and substrate in hot and dry climates. In fact, extreme heat requires the use of plants with certain properties, especially species with high leaf succulence and low water use, in order to survive these difficult conditions. Southern Algeria covers approximately 84 % of the Algerian surface. It is characterized by a harsh climate, low annual rainfall, water scarcity, and a hot weather. One of the problems that face Southern people is water deficiency. By integrating the “green roof”, energy consumption in building will be reduced. Moreover, they will contribute to the preservation of the Saharan natural ecosystems by creating more green areas and giving an aesthetic touch to the urban landscapes. Further, using greywater as an irrigation source for the realization of these green envelopes is considered as great way for sustainable development and an important strategy in the sustainable water management schemes in this water-stressed region. Some researchers demonstrate that it is safe to use lightly treated greywater for irrigation ( (Pinto, Maheshwari, & Grewal, 2010). However, (Rodda, Salukazana, Jackson, & Smith, 2011) indicate in their investigation that greywater gives a potential source of water for household crop irrigation which additionally shows some fertilizer properties, but its use requires more precaution due to its disadvantage which is present in salt and metal accumulation in irrigated soils over time, in addition to an increase in sodium and metal concentrations in crops.

This work is an exploratory search for solutions to realize green roofs in the Saharan climate such as the climate of Bechar.

This study was initiated for three purposes:

- To collect the different plants species that can be implemented in the vegetated envelope as well as those that can be applied in the green roofs and which survive in the hot dry climatic conditions.
- To support the development of greywater irrigation initiatives.
- To analyse and assess the effect of vegetated roofs and walls on the dynamic thermal behaviour of the building. Besides, this investigation is carried out during the cooling and heating periods using TRNSYS.

## 2. Methodology

First, a selection of different plants that can grow on the roofs of buildings in regions with hot and dry climates is presented through a bibliographic review. Afterwards, and given the aridity of the climate in the studied area, gray water irrigation is proposed as a solution, testing by chemical analysis the possibility of using this water without risk. Finally, a numerical simulation with the TRNSYS software coupled with COMIS was established in order to verify the impact of green walls and roofs on the thermal comfort and the energy consumption of the building in the studied area.

## 3. Which vegetation on the roofs?

Saharan flora appears to be very scarce when comparing the small number of species that live in this desert to the large surface it covers. Some authors collected plants adapted to hot and dry climates and that can be applied to green roof. However, these plants cannot be adapted to all the climates in the world. Species from one part of the world may not be suitable for other regions if climates differ.

The success of the green envelope depends essentially on the growing medium (substrate) and on vegetation that constitutes it, on the orientation of the building and weather conditions. Several studies have recommended evergreen and native plants for an extended life of green roof ((Tran et al., 2019); (Schindler, Blaustein, Vasl, Kadas, & Seifan, 2019)). Indeed, for southern Algeria with its hot and dry climate, these conditions trigger plant mortality.

### 3.1. Plants for roofs realization

According to our literature search, green roof studies that were carried out in hot and dry climates are less important compared to other climates (Kazemi & Mohorko, 2017). Australia has taken the lion's share in these studies (Du, Arndt, & Farrell, 2019; Rayner, Farrell, Raynor, Murphy, & Williams, 2016). However, no work dealing with the behavior of plants in the Algerian Saharan region has been carried out.

First, Botanists were consulted to list the plant species that can grow on the roofs in hot dry climates. Then, a bibliographic research on the studies already made using these plants was also performed. The main conclusion is that the choice of these plants is based on several parameters:

- high lifespan,
- rapid coverage,
- ability to self-sustain,
- grow aggressively (not invasive),
- store water.

For existing buildings, it is preferable to use extensive green roofs that are lightweight systems to avoid any increase in the structural load of the building. Plants with relatively shallow roots is very recommended.

Succulents are the most suitable for hot and dry climates, as drought-tolerant plants since they are low consumers of water, more than their large capacity to store water in their leaves (Rayner et al., 2016).

Sedum species are the most appropriate due to their wide use around the world in the extensive green roof installations, and due to their shallow root system (MacIvor & Lundholm, 2011). They are not invasive and may grow well in shallow and dry substrates, where most other species cannot survive.

Among the sedum species, sedum sediforme has been the subject of several studies (Bevilacqua et al., 2015; Coma et al., 2017; Azeñas et al., 2018; Dirks et al., 2016) who has shown the adaptation of this kind of succulent to hot and dry conditions of summer. In Algeria, Sedum sediforme is very common in the Algerian Tell as well as in the Aurès massif. (Nektarios et al., 2015) examined the effect of substrate depth on sedum sediforme growth. Their results show that even with a depth of 7.5 cm



these plants can be used successfully in the Mediterranean climate but require irrigation. However, (Rowe, Getter, & Durhman, 2012) have shown that this species can survive no more than two years for a depth of 5cm in a humid continental climate in Michigan. (VanWoert et al., 2005) have shown that some genotypes of this plant can withstand minimal or no irrigation. This plant can survive without irrigation for 14 days as demonstrated by (Nektarios et al., 2015). In addition, (Van Mechelen, Dutoit, & Hermey, 2014) indicated that sedum sediform increases the insulation capacity of the roof to more than 82%. A similar result was provided by the work of (Coma et al., 2017) under dry Mediterranean continental climate.

*Sedum Rubens*: is an annual plant of the family Crassulaceae of 3-12 cm, this plant grows in the Algerian Tell. No work that integrated it into a green roof was found.

*Sedum acre*: Perennial plant of 4-8 cm. (Vahdati, Tehranifar, & Kazemi, 2017) examined its planting in green roof in Mached in Iran. On the other hand, (Rowe et al., 2012) studied the effect of substrate depth of green roof on more than 24 succulents. Sedum acre was able to maintain from 4 to 7 years and survive in a depth of 2.5cm in Michigan. Additionally, it was able to resist without water for 10 days in the hot and dry climate of Melbourne in Australia (Farrell, Mitchell, Szota, Rayner, & Williams, 2012). This plant has stronger stem, larger flowers and yellowish leaves in Algeria, much larger than the one being planted in Europe.

*Sedum caeruleum* L. Crassulaceae, Saxifragales: is very common in the Algerian Tell as well as in the Aurès massif. It is found on rocky slabs and rockeries.

*Aloe vera* is famous as herbal medicine. This plant is widely used in the study area especially for a decor. Yet, there are no previous studies on it. However, (Jalali, 2011) recommended it in green roof for Dubai climate. The plant contributes to the reduction of air pollution as it was mentioned in the work of (Tan & Sia, 2005).

*Carpobrotus acinaciformis*: or "Witch's Claw"; is widely used in the study area for decor and gardening. It survives for years and supports the great

wave of heat. No previous work has been done before; however (Razzaghmanesh, Beecham, & Kazemi, 2014) examined *Carpobrotus rossii* a plant of the same family as '*Carpobrotus acinaciformis*' that grow in southern Australia. Their result shows that this species is resistant to hot and dry climate, it also has given a large horizontal extension of the cover. (Vahdati et al., 2017) studied another species of the same family "*Carpobrotus edulis*". According to them, it is a good choice for hot climate of summer in Mashhad, because it has a good resistance even for most stressful months.

*Prickly pear (Opuntia ficus-indica)*: This plant is well adapted to the hot and dry climate. This perennial plant, persistent type can reach up to 3 to 5m. Previous studies have shown that the integration of taller plants on green roofs could be a strategy for optimizing green roofs. Higher plants better reduce the temperature in the substrate (Sailor, 2008).

*Sansevieria trifasciata*: is a subtropical species of succulents. It has an anti-pollution ability to clean the air by eliminating the fumes of toxic substances. The original plant of Africa can reach 170 cm. it grows well in the south-east of Algeria. While in the south west, its use is limited to decoration. In literature, and for its integration in green roof, (Lin & Lin, 2011) illustrated that this species is drought-resistant and offers good coverage of extensive green roofs with large areas. The authors conducted their study in a tropical climate of the south of Taiwan. Although no study has been carried out on this plant in dry areas, the success of this plant in the hot and dry climate in Biskra city (south-east Algeria) encourages its use in extensive green roof throughout the south of Algeria.

*Aptenia cordifolia*: a small perennial plant with succulent foliage. It grows very quickly and carpets large areas. This species can withstand extreme heat, cold, and salinity. This plant has been tested in the work of (Schweitzer & Erell, 2014) in Tel Aviv. Their results showed that this plant can undergo long dry periods, its good contribution to reducing the temperature of the building thanks to its good cover of the roof and it requires less irrigation.



### 3.2. Herbaceous plant

*Gazania rigens*: native to southern Africa about 50 cm, is well adapted to the Mediterranean climate. This species has been the subject of several studies in different climates. In Algeria, this species grows well in the Tell and some South-eastern cities.

*Sauge (Salvia)*: a native plant of the edges of the Mediterranean, but recently largely naturalized around the world (Savi et al., 2014), it grows well in southwestern Algeria, it is easy to cultivate, and it does not require enough irrigation. It has been the subject of research particularly in Italy (Savi et al., 2014); (Vaz Monteiro et al., 2017)) where the ability of this plant to increase the cooling of green buildings even in substrates of 8 to 12cm deep.

*Rosemary Rosmarinus officinalis*: it is one of the most popular plants in Algeria, able to reach up to 1 m 50 high; this perennial evergreen plant of Mediterranean origin has been acclimatized in different types of climates in the world, its lifespan is 20 years. It enjoys warm or moderately dry climates; it also showed a high survival rate, as some studies have). Under Mediterranean climates, this plant has been suitable for extensive green roof ((Jesús Sánchez-Blanco, Ferrández, Navarro, Bañón, & José Alarcón, 2004); (Coma et al., 2017)), with depth substrate of 15 cm, its root is not shallow. It requires full sun, and it resists well to drought. Its dense foliage and its hairy leave give a very good insulation to the roof and low transpiration. In Algeria, rosemary is one of seven plant species exceeding 50,000 hectares in the national territory (Zoubeidi, 2004). It grows abundantly in the Saharan regions.

*Cymbopogon citratus (Lemongrass)*: it can reach 1 meter high. No work that used it in green roof was found except (Dirks et al., 2016) who recommends it as green roofs that includes horticultural and medicinal products. According to the authors, lemongrass is recommended for hot and dry climatic conditions, water stress and salinity. In southwestern Algeria, the plant has been grown in some green garden and parks. It holds well to extreme climatic conditions according to some observers.

*Basil (Ocimum basilicum)*: it can measure 20 to 60 cm in height. Well known in Algeria and is used for repelling insects especially mosquitoes. It requires irrigation since it does not support water stress. The plant has been used by some authors as extensive green roof ((Eksi & Rowe, 2016); (Van Mechelen, Dutoit, & Hermey, 2015)) who encourage the production of food also from green roof.

*Canna*: is a tropical plant with its exuberant foliage and which can reach 0.7 m of height. No work has been found that relate green roof to this plant. However ((Fowdar, Hatt, Breen, Cook, & Deletic, 2017; Vijayaraghavan, Reddy, & Yun, 2019) conducted critical views on the quality of water from vegetative roofs, where they cited the positive effect of Canna on runoff quality. It also contributes well in the elimination of pollutants that may exist in wastewater (Fowdar et al., 2017).

*Narcissus*: Perennial herbaceous plants of the family Liliaceae. Its height varies from 10 to 40 cm. The plant presented a successful performance in the work (Nagase & Dunnett, 2013) where it was able to graft in substrate depth of 10 cm in the UK and without irrigation. It is well known in Tell and its use in green roof in southern Algeria can help add an aesthetic touch to the city.

*Marjoram*: is delicate, aromatic, fragrant and easily cultivated. It can reach 60 cm in height. (Karachaliou, Santamouris, & Pangalou, 2016); and (Papafotiou et al., 2013)) studied it under a Mediterranean climate.

*Leopoldia comosa*: Native to Southern Europe, Iran and Turkey. It reaches 20 cm. It has been cited in the work (Van Mechelen et al., 2015).

*Geranium*: is a genus of herbaceous plants of the family Geraniaceae. This species has been encountered in some studies (Nagase, Dunnett, & Choi, 2017).

*Strelitzia reginae (bird of paradise)*: It is 2 m high. Its production is important in Algeria. Algeria used it as symbol for a stamp in 1969. (Fowdar et al., 2017) examined the effect of certain ornamental plants implanted in a living wall system capable to fil-

tering greywater. The plant has given important results in eliminating certain pollutants. *Strelitzia reginae* is grown in Bechar for decor, gardening and parks.

#### 4. Greywater as an irrigation solution for green envelopes

Production of Greywater in poor areas may go down to 15-20 liters per day per person, while the inhabitants can waste tenfold of this amount (Sou, 2009).

Greywater is collectively dumped with blackwater in Bechar.

The population of Bechar in 2017 was 205'112 and the water consumed by a person was estimated by 163 l / day (D.P.S.B: Direction of the programming and the follow-up of the budget of Bechar).

Greywater analysis was performed on samples collected from house. It was disposed from sinks, shower, laundry, dishwashing and kitchen; they were collected in basins.

##### 4.1. Greywater analysis

The performed analysis and results are illustrated in Table 1. Noting that each sample was analysed in triplicate.

The conclusions that can be drawn according to Table 1 are:

- Analysed grey water is acidic (pH = 4.08) due to presence of detergents (bleach, shampoo, soap,) and surfactants. For irrigation, the pH should be increased by adding the slaked lime ( $\text{Ca}(\text{OH})_2$ ), up to the value of pH 9.5.
- The turbidity measurement gave a first indication on colloidal matter of mineral or organic origin. Sus-

pended solids are organic and mineral materials. A simple filtration with sieves up to 0.2 mm can help in reducing the turbidity and suspended matter, which could be further reduced by simple decanting.

- The conductivity values are very high (4.71 ms/cm); the limits being 1.90-2.36 ms/cm. The greywater contains mineral salts from detergents. In his thesis, (Metahri, 2012) gave a table (page 64) indicating the tolerance to the salinity of some cultivated plants (adapted from FAO, 1985). According to results in Table 1, the conductivity remains high.
- The waters of industrial effluent with high COD decrease the oxygen concentration in water, yet such water can be used for irrigation.

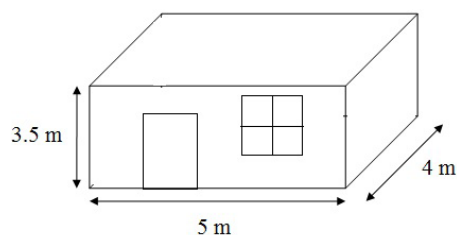
#### 5. Simulation: Impact of green roof and walls on thermal comfort and energy consumption of buildings

TRNSYS-COMIS software was applied to evaluate the impact of green roofs and facades on thermal comfort and energy consumption of buildings. A housing cell of 120 m<sup>2</sup> of space and 3.5 m high, as shown in the figure 1, built on the ground floor with a surface window of 1.2 m<sup>2</sup> and a door facing south is chosen for this study.

The rectangular shaped living cell is simulated in TRnbuild at a thermal zone, where all the multilayer walls have been defined with their heat transfer coefficients. Type 77 (the ground temperature model) was used to calculate the temperature below ground as boundary condition for the floor on solid ground. In parallel, this cell was simulated in COMIS by introducing all the coeffi-

**Table 1.** Results of the analysis of the sampled waste water.

Parameter	Devices	Method	Unity	Values obtained
pH	multi analyseur pH meter	NF T 90-008	/	4.08
Conductivity	multi paramètre pH meter	NF EN 27888	s/cm	4710
TSS (total suspended solids)	gravimetric method [77]	NF EN 872 filtre fibre verre Sartor	%	10
CAT (Complete Alkalimetric Title)	Titrimetry	NF EN ISO 9963-1	g $\text{CaCO}_3$ /l	0
COD (Chemical oxygen demand)	open reflux method [77]	NF T 90-101	mg $\text{O}_2$ /l	218,18
Turbidity	Turbidimeter 2100N IS	ISO METHOD 7027	NTU	1031



**Figure 1.** The housing cell used for the simulations.

**Table 2.** Description of the external walls and the low floor of the studied cell as well as their thermal transmission coefficients  $U$ .

Wall	Materials	Thickness(m)	U (W/m <sup>2</sup> K)
Floor on ground	Tile paving	0.020	0.864
	Concrete	0.200	
	Stones	0.400	
Wall	Internal finish	0.030	0.767
	Clay brick	0.10	
	Air gap	0.03	
	Clay brick	0.15	
	External finish	0.030	
Flat roof	Internal finish	0.030	2.487
	Flooring block	0.160	
	Mortar	0.030	

**Table 3.** Description of the green roof.

Wall	Materials	Thickness(m)	U (W/m <sup>2</sup> K)
Green roof	Internal finish	0.030	0.998
	Flooring block	0.160	
	Mortar	0.040	
	Vegetable substrate	0.120	

**Table 4.** Studied case.

Studied case	Abbreviation
Common roof, used as reference	Ref.
South wall covered with vine plants	Green S
West wall covered with vine plants	Green W
Green roof (grass)	Green R
Combination Both south wall and roof vegetized.	Green S R
Combination Both south and west walls as well as roof vegetized.	Green SWR

cients necessary for the aerologic simulation:  $C_p$  "Wind pressure coefficients" for all the direction of walls and for eight directions of wind that were calculated by  $C_p$  Generator; discharge coefficients ( $C_d$ ) and coefficient for the cracks ( $C_s$ ) of the vertical openings. The Green roof and green walls simulation was carried out using Green envelope model developed by (Rabah, 2013), this model proposed a modified thermal resistance which takes into account heat transfer and vapor transfers and their evolution according to the water availability. The model assumes the revegetation model as a system composed of two separate layers: The leaf canopy (the foliage) and the substrate considered as porous medium defined by its thickness, by its maximum water retention capacity and by its thermophysical properties which depend on its water content. The model is written in Matlab programming language and is coupled to TRNSYS. From the meteorological data and the heat flux through the building walls, it calculates the sensible heat fluxes, the latent heat fluxes and the radiative fluxes on the foliage and on the substrate surfaces.

The characteristics of the different layers of materials constituting envelope elements chosen in this work, as well as the thermal transmission coefficients. See, Table 2.

In the case of a green roof, the value of the vegetal substrate was introduced from the work of (Rabah, 2013) (Table 3).

Six cases were studied (Table 4). It has been assumed that the cell houses 7 occupants.

For the simulation of the walls, the vegetation reflects a part and absorbs the rest of the solar radiation but remains at relatively low temperature due to water evaporation.

## 6. Results and discussion

The simulation results are presented as hot and cold hours, in Table 5, corresponding to the number of hours when the operative temperature is out of the comfort range for category (III); a range satisfying 85% of residents according to EN 15251 (Figure 2). Results showed that the number of cold hours is increased when the walls are green, and reduced by a green roof.

**Table 5.** Temperature ranges, annual hours of discomfort and comfort time ratio in the free-running cell.

	Reference	vegetated cases				
		GS	G W	G R	G S R	G S W R
Max. temperature	40.7	40.5	40.4	36.3	35.9	35.6
Min. temperature	8.8	8.6	8.5	12.0	11.7	11.5
Cold hours	3133	3243	3267	3053	3222	3373
Hot hours	2081	1954	1942	1823	1614	1360
% comfortable time	40.5	40.7	40.5	44.3	44.8	46.0

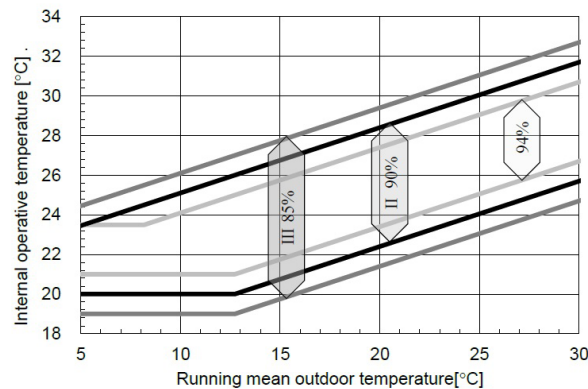
During the hot season, and for all the studied cases, the hot hours decrease with integrating plants into building. The association of the green roof with the vegetated West and South walls give the best results with 721 less hot hours and a maximum temperature reduced by 5°C compared to the base case.

The solar radiation received on a horizontal surface is greater than that on the west facade; the latter is larger than that received on a south facade.

Even when neglecting the effect of moisture transport in the studied cell envelope, the vegetation of the roof increases the minimum temperature during the winter by 3°C and decreases the maximum temperature by 4.5°C in summer. Throughout the year, the percentage of comfort time is improved by vegetating the roof but remains unchanged if only walls are vegetated.

The heating and cooling loads calculated for the reference temperatures  $T_c = 18^\circ\text{C}$  in winter and  $T_c = 28^\circ\text{C}$  in summer for the different cases, are illustrated in (Figure 2).

The Algerian rule DTR C 3-4 (Technical Report, 'Regulatory Technical Document,' 'Thermal Regulation of Residential Buildings - Calculation Rules for Heat Loss') on the dimensioning of air conditioning systems fixes domestic basic conditions. Standard comfort requires the air temperature to be  $27^\circ\text{C}$  with a relative humidity of 50 to 60% according to the duration of the stay, while for the improved comfort, the temperature drops to  $24^\circ\text{C}$  with a relative humidity of 45 to 50% according to the duration of the stay. Contrarily, article 4.4 of the DTR C3.2 (Technical Report, 'Regulatory Technical Document,' 'Thermal Regulation of Residential Buildings - Calculation



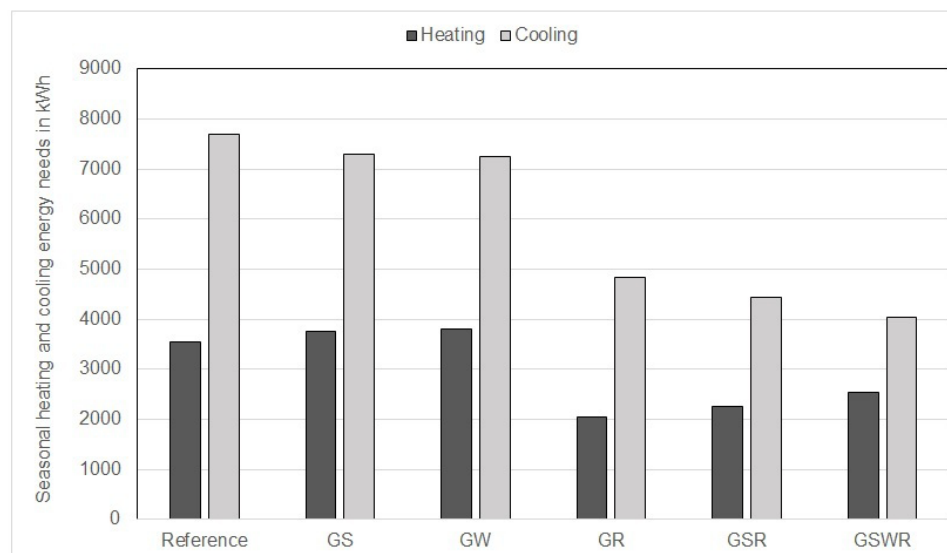
**Figure 2.** Comfort range in premises with natural ventilation according to EN 15251.

Rules for Heat Loss') gives the temperatures to consider for these calculations. It is  $21^\circ\text{C}$  in continuously occupied premises and  $18^\circ\text{C}$  for circulation areas (hallways, stairs). The comfort conditions proposed in this study are only as severe as in the industrialized countries. To reduce energy needs, acceptable but realistic comfort conditions were adopted for the simulations. It is well known that occupants of naturally ventilated space tolerate larger margin by adapting their conditions.

According to these histograms (Figure 3), the following conclusions are drawn:

- The vegetation of the south or west walls increases the energy need for heating. This is explained by the shadow created by these plants that prevents the solar rays to reach the walls of the building.
- Vegetation of the roof reduces the energy needs in winter. It gives the lowest value among the studied cases.
- The association of the green roof and green south or west wall resulted in heating needs lower than the base case but larger than the green





**Figure 3.** Heating and cooling need for the different cases.

roof. This proves the effective contribution of vegetation of the roof in the reduction of these needs.

- For the five studied cases, the cooling needs decrease with walls vegetation.
- Vegetation of the roof and the south and west walls gave the best results in the warm seasons. The calculated reduction of cooling need is more than 3600 kWh compared to the reference case.
- The roof only decreases the cooling need 6 times compared to the south or west vegetating wall.

## 7. Conclusion

Previous studies have shown the effectiveness of green roofs and walls as sustainable technologies in different climates. The question that was asked is what if these technologies can be realized in Bechar.

In this study, a variety of native and non-native plants from the southwestern region of Algeria were used. These recommended plants were selected based on two parameters:

- their adaptation to study climates by the visual observations made by the authors in the study area.
- research that examined the effect of integrations of these plants on building envelopes,

The proposed database privileges the use of succulent species particularly *Sedum sediform*, *Aloe vera* and *Carpobrotus acinaciformis* that can resist

the harsh climatic conditions. *Carpobrotus acinaciformis* is the most recommended for its great success in the study area. As for Herbaceous plant, the basil, romarain, and canna can adapt to Bechar town despite low nutrient supply, drought and strong winds especially in spring. A successful realization of green building lies in the irrigation of plants, although our choice is limited on certain plants that are drought-tolerant, irrigation remains important for long-term survival taking into consideration the scarcity of rainfall.

Greywater is proposed as an alternative water source. An analysis of the water was conducted. The water was too acidic, contained some organic load and had a very high turbidity. It was purified by adding some slaked lime and filtration on sand is recommended. Analysis of thermal and energy performance of green roofs and walls are performed with a comparison with conventional concrete roofs and walls. The results highlight the significant impact cooling energy loads of green roof compared with green walls in this climates. However, west-facing and south-facing orientations have given very similar results in energy needs and of comfort.

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# Axis of succession and axis of intention of time: Unpacking temporal dynamics of colonial space in Jerusalem

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## Abstract

The article explores the impact of colonial urban planning on the temporal dynamics of the colonized people. This is discussed using the city of East Jerusalem as a colonized city, and the area of Kufr Aqab, located within the municipal boundaries but outside the Separation Wall, as a case-study. The article argues that the use of the spatial policy of colonial urban planning affects the daily lives of the colonized people not only spatially but also temporally and in different ways. The methodology is both qualitative and quantitative, and based on Elliott Jaques's theory on the "Form of Time" taking into consideration what he identifies as the axis of succession and the axis of intention of time. These axes are reflected in the succession of time episodes as well as the intentions of the people, thus showing the effect of how the past, present and future are perceived. This is supported by quantitative analyses of a questionnaire of a sample of 284 people from Kufr Aqab in East Jerusalem. The article explains how colonial policies deeply affect the temporal dynamics of the daily lives of the colonized people, creating loops of temporal episodes that affect the essence of perception of time, its organization and management, as well as their adopted life style.

## Keywords

Colonial urban planning, Israeli checkpoints, Jerusalem, Temporal control, Time.



## 1. Introduction

For thousands of years, the concept of “time” has been a subject thought about by philosophers, physicists, and social scientists. Literature on time is therefore abundant, whether within philosophy such as Martin Heidegger’s *Being and Time* (1953), extending to other areas such as economics, physics, human rights, or social and behavioral sciences. Many have contributed to the discussion and development of its meanings and interpretations, whether about time itself or combined with the concept of “space”, as well as other concepts. Anthony Giddens, for example explained the importance of the space-time concept, not as mere containers but as constitutive features of social systems where relations between objects and events are expressed (1981: 30-1). Alfred North Whitehead also saw that events are not substantive entities but a sequence of temporal-spatial entities within a process where the character of space is emphasized through time (1926: 52). Also discussed have been time-budget studies to assess how time is used across periods and how temporal rhythms reflect the analyses of urban life, traffic, and lifestyles. Analysis of travel times between different spatial areas and nodes, and their influence on deciding the location of different facilities or amenities, has been tackled within urban studies, urban planning and urban geography (See Mir et al, 2010, and Rao and Rao 2012). Other studies have analyzed time in relation to space and movement in different parts of the world. A quantitative approach to urban analysis as an example was developed by Chen Zhong in collaboration with others to identify urban transformation in Singapore and to reveal the spatial structure of urban movements; the spatial analyses were done first and the travel records were documented to evaluate travel demand to identify urban hubs, centers and borders (Zhong et al. 2014). Also, statistical analysis of human travel has been implemented in cities such as London, Shenzhen in China, and Santiago in Chile (See Park et al 2008, Liang et al 2009, Munizaga and Palma 2012).

Space and time are often dialectical in their influence on each other. When space is developed or changed, temporal dynamics change. Thus, when urban planning strategies and tools are used, they affect the development of space and consequently the temporal dynamics in terms of perception and practice of the people who use it. In colonial settings, when urban planning is used as a spatial policy by a colonial power, the changes in urban space may be vast and therefore the influence on “time” is enormous.

This paper shall focus on “time” within the specific context of a colonial setting, and under the impact of the spatial policy of Colonial Urban Planning, in which the colonizer organizes and re-organizes spaces through its apparatus according to its own interests and at the expense of the colonized local inhabitants. Using the city of Jerusalem, the research builds on existing research that: 1) places the Palestinian-Israeli conflict in a colonial framework and regards Israeli control over the Palestinian territory, occupied in 1967 including East Jerusalem, as a form of colonialism (See for example: Rodinson 1973, Davis 2003, Veracini 2006, Pappe 2007, Halper 2008), and 2) analyzes colonial urban planning, which developed spaces of control and spaces of resistance in various parts of the world (See for example King 1976, Legg 2007, Hosagrahar 2005, Yeoh 2003, Celik 1997, Samman 2013, 2018, Rakodi 1995, Kusno 2000, Parera 1988). Such studies have developed important discussions about several variables that affect colonial urban planning. However, while these variables may have been analyzed within the broader context of the passage of time in history, none have focused on time as a distinct variable and the power to save or deplete it within a colonial framework. Thus, the broader objective of the research is to advance the understanding on how colonial urban planning impacts the temporal dynamics of the colonized.

Many studies have analyzed aspects of colonial urban planning and its impact on the control of space in the Occupied Palestinian Territory including East Jerusalem, such as Eyal Weizman’s study on the architecture of occupa-

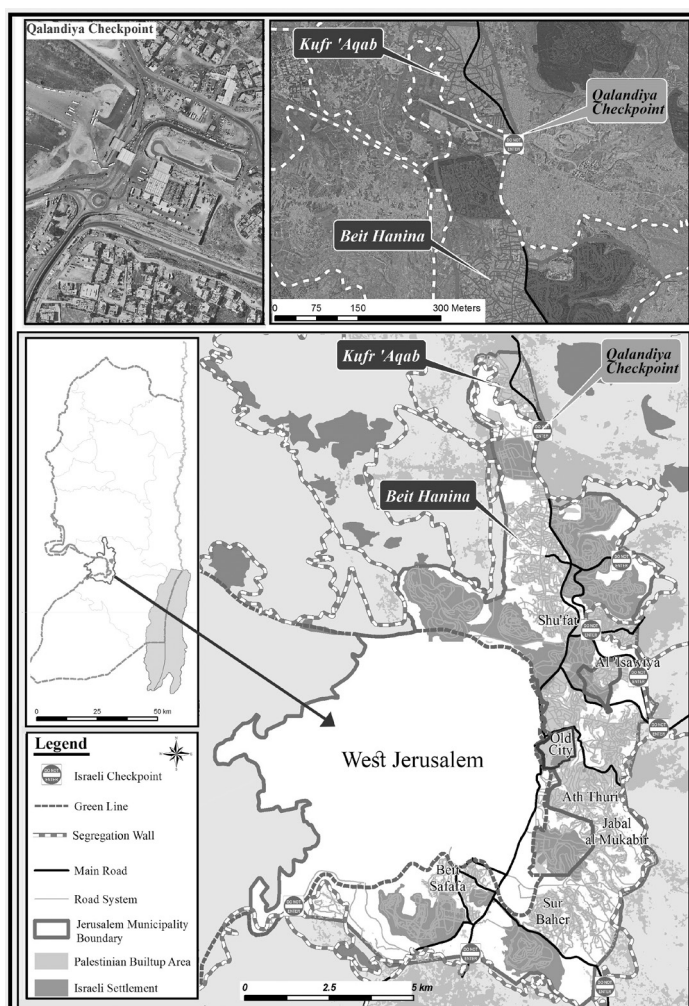


tion (Weizman 2007), Oren Yiftachel's study on settlements (Yiftachel 2003), Ray Dolphin's study on the Separation Wall (Dolphin, 2006), Nurhan Abuji-di's study on urbicide and the impact of the conflict on Palestinian urban space (Abuji-di 2014), and Saifi and Samman's study in 2019 on urbicide and housing. However, little research has been done about the colonial control of time. Jerusalem, currently under Israeli rule provides an important case study to analyze "time" as the colonial control is ongoing. This is not the case if the focus is on studying examples of past colonial situations, such as the French colony in Algiers or the British colony in Sri Lanka.

As an advanced form of colonial power, Israel has created new forms of colonization and colonial control; it has not only colonized the space and people, but also the colonized's time. The colonized's time is successive-

ly elasticized to create new elongated rhythms of daily lives of the Palestinians. The use of the spatial policy of colonial urban planning in Jerusalem has created a geopolitical map of the city in which spaces are separated and segregated and people's everyday life is controlled in different ways. The spatial policy of colonial urban planning began in the Occupied Palestinian Territory including East Jerusalem after the 1967 war, when the new boundaries of Jerusalem were demarcated to include vacant lands and to exclude populated areas. These vacant lands were gradually used for building Israeli settlements.

After 1991, this policy became more obvious when, checkpoints became an increased means of enforcing closures in the West Bank, Gaza Strip, and around East Jerusalem, thus creating fragmented areas in the occupied territory. Since 2002, this policy has been augmented by the building of the Segregation Wall, further raising the level of segregation, surveillance and control (See Figure 1). Thus, colonial urban development creeps through space incrementally and transforms the colonized's space into one that is dominated, controlled and where the colonized's everyday life is surveilled and controlled. This is part of what Jeff Halper calls creating facts on the ground as part of a matrix of control (Halper, 2008). This is the result of implanting various kinds of colonial elements, and thus enforcing a new spatial reality, whether in terms of Israeli settlements, Israeli outposts, or areas demarcated as nature reserves and later used for Israeli colonies or settlements, military outposts, security headquarters or bases. These entail confiscation of Palestinian land thus minimizing areas available for Palestinian building and growth. Various types of infrastructure such as roads, highways, and the Segregation Wall are also used to exclude and divide different urban areas. Part of the Segregation Wall runs through the northern part of the Jerusalem Ramallah main artery (See Figure 2). What used to be a four-lane road, is now a two-lane road from each side of the Wall, and has been severed by the Qalandia checkpoint (See Samman 2013: 110-123).



**Figure 1.** Map of Jerusalem showing Kufr Aqab, Qalandia Checkpoint, and the Segregation Wall.



**Figure 2.** Both sides of the main Jerusalem-Ramallah Road split by the Segregation Wall, approaching Qalandia Checkpoint.



**Figure 3.** Different viewpoints of overcrowded Kufr Aqab.

In Jerusalem, the Segregation Wall has further created outcast municipal areas like the neighborhood of Kufr Aqab which is within the municipal boundaries but outside the Segregation Wall. Consequently, residents in such areas need to pass through checkpoints, to reach other parts of the city.

Kufr Aqab is located in Jerusalem, 11 kilometers north from the Old City. It has been affected greatly by the Israeli colonial urban planning whether through Israeli settlement building, implantation of Israeli checkpoints or the construction of the Segregation Wall. It is now encircled by the Israeli

settlement of Kokhav Ya'akov, the Qalandia checkpoint, and the Segregation Wall; it has no possibility for expanding horizontally because 30.6% of the surrounding land was confiscated for the purposes of the Israeli settlement (ARIJ 2012: 15).

The Qalandia checkpoint, located in the northern part of Jerusalem, south of Kufr Aqab, is the checkpoint through which most people from Kufr Aqab have to commute daily in order to reach other areas within the municipal boundaries of Jerusalem located inside the Segregation Wall (See Figure 3). This directly affects their daily

temporal patterns because of elongated intervals of waiting-time at the check-point. The planning and management of these military crossing points have impacted how the people of Kufr Aqab perceive, manage and practice the temporal patterns of their daily life. The focus of this paper shall therefore be on the temporal aspect of the everyday life of the people living in Kufr Aqab.

## 2. Research question and methodology

The aim of this research is to discuss the impact of the spatial policy of colonial urban planning in Jerusalem on the dynamics of “time” whether in terms of succession or perception by the local Palestinian inhabitants. The objective is to contribute to the study of colonial urban planning and the role of colonial elements of control in imposing a way of life on the colonized. A specific focus shall be on the colonial impact on how time is spent, managed, and perceived. These shall be discussed using the theory of “Form of Time” introduced by Elliott Jaques (1982), which discusses the axes of succession and intention of time. The axis of succession of time entails the flow of events that could be recorded in sequence of earlier and later events, and the axis of intention of time could be explained as a slice of the axis of succession that can have a mapping of the contemporaneous past, present, and future (Jaques 1982: 103). The choice of Jaques’s theory on the form of time is based on its comprehensiveness and its potential to provide explanations of socio-political temporal dynamics.

The main research questions of this paper are: How does the spatial policy of colonial urban planning enable the depletion of accomplishment of time of the colonized? And how do local colonized residents (the Palestinians) perceive the dynamics of “time” in their everyday life?

The following sub-questions extend from the main questions:

- How does colonial urban planning affect the “time of succession” of the colonized people? What are the experiences that create elongated time “episodes” (periods)?

- How is the dimension of “time of intention” affected in the daily lives of the colonized people? And how does the checkpoint temporally affect the daily lives of the Palestinians from the area of Kufr Aqab in terms of perception and practice, and thus impact their past, present, and future?

The methodology used to discuss these questions combines quantitative and qualitative analysis. The qualitative part is based on the theory of Elliott Jaques on the “Form of Time”, specifically his proposed axis of succession and the axis of intention. Their analyses are discussed within the context of the spatial policy of colonial urban planning. The quantitative part includes fieldwork through the collection of data using questionnaires. Given the population number of Kufr Aqab being at least 48,291 (based on the Palestinian Central Bureau of Statistics, 2017), a representative sample should include 266 people (on a confidence level of 95% and margin of error of 6%). The sample, in this study exceeded this number to 284 people who were willing to participate in this survey, living in Kufr Aqab and who passed through checkpoints at least six times a week. They were asked questions about the patterns of their daily life movement and especially through the Qalandia checkpoint, their perception of time as well as their daily management of it. Two field researchers walked the streets of Kufr Aqab, knocked on doors, and asked people to participate in the survey after explaining the purpose of the research. Children participated only after obtaining their parents’ approval. The survey took place on different week days and at different times of the day, during the months of August until early December of 2018.

### 2.1. Description of sample

The sample consisted of 284 people of which 55.6% were males and 44.4% were females, ranging from the age of below 18 (teenagers) to above 65 years old. The highest percentage 33.5% was the age group between 18-25 years old. The sample had diverse educational levels: 35.2% had less than a high-school education level, and 24.6%



had a BA degree. They were also either students 26.1% (of schools, colleges, or universities), or working in different types of jobs, such as workers in Israel 31%, or employees 30.3%. Of the total respondents, 72% crossed the checkpoint on their way to work in Jerusalem, and 22% crossed the checkpoint to go to educational facilities. More than 46% used private cars while more than 49% used buses (public transportation). They had different levels of family income, and most of them (over 96%) were holders of Jerusalem Identity Cards (IDs) (See Table 1 and Table 2).

The qualitative and quantitative analyses are used to reflect on the relation between the use of colonial urban planning as a spatial policy by the colonial power and its impact on temporal dynamics of the colonized on two levels: 1) how Palestinians handle their everyday practices, and 2) how their perception of “time” is developed. The results of the research shall provide a new understanding of colonial urban planning and its impact on the colonized, not only spatially but also temporally. This in turn has wider implications on reducing inequality, making cities inclusive and promoting just and peaceful societies as stipulated

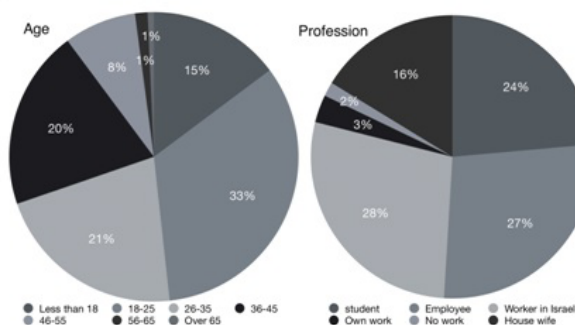
in the Sustainable Development Goals (SDGs) of the United Nations Rio de Janeiro Conference on Sustainable Development, Rio+20 in 2012 (UN, 2012).

### 3. The case of Kufr Aqab- A part of Jerusalem left behind the Segregation Wall

Kufr Aqab, located in the northern part of Jerusalem, has transformed from a village to a congested urban area over the past two decades. It is inhabited mainly by Palestinian Jerusalemites who cannot afford to rent or buy housing units in Jerusalem inside the Wall, and by married couples in which one of the spouses has a Jerusalem ID and the other has a Palestinian West Bank ID. This is because the spouse with the Palestinian ID cannot enter the Jerusalem part within the Segregation Wall without an Israeli permit. He/she cannot live inside the Wall except after going through a complicated, long procedure of “family reunification” application at the Israeli Ministry of Interior. The procedure normally takes a long period of time, often more than ten years, and even then the application could be rejected after going through different phases that might include deliberations and decisions in the Israeli courts.

**Table 1.** Description of sample.

Age		Social Status		Education Level		Profession		Number of family members		Family Income in New Israeli Shekels (NIS)	
In years	%	Description	%	Description	%	Description	%	In numbers	%	In NIS	%
Less than 18	14.8	Single	53.5	Less than high school	35.2	Student	26.1	2	2.5	2000-4999	2.8
18-25	33.5	Married	40.8	High school	23.6	Employee	30.3	3	7	5000-7999	19.4
26-35	21.5	Divorced	1.8	Diplome	15.5	Worker in Israel	31	4	17.3	8000-10999	40.5
36-45	20.1	Widowed	3.9	BA	24.6	Own work	7.4	5	23.9	11000-13999	30.3
46-55	8.1			MA	1.1	No work	3.5	6	28.5	14000-16999	5.6
56-65	1.4					Housewife	1.8	7	12.3	17000-20000	0.7
Over 65	0.7							8	6.7	Un-specified	0.7
								9-10	1.8		







**Figure 4.** Different viewpoints of Qalandia Checkpoint from within and outside the Segregation Wall.

The high increase in the number of residents of Kufr Aqab could be viewed as the outcome of various Israeli policies whether political, urban, or legal. People, who cannot live in Jerusalem within the Segregation Wall, find no other option but to live in such areas as Kufr Aqab, to fulfill the requirements of the Israeli “Center of Life Policy” – enforced on Palestinians only – to maintain their legal status as Jerusalemites and to be able to carry Jerusalem IDs (See Figure 4). This policy has been enforced by the Israeli Ministry of Interior since 1995, which requires Palestinians holding Jerusalem IDs to live within the Municipal boundaries of Jerusalem and to prove that their “center of life” is in Jerusalem. Lack of such proof exposes them to the threat of having their residency in Jerusalem revoked, and thus losing their legal status; since 1967, at least 14,500 Palestinian Jerusalemites have had their residencies revoked by the Israeli authorities (OCHA-OPT, 2017).

People living in Kufr Aqab persevere bearing the congested living conditions while under the constant threat of losing their residency, should the Israeli authorities enforce a new policy to exclude such areas behind the Wall from the Municipal boundaries to reduce the number of Jerusalemite Palestinians in the city. In fact, Israeli officials including the Israeli Prime Minister Benjamin

Netanyahu, in 2015, mentioned the idea of revoking the residency status of Palestinians living behind the Wall; they could be denied entry to Jerusalem at any entry point through the Wall when the checkpoints are closed, or when a change in their status may be imposed. Such policies and statements are in tune with the Municipality’s Master Plan for 2020 – or the Jerusalem 2000 Plan – which specifically stated the goal to reduce the percentage of the Palestinians in the city from 40% to 30%.

In 2008, the Civic Coalition for Defense of Palestinian Rights in Jerusalem in conjunction with the Engineering Center for Studies and Planning in Haifa prepared a report analyzing the Jerusalem Plan 2020. It indicated that while Israel was a signatory of the United Nations Sustainable Development Goals (SDGs) of the Rio de Janeiro Conference of 2012, it has continued to use its Jerusalem 2000 Plan as the reference to implement its discriminatory and colonial policies and practices towards Palestinians in Occupied East Jerusalem. The Jerusalem 2000 Plan has been the reference for Israeli planning authorities and the Jerusalem Municipality for drawing up master-plans for expanding illegal Israeli settlements in Occupied East Jerusalem, for restricting the issuing of building permits for Palestinians, and exacerbating the shortages and needs

of the growing Palestinian population in the city. The Jerusalem 2000 Plan set its goal to enforce a Jewish population majority of 70% in the city and to enforce the reduction of Palestinian residents in the city to a maximum of 30%. Indeed, by the end of 2017, at least a third of Palestinian homes in East Jerusalem did not have Israeli-issued building permits meaning that a potential 100,000 Palestinians still face the threat of being displaced; also, since 2000, around 1,400 Palestinian houses and structures have been demolished by the Israeli authorities (OCHA-OPT, 2017). These policies and practices contradict the SDGs goal to reduce the inequalities within countries (goal 10); they in fact maintain inequality in the city. The Jerusalem 2000 Plan furthermore contradicts the SDGs of promoting peaceful and inclusive societies for sustainable development (goal 16). Not only has the plan not taken into account the social and economic structure of the Palestinian population in East Jerusalem, but it has ignored to provide solutions to solve the Palestinian housing crisis and to advance their social and economic status in the city. Indeed, by the end of 2017, 73% of Palestinian residents in East Jerusalem and 83% of its Palestinian children were living below the Israeli-defined poverty line (OCHA-OPT, 2017). The consequences of the implementation of the Jerusalem 2000 Plan are in violation of the SDGs (goal 11) to make cities and human settlements inclusive, resilient and sustainable (UN, 2012a). Such policies and practices which aim to enhance Israeli control and presence in Occupied East Jerusalem at the expense of the Palestinian Jerusalemites, have been deemed as colonial in nature (Veracini, 2006, 86; Wolfe 2006).

Several studies have discussed the suffering of the people living in Kufr Aqab. Doaa Hammoudeh & et. al. (2016), using a methodology of 63 in-depth interviews with people living in Kufr Aqab, discussed the interconnection between the political and social contexts and their impact on the well-being and quality of life of the residents of Kufr Aqab, and especially the spouses with different legal status. Further discussion on the suffering of these spouses was discussed by Fadwa Alla-

badi and Tareq Hardan, where they focused on the legal status of these people and its impact on the choice of place of living and the suffering they encounter, especially on women (See Allabadi and Hardan 2016). Candace Graff (2014) also discussed how the political context has impacted different sectors such as infrastructure, education and health in areas of Jerusalem behind the Wall like Kufr Aqab and Shufat refugee camp and how it has negatively affected the lives of the people.

Colonial urban planning affects the people of Kufr Aqab in different ways. They have to live in this congested area which lacks possibilities of urban expansion. They have to pass through fixed checkpoint structures to pass through the Segregation Wall. According to the sample of this research, 98% of those who commute to Jerusalem go through the Qalandia checkpoint. This affects their daily lives as parents and as children who may have to commute back and forth for work or school in Jerusalem. Teachers and students are stopped and checked, delaying their arrival to schools. Moving across the Qalandia checkpoint impinges on these people in the way they regulate their daily schedules when commuting back and forth. This is because the checkpoint resembles a border crossing but within the same city, and crossing it is an uncertain journey that could be done in ten minutes or could take several hours. The uncertainty of crossing the checkpoint is part of a wider context that is affected by the spatial policy of colonial urban planning implemented by the Israeli Government by leaving such areas as Kufr Aqab behind the Segregation Wall. The impact of the checkpoint goes beyond crossing it, but encompasses the whole context of mobility before and after the checkpoint, and experiences within these spaces.

#### **4. The dynamics of the “Form of Time” in everyday life in colonized Jerusalem**

Elliott Jaques, in his book “The Form of Time” (1982), discussed the concept of time, the experience of time, and the organization of time by developing a theory based on two dimensions. He explains:

"There is the axis of succession threaded with an infinite number of discontinuous points along which can be mapped a recordable and dateable sequence of earlier and later events. Then there is the axis of intention abstractable as a single dateable slice cutting across the axis of succession, and on to which can be mapped the field of contemporaneous past, present, and future. Each of the two dimensions of time is associated with a different cognitive modality. The axis of succession is experienced in terms of the atomistic modality, characteristic of conscious focused perception of things at a distance from other things distributed earlier or later in time. The axis of intention is experienced in terms of the less discriminated field modality, characteristic of preconscious awareness and unconscious sense, without focused things, without consciously known boundaries, but with a general sense of wholeness and intention and of unconscious contemporaneous field-of-force of past, present, and future directed toward a goal" (Jaques 1982: 103).

According to Jaques's analysis, it is important to identify two dimensions of time, as one dimension would not be sufficient to analyze the external and internal temporal dynamics. One dimension would not consider the internal psychological perceptions, whether conscious or unconscious, or the social measures. Therefore the axis of intention would include the dimension of the experience, rather than only the calculation of a temporal episode (Jaques, 1982: 105, 121). The present is extensive as it has the temporal and spatial order; it includes the memory, the perception, the desire and intent. The present is lived in time-filled episodes, within a temporal frame... (Jaques 1982: 125).

Time of succession entails readings of periods of time without necessarily having a clear direction in the space or relation with past or future, but rather an abstraction of points in time - abstract reading that is expressed in clock time but not reflected in a specific meaning of the episode of time. While in the axis of succession one could read the various temporal stages within an

episode, in the axis of intention, each moment will encompass a combination of memory (past), perception (present), and desire (future) that influence how time is experienced. In the adaptation of new circumstances, the experience is constantly changing and developing as the relations between the past-present (memory), the present-present (perception), and the future-present (desire) are continually changing and developing (Jaques 1982: 121). The influence of past and future on present is evident also in the adjustment responses of "past" and "future" at the "present" moment. The perceived image of the past is adjusted and the future has a modifying affect (De Gans 1994: 339). If the moment of the present according to Jaques is filled with a living memory, living perception, and living desire and intent (Jaques 1982: 125), then how would a moment be described under a colonial setting when the time of the colonized population is continually and continuously expanding to include more moments of present within? While Jaques suggested this as a theory under normal circumstances, how does living under a colonial setting influence the axis of succession and the axis of intention in the daily lives of the colonized?

Under a colonial setting, and by implementing strategies of colonial urban planning, a new spatial order is introduced to characterize the colonized space with segregation and control. This in turn has an impact on how time is managed by the colonized population, as the spatial order would affect the mobility and achievements of tasks. When moments of present are inflated to include more moments - as new loops of moments are interjected within, the axis of succession encompasses more than was planned in terms of reading and measurement, and thus the axis of intention would have a more developing impact on the individual. When asked, 89% of the study sample of people in Kufr Aqab agreed that the city planning affected "time"; 68.3% thought that the way the city is planned, extensively affects time while 21.8% thought it affected time a little bit; 9.9% did not think that city planning affected time and time perception and management in daily life (See Table 2).

**Table 2.** Crossing checkpoint data (spatial and temporal).

Means of transportation		Crossing checkpoint per week		Time spent at checkpoint		Does city planning affect time?	
Description	%	Times per Week	%	In minute	%	Description	%
private cars	45.4	10	46.1	31-60	31.7	Yes extensively	68.3
Bus	45.1	12	18.3	61-90	44.7	Yes- A little bit	21.8
Other means	9.5	14	19	91-120	15.5	No	9.9

Means of transportation

● Private car ● Bus ● Other means

Crossing checkpoint per week

● 10 times ● 12 times ● 14 times

Time spent at checkpoint

● 31-60 min ● 61-90 min ● 91-120 min

**Table 3.** Perceptions and experiences of checkpoint.

Perception of Time lost		Making use of time while crossing checkpoint		Delays at checkpoint during previous month		Way of compensating lost time		Compensation of lost time	
In minutes per day	%	Description	%	Times per month	%	Description	%	Description	%
0-30 min per day	41.9	Yes	37.3	0-5	63.3	Compensating work hours	43	Yes	71.5
31-60 min per day	43.7	No	62.7	6-10	25.7	Study at home	15.1	No	25.7
				11-15	16	Payment of money	14.8		
				16-20	3.5	No compensation	1.1		
				21-25	1	No answer	26.1		
				26-30	0.7				

Delays at checkpoint during previous month

● 0-5 times ● 6-10 times ● 11-15 times ● 16-20 times ● 21-25 times ● 26-30 times

Way of compensating lost time

● Work hours ● Study at home ● Payment of money ● No compensation ● No answer

In Kufr Aqab, the time dimension is often violated as uncertainty is the apparent state during mobility, as with the uncertainty of achieving tasks on time during the day. Therefore, new temporal episodes are created while waiting to commute from one place to another through checkpoints, or while in traffic congestions created by the colonial urban policies which have

made Kufr Aqab a bottle neck area for Palestinian traffic from the north to the central area. This is especially the case when crossing the Qalandia checkpoint, as the study sample indicated that 98.2% move through the Qalandia checkpoint to go to Jerusalem and its environs. Most of them crossed it on a daily basis and experienced temporal episodes of waiting



to get through. In the axis of succession, the calculated number of times of crossing was ten times per week for 46.1% of the study sample, 18.3% of the sample crossed it 12 times per week, and 19% crossed it 14 times per week. While going from Kufr Aqab to Jerusalem past the Segregation Wall is supposedly a short journey within the same city which, under normal circumstances, takes less than half an hour, the temporal episodes of crossing are expanded greatly. On average, and within these journeys of daily schedule, 44.7% of the sample spent between an hour and an hour and a half (61-90 minutes) going from Kufr Aqab to cross the checkpoint; 31.7% spent between half an hour to an hour (31-60 minutes), and 15.5% spend between an hour to two hours (91-120 minutes). While returning to Kufr Aqab, 43.3% of the sample spend between half an hour to two hours (91-120 minutes), and 31% spend half an hour to an hour (31-60 minutes) (See table 2). In terms of the perception of the loss of temporal episodes, 43.7% of the study sample perceived that they lost between half an hour to an hour (31-60 minutes) every day. According to their answers, in the last month of conducting this survey, 25.7% were delayed 6-10 times, 16% were delayed 11-15 times, and 3.5% were delayed 16-20 times (See table 3).

This measurement of time does not end with the crossing, but is extended further: 71.5% of the sample needed to compensate for the time lost while commuting daily through the checkpoint into and out of the Segregation Wall. This happened to 43% of the sample who had to make up for lost time by working extra hours, or their salaries would be cut accordingly as was the case for 14.8% of the study sample. Others, 15.1%, had to spend more time studying at home because they were late for their lectures and classes. However, only over a third (37.3% of the sample) thought that they could make use of the time lost while crossing the checkpoint, but in practice most of the people (62.7%) could not use it, especially those who were driving (See Table 3).

In Kufr Aqab, it is clear that on the axis of succession episodes of time were expanded and repeated. This was because every step took much longer time than anticipated due to the closure and surveillance policies that resulted from the colonial urban planning of the area, and from the checking procedures of people crossing the checkpoint. While moments within the axis of succession encompassed the axis of intention, these were further developed and accelerated to affect the experience and the quality of time that was spent. The steps of going through the checkpoint did not only include reaching the checkpoint, getting checked and leaving it; each step encompassed new experiences and interactions with spaces and people while waiting. This does not necessarily mean that individuals were conscious of how and why these experiences are specifically developed. This is significant in the axis of intention as 72.8% of the sample expressed anger and nervousness, and 8.8% felt humiliated while crossing the checkpoint. Yet, 69.7% accepted the existence of the checkpoint as a daily reality that would not seem to change; only 29.9% thought of it as a temporary setting that would be removed one day. This could be because the sample included 48.3% individuals who were under 25 years old representing the generation that has grown up experiencing the existence of the Wall and the checkpoints and who have not seen or experienced a different setting, particularly how it looked like before the Wall, in contrast with the older generations who have experienced a time before the Segregation Wall was constructed.

How did the people of Kufr Aqab manage their daily life and how did they perceive "time"? The moments of suffering while commuting daily through the checkpoint or while managing daily tasks, were inflated thus affecting the feelings and experiences. Almost all of the people within the sample (96.8%) expressed their distress and annoyance with the successive congestion as they approached the checkpoint and when they crossed it; 15.8% of the sample explained that they had encountered specific un-

pleasant incidents at the checkpoint, such as problems with soldiers due to security suspicions, security checks, or problems with checking their documents (See Table 4).

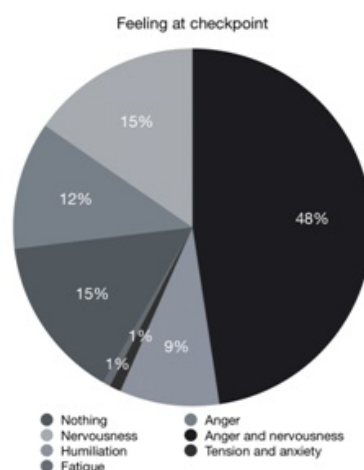
This also added to the loss of time and intensified the feelings of disturbance during the moments of crossing the checkpoint. The experiences at the checkpoint became the dominant episodes because of the intensity of the resulting distress and from the feeling of having lost time. These experiences also affected the successive temporal episodes of the day, since the individual in pursuit of the aspirations to continue with their schedule of the day, would use memories of experiences and perceptions of the personal inner, and outer worlds. Jaques explains the relation between past, present, and future and the perceptual organization of time of a person in the following quote:

“Past, present, and future are all simultaneously and continuously together as one integrated field in his mind as he orients and implements in the course of this dialing episode. They constitute the changing content of the person’s outlook mapped onto the temporal axis of intention” (Jaques 1982: 121-2).

Each episode of time influenced by colonial urban planning affected the axes of succession and intention in several ways: by having to deal with the existence of congestion and the need to pass through the Segregation Wall, and by experiencing the crossing of the checkpoint which developed additional daily experiences. These experiences developed memories that affected the development of the present-of-the-past, in the sense of directly impacting the present-of-the-present. This affected the organization of mental activity that would assess the desired present that is foreseen for the short-term or longer future. Jaques denotes: “[t]he particular organization of memory, perception, desire, and intention in each person sets the limits of personal identity and of meaning and defines the individual self” (Jaques 1982:104). Each individual differs from the other, in setting his or her goals and in the way of dealing with them in terms of temporal episodes. The mind oscillates between “an orientating stance and an implementing stance - between planning, evaluation, and direction and goal-setting, on the one hand, and

**Table 4.** *Encountering the checkpoint.*

Feeling at Checkpoint		Most annoying aspects at checkpoint		Incident at checkpoint	
Description	%	Description	%	Description	%
Nothing	14.4	Congestion	30.6	Incidents (problems with soldiers, security checks, paper problems, security doubts by soldiers ....)	15.8
Anger	11.3	Congestion and other things like: Cutting the line by others, beggars, infringing on private space, Street vendors	66.2		
Nervousness	15				
Anger and Nervousness	46.5				
Humiliation	8.8				
Tension and anxiety	1				
Fatigue	0.7				



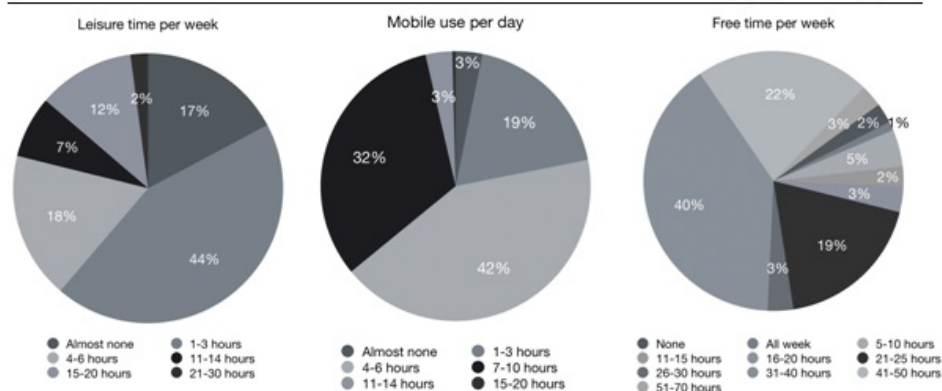
acting in the direction set and carrying out planned activity, on the other” (Jaques 1982: 104).

However, when successive disappointments are faced, and moments become stuck and expanded with further loops of moments that create new temporal episodes, the desire to accept further temporal episodes in the longer run, decreases; thus activities which encompass further mobility within the colonized space decreases. This means that people tend to reschedule their goals to other priorities that meet their basic needs and represent the most important goals. Jaques explains two aspects related to this rescheduling. The first is that our goals are not static; they are changing entities, they are often modified whether in terms of contents or targeted time of completion (Jaques 1982: 115). It could also be cancelled depending on conscious or unconscious evaluations. The second aspect is that the individual is continually making evaluations in the “context of his past experience and knowledge and in relation to his intentions” (Jaques 1982: 116). These experiences inform the present of what is to be achieved or suspended.

The results of the field work in Kufr Aqab, showed that there are trends in how time is managed and organized. Suspension and abandoning of desires and consequently setting up of goals are evident. Quality- time is therefore minimized due to experiences that are successively disappointing. This is evident in the way time is managed and used. Almost 40% of the sample had 31-40 hours of free time per week; 21.8% had 41-50 hours free per week, and 18.7% had 21-25 free hours. This meant that around 80% had between 21 and 50 free hours per week spent mostly at home. This indicated that there was a kind of retraction from exposing oneself to disappointments. When asked about leisure time, 17.2% of the sample had no, or almost no, time allocated for leisure per week, and 44% had one to three hours per week only. This means that over 50% had three or fewer hours for leisure per week. Also, 62.3% of the study sample spent no more than three hours per week for socializing and visiting relatives; 10.5% even allocated none or almost no time for visiting relatives even from the immediate nuclear family. People tended to spend more time at home and spent

**Table 5.** Utilization and amount of free time.

Leisure time per week		Visiting relatives per week		Mobile use per day		Free time per week	
In hours	%	In hours	%	In hours	%	In hours	%
Almost none	17.2	Almost none	10.5	None or very little	3.2	None	2.5
1-3 hours	44	1-3 hours	62.3	1-3 hours	18.7	All the week	1.1
4-6 hours	17.6	4-6 hours	16.5	4-6 hours	42.3	5-10	4.6
11-14 hours	7.4	7-10 hours	7.4	7-10	32.4	11-15	2.5
15-20 hours	11.6	11-14	0.7	11-14	3.2	16-20	3.2
21-30 hours	2.1	15-20	2.1	15-20	0.4	21-25	18.7
						26-30	3.2
						31-40	39.8
						41-50	21.8
						51-70	2.8



hours navigating their mobiles; 42.3% spent four to six hours per day, while 32.4% spent seven to ten hours. This means that almost 75% spent between four to seven hours on their mobiles (See Table 5).

So despite the abundance of free time, there was no desire to achieve quality time, or recreation because the memories and experiences created by exposure to mobility in the colonized space, affected the past-present, the present-present, and the anticipated-future. Consequently, desires were reevaluated, changed, and goals were deviated. This also was an indication of the deep frustration from the difficulty encountered to achieve quality and recreation time.

## 5. Conclusion

The article has shown that changing and re-changing decisions of everyday life, within a representative sample of the inhabitants of Kufr Aqab was reflective of how the colonial setting deeply affected the lives of the colonized people. On the one hand, the present was affected by the past and perceived future, and thus affected decisions of the moments of the present that cumulatively changed the perception of time and consequently changed the goals to adapt to circumstances and the decisions of everyday activities. On the other hand, these cumulatively affected or changed the lifestyle of the individual.

While other colonial studies have discussed how colonial urban planning affected the colonized people, the temporal aspect was missing. This article delved within the temporal aspect to show how the present is affected by analyzing the internal and external social and psychological aspects within the individuals, thus adding a new analytical dimension to colonial urban studies.

Through the case of Kufr Aqab, the article showed how Israeli colonial urban planning has created a geopolitical map in Jerusalem with spaces of separation and segregation that have affected the daily lives of the Palestinians. Through the use of Elliotte Jaques's Axes of Succession and Intention, the article showed that the impacts of Israeli policies on the temporal dynamics of Palestinians were great, if not quite

significant. It was not only the succession of elongated periods of time that were lost while pursuing daily mobility to work, education and other important needs, but also daily lifestyle practices were changed due to the intensity of the events experienced. What culminated was a change in the essence of the perception of time.

The results of the research are important at least on three levels: On the Palestinian level, the research articulates the aspects of colonial control that need to be addressed and factored into re-claiming agency in countering policies implementing a unilateral colonial version of the future. These outcomes could be used by policy-makers, human rights organizations and local communities to advocate rights against spatial and temporal colonization as well as thinking of policies and ways which factor rectifying the resulting appropriation of space and the consequent change in the perception of time and its use. On the level of action that could be taken, it is important as it provides relevant information that could be used in Palestinian alternative urban planning which could confront colonial urban planning. And, on a societal level, it provides information to increase the awareness of the local colonized population in terms of rethinking their daily temporal patterns and the potential ways of redesigning them more efficiently and effectively. Also, this could give an indication about the extent to which technology could be used to break-up the exclusive colonial control of time and space. Furthermore, the raw data produced could be used for further research on the topic of patterns of daily life and the use of time in Jerusalem and in other contexts whether in Palestine or in other countries.

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# Children's participation in built environment design: The case of "Play Without Barriers" project

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## Abstract

Since participation theory became a crucial issue in various disciplines after late 1960's, creating actual participatory processes generated an important question of debate. Today, in recent conditions the validity of urban design or local governing policies are evaluated depending on how much importance they attached to participatory approaches and social governance models. The earlier individuals start to involve participation into their lives, the more conscious they become. Therefore, participatory projects should consider the existence of youth and children in urban life and built environment design.

This paper discusses the effects of built-environment education on the young participants while introducing a brief explanation of an educational model named "Play Without Barriers" (PWB), supported by several shareholders and which is designed also as a child participation project. PWB is a long term project which expanded into three years and came up with concrete results such as a play-ground project designed by its users, children, who participated a 27 week long educational program. From the beginning of the project, the participants (children aged between 8-14) found the chance to work with all of these shareholders, represent their ideas and get involved in the whole process.

The general outline of the paper includes a literature review on the pros and cons of built environment education and participatory design, discussion of a case study (PWB) while mentioning the methods used in the education and application phases of this project, followed by a criticism of the process and declaration of the outcomes.

## Keywords

Built environment education, Participation, Urban awareness, Children and architecture.

## 1. Introduction

The built environment<sup>1</sup> depends on several dynamics such as politics, economics, design, human rights, all of which are deeply related with the discipline of architecture. As far as built environment has a multi-disciplinary context, the decisions affecting the quality of the built environment are taken by individuals from different professions. Each member of society, consciously or unconsciously, becomes determinant in the decision-making process by using his/her individual initiative. This initiative might be taken in urban management or in law-making as a legislator, as a member of an NGO or as a simple citizen in voting for urban policies or simply shaping his/her private properties. When all of these decisions come together, they form the urban quality of the built environment. Therefore, every single person, including children, ought to be aware of built-environment issues, independent of being a professional or not. It can be asserted that the quality and sustainability of the built environment depend on the public's acceptance of urban culture.

An efficient way to create awareness of the built environment is to actualize educational programs for the public about urban consciousness. This is required in order to procure ideal circumstances where each citizen fulfills his/her responsibilities about the built environment. Magliocco (2003) claims that in order to make "architecture", architectural education is not always an obligation, but the education of the public on built environment is a must. It should not be assumed that the importance of a qualified architectural education for the professionals is underestimated. But without consciousness of the public, the quality of the professionals is not enough to shape the urban environment. The quality of architectural environment is directly proportionate to the consciousness and participation of both the professionals and the users.

Built environment education<sup>2</sup>, which will be examined thoroughly in the following chapters, aims to raise consciousness on environmental issues and motivate children and youth to take active roles as responsible public

figures (Otero & Mira, 2003). In the Belgrade Charter (UNESCO, 1975), it was stated that the major target group of built environment education included pre-school, primary, secondary and higher education students as well as their teachers. One of the fastest and efficient ways to reach the entire public derives from attracting the children's attention and having them spread these facts to their social sphere. Based on this assumption, in order to constitute social benefit, different models of built environment education programs for children are being arranged all over the world by many institutions such as the Chamber of Architects, NGOs, municipalities, universities, museums, art institutions and private initiatives.

Built environment education also has crucial importance in involving the citizens into the urban decision taking processes through public participation. There are many aspects of participation. In the scope of this paper the educational benefits of the participatory process will be examined. The case study discussed in this essay is called "Play Without Barriers" (PWB). It is developed as a voluntary-based urban school aiming to create consciousness of the built environment and inclusion of young people into the development of their living environments. The content and the methodology of the educational schedule are briefly explained in the following chapters and in the conclusion; the qualitative outcomes of the project are evaluated.

## 2. Literature review

PWB Project, which is examined within the scope of this article, aims to develop the urban consciousness of the participants provided by a long-term educational program. Raising the urban awareness of the participants, they are expected to work in collaboration with the other actors taking place in the design process of the urban environment. The final result of this collaboration is expected to be a concrete design product that will be a part of the urban image. Being a part of this design process requires a satisfactory level of knowledge on these issues. Therefore, in order to determine the accurate methodology of the PWB Project, the



literature review was focused on two main topics. The first of these topics was “built environment education”, and the second was “children participation in built environment”, which is a necessity for supplying proper background for conscious participation.

### 2.1. Built environment education (B.E.E.)

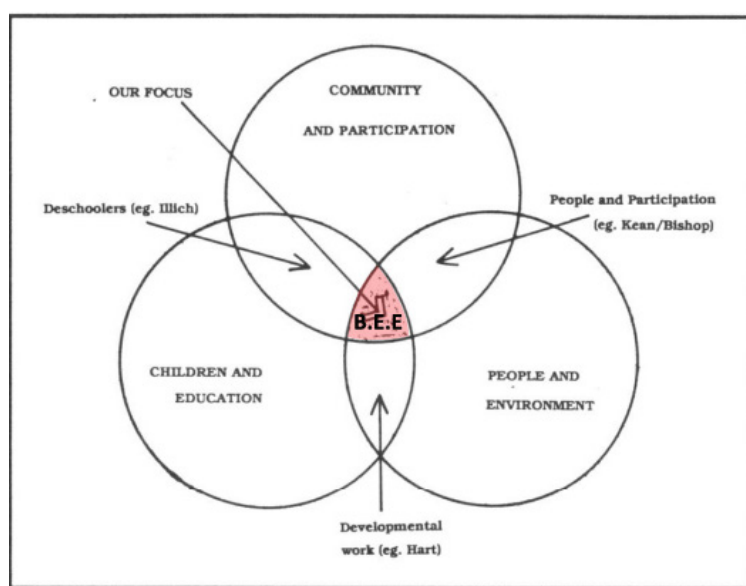
The evolution of the concept of “built environment education” is parallel with the participation theory examined in the previous section. The current social and political conjuncture has caused new concepts, needs and interests to be shared on the social platform. The polyphonic and interdisciplinary approach which has transformed most of the disciplines in 1970’s was also effective in built environment education. In this period, both artistic and scientific methods have changed, and interactive systems have started to be applied in all fields. Many professionals have started to define their professional identity through their relationship with other disciplines, creating an environment for interesting cross-sections. The intensification of interdisciplinary studies has also accelerated the development of built environmental education models.

Social transformation in the 1970s, the “citizen rights” of the individual, the importance of local policies and the fact that the citizen became an ef-

fective figure in the determination of local policies also brought a new opening to built environment education in terms of “participatory democracy”. With the development of social policies, the user became a more active figure in the formation of architectural and urban space, and this has necessitated him to take part in these design processes. Therefore, the fact that the user became a partner in these critical decisions has created the need for environmental awareness and built environment education has become an inevitable necessity for the formation of qualified urban spaces and living environments.

The basic framework of built environment education was developed in the Belgrade Conference on Environmental Education (1975) and the Tbilisi Intergovernmental Conference on Environmental Education (1977). The common point of the publications published at the end of these two conferences is the subject of each individual’s right to create a respectful stance towards the environment by equipping them with the necessary knowledge, skills and awareness. The aim of environmental education is to turn students into active citizens who are part of a democratic society (Otero & Mira, 2003).

Built environment education brings together many social factors due to its scope and method. Creating environmental sensitivity, enriching the educational content using different tools, completing the areas missing in the conventional education curriculum, and ensuring that a person exists as an active citizen in social life and acquiring a participatory identity in the decisions affecting his own life are among the basic objectives of built environment education. Built environmental education stands at the intersection point of these objectives, which we can collect under three main topics: environment, education and participation. Bishop, Adams and Keen (1992) expressed the intellectual scheme of the built environment education they define in the relations of “society and participation”, “children and education”, “human and environment” with a cluster diagram (Figure 1).



**Figure 1.** Interaction of fields in B.E.E. (Bishop, Adams and Keen, 1992).

Horelli (1997) mentions the importance of the existence of multi-stakeholders in built environment education. This is directly related with the participatory nature of B.E.E. The inclusion of various disciplines in the educational process, increases the quality of the educational schedule. Horelli also asserts that the least recognized one of 3P (Provision, Protection, Participation) formula which was mentioned in UN Convention of Rights of the Child is “participation”. Therefore, a functional B.E.E. program should put the participatory approach forward. Because as Horelli refers from Alanen (1997) and Valantine (1997) *“the new sociology of childhood regards children as social actors and interactive agents who engage with people, institutions and ideologies, and who forge a place for themselves in their social worlds”*.

Sutton and Kemp (2002) emphasize that built environment education, which implemented with a participatory approach, is beneficial in the development of the child’s creative thinking, aesthetic judgment, awareness of social inequalities, social communication skills and ability to design change. As a result of the application of the products of B.E.E activities, the children can also find the opportunity to balance the dominance of adults on the built environment. Because almost all of the places where children carry out activities that shape their social lives are shaped according to the decisions made by adults.

If the education process has an operational quality in itself, this will contribute to the formation of environmental awareness. If the student / participant can also have an influence in deciding on the scope and method of the schedule, and if the outcome of the educational program is aimed to solve an actual problem, this process might be described as an “action” (Jensen and Schnack, 1997).

B.E.E. Programs have been carried out for long years in many countries through various channels. These training programs include short and long-term trainings of architectural associations through volunteer architects, studies organized by non-governmental organizations, programs organized by municipalities, projects carried out with

a university partnership, programs run by various museums and art institutions, workshops organized by private institutions and individuals.

These programs have some subjective qualities required by the conditions they are in, but they meet at a number of common points (Arin, 2018). According to this:

- The creation of sustainable, qualified living environments is possible by creating social awareness about the built environment. Achieving this goal in the long term is possible with B.E.E. programs to be provided from an early age.
- B.E.E. programs for children make it possible to reach larger masses by reaching their families and close environments.
- The discipline of architecture has a wide educational potential due to its rich content. B.E.E. programs for children can be used as a tool to create environmental awareness as well as supporting the courses in primary and secondary education curricula.
- B.E.E. programs contribute to the development of the participants’ skills of creativity, experimentation, thinking in three dimensions, developing visual memory, using different expression techniques, and establishing interdisciplinary relationships. In addition, it provides an environment for them to improve their social communication and self-expression skills.
- B.E.E. programs encourage individuals to gain an active citizen identity starting from an early age.

Considering all these factors, the dissemination of B.E.E. models as an informal education system that supports formal education is important for the establishment of active citizenship awareness, the development of urban culture and the creation of qualified living environments.

## 2.2. Children participation in built environment

In her frequently referred article, Arnstein (1969) states that “the idea of citizen participation is a little like eating spinach: no one is against it in principle because it is good for you”. In most cases participatory projects are

praised as they are reflections of democratic culture, and these projects are supported by institutions holding power mechanisms. But the main dilemma is whether this support is sincere or a pseudo attempt chosen by authorities in order to polish their images. The real citizen participation projects force the authorities to share their power with the participants. If the authorities tend to stay in their comfort zone and prevent from sharing their power to decide; the participatory projects stay on the “pseudo” side, which are defined as non-participation and tokenism in Arnstein’s ladder. When “children participation” is the subject of discussion, the administrators’ attitude becomes even more mimicking. As far as children are generally considered incapable of making decisions on their own behalf, the general inclination in children projects is working for children, rather than working with them. Hart (1997) adapted Arnstein’s ladder into children participation, and there is a similar segregation between participation and non-participation.

Built environment education is directly related with the urban culture and the city which is the collective production of the urban dwellers. According to Harvey (2012), the right to the city is the urban dweller’s right to reinvent and reshape the city according to his/her needs and wishes. But this right is a collective right, not an individual one. The urban dweller should be aware of the fact that the city does not belong to an individual, but to the whole society.

Awakening urban consciousness is only possible by promoting the values of the built environment at the early stages of human life. Built environment awareness becomes a part of the natural flow of life, only in case the child grows up with these values. But there is a general tendency to exclude children from built environment decisions, even though their lives are directly affected by them. As in many other fields, adults are making decisions about the built environment on behalf of children. But having a voice in the shaping process of his/her own built environment independent from the individual’s age, gender, race is an issue that should be

evaluated in the frame of civic rights (Hart, 1997; UNICEF, 1989). From this perspective, children should be included in the urban design process as active participants. It is a public responsibility to set the necessary platforms for child participation.

Being one of the pioneer researchers in the field of “children participation”, Driskell (2002) claims that a major misbelief about child participation is that having been children years ago, adults assume that they have the ability to think and decide on behalf of children. But the point that escaped the attention is that “being a child / young” is an unstable context which changes in time. No one else can fully understand what it is like being a child in today’s world, rather than themselves. Therefore, adults should take a facilitative role instead of being an oppressive leader in participation projects, considering that the needs and perception of children might have evaluated through time.

Banerjee, Uhm & Bahl (2014) claim that child’s experience of space differentiates from adult’s in several ways. Children’s perception of scale, their vivid and varied experiences obtained from previous mental associations or memories, their perceptions shaped by more tactile instead of visual qualities of the surrounding environment are the main reasons of this differentiation. This situation reveals the urge for involving children in the design process of urban space especially when the subject is directly related with them.

There are a number of programs all over the world that come out with the assertion of being a children’s participation project. But the important thing is to create a meaningful participation which includes the interactive participation of the children on the subjects affecting their individual and social lives. This participation process should be structured by the pursuits, aims and competencies of the children instead of passivizing them. An ideal participation project should have some specific qualities. It should be transparent, have a voluntary component, promote children to present their ideas, let them understand the whole process with all its aspects, offer the opportunity of build-

ing up the structure of the activity to children and let the children see the results of their participation and efforts (Chawla, 2001). By this way children might feel the sense of belonging to the project, totally understand the importance of their existence in the participation process. This transparency and awareness lead to success of the project, in which children become determinant.

The common approach, which ignores the rights of children as equal citizens, is the main reason why children participation projects generally fail to reach a satisfying level. But according to the 1989 United Nations Convention on the Rights of the Child, children have the rights to get a proper education, to be active participants of the social and cultural life, to have a word in any kind of field affecting them and to declare his/her ideas. Since the 1990's in the field of architecture there have been various short term and long term children participation projects which include children into the design process. Freeman & Tranter (2011) claim that children participation projects should not focus on making research about children, but making research with / by children. Professionals have to avoid alienating children from the design process.

Knowles-Yanez (2005) argues that including children in community decisions should be considered within youth activism, public participation, children's rights, experiential education and sustainability. She summarizes the benefits of including children in planning processes as: enabling personal and intellectual growth of the individual, turning the participant's ideas into action and creating a new platform for the community development. The collaborative projects where children find an opportunity to express their ideas on urban design and architecture would benefit both the children and the professional designers. Children should find a way to put their mark on urban environment through participation projects, instead of dealing with abstract projects that neither come out with concrete results nor go further than stalling them.

İncedayı (2002) identifies "participation" as the "initial step on the way to democracy" as participation is the main constraint of the concept of the democratization process. Along with being against giving privileges to a specific class, democracy intends to include all citizens into the decision-making processes that directly affect his/her life style. Therefore, built environment education should be provided for an extended age and social class span including all members of the urban community. In order to evolve urban awareness into a habitual reflex, it is important to start this education at an early age. Speaking of democracy, children should not be excluded from the common ground. Beckman's (2010) words briefly summarize the importance of involving children into urban issues through education and participation: *"It is a question of democracy; we mostly live in an urban setting and that is a man-made environment, influenced by different persons throughout history. We must give the students a belief that they can, through democratic processes, have a say in how the city will change."*

Referring to all of these factors explained above, it might be claimed that a successful built environment education model ought to be shaped both as a medium for creating awareness on environmental issues and also a direct way of participating in environmental design. Providing a proper environmental education and including children and youth in the urban decision-making process, generally assumed to be a "grown-up subject", is also important for letting children gain their self-confidence, which is important also for their social development.

The potential of built environment education supported by various disciplines, one of which is architecture, provides the range of knowledge that children require for their cognitive development. Meskanen (2010) states that: *"Through architecture education it is possible to support the child's natural inclination to be curious, study his/her surrounding, as well as make observations and conclusions from them. Architectural education links together sciences and arts, and supports the development of creativity."*



Sanoff (2008) defines IAP2 (The International Association for Public Participation) which was founded in 1990, as a union that seeks to promote and improve the practice of public participation in relation to individuals, governments, institutions, and other entities that affect the public interest in nations throughout the world. In 2006, IAP2 released a toolbox explaining the methods of public participation. According to this toolbox there are various methods used in public participation projects. For informing, fact sheets, open houses, web sites might be used; for consulting, public comments, surveys, focus groups, public meetings might be used; for involving, workshops and deliberative polling might be used; for collaborating, citizen advisory committees, consensus building, participatory decision making might be used and for empowering citizen juries, ballots and delegated decision might be used. Beyond these flyers, web-sites, TV programs, briefings, fairs, call-centers, information-centers, technical reports, forums, periodical meetings, educational activities, symposiums, charrettes are the other tools that might be used in public participation (IAP2, 2006).

In PWB project, in order to maintain a healthy participation process, a number of these methods were used. There was a focus group collaborating with professionals, there were periodical weekly meetings as a part of built environment education, there were workshops bringing the shareholders and participants together and decision taking mechanism was delegated partly to the participants. After explaining participation and built environment education approaches briefly until this point, the following chapters will focus on the whole process of PWB Project which is basically a children participation project using educational methods as a tool for participation.

### **3. Methodology of the case study: "Play Without Barriers" (PWB) project**

Participatory process is crucially important in urban design in order to construct a common good, promote sustainability of the project by establishing sense of belonging between the user and

urban space. From this point of view, it might be assumed that including the potential users into the design process will raise the quality of the public space.

Considering all of the necessary criteria for a successful example explained in the previous chapters, a built environment education program called "Play Without Barriers" (PWB) was organized in Nilüfer (Bursa, Turkey). Bursa is the fourth biggest city of Turkey and located in the northwest part of the country. Nilüfer is a relatively new district of Bursa developed largely over the last few decades.

PWB is an educational participatory project, which tends to transfer built environment culture to the participants whereas include them in the designing process of an urban space. By this way, a playground will be designed with the contribution of its potential users for the common interest of city-dwellers. This project had education and realization phases. The project was coordinated by the Nilüfer Kent Konseyi (Nilüfer City Council)<sup>3</sup>. The author's participation in the project was as the coordinator and instructor in the educational phase. There were also other shareholders involved in the project including the Departments of Architecture and Education from universities in Bursa and Istanbul (Bursa Technical University, Istanbul Technical University, Uludağ University), the Nilüfer Municipality, the District National Education Directorate (under the Ministry of National Education), the Chamber of Architects - Bursa Branch, the Chamber of Landscape Architects - Bursa Branch, and "Bizim Ev" Social Life Support Center for the Disabled. The variety of the shareholders nourished the participatory character of the project. This project was conducted by the collaboration of a number of civil initiatives, academics and supported by the local government. From this aspect PWB is a pioneering example for Turkey in the field of citizen participation.

Our research questions in this project focus on:

- How can children get involved in urban participation?
- How can children become aware of their city-rights as a dweller and be encouraged to use these rights?

- How do children's designs of a playground differentiate from adults' depending on their perception and experience?
- How can children's design approach be reflected to real space?

### 3.1. The objectives of the PWB project

The main objective of the PWB Project was to provoke urban awareness and to transform this program into an "urban culture school" over the long term. This should not be confused with vocational education. Instead, PWB aimed to provide necessary knowledge for all urban dwellers in order to consciously participate in the urban design. The secondary goal of the project was to develop a preliminary design for a playground accessible for all children having different physical and mental abilities. Ward (1977) states that children are bored of standard playgrounds designed by adults and which do not consider the needs and tastes of the real users: children. In this case, they (the children) have to interpret the urban space in their own way. Regarding to the deficiency of satisfactory child spaces in urban environment, an educational schedule was designed in order to give the proper theoretical and practical knowledge necessary for requiring children, the potential users of the playground, produce a design for their own needs.

In the PWB example, the Nilüfer Municipality, one of the shareholders, perceived this educational program aiming to obtain a final product as an opportunity to have the young users participate in the urban planning process and made use of it by sponsoring the application phase. The playground site in the Municipality's property was assigned to the project that would be obtained from the works of the participants at the end of the educational phase. In this way instead of making an imaginary design, the participants experienced all stages of a realistic architectural / urban design process.

### 3.2. Participants of the PWB project

As explained in the previous section, the PWB Project aimed to let the children design a playground for them-

selves in which both disabled children and children without any disabilities would be able to play together. The project took its name from this specific purpose. The children who would attend to this program were chosen according to several criteria. The first criterion was to create an inclusive playground in which everybody could feel himself/herself involved. This could only be managed by applying universal design principles and letting people express their ideas on behalf of themselves, not anybody else. This meant disabled children should also find a way to present their demands. A total number of 30 attendees were planned, 6 of whom were disabled. The disabled children attended the project with the support of "Bizim Ev" Social Life Support Center for the Disabled. The second criterion was to involve the actual users of an urban space in the designing process. Therefore, the attendees of the program were chosen from among the residents and the students attending the schools nearby the project site. The third criterion was the age of the participants. They were between 8-14 years old, as this group was the most appropriate group to learn and benefit from the built environment education, while also being the potential age group to use the playground.

### 3.3 The implementation process of PWB project

The PWB Project had two phases. The initial one was the educational phase, and the following one was the realization phase. In the educational phase, the participant children attended periodic seminars and workshops about environmental issues based on architecture and landscape design. At the end of this phase, these participants produced a preliminary design by teamwork. The application phase was the process of transforming the children's preliminary design decisions into a quality playground in the urban environment. The most distinctive feature of this project was that the playground design proposed by participating children would be applied on an urban site. The technical procedure of the project was conducted by the responsible departments of the munici-

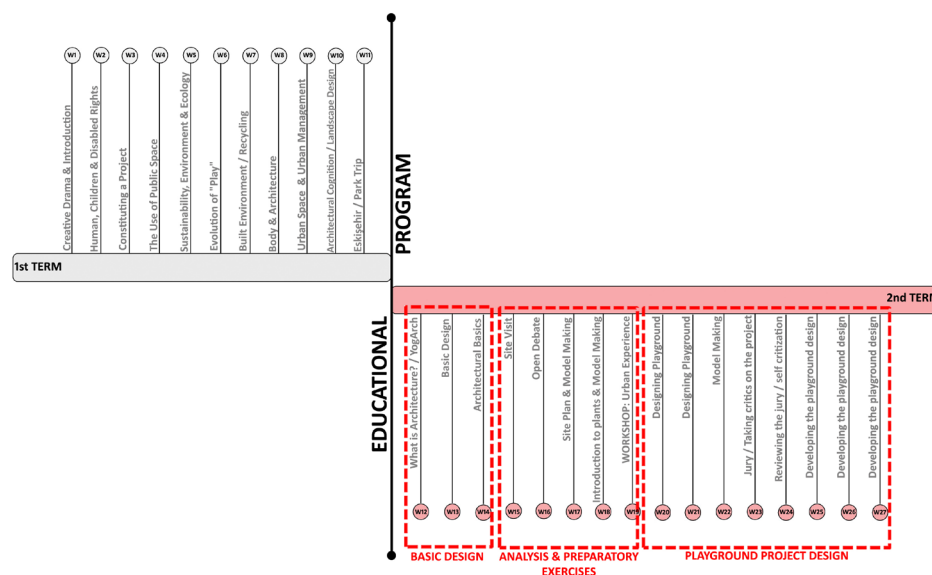


Figure 2. Weekly schedule of the educational program.

pality and during this process, periodic meetings were held with the attendance of the technical groups, educators and the participant children. The main intention was to involve the participants, who were the designers of the playground project, also in the application phase. As soon as the technical drawings were prepared by the responsible departments of the municipality, the construction started on 22.04.2014. The playground officially opened on 06.10.2016. In the scope of this article the educational phase of PWB will be examined thoroughly.

#### 4. Discussion: The educational phase of PWB project

Educational phase of PWB involves the modeling of an educational schedule, the implementation of this schedule with the participants for 27 weeks and obtaining a playground design project during implementation of the educational program. In this chapter the educational schedule and the playground project, which is the final design product of this program, will be explained.

##### 4.1. The educational schedule of PWB project

The first term of the educational schedule included 11 weeks, the second one included 16 weeks. All of these weeks had a sequential complementary context and might be observed under four main sections. The first section

was between the 1st and 11th weeks involving theoretical exercises and seminars. The second section was between the 12th and 14th weeks involving basic design exercises. The third section was between the 15th and 19th weeks involving analysis and preparatory exercises for the playground. The fourth and last section was between the 20th and 27th weeks and included the design exercises of the playground (Figure 2).

The first ten weeks were theoretical seminars related with the design knowledge on various subjects, and the last week of the first term was a trip to a city park in order to examine real world examples. Each week there was a meeting on Saturday that lasted for 3-4 hours. Each of the seminars was given by experts of that topic.

The second term consisted of inter-related practical exercises that aimed to teach methods of design and representational techniques. The educational curriculum of the second term was planned to make the participants experience the design process of the playground project step by step. There were generally two professional designers each week in workshop-place to explain the task and help the participants without over-shaping their creativity. The methodology of these design activities was based on brain storming, team work, face to face education, table crits and self-representational techniques.

In the first section, which lasted for 11 weeks<sup>4</sup>, the basic theoretical background needed in the design process was given. The topics of the seminars were chosen in order to create a general urban awareness and supply necessary information about the built environment and an inclusive playground design. This theoretical knowledge was helpful for the designing process and essential to constitute urban consciousness. This theoretical background also nourished the participants' capacity of being a part of team-work. When all of the various topics mentioned in the seminars came together, they formed an essential cognitive development for the following design process.

The second section was based on various exercises that would share information about basic design principles and give clues about the ways and instruments of design. This section lasted for 3 weeks<sup>5</sup>. These basic design exercises were useful for understanding structural principles of architectural elements and spatial concepts, gaining hand skills, learning architectural representation techniques and some concepts like scale important for presenting an architectural design idea.

The third section included analysis and preparatory exercises before continuing to the design of the playground. They were about analyzing the project site and neighborhood, and setting the principal goals of the design. This section lasted for 5 weeks<sup>6</sup>. Depending on the data collected during the exercises of this section, participants prepared a three-dimensional site model which would be the basis for their design activities. These exercises enabled the participants to go through all stages of the environmental and architectural design process from the beginning. They experienced collecting data from the site and observing the characteristics of a project site, analyzing the needs, developing their ability to express themselves in public, doing research on a topic and presenting it to others and getting used to working harmoniously and productively with other individuals.

The fourth section lasted for 8 weeks<sup>7</sup>. The aim of this section was to develop the ability to design for a specific purpose, learn all factors affecting an architectural design, experience all different levels in the architectural design process (initial sketches, making up a requirement list, conceptual design, jury evaluation, redesigning the project, etc.), gathering a playground project at the end of a collaborative study as a final product. The children used various expression methods such as drawing, writing, model making, taking photographs, discussing in groups, etc...in order to visualize their design ideas. Besides the sessions in the classroom, the group made visits to a greenhouse and several times experienced outdoor playing activities that were turned into a part of the educational schedule in order to make children recognize the play opportunities that the natural environment offered, as they were mostly isolated from nature in their daily life being captured by technology. The participants worked in groups in order to consider other users' needs besides their own.

At the beginning of each meeting the participants received a sheet explaining the context of the workshop, aimed outcomes, hints that should be considered and the materials that would be used. During the workshops the participants were encouraged to express their ideas by question and answer method supported by table-crits, face to face communication and group discussions. The data collected from the questionnaires (searching the qualitative outcomes) applied each week were used for analyzing the process. Meanwhile the notes taken during the discussions, the video and camera shots were archived in order to document the project.

#### **4.2. The final product of the PWB project educational phase**

At the end of the educational phase, the participant children designed a playground project and prepared a 1/50 scaled model of it as a cooperative effort (Figure 3). The model and drawing charts prepared by children were exhibited to public and the residents living by the project area, at the end of the educational phase.





*Figure 3. 1/50 scaled model of the PWB playground.*



*Figure 4. The Sense Labyrinth.*



*Figure 5. Giant ground chess.*

The participants developed various design alternatives during the whole process, but at the end they came up with a cooperative design that was found to be optimal for the needs of all users and convenient for the site. The design principles of this playground were to protect the existing natural characteristics and texture, design play areas that enable various play scenarios instead of sticking to stereotype play equipment, use the recreational opportunities that nature offers and develop a playground in which everybody with different physical and mental abilities, both children and adults, would share the joy of playing.

The participants' effort to create inclusive play spaces is also remarkable. There are distinctive play opportunities designed with this sensitivity. For example, the sense labyrinth is shaped by fragrant plants shorter than human length in order to activate sense of smell. The user might find the exit by following the change of smell which makes it easier for the visually impaired to find the way out. Also the width of the routes of the labyrinth is designed according to the spatial needs of a wheel-chair user (Figure 4).

The design principles of giant ground-chess make it possible for the visually impaired to use it. Both the checked ground and the diverse colored pieces are supported with different textures which make it easier to perceive by touching (both by foot and hand). Also the metal pins located on top of the pieces support the tactile perception (Figure 3).

The sand hill is designed as a meeting point for the children using wheel-chairs and the ones who are able to walk. On one side there is a small sand hill which combines with a sand table on the opposite side. The children who climb the hill might play together with the ones who approach the sand table by following the rubber coated trail (Figure 6).

During the educational process, the participants were introduced to various examples of playground projects worldwide. The instructors avoided directing participants to the playscape zones of a playground, on purpose. The aim of this attitude is to motivate participants' design of the playground project accord-



ing to their creativities, personal experiences, tastes and needs. At the end, it is observed that the cooperative project that the participants designed instinctually turned out to embody all sorts of play zones that are classified to be present in an ideal playground. These zones ought to support the physical, cognitive, emotional and social development of children (Hart, 1993). Theoretically, an open-air playground should offer various play activities such as functional, symbolic and constructive play (Frost, 1992). From this perspective, the design elements of the PWB playground might be classified under these activity zones. A mud pond, climbing walls and trampolines are serving gross-motor development by presenting functional activities. The toy hospital and the sense labyrinth are spaces for manipulative play, whereas the geodesic dome is for open-space play, the tree houses for personal play, the tunnels and hills for nature play. All of these serve for symbolic and constructive play according to Frost's classification. Besides these there is a remarkable concern about the use of natural materials, creating an inclusive play environment and benefiting from the natural texture of the site. Depending on these facts, it might be assumed that the PWB playground has a qualified spatial potential including various play zones that are designed through transformation of the developmental needs of the child firsthand.

The design data is collected by the education team by various archival methods. The scaled model of the playground area and the playing equipment are photographed and also physically archived. The drawings, the questionnaires, the decoding of the interviews with the participants were all analyzed and archived. These were all shared with the realization team (the voluntary members of Academic Chambers and the technical staff of the local government) in order to acquire the most accurate application project. Also the data collected from the workshops are arranged as posters and shared with the residents living in the neighborhood of the playground area in accord with the transparency of the process. By this way the potential users were informed from the project before the construction process was started.



Figure 6. Sand hill.

#### 4.3. The application phase of the PWB project

Once the playground project design was completed by the participant children, the application phase of the project, which is the most unique quality of the PWB Project, started. Most of other built environment education programs focus on design issues and ignore public participation. But when children personally experience a participatory urban design process and find the opportunity to work with various actors in this process, they feel themselves more involved. As far as the municipality, where the project site is located, was one of the shareholders of the project, the building (application) phase became easier to realize. Between 16.07.2014 and 22.04.2015 there were many meetings that brought all of the shareholders together. In some of these meetings the participant children also existed and witnessed the application of the project production process. The details of the playground features designed by chil-

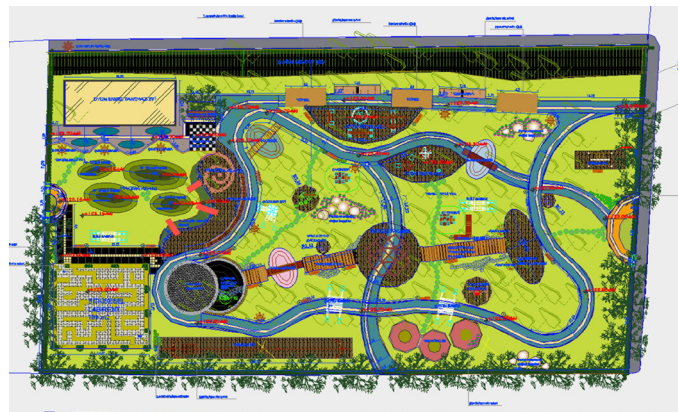


Figure 7. Application project of PWB playground.

dren are solved at the end of long discussions held between technical people responsible for the application process, play equipment producers, educators and the coordinators of the educational process and the participant children. The construction drawings (Figure 7) were prepared by professional architects and landscape architects working at the Municipality with the technical support of members of the Chamber of Architects.

Until the ground-breaking ceremony, which was held on 22.04.2015, a number of revisions were made in the project until the technical staff and the participant children (designers) arrived at an agreement. The building process was proceeded by the contractors and supervised by the Municipality. This process lasted for approximately one and a half years. During this term, the participant children visited the project site and examined the building process and collaborated in some of them. For example, a mosaic workshop was held for the decoration of the entrance gate of the playground, and some of the proj-

ect participants worked together with other children from the neighborhood (Figure 8). By this way, the participants of the PWB project and the potential users of the playground got involved in the construction process, either. Such kind of an inclusion make the participants perceive that they become a part of the solution of a real-life urban design problem, rather than dealing with an abstract design project. The realization process is extremely important for the success of citizen participation project as stated by Irvin & Stansbury (2004). The participants expect to get return on their efforts. Otherwise they feel stalled and lose their trust in the participatory process. Therefore, including the participants in each step of the realization phase and providing them the opportunity to witness the progress of the project is necessary.

When the construction process was over, the playground (Figure 9) opened on 06.10.2016 and has been actively used by the residents of the neighborhood and students from the nearby schools since then.



**Figure 8.** Participants attendance during the application phase of PWB.



**Figure 9.** The air view of PWB Playground.



## 5. Findings and results of PWB project

In order to evaluate the results of the PWB project, some questionnaires were conducted with the participants at the beginning, throughout the educational process and when the project was completed.

According to the answers that the participants gave to the questionnaire that was made at the beginning of the project, the participants weren't aware of user impact in built environment, user-participation approaches in urban design, citizen's rights and responsibilities arouse just because of living in the city and also they were complaining about the boredom of the child spaces designed by adults. However, according to the answers that the participants gave to the questionnaire that was made when the project was completed, the participants started to see themselves as crucial actors in the formation of built environment as being the users of it, their common life perception got stronger, they developed «city right» consciousness and they found a platform to mention their critics about urban problems, offer their solutions for these and show their contribution.

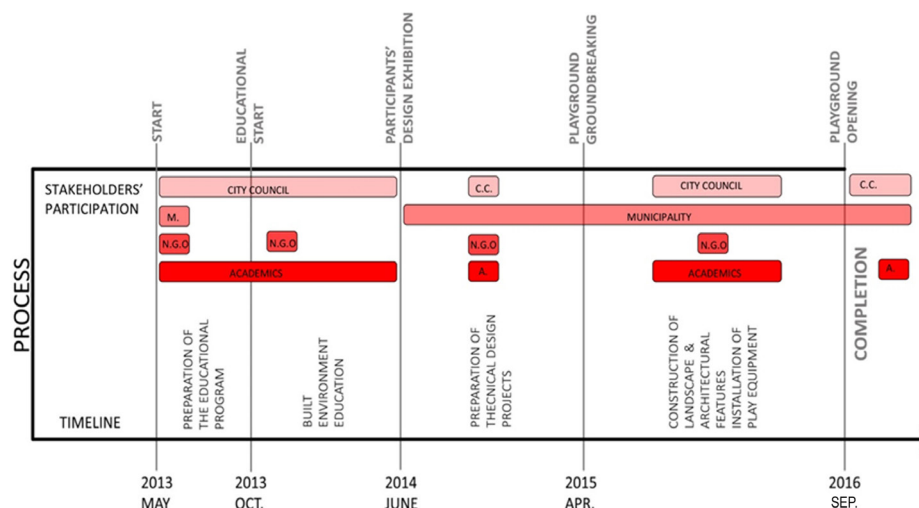
According to Polineva Rajeva (2017), some the main objectives of built environment education are to increase students' awareness of the spaces they live in and their understanding of the relation between people's activities and changes in our environment both natural and built; to give children a possibility to exercise their sensitivity, imagination, taste and critical judgment; to develop children's skills for observing, analyzing and problem-solving; to develop children's skills for working in a team and communicating and to give students an opportunity to experiment with different techniques and real materials. When the pre and post-education questionnaires are examined, it might be seen that most of these objectives are realized in the case of PWB. During this long term program, the participant children found the chance to examine their living environment and the needs of different dwellers of this urban environment. In the setting of a mini-design studio, the participants found a

chance to discuss, observe, analyze and develop solutions for a specific design problem. The feedback from the participants and their parents show that the competence earned as a result of this hard work, was reflected to their daily-lives and attitudes. Working in groups, they found the chance to develop solutions for the problems they determined. The post-educational data collected from children show that they learned to empathize with other people and establish a dialogue in order to solve common problems, due to the team working experience. During the process, the participants tried many expressional methods in order to narrate their ideas and make them possible to implement. This helped them improve their self-expression and communication skills.

The main difference of PWB from similar B.E.E. projects is that the educational process is handled as a long-term whole and the product that is revealed at the end of this process is implemented in urban space. In our country, projects related to environmental education, which have been leaded especially in the last three decades, have been carried out within many different institutions and organizations. However, most of these projects are shaped as short-term workshops. The emergence of a playground design project, which was entirely designed by children, has enabled PWB to be a unique example that concretely includes children in urban participation processes. The diversity of the project shareholders and the local government being one of them made it easier to implement the final design project. Also, an important fact that about PWB is that, the design project obtained during the educational phase was also constructed on site. By this way the participants' efforts weren't wasted. Correspondingly, their beliefs in participatory projects became stronger. Opposite practices cause negative prejudices against participation projects in the society by decreasing the motivation of the participants, as mentioned in previous literature review.

The model created with PWB combines B.E.E. and children / user participation in urban design processes.





**Figure 10.** The work sharing schema of PWB shareholders.

The different components that make up the social structure of the city have come together in this context as project shareholders. In addition to the participants (children), which are the main keystone of the project, the meeting of other shareholders (academic environment, professional chambers, city council, municipality) on a common platform strengthens the participatory aspect of the project and increases its functionality. All shareholders have stated within the scope of the protocol signed at the beginning of the project, at what stages they can support the project process within their authority, responsibility and knowledge. Accordingly, all shareholders have contributed at different stages to the project process, ranging from the design of this social responsibility project to the implementation of the playground design revealed at the end (Figure 10). After the construction was finalized the meetings of the Child Assembly of the Nilüfer City Council started to take place in PWB Center which is located in the playground as a part of the participants' design. In some of these meetings, there are workshops focused on urban design issues. This situation supports the sustainability of the playground.

B.E.E. might be considered as a method that local government can use to ensure user / citizen participation in the design of the built environment. The implementation of the products of the participatory process proves that the ideas of the citizens' are really valu-

able. Such projects also enable citizens to establish a bond of belonging with the city. Within the scope of PWB, children and individuals with disabilities, which we can count among the disadvantaged groups in terms of direct representation, had the chance to express their opinions and contribute to the urban design process.

This long-term education project, which brings together participants from different social and cultural backgrounds, with different physical abilities, has also contributed greatly to the social development of children. In the programs that have similar goals but are designed for shorter periods, every participant cannot find the opportunity to express him/herself equally; within the scope of a long-term project such as PWB, participants can find an environment where they can easily express themselves.

## 6. Conclusion

Built environment education is related with being a part of urban culture rather than being a vocational education. Being born as a dweller, it is a natural right and responsibility of the citizen (regardless of his/her age) to be a part of shaping the built environment. There is a general tendency to exclude children from urban design participation projects, asserting that they are not mature enough. But the final products of PWB prove that when necessary conditions are supplied, along with proper cognition and education, children might become as

willing, successful and responsible as adults about urban participation. Furthermore, children might be evaluated as more creative compared to adults, as their minds are not as yet totally ruined by stereotypes.

Another important aspect of the project is to encourage children to participate in the public issues that are related to them before reaching adulthood. Being conscious about these subjects and being accepted as equal participants would raise the children's self-esteem and benefit their social development. According to Granath (2001), participation shifted from "object-oriented" to "process-oriented" way. In long term, participation supports the diffusion of democracy culture in public and improvement of citizens through learning.

Built environment education is crucial for the 21st century because it is about understanding not only the built environment itself but also the principles of design and participation. The main malfunction come across in participatory projects can be summarized under two topics. The first one is that of ignoring the necessity of informing the participants about the issues where input is expected and the cognitive infrastructure is to be set. In most urban participation cases, the inhabitants who have no information about urban culture are expected to get involved with the process. In such cases the applicability of the ideas becomes risky. The second one is not being able to actualize the participation projects for various reasons (for example, the outcomes which are not possible to realize as explained previously or the neglecting attitude of the authorities). Generally, patronizing projects are applied instead of the ones obtained from the participatory process. This attitude results in the disenchantment of the participants and prevents them from being involved in future projects. But as Arnstein (1969) stated, participation should be a process in which "nobodies" become "somebodies" with enough power to make target institutions responsive to their views, aspirations and needs. Starting from this point of view, the PWB Project is designed in order to eliminate these two deficiencies. The educational phase

is constructed with the aim of raising awareness of the individuals on urban and built environment issues. The application phase proves that the sacrifice and the efforts of the participants are appreciated. The variety of the shareholders of PWB supports the democratic culture notion trying to be spread as a side effect of the project. Meanwhile, since the local municipality was also one of the shareholders, it became easier to solve legal and financial problems in the application phase of the playground. Besides these positive effects, it must be indicated that the large number of the shareholders caused the application phase to progress slowly at some points. Bringing all the shareholders together and reaching a consensus required more time than it had been planned in the beginning.

In this study, it is attempted to make children become aware of their city-rights as dwellers and encourage them to use these rights by supporting them with a built environment education program providing the necessary knowledge and foundation. At the end, it occurred that the benefits of such a project are not limited only to children. As far as children are the best way to reach a wider populace starting from their family and neighborhood, the knowledge provided in these educational programs will rapidly spread out among the society. Built environment education is important for all members of the urban society not for designing the urban environment according to their taste but for noticing the difference between qualified and unqualified environments and being able to use their civic rights to live in a qualified built environment. At the end of the educational phase of PWB, the participants understood that they were some of the main actors shaping the built environment. They developed a civic identity and a civic praxis. As mentioned in the previous chapters, PWB aimed to raise awareness on urbanism and citizenship, make urban youth take actions against urban issues related to the public life. Therefore, it can be assumed that PWB achieved most of its goals by strengthening the common life perception, making children and youth request their demands about built en-

vironment and present solutions for the problems they criticize, encouraging the participants to enhance civic engagement with urban life. Lee (2006) states that design experts design with users in concrete space, rather than designing for users from the abstract space in participatory projects. Based on this point of view, including the real users in the design process is the main motto of PWB Project, as a key to create “living” spaces.

Another important benefit of the project was making the participants put themselves in other people's shoes. As a group working together, all participants (both abled and disabled children) searched for the ways of creating play spaces that they would all enjoy playing together. The original playing spaces / equipment designed by the participants which are explained in the previous chapter (such as sense labyrinth, sand hill, ground chess) show the participants' sincere approach to obtain inclusive play spaces. Regarding these outcomes, it might be predicted that if there would be an opportunity to maintain this type of project with larger groups, the urban culture could be widely disseminated. In this case, with a more conscious urban community, it would be possible to retrieve a more qualified and sustainable built environment from which all citizens and institutions would benefit.

### Endnotes

<sup>1</sup> Built environment: Human-made surroundings that provide the setting for human activity

<sup>2</sup> Built environment education is based on the development of spatial perception and awareness and also transfer of knowledge about the built environment.

<sup>3</sup> The City Council is a civic initiative which aims to promote every citizen without any discrimination to become involved in local government mechanisms and encourage them to take an active role; bringing various working groups formed on a voluntary basis together under the same roof.

<sup>4</sup> between 26.10.2013 – 18.01.2014.

<sup>5</sup> between 15.02.2014 – 01.03.2014.

<sup>6</sup> between 08.03.2014 – 05.04.2014.

<sup>7</sup> between 12.04.2014 – 31.05.2014.

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# Developing a web based software for the evaluation of architectural designs

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## Abstract

When the architectural design is handled based on process and product, we see that many parameters come into play at the point of decision making. Especially as the design problem gets complicated, the value parameters increase so much. Producing solutions to these complex problems only with personal judgments does not yield very productive results in the accuracy of the results. Decision support systems with effective use are needed to select solution suggestions in the design process, at the point of converting personal judgments into real data. For this purpose, a structured decision support method on the fuzzy AHP approach for design evaluation is presented, and a web-based interface is introduced that increases the usability of the method in practice. The interface has been developed based on ASP.Net platform as a web-based evaluation software that allows the participation of many evaluators independent of time and space. The effectiveness and advantages of the developed software are discussed in evaluating the designs obtained in an architectural design studio environment. The software called DDSS (Design Decision Support Software) has shown that it can be applied more effectively in multi-criteria decision-making problems by eliminating the synthesis processes and providing the opportunity to reach faster results. Consequently, when the decision support method presented is used through the developed software, it is seen that more conscious and objective evaluations can be made about the designs in the decision steps in the architectural design process, which has a complex and contradictory structure intertwined with abstract concepts as characters.

## Keywords

ASP.Net, Decision making, Fuzzy AHP, Web software.

## 1. Introduction

Decision making is one of the most important functions of the human being by nature. In general, after learning about options or alternatives, it can be defined as the process of choosing the most appropriate option for the outcome we want to achieve.

Undoubtedly, people of all ages have to make decisions in the face of situations or events. Decision making, which is an indispensable phenomenon of our lives, is a necessity as well as a requirement. When the decision-making phenomenon is considered as method-oriented in architecture, the fact that design objectives and criteria can change even in the process of design, the uncertainty of the solution path in the development of solution alternatives and subjective decisions increase the importance of decision-making methods in the selection of solution proposals.

At this point, decision support systems, which were firstly used in management sciences and then applied in other engineering disciplines and architecture, emerged with the increasingly complex structure of knowledge, the need for information management, the need for coordination between different types of information, and the search for a system to support the designer. These methods, which are based on artificial intelligence studies, have been widely used in recent years especially in engineering and management areas by combining with many different tools and techniques in the solution of complex, unstructured or multi-criteria problems (Manupati, Ramkumar, and Samanta, 2018).

Considering the design practice, design, which is an intellectual action we encounter in almost every area of our lives; In general terms, it can be described as an interactive problem-solving process consisting of different decision-making steps to reach specific goals.

However, in the literature review, it is understood that the decision support methods that can enable decision steps in the architectural design process with systematically and which can be used in these steps and will be able to make decisions according to the cur-

rent conditions and problems in the design process has not been handled sufficiently in terms of decision steps in the architectural design process by being limited to the choice of material or location.

In the study, which is performed by Palabiyik and Colakoglu (2012), to carry out the systematic methods of decision making in the design process, a method has been developed to help decision making and the potentials of this method in terms of evaluating the alternatives in the design process and final products have been investigated.

When the advantages, disadvantages and prospective recommendations of the study are evaluated, developed fuzzy multi-criteria decision-making method is seen to provide a rational structure of decision-making, help make more informed and objective decisions about the evaluated designs, make it possible to make collective decisions by including more than one person in the evaluation and provide feedback by revealing the positive and negative aspects related to the designs in the assessments to be made during the design process.

Conversely, the fact that data synthesis activities are carried out through Microsoft Excel program in the assisted decision-making method brings some disadvantages. The fact that this process, especially the data synthesis step involves a large number of repetitive mathematical operations, leads to application difficulties in both formulation and coding and data entry processes. This causes a limited number of users to use the method and compromises data security in the event of a system failure in the computer where the working data is stored.

In this study, a decision support method based on the fuzzy AHP approach to design evaluation and a web-based interface that increases the application potential of this method in the architectural design process is presented. The interface has been developed based on ASP.Net platform as a web-based evaluation software that allows the participation of many evaluators independent of time and space. In the development of the software called DDSS (Design Decision Support Soft-

ware), the C # programming language in the middle-level language group was preferred, and the effectiveness and advantages of the method presented in the study together with the developed software were discussed in the process of evaluating the designs obtained in an architectural design studio environment.

In this context, the study is organized as follows. Chapter 2 is structured in two stages; In the first stage, the concept of design and decision making in the architectural design process, in the second stage, the decision support method AHP, Fuzzy Logic and Fuzzy AHP theories, and Chang's Order Analysis Method are given with the basic features. In Chapter 3, the use and effectiveness of the method with the developed web-based software are discussed during a case study. In Chapter 4, evaluations are made on the developed DDSS software, and results and forward-looking suggestions are presented over the potentials of use with the method presented.

## **2. Background and preliminary**

### **2.1. Concept of design**

Design, which is handled and evaluated with different aspects in many fields, is research and problem-solving process that generally works within constraints. The goal of this process is to find and offer sustainable and creative solutions that meet the needs specified in the problem description (Giaccardi and Fischer, 2008). Design, a sophisticated cognitive action, begins by generating an abstract idea in architecture and continues with the transformation of this idea into concrete spatial formations. This idea that triggered the start of creative design; Alexander (1964) defines it as "image", Darke (1979) as "primary generator", Rowe (1987) as "organizing principle" and Lawson (1997) as "concept". In this context, architectural design can be defined as the process of creating solutions synthesized in the form of a built environment that starts with a creative idea and meets both practical and impressive requirements according to existing constraints and resources in a utilitarian and aesthetic manner. In the architectural design process, which

consists of multiple sub-processes, where different solutions are developed at different times, the creation-evaluation-selection cycles are repeated continuously throughout the entire process to produce design solutions (Roozenburg and Cross, 1991). In this process, which has a hierarchical structure, the relative weight given to each of the quality features of architectural design, such as;

- its suitability for use and adaptability to private/specific activities,
- its durability and permanence,
- and the aesthetic aspect achieved by its form can vary greatly (Ackerman, 2013).

Today, the market that requires specialized design solutions according to customer demands has been diversified and divided into sections. In this environment, architectural designs, whose complexity has increased exponentially due to socio-economic changes, environmental and energy problems, should also increase customer satisfaction by meeting individual needs. For this reason, it is essential to optimize the architectural design process according to many different (sometimes contradictory) requirements and constraints and to choose the solution from the various alternatives produced. At this stage, most designers highlight intuition and experience that may not be sufficient;

- when the desired design solution cannot be found easily,
- when the cost of failure is extremely high,
- when the design task is extremely complex, or
- when multiple stakeholders are involved in the design for the design (Darke, 1979).

At this point, Cross (2000) states that traditional design methods are not suitable for many design projects due to complexity, high probability of error and lack of tools for teamwork.

Therefore, especially in the conceptual design phase of the architectural design process; More rational and systematic approaches are needed to make decisions that have primary and comprehensive effects on representation, performance and costs (American Institute of Architects, 2007; Cross 2000).

Although several systematic approaches have been proposed in the literature to organize, guide and facilitate the architectural design process (Simon and Hu, 2017), it seems that the applications of the systematic methods developed for decision support are quite limited in architectural practice. This situation may be related to the fact that the methods that help decision making developed in the field of architectural design dominated by individual processes and subjective evaluations are not as successful in evaluating qualitative data as in evaluating quantitative data (Palabiyik and Colakoglu, 2012).

## 2.2. Decision making in architectural design process

Most studies on the architectural design process show that at this stage, designers often use their knowledge and past experience by using traditional methods to formulate an obvious problem and support an alternative solution based on it (Darke 1979). Gregory (1966) defines architectural design as a process that includes thinking and decision making activities. According to him, the thinking phase that forms the basis of the design; the process in which many criteria are considered separately, and the decision-making phase; It refers to the process in which ideas are compiled, refined and made concrete.

In an architectural design structured according to the traditional understanding, decision making and implementation are learned with a project-based “studio” approach. In this process, where designers explore design alternatives and results with activities related to sketching, modelling and discussion, learning and decision making based on visual analogies is an indispensable tool for designers and architects (Simon and Hu, 2017).

In general, while developing alternative solutions in the architectural design process; decisions are handled at different levels under different scenario types. In this context, high-level decisions are made; Includes scenarios such as team organization, product cost, business breakdown and suppliers. A mid-level decision includes such issues as design requirements, material selection, subsystems and components, and the man-

ufacturing and manufacturing process. At a low level, a designer can determine the design goals, forms, dimensions, etc. of individual components (Zhuang, Hu, and Mousapour, 2017).

Accurately assessing the decision-making process influenced by a range of conditions and contexts that can be controlled (such as the business context) and uncontrollable (such as market, financial requirements, and user preferences) is essential in determining the levels and long-term effects of design decisions. Because decisions with long-term effects are often irreversible after implementation. This situation requires the necessity to consistently justify the decisions taken during the early design phase, especially in the context of architectural design. Otherwise, severe environmental damage may occur. Therefore, it is significant for the decision-maker in the process to seriously analyze the meaning and impact of the alternatives before reaching a decision (Zhuang, Hu, and Mousapour, 2017).

It has been developed in recent years to assist designers in the decision-making process; Various methods such as decision matrix (Shafer, 1976), decision tree (Shamim, Hussein, and Shaikh, 2010), quality function deployment (Akao, Mazur and King, 1990) are widely used. These methods are usually ad hoc structured and comparatively largely subjective judgment or designer intuition. Besides, methods such as utility theory and game theory, which are examined in research on feasibility and feasibility in the fields of management science and economics, are also used to support decision making in design, primarily in engineering and product design (Simon and Hu, 2017).

In this context, although decision-making has been extensively studied in engineering design where scope and risk are well defined, it has not been extensively studied in the architectural design process where more uncertainty and risk are involved (Simon and Hu, 2017). This situation is related to the decision making stages in the architectural design process, besides quantitative values, qualitative values that contain subjective judgments due to human evaluations (Lawson, 1997).



The basic understanding adopted in this study is to examine the architectural design problems as a multi-criteria decision-making problem by considering the qualitative and quantitative criteria in the decision-making process. With this aspect, it is aimed to introduce a practical approach in expressing uncertainties, which allows to work with multiple criteria with different features and to compare alternatives with each other with the decision support method presented within the scope of the study.

In this context, due to its potential in decision making and its effectiveness in expressing subjective judgments in the architectural design process, the decision support method presented within the scope of the study is structured on the fuzzy AHP theory, which is used extensively in the fields of management sciences and engineering, where fuzzy logic and AHP are used together. Technical information about AHP, Fuzzy Logic and Fuzzy AHP is given in the following section.

### 2.3. AHP method

AHP is a multi-criteria decision-making method developed by Thomas Saaty in the 1970s, making it possible to make decisions individually and as a group, while choosing among many alternatives under certainty or uncertainty. The main idea of AHP is to divide a complex and unstructured decision problem into a series of multi-level hierarchically arranged components to minimize complexity (Saaty, 1980). Measuring subjective decisions of decision-makers by assigning corresponding numerical values according to the importance of the factors considered is an essential feature of AHP (Saaty, 1994a). Because it is straightforward to understand and involves simple mathematical calculations, AHP has attracted considerable attention in the analysis of various decisions regarding complex, technological, economic and socio-political problems and has been applied successfully in many areas including marketing, finance, education, public policy, economics, medicine, sports, informatics (Saaty, 1990; 1994a; 1994b).

Saaty (1990) states that perhaps the most creative task in making a decision is to choose the factors that are important for this decision problem. After selecting these factors in the Analytical Hierarchy Process, the process takes place in five main stages: the development of a hierarchy tree, which is a graphical representation of the decision problem, descending from a general target to the criteria, sub-criteria and alternatives consecutively, the development of binary comparison matrices, taking relative priorities, checking consistency and obtaining the general priority of decision alternatives.

Saaty (2001) listed the ten advantages of AHP, which is a decision-making method, as unity, complexity, interdependence, hierarchy structure, measurement, consistency, judgment and consensus, synthesis, imbalances and process repetition. However, the fact that the 9th scale used in binary comparisons in this method is insufficient in explaining the uncertainties can significantly affect the decisions to be made. It is seen that AHP is used in conjunction with Fuzzy Logic to better reflect the way of human thinking by expressing uncertainties and thus creating more appropriate and consistent decisions (Brunelli, 2015).

### 2.4. Fuzzy logic theory

Lotfi A. Zadeh with his article "Fuzzy Sets" published in 1965, by introducing the concept of fuzzy sets to the world of science; it brought a completely new perspective to systems, logic and reasoning models (Zadeh, 1965; 1968).

Unlike traditional logic systems, fuzzy logic aims to present an approximate model rather than precise reasoning (Bellman and Zadeh, 1977). Fuzzy logic in which the concept of degree is introduced in the verification of a condition and the definition of the condition at an intermediate value between true or false provides precious flexibility for logic. Thus, it is possible to take into account the mistakes and uncertainties, and with fuzzy logic, inference systems closer to human behaviour can be created (Zadeh, 1984).

Fuzzy logic is based on the mathematical theory of fuzzy sets, which is the generalization of classical set theory. The fuzzy set is an object class whose membership degrees are continuous. Such a cluster is characterized by a membership (characteristic) function that assigns a degree of membership ranging from zero to one for each object (Zadeh, 1965).

In classical set theory, the elements of the universe are defined in two groups, those that belong to an M set and those that do not. The elements belonging to the cluster are assigned “1”, and those who do not belong to “0” are assigned to explain whether they are members of the M cluster or not. In the fuzzy set approach, there is no precise classification as members or non-members, and the elements of the set are defined by membership functions. These functions assign real values to the elements in the interval [0,1]. These real values show how suitable the elements are to the concept represented by the fuzzy set M (Palabiyik and Colakoglu, 2012).

Fuzzy logic systems structured on fuzzy logic and fuzzy sets theory are rule-based systems used to solve different types of problems in economics, linguistics, law, artificial intelligence and other human-centred application areas (Herrera, 2005; Zadeh, 1965). The processing of input and output data in the fuzzy logic system is performed in three stages, as shown in figure 1: These stages are as follows:

1. Fuzzification: In the fuzzification stage, membership functions are defined for both input and output variables to transform the data input received from the user into meaningful linguistic data with fuzzy components in varying degrees.

2. Fuzzy Inference: At this stage, fuzzy control rules are applied with a series of IF-THEN conditions to organize meaningful input-output relationships and obtain linguistic outputs.

3. Defuzzification: In the defuzzification phase, linguistic outputs are converted into numerical outputs by specific calculation methods (Naz and Nadin, 2018).

Fuzzy logic came to the fore in explaining the relationship between real life and logic and has been able to produce more realistic solutions to many problems.

## 2.5. Fuzzy AHP method

Fuzzy AHP, which results from the combination of fuzzy logic and AHP method, is based on fuzzy set theory, which uses fuzzy numbers in the inputs of binary comparison matrices put forward by Zadeh (1965) (Table 1).

The first study on fuzzy AHP was conducted by Laarhoven and Pedrytcz (1983), which compared fuzzy rates expressed with fuzzy triangular numbers. In 1985, Buckley developed a new model by identifying fuzzy priorities of binary comparisons through trapezoidal membership functions. Later in 1996, Chang introduced a new approach using fuzzy triangular numbers for the binary comparison scale of fuzzy AHP and using the extent analysis method for the synthetic grade values of these binary comparisons. In this study, Chang’s “Extent Analysis Method”, which is similar to the classical AHP method and easier to apply than other methods, is used.

It is seen that the fuzzy AHP method is used in many different areas of decision making. Bozbura, Beskese, and Kahraman (2007) proposed the fuzzy

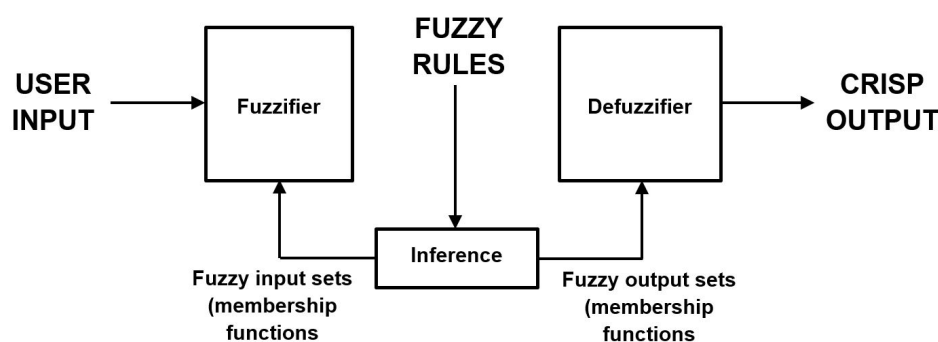


Figure 1. Conceptual scheme of a fuzzy logic system.

**Table 1.** Triangular fuzzy transformation scale.

Linguistic Variables	Triangular Fuzzy Values	Triangular Fuzzy Corresponding Values
Equally important	(1, 1, 1)	(1, 1, 1)
Intermediate value	(1, 2, 4)	(1/4, 1/2, 1/1)
Moderately important	(1, 3, 5)	(1/5, 1/3, 1/1)
Intermediate value	(2, 4, 6)	(1/6, 1/4, 1/2)
Strongly important	(3, 5, 7)	(1/7, 1/5, 1/3)
Intermediate value	(4, 6, 8)	(1/8, 1/6, 1/4)
Extremely important	(5, 7, 9)	(1/9, 1/7, 1/5)
Intermediate value	(6, 8, 10)	(1/10, 1/8, 1/6)
Definitely more important	(7, 9, 11)	(1/11, 1/9, 1/7)

AHP method to improve the quality of the “human capital” measurement indicators in priority. Pan (2008) used the Fuzzy AHP method to select the appropriate bridge construction method. Sun (2010) developed a performance evaluation model by integrating fuzzy AHP and fuzzy TOPSIS methods. Taylan et al. (2014) conducted a study on the comments about “selection of construction projects and risk assessment with Fuzzy AHP and Fuzzy TOPSIS methodologies”. Chen, Hsieh and Do (2015) performed a study on evaluating fuzzy AHP-based teaching performance and a comprehensive assessment approach. Toklu, Erdem, and Taskin (2016) proposed a fuzzy model for strategic planning in production companies. Li et al. (2017) proposed a mixed approach based on fuzzy AHP and fuzzy linguistic method for the evaluation of in-flight service quality. Awasthi, Govindan and Gold (2018) used a fuzzy AHP-VIKOR-based approach to multilayer sustainable global supplier selection. Harputlugil et al. (2014) conducted a study that focused on conveying the preferences of stakeholders to the design team in the architectural design stages in order to increase the architectural design quality. However, there are a limited number of studies in the literature that try to combine the fuzzy AHP method with computer systems. The study developed by Cakir and Canbolat (2008) developed a web-based decision support system for multi-criteria inventory classification using fuzzy AHP methodology and the survey by Armillotta (2008) uses adaptive AHP decision model for the selection of layered production techniques can be given as examples of the few studies conducted in this field.

In this study; With the fuzzy AHP-based decision support software developed, it is aimed to contribute to the development of alternative designs by making the evaluations in the decision steps based on product and process in a more effective and faster manner in architectural design. In this direction, the mathematical process related to fuzzy AHP method, which is the Chang’s Extent Analysis Method, which forms the infrastructure of the software, is given in the continuation of the section.

## 2.6. Chang’s fuzzy AHP method (Extent Analysis Method)

The Extent Analysis Method developed by Chang (1996) aims to achieve the significance of the criteria and the performance of the alternatives according to each criterion by solving blurred reciprocal binary comparison matrices as the main idea. This approach can be addressed in 4 stages. The application of the method, together with these steps, is described below.

*Stage 1: Fuzzy synthetic value analysis.* The primary purpose of this analysis is to determine the significance of the criteria and alternative performances by solving blurred binary comparison matrices.

If  $A = \{a_1, a_2, \dots, a_n\}$  is the object set and  $U = \{u_1, u_2, \dots, u_m\}$  is accepted as the objective set, each object is taken, and synthetic performance analysis is performed for each purpose. Thus,  $m$  synthetic (expansion) analysis values for each object are obtained as follows (Palabiyik and Colakoglu, 2012; Paksoy, Yapıcı Pehlivan and Özceylan, 2013).

$$M_{gi}^1, M_{gi}^2, \dots, M_{gi}^m, \quad i=1, 2, 3, \dots, n \quad (1)$$

Here,  $M_{gij}$ , ( $j=1, 2, 3, \dots, m$ ) are each fuzzy triangular numbers and the fuzzy synthetic magnitude value for  $i$  object is found by the following equation.

$$S_i = \sum_{j=1}^m M_{gi}^j \odot \left[ \sum_{i=1}^n \sum_{j=1}^m M_{gi}^j \right]^{-1} \quad (2)$$

The  $M_{gi}^j$  specified indicates the performance of the  $a_i$  object for the  $u_i$  purpose.

**Stage 2: Comparison of fuzzy synthetic values.** If a fuzzy binary comparison matrix is determined, the principle of comparing fuzzy numbers for the weighed vector values under each criterion is needed.

The probability of  $M_1 \geq M_2$  can be defined as follows.

$$V(SM_1 \geq SM_2) = \sup_{x \geq y} [\min(\mu_{M_1}(x), \mu_{M_2}(y))] \quad (3)$$

If a pair  $(x, y)$  is given, if  $y \geq x$  and  $\mu_{M_1}(x) = \mu_{M_2}(y) = 1$ ;

since the fuzzy numbers  $M_1 = (l_1, m_1, u_1)$  and  $M_2 = (l_2, m_2, u_2)$  are convex,  $V(M_1 \geq M_2) = 1$ .

$$V(M_1 \geq M_2) = 1 \quad \text{if } m_1 \geq m_2, \quad (4)$$

$$V(M_2 \geq M_1) = \text{hgt}(M_1 \cap M_2) = \mu_{M_1}(d)$$

In the above equation,  $d$  is the ordinate of  $D$  the highest intersection between  $\mu_{M_1}$  and  $\mu_{M_2}$ .

If  $M_1 = (l_1, m_1, u_1)$  and  $M_2 = (l_2, m_2, u_2)$ , the ordinate of  $D$  can be obtained from the following equation.

$$V(M_2 \geq M_1) = \text{hgt}(M_1 \cap M_2) = \frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)} \quad (5)$$

To compare  $M_1$  and  $M_2$ ,  $V(M_1 \geq M_2)$  and  $V(M_2 \geq M_1)$  values are required (Figure 2) (Chang, 1996).

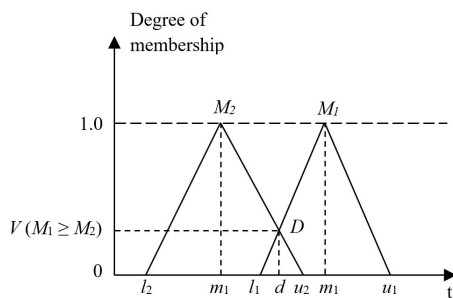


Figure 2. Comparison of synthetic values.

**Stage 3: Calculation of weight performances.** The probability that a convex fuzzy number is greater than  $k$  the convex fuzzy number  $M_i$  ( $i=1, 2, \dots, k$ ) can be defined as follows:

$$V(M \geq M_1, M_2, \dots, M_k) \quad (6)$$

$$= V[(M \geq M_1) \text{ ve } (M \geq M_2) \text{ ve } \dots \text{ ve } (M \geq M_k)]$$

$$= \min V(M \geq M_i), i = 1, 2, \dots, k \quad (7)$$

$$\text{If, } d'(A_i) = \min V(S_i \geq S_k)$$

$k = 1, 2, \dots, n$ ;  $k \neq i$  is assumed, the non-normalized weight vector can be specified as in Equation 2.19.

$$W' = (d'(A_1), d'(A_2), \dots, d'(A_n))^T \quad (8)$$

In this equation,  $A_i$  ( $i = 1, 2, \dots, n$ ) refers to  $n$  elements.

**Stage 4: Normalization.** Weight vectors ( $W$ ) obtained by normalization can be expressed as follows.

The  $W$  value in this equation is a non-fuzzy number (Chang, 1996).

$$W = (d(A_1), d(A_2), \dots, d(A_n))^T \quad (9)$$

Manually editing and controlling the mathematical operations given above causes application difficulties in terms of fast and efficient use of the method. With the DDSS web-based evaluation software developed within the scope of the study, it is aimed to use the method more efficiently by ensuring that the data synthesis activities involving all these mathematical operations are carried out automatically by hiding from the user (Figure 3). In the following section, the general features of the developed software and the application of the decision support method over the software are discussed with the process of evaluating the designs obtained in an architectural design studio environment.

### 3. General editing of decision support method

The application of the method through the developed DDSS software is discussed in two main stages as analysis and synthesis. The first analysis phase takes place in 4 steps:

Step 1: Establishing the hierarchical organization by defining evaluation criteria,



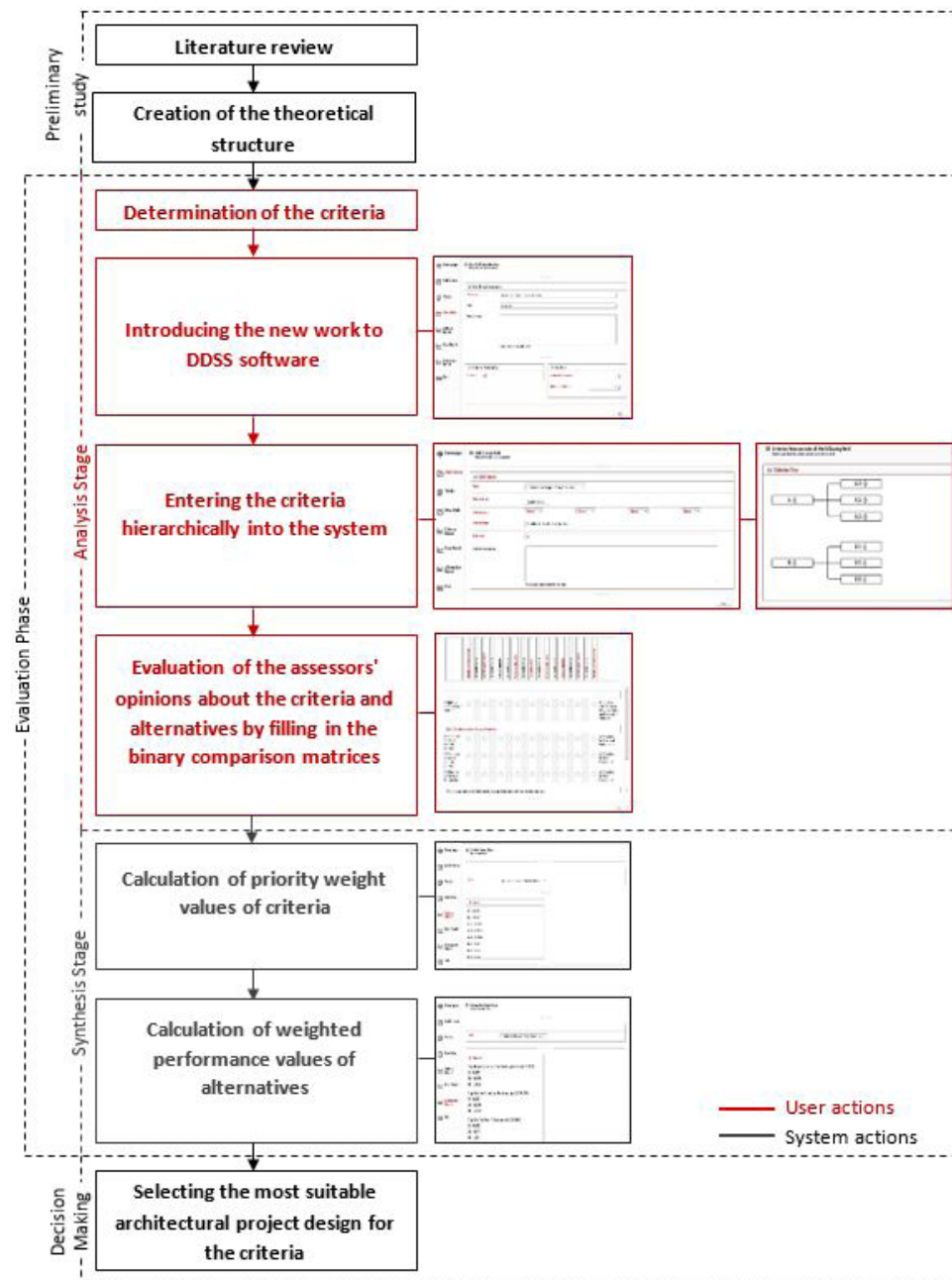


Figure 3. Stages of the methodology used.

Step 2: Introduce the new study to the system via DDSS software,

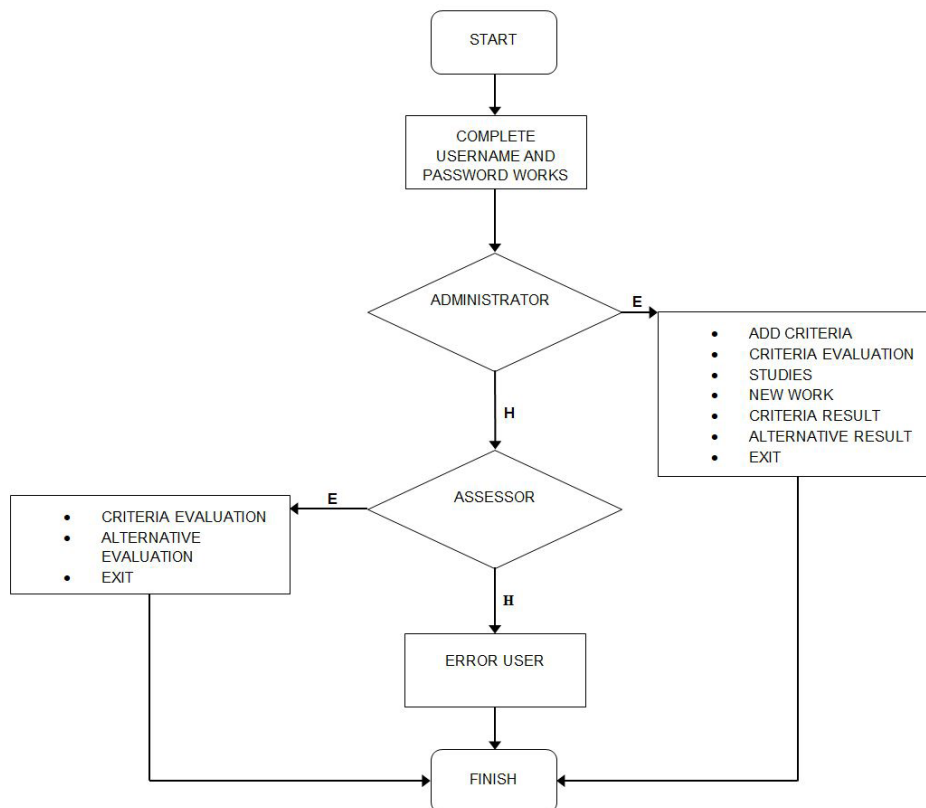
Step 3, entering the evaluation criteria of the new study into the system,

Step 4: The evaluators enter data into the system through DDSS software, which expresses their thoughts and values about the evaluation criteria and alternative designs that are evaluated.

The synthesis stage, which is the second stage, is carried out in 2 steps consisting of determining the weight vectors expressing the relative importance of each evaluation criteria, calculation of weighted performance values of each alternative according to deter-

mined criteria by creating the result performance matrix. The three steps mentioned at this stage are carried out by the developed software without any action. Following these processes in the background of the software, the last step is that the administrator can view and evaluate the result data of the evaluation criteria and alternative designs.

The general process algorithm related to the steps performed with DDSS software, which is envisaged to be used more effectively by the process, especially in the synthesis stage, is given in Figure 4.



**Figure 4.** Introduction to the system and process algorithm.

The general infrastructure of the software and the processes that must be done on the software are discussed in detail in the rest of the section during the evaluation of the designs obtained in an architectural design studio environment.

### 3.1. Theoretical background of DDSS software

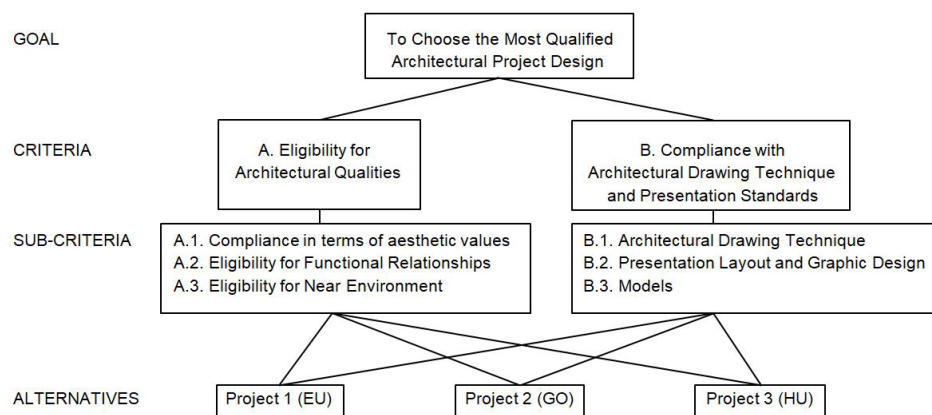
The developed software is web-based due to the advantages of being accessible by different people at different places and times. In the first stage of the design of web-based software, the web interface made with Adobe Photoshop program was converted to HTML (Hypertext Sign Language) with Adobe Dreamviewer program, and necessary CSS coding was done. The generated HTML files were programmed with Microsoft Visual Studio software, and .aspx pages were created. Asp.Net infrastructure has been used to create these dynamic web pages due to its advantages, such as ease of use and management. The programming language is C #, which works in compliance with Asp.Net platform, offers ease of use and works according to object-oriented programming principles.

MsSQL database management system was used to store the data to be used in the study, and “SQL Server Management Studio” program, which enables access, configuration, management and development of all components, was used to manage MsSQL. In the last stage, the files are prepared to be published by providing the necessary domain and hosting services to work on the web.

### 3.2. Effectiveness of the method with DDSS software: Field study

The functionality of the developed DDSS software is still considered in design studies of different content and scales, both in the process and in the context of evaluating the architectural design alternatives obtained as final products.

In this study, to test the application of the method via DDSS software; in the first year of the architectural design studio, where the students met with the form, space and the principles that guide them in the urban built environment, it was aimed to design the houses where the functional requirements of the housing phenomenon were solved with the physical environ-



**Figure 5.** Hierarchy of criteria used in selection of architectural project design.

ment data and the correct applications to the structural problems. Among the residential designs obtained at the end of the process, three designs that were considered to be more qualified than the others were selected by the project executives within the scope of the field study to investigate the effectiveness of the developed software.

### 3.2.1. Analysis phase of decision support method

The evaluations of the selected designs made by the project executives using DDSS software are stated below in 4 steps performed during the analysis stage of the decision support method.

*Step 1\_ Determining the evaluation criteria and forming a hierarchical organization:* The process starts with the determination of the evaluation criteria related to the intended design subject. Next, a hierarchical organization chart showing the relationships between the evaluation criteria determined is formed. The criteria determined within the scope of the field study and the hierarchical decision tree created are indicated in Figure 5.

*Step 2\_ Introducing the new study to the system via DDSS software:* After defining the criteria, the main page of the software is accessed via the web. In the login screen that appears on the main page, the verification process is performed according to the user name and password. The login screen offers two different options for administrators and users to log in to. By entering the user name and password correctly in the administrator login field, you are logged in with full access to the administrator's homepage. Via the homepage,

new studies can be created, criteria can be added to the studies, values entered by the evaluators can be controlled, criteria and alternative results and data from previous studies can be accessed.

During the introduction of the new study, the required information is entered into the system via the "new study" page. Within the scope of the field study, Architectural Design I - Project Evaluation " was introduced in the study name field, and the number of alternatives and evaluators was entered as 3. When the evaluator and alternative numbers of the study are written, the areas in which the name and password are registered in the specified numbers are formed. The evaluators can enter the system with the evaluator password entered in these fields. If the "publish" box is checked, the evaluators can log in and see the work they will be evaluating.

*Step 3\_ Entering the evaluation criteria of the new study into the system:* After the new study is created, the process to be performed is to enter the determined criteria into the system in hierarchical order. The specified criteria are entered into the system from the "add criteria" page. If criteria are added without selecting anything in the criteria group field, the main criteria (first step) are formed (such as A, B, C). If one of the main criteria is selected from the first box of the criteria group field, the entered criteria will be a sub-criterion of the main criteria (second step). For example, if A is selected as the first criterion group, the criterion whose information is entered will be A.1. Similarly, if the main criterion and a sub-criterion are chosen from the first

Figure 6. Binary comparison chart of criteria.

and second boxes, the resulting criterion will be the third step. When the name, code (such as A, A.1, A.1.1) and description of the criterion are entered and saved, a hierarchical decision tree of the criteria is formed at the bottom. Within the scope of the field study, the criteria were entered into the system according to the hierarchy in figure 5. The hierarchical organization chart can be controlled to prevent errors in cascading criteria. When the criterion input is completed, the comparison charts that the evaluators will evaluate are created by the system.

At the point of adding criteria in the developed DDSS software, it is possible to use the criteria of previous studies in a new study by calling from the database. Since the criteria of the studies are kept by the system, a criterion library is formed, and the criterion base can be created in similar studies thanks to the feature of transferring criteria from previous studies. If the criteria will remain precisely the same, and their weights can be used, the criterion data of the previous study can be used directly by copying the study instead of adding the criteria.

Step 4\_ Evaluators enter data into the system via DDSS software, which expresses their opinions and judgments about the evaluation criteria and alternative designs that are evaluated: After the new work is created by the administrator and the criteria are entered into the system, users can access the user interface by logging in to the system with the user name and password defined to them from the user login page. Through this interface, users can only make evaluations using the paired comparison scales of the criterion evaluation and alternative evaluation processes, respectively.

In the calculation of the priority weight values of the criterion determined according to the expectations about the intended architectural design, the evaluator first makes the paired comparisons of all criteria on the paired comparison tables according to their own knowledge, experience and value judgments (Figure 6). These scales are formed by using the 9-comparison table (Table 1) bidirectionally and using the verbal judgments used in daily life and reflecting a certain degree of superiority (certainly more



important, very strongly important, strongly important, moderately important, equally important). All evaluations are completed by ticking the boxes corresponding to the severity of the criteria on the right and left sides of the comparison chart. In the comparison chart, if a period exceeds the criteria, short descriptions entered by the administrator of that criterion can be displayed. In case of incomplete comparison charts, the system notifies the user and does not allow the data to be saved until complete. After the evaluation of all criteria, the evaluator presses the “save” button, and the verbal data is converted to digital form and saved in the database. Within the scope of the field study, all three evaluators made evaluations on different computers and at different times over the web.

### 3.2.2. Synthesis phase of decision support method

*Step 1\_ Calculation of priority weight values of the evaluation criteria:* After all, evaluators have completed the data entry, in the synthesis stage of the decision support method, the system creates the priority weight values for

each criterion by making the necessary calculations for the steps such as conversion, blur, syntheticization, and normalization by fuzzy AHP method in the background.

*Step 2\_ Calculation of weighted performance values of alternatives:* This process is very similar to the process where the priority weight values of each criterion are found. The most significant difference in the process of calculating the weighted performance values of the alternatives is the dual comparisons of alternatives according to each criterion. In this process, after the evaluations are completed, the necessary calculations are made, and in the last stage, the importance of the alternatives is multiplied by the weight of the criteria they are compared and weighted according to the importance of the criteria. After determining the weights of the individual alternatives for all criteria, the overall weight of the alternatives is calculated, and the evaluation process is completed.

The software algorithm that shows how the processes in the synthesis stage are performed in the background of the system is given in Figure 7.

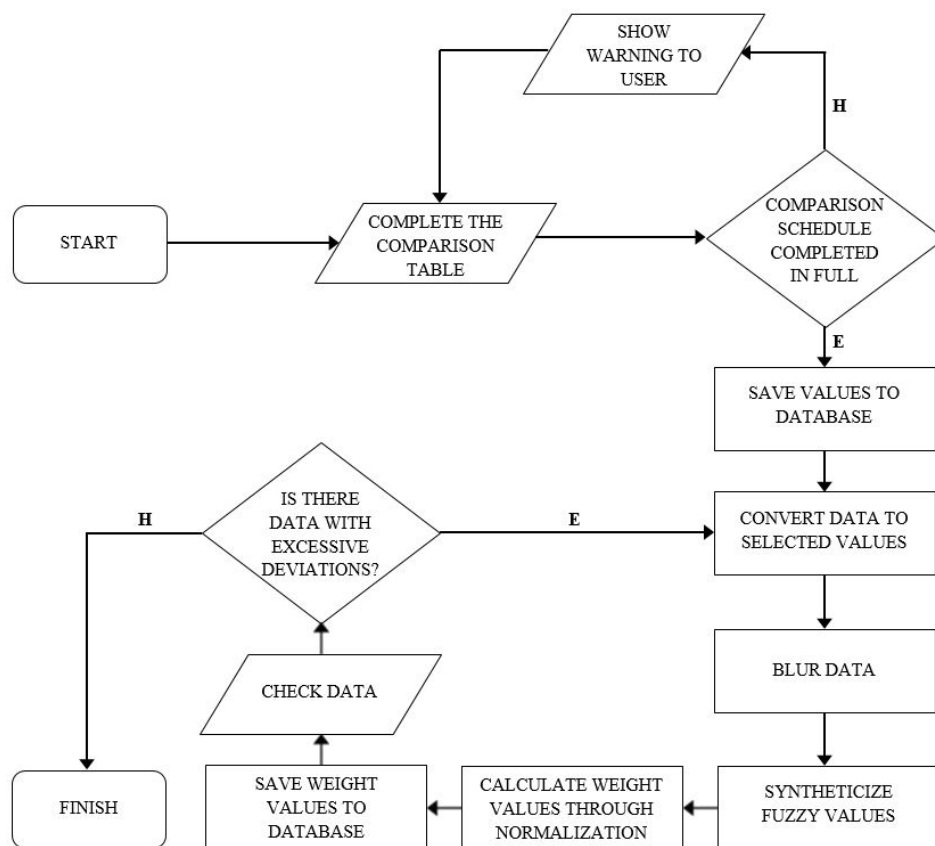
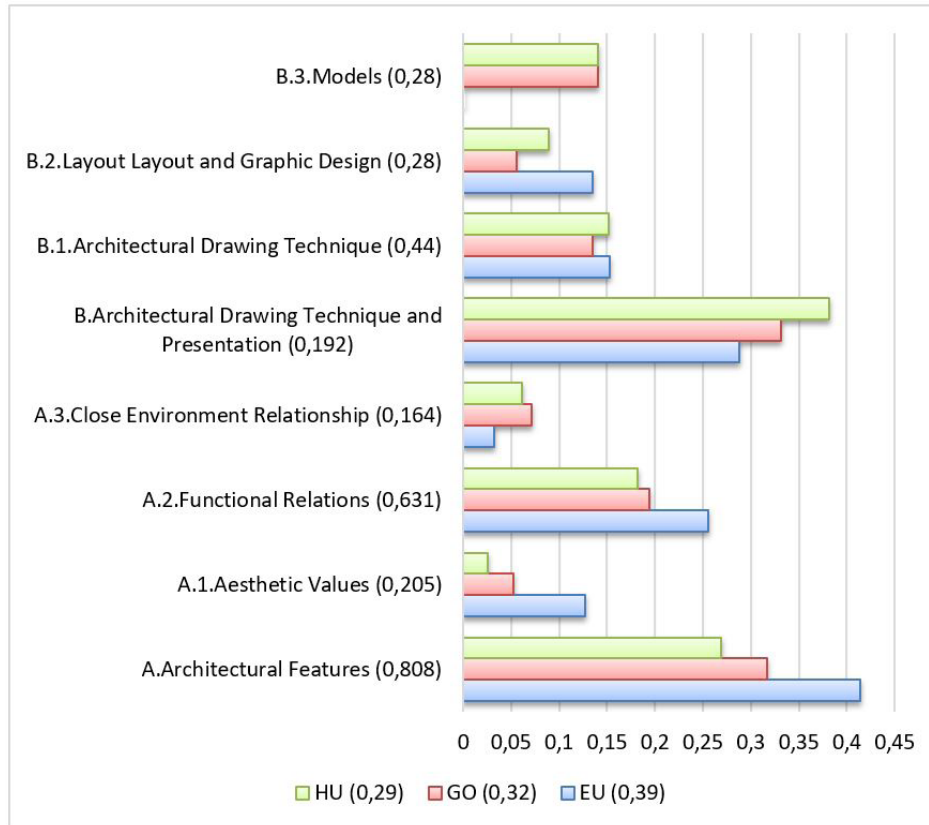


Figure 7. System evaluation algorithm.

**Table 2.** Weighted performance values of alternatives according to each criterion.

After users finish entering data, the administrator can log back in and view the results of the work. When the criterion results and alternative results pages are introduced, and the related study is selected, the results of that study can be displayed. If the administrator checks the evaluator data from this page and detects an incorrect evaluation, he or she can delete the evaluation data from this database. If there is a change in the number of evaluators, when the result page is re-displayed, the results are updated according to the existing evaluators.

In Table 2, the priority weight values of each evaluation criteria determined within the scope of the field study are presented graphically. According to the results of the evaluation carried out by three project executives, criteria A (conformity in terms of architectural characteristics: 0,808) are considered to be more critical in terms of evaluating the intended designs according to criteria B (compliance to architectural drawing technique and presentation standards: 0,192). A similar assessment can be made between the A2 criterion (suitability in terms of functional

relationships: 0.631) and the A1 (conformity to aesthetic values: 0.205) and A3 criteria (close environment relationship: 0.164). On the other hand, although there is not a big difference between the weight values of the B1, B2, and B3 criteria, the B1 criteria (architectural drawing technique; 0.44) are compared to B2 (layout and graphic presentation: 0.28) and B3 criteria (model: 0.28). According to the evaluation of the designs considered to come to the fore.

EU, GO and HU design alternatives (Figure 8) were evaluated according to each decision criterion within the scope of decision support method and evaluation results (EU = 0,39, GO = 0,32, HU = 0,29) were obtained. According to these results, EU design which was developed under accepted conditions, was found to be 39% more successful than the other designs GO and HU in the evaluation made by the group executives. In other words, the design with GO nickname is 32%, and the design with HU nickname is 29% successful compared to other alternatives. In this case, it is determined that the most appropriate design alterna-



Figure 8. Design alternatives EU, GO, HU.

tive is EU nicknamed design. Table 2 shows the criteria that the three alternative designs evaluated were found to be more successful.

#### 4. Results and discussion

Today, with the developing technological, social, economic, political and environmental factors, the design problem has become increasingly complex. In particular, increasing material diversity, production methods, production systems, scientific and technological advances force the designer to make de-

cisions with many economic, social and environmental impacts that he cannot predict in the design process. In this process, only a certain number of data can be consciously evaluated by a decision-making method that is not systematic and is based entirely on the knowledge and experience of the evaluators. At this point, it is essential to carry out decision-making in the design process by systematic methods and to develop decision support methods that enable decision making according to the conditions and time in the design problem.

In this study, a fuzzy multi-criteria decision support method which enables a better organization of the design process with an analytical approach to the design problems encountered and subjective evaluations within architecture as well as objective assessments to be made in decision steps is presented. To use this method effectively, a web-based computer software called DDSS has been developed. The effectiveness of the developed software was discussed in the process of evaluating the designs obtained in an architectural design studio environment.

The developed DDSS software generally increases the usability of the method by the designers by hiding the matrix operations needed for determining the synthetic values required by the decision support method presented. The advantages it provides are detailed below;

- In each new study, the reorganization of the model is prevented, and the necessary steps to achieve the results are reduced.
- By entering the evaluation data directly into the system by the evaluators on the web, a secondary data entry process is eliminated. Thus, it enables the desired number of evaluators to input data directly to the model at the same time wherever it has internet access.
- While the system can work on a single computer in applications made through Microsoft Excel program, all users can enter data from different computers at the same time with the software running on the web and thus loss of time is prevented.
- Since the system operates with the same codes in each run, the margin of error is reduced to a minimum. This situation is seen as an essential advantage for achieving more accurate results in evaluations.
- The software works like a standard web site, providing users with an easy to use without requiring expertise.

In addition to the advantages provided by the DDSS software, the identified disadvantages that need to be developed are as follows:

- Since no evaluator pool is created in the system, a new evaluator is added in each run, and the system fails if the passwords are the same. Therefore, if the same evaluator participates in different studies, a different password must be defined.
- Since it is assumed that there is only one user as an administrator, all work data can be accessed if other people use the software, and this creates a security vulnerability.

In addition, in the implementation of the decision support method through the developed DDSS software, criteria and alternative numbers are issues that need to be taken into consideration. As both the criteria and the number of alternatives increase in design evaluations, binary comparisons for evaluators are exhausting, and the method is no longer convenient.

As a result, with the developed software, primarily by eliminating the synthesis processes and providing faster results, it has been shown that the method can be applied more effectively in multi-criteria decision-making problems encountered in the architectural design process. Thus, it has been seen that with the use of the decision support method, evaluations can be placed in a rational structure in the decision steps in the architectural design process and more conscious and objective assessments can be made about the designs.

In future studies, if it is possible to independently evaluate a single alternative to the decision support method supported by the DDSS software developed; It is foreseen that it can be integrated into systems such as LEED, CASBEE, BREEAM, IISBE, Greenstar where green buildings are evaluated and certified, and even a national-based green building evaluation system which is integrated with the decision support method can be proposed. It is also thought that assessing a single alternative will increase the potential of the method to be used in architectural design competitions.



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# Determination of Syrians re-making home interiors through visual research methods: The Sultanbeyli case

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## Abstract

One of the most important problems of Syrians subjected to forced migration since 2011 is obtaining shelter. This study explores how displaced Syrians living in Sultanbeyli, a district in Istanbul, Turkey, are re-making their home interiors. Syrians in Sultanbeyli are transforming their residences, especially indoors, based on their physical and psychological needs and cultural habits. This paper begins with a brief introduction followed by background information about such related concepts as “house,” “home,” and “home-making,” and home re-making practices in the context of forced migration. The Sultanbeyli case is then explored. Sultanbeyli is chosen as a study area because it maintains a supportive living environment for displaced Syrians. The case study was conducted with Syrian families of middle or lower income groups in their home environment. The method of the study was based on visual research methods, including the use of photographs, drawings, physical traces and annotated diagrams. Data were obtained regarding family structure and composition, lifestyle, activities, spatial use and organization, and furniture layout. The findings show that social, cultural, and behavioral codes have an important role in home re-making processes and practices. They also show that the supportive relationship between people and their living environment has an effect on developing a sense of belonging and place attachment. More specifically, they show that a supportive living environment also enhances cultural hybridization over time. Because of this, it is crucial to conduct new research studies with participant groups to follow the changes that take place over time.

## Keywords

Forced migration, Home-making, Interiors, Syrians, Visual method.

## 1. Introduction

Since March 2011, millions of people have migrated to neighboring countries due to the civil war and conflict in the Syrian Arab Republic. Turkey has the longest land border with Syria (911 km); therefore, it has been directly affected by this drastic situation. As a result of this mass displacement, Turkey has become a country both hosting and providing a transition zone for refugees and migrants. In the early years of the crisis, Syrians were perceived as guests, with an “open door policy” being implemented by the Turkish Government and “host-migrant” discourse being adopted. In 2014, the *Temporary Protection Regulation* (Directorate General of Migration Management [DGMM], 2020; a) was issued especially for Syrians, whose numbers have increased steadily in Turkey. Although the situation and conditions of Syrians require them to become refugees, their legal status was designated as “temporary protection” in Provisional Article 1 of this regulation.

At the time of this writing (2020), Turkey hosts approximately 3.6 million registered Syrians, the vast majority of whom are facing the problem of obtaining shelter. Shelter is one of the most basic human needs and a human right guaranteed by international conventions such as Article 25 of the *Universal Declaration of Human Rights* (United Nations [UN], 1948) and Article 11/1 of the *International Covenant on Economic, Social and Cultural Rights* (United Nations Human Rights [UNHR], 1976). Because of this, one of the most important indicators of survival in a newly settled environment is whether or not the need for shelter is being met. Despite all the negativities that have taken place, the need for shelter of some of the Syrians in Turkey was solved by temporary accommodation centers consisting of tent and container camp sites in the short and medium term. However, Erdoğan (2018) noted that more than 93% of Syrians have dispersed in different urban areas and cities in Turkey. It is known that Syrians, especially lower income groups, prefer slum or previous slum areas for

living because of economic, religious and lifestyle similarities between the newcomers and the local inhabitants. These areas in major cities such as İstanbul have become the main sites of settlement for Syrians (Kılıçaslan, 2016).

There are several studies, reflecting the perspectives of several disciplines, about the life and the physical conditions of the temporary accommodation centers and refugee camps where many Syrians are living. However, there are not enough studies focusing on the development of a peaceful coexistence for ensuring both temporary and long-term adaptation, which is one of the most vital issues for both Syrians and their host communities and countries. The spatial aspect of adaptation needs to be taken into account along with its social, cultural, political, and economic aspects. In other words, it is essential to ensure peaceful living with local inhabitants to truly solve the problem of sheltering Syrians in Turkey (or sheltering any refugees anywhere, for that matter). Thus, finding a solution in the existing residential areas is socially, economically, and politically sustainable and humanely supportive in the long term.

In forced migration situations resulting from “push factors” such as civil war, conflict, persecution, coercion, and survival, home-making practices cannot be considered a process detached from previous life experiences. As Jansen and Löfving (2009) state the home making in new surroundings means establishing a new life in accordance with the life lost and left behind. Therefore, the perceptions of people’s personal and cultural identity are closely related not only to the loss of their homes, but also to their loss of “home”. Home is considered a socio-cultural unit and is mainly identified by the family. In addition, home is not only a place where daily life usually takes place, but also a “symbolic space” (Boccagni & Brighenti, 2015, p.1). The new home then becomes an important place where future expectations are built and traumas are rehabilitated, especially for displaced people and those forced to migrate.



As Rapoport (2005) states that “Habitat selection involves both rejecting or leaving undesirable, unsuitable, un-supportive, or inhibiting environments (what are called pushes) and seeking out desired, suitable, and supportive environments (what are called pulls)”, (p.11). The Sultanbeyli case is then explored in this study as it is a supportive living environment for displaced and forced migrated Syrians.

The aim of this study is to determine the home interior re-making practices of Syrian families based on their physical and psychological needs and cultural habits in the district of Sultanbeyli, where the practice of living together spontaneously developed. The data-gathering process of the study was based on visual research methods<sup>1</sup>, including the use of photographs, drawings, physical traces, and annotated diagrams for obtaining data regarding spatial use and cultural and behavioral habits of Syrians.

The paper begins with background regarding the concepts of house, home, and home-making and more specifically home re-making within the context of forced migration. Then follows a case study focusing on the home interior re-making practices of a participant group of Syrian families living in Sultanbeyli, in İstanbul, Turkey. The data collection, data analysis, and findings frame the study. Finally, the paper proposes conclusions and suggestions for future researches.

## 2. Background

As Somerville (1997) states, “An adequate theory of the meaning of home must explain it as a complex, multi-leveled or multi-dimensional construct” (p.226). Aside from negative meanings of home explored in gender studies as well as possible negative material and economic associations, the home, associated with private space and family and family life, is a physical, social, cultural, psychological, emotional, and symbolic place where privacy needs are met and family members are protected and secure.

Tuan (2011) emphasizes that the home is “a place where every day is multiplied by all the days before it.” (p.144). In this sense, “The house is a

physical unit that defines and limits the space for the members of the household” (Lawrence, 1987, p.155). However, Dovey (1985), Lawrence (1987) and Mallet (2004) states that “home” refers to the relationship and interaction between humans and spaces and contains symbolic, intangible, and invisible aspects. Hayward (1975), Dovey (1985), Lawrence (1987), Somerville (1997), (2012) and Kreuzer et al. (2017) define the different aspects of home through its physical, psychological, social, individual and cultural dimensions. To define a holistic conceptual framework, Fox (2011) groups multi-layered types regarding home as a “physical structure”, “territory”, “identity—as a symbol of one’s self” and a “social and cultural unit.”

Rapoport (1969) emphasizes the cultural dimension of home. According to him, the “house form is not simply the result of physical forces or any single casual factor, but is the consequence of a whole range of socio-cultural factors seen in their broadest terms.” (p.47). In addition, the cultural aspect of home is associated with worldviews, values, ideals, images, schemata, meaning, and so forth as well as lifestyle and activity systems (Rapoport, 2005). In this sense, behavioral patterns are very important components regarding lifestyle and activities. Altman’s (1975) approach is “to view the environment from a twofold perspective—as a determinant of behavior and as a form or extension of behavior.” (p.5). Lang (1987) states that changes in behavior depend on culture, environment, or various personal identities and structures.

Home-making prioritizes needs in the new location through consideration of activities, social relations, behavioral and cultural codes, needs, images, and symbols, both personally and communally. In this regard, sense of belonging, place attachment, and identity are quite effective parameters for establishing the relationship between people and their environment in the process of home-making. As Fox (2011) cited from Sixsmith (1986), “Home provides the spatial framework of the occupier’s life, and through its familiarity can foster a sense of belonging”, (p.10). Likewise, place attachment

is defined as “an emotional, affective bond between people and place” by Antonsich (2010, p.654), and Low and Altman (1992) explain it as “a complex phenomenon that incorporates several aspects of people-place bonding” (p.4) and argue that place attachment is “generated by the identification of place and person over time.” (p.179). In addition, the reflection of identity has a crucial role in the process of home-making, developing in time. As Rollero and Piccoli (2010) state that identity is more time-dependent compared to place attachment.

Rapoport (2005) states the importance of distinguishing the various elements as “fixed,” “semi-fixed,” and “non-fixed” in the home-making process. Altman et al. (1980) argue that “in contemporary situations, where people generally do not directly shape their environments, semi-fixed elements become particularly important and play a major role in personalization and other ways of expressing individual and group identity.” (p.12). In this sense, furniture, mementos, and other objects transform a house into a familiar place, that is, a home.

Boccagni (2020), mainly working on the migration-home relations, draws attention to migrants’ space appropriation and horizons of home making. According to him, the home re-making practices can be categorized into four; “ways of improving space,” “ways of enabling cultural reproduction and biographical continuity” and “ways of privatizing space” and “ways of beautification of space” (p.9). In addition, the home is identified as “the place or cultural context of migrants’ origins” (Kreuzer et al., 2017, p.335). Therefore, the background plays an important role for displaced people in the home-making process. it creates a tension between homeland and new cultural environment (Boccagni et al., 2020).

Considering these factors, it can be said that the loss of the home is a traumatic experience, particularly when the loss is outside of the person’s choice and control. As Esentepe and Günçe (2019) state, “Migration movement is one of the forcefull phenomena that affect the well-being of individuals.” (p.276). Therefore, it is important to create sup-

portive living environments for people who have been subjected to forced migration. As Fadlalla (2011) states, “Refugees who had lost their original homes many times find themselves lost and detached in new environments.” (p.139). In this sense, home re-making practices related to forced migration involve the lost and left behind living environment, that is, home and homeland and such connotations as culture, mementos, lifestyle, beliefs, values, and so forth. As Pala (2015) points out, home re-making can be read as practices to reconstruct a “place of existence” (p.88), which Fadlalla calls a “physical manifestation of identity” (p.139).

Loss of home is related to loss of economic assets (properties, goods, incomes) as well as loss of daily life practices, solidarity networks, and self-perception. Taylor (2015) depicts that “home and home-making are multi-layered and complex processes.” (p.154). In this sense, time (specifically the duration of time since leaving home and homeland) is the most important element in the home-making process of displaced people. In other words, the home-making is related to time as it is spatial (Pala, 2015). Additionally, the way “how migrants’ end eavours to make themselves at home” (Boccagni et al., 2020, p.9) are influenced by place, time and time-bound belonging and membership.

Studies in the fields of environment-behavior and social-cultural antropology reveal the importance of the relationship of culture, identity, and place with time in the construction of space and its meaning. In other words, they all affect the situation of being settled in the new environment. Developing a sense of belonging to a place over time, against the odds of being displaced from home and homeland, results in a better quality of life, better physical and mental health, more satisfying social relationships, and greater satisfaction with the physical and built environment. On the other hand, people who cannot develop a sense of belonging to their new home and home environment perceive their new home negatively compared with the previous one (Anton & Lawrence, 2014).

When displacement is due to forced migration, home has a meaning beyond its material and spatial aspects. In other words, the home is the place where a sense of belonging, place attachment, and identity are provided, where traumas are rehabilitated, and where there is a healthy return to daily activities and living habits. Thus, in the context of forced migration, home re-making constitutes an important practice for reconstructing domestic life blended with previous life perception and experiences and becomes a “place of existence in which relocation is built” (Pala, 2015, p.88) in the new environment.

### 3. The study

This study explores home interior re-making practices of Syrians who came to Turkey through forced migration to preserve their lives, safety, and security due to the civil war and conflict which has occurred in the Syrian Arab Republic since March 2011. As Biner and Soykan (2016) state that the process of re-making home has been focusing on future expectations. It is clear, however, that people’s past experiences are an important factor in establishing current and future expectations. The future is determined by past and current cultural ties and social and physical relations both within and with the newly settled place. For this reason, it is important to explore and understand the way of life, family structure, relationships, roles, habits, values,

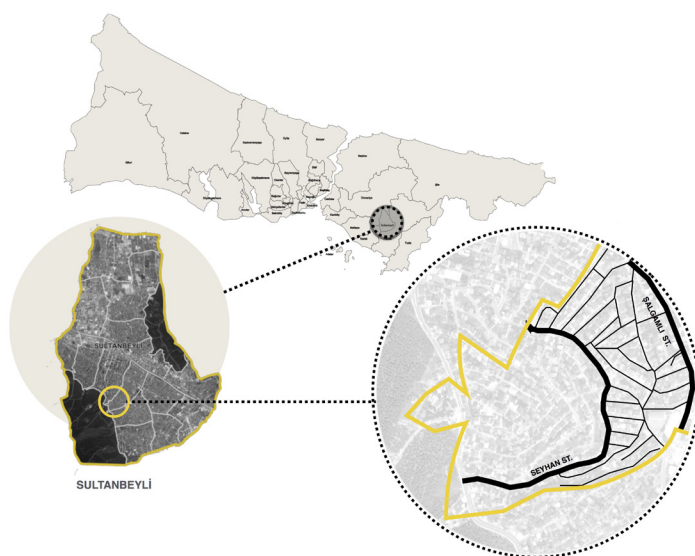
privacy thresholds, and behavioral and cultural codes in studies regarding home and the home environment. Within this larger context, the aim of this study is to determine the home interior re-making practices of Syrian families according to their cultural and living habits through visual research methods.

#### 3.1. Study area

The field study area was determined by literature-based research such as published reports of various institutions and organizations, information from the authorities carrying out research on related issues, and studies that were conducted in the previous stage of this study. The city of Istanbul accommodates the largest Syrian population in Turkey (DGMM, 2020; b), and the Sultanbeyli district hosts the largest Syrian population in Anatolian site of the city of Istanbul (Erdoğan, 2017); therefore, Sultanbeyli was designated as the study area (Figure 1).

Sultanbeyli is a unique place when compared with the other districts of Istanbul in terms of shelter, health, education, employment, and other services provided for Syrians by the Sultanbeyli Municipality. An old slum area, Sultanbeyli is preferred by Syrian families because they have similar beliefs (religious aspect), economic income, and cultural habits as the local inhabitants. In other words, Syrians prefer to live in environments that are similar to those they lived in back in Syria. This situation fosters the spontaneous social, cultural, psychological, and economic integration of Syrians with the locals and supports coexistent living practices between the two groups of people.

Sultanbeyli consists of 15 neighborhoods. However, Syrians mostly live in “Hamidiye Neighborhood,” “Mecidiye Neighborhood,” “Turgutreis Neighborhood,” “Abdurrahmangazi Neighborhood,” “Mehmetakif Neighborhood,” and “Fatih Neighborhood,” according to information obtained from the Coordination Center of Sultanbeyli Refugees and Asylum Seekers Assistance and Solidarity Association. Within this wider scope, the field study was limited to the area between Seyhan and Şalgamlı Streets in Fatih Neighborhood in



**Figure 1.** Study area, Sultanbeyli, Istanbul.

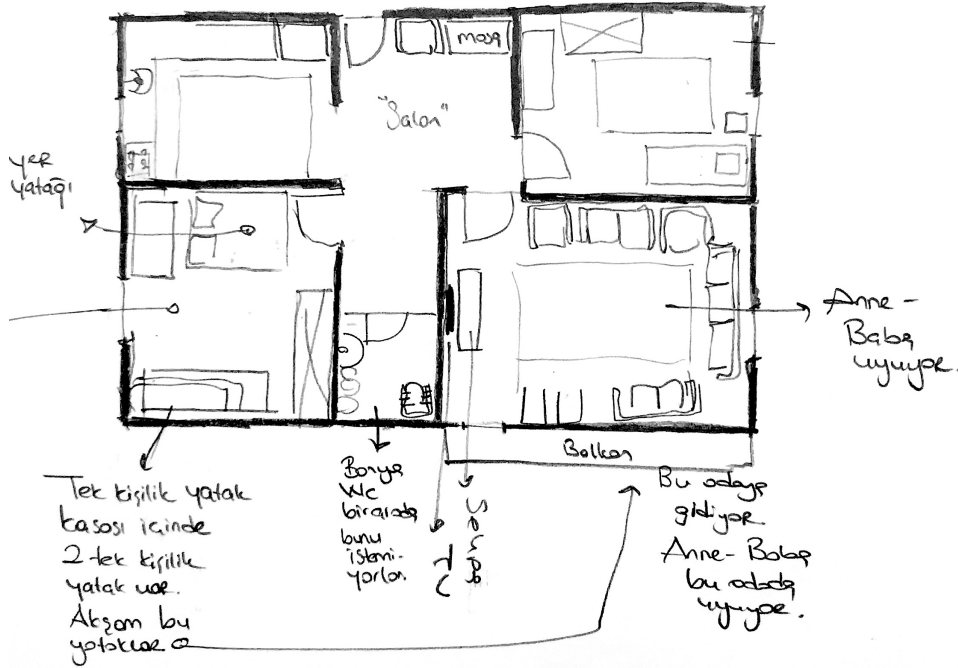


Figure 2. A schematic plan drawing at site.

Sultanbeyli district. It was determined that Syrians were living extensively in this neighborhood based on research conducted in 2017. Since the general housing typology in Sultanbeyli consists of 3-5 story apartment buildings, the study was limited to this type of building as well.

### 3.2. Participant group

As Rapoport (2005) states, it is “most important to consider the family when dealing with housing, particularly since many current changes in housing form and use are intimately related to various changes in the nature of the family unit” (p.111). Therefore, the participant group of the study consisted of 18 Syrian families of middle or lower income living in Fatih Neighborhood in Sultanbeyli district. Syrian Coordination Center [SUKOM], a web-based database developed by the Sultanbeyli Municipality, was used to determine the participants, who were selected randomly from among the 63 families considered adults (18+). The participants all signed the “Informed Consent Form” prepared in Arabic and Turkish and accepted site visits to their residences, that is, their home environments. There were two rounds of visits, one in January and February and the other one in June and July 2019.

### 3.3. Method

The data were collected through visual research methods. Data collected with visual research methods are a valuable source for observing, recording, and analyzing the visual characteristics of the physical environment to obtain initial ideas and insights. In addition, the use of visual research methods for obtaining data related to culture, space, and behavior in the home environment is quite common. Sanoff (2016) lists some of the many methods that can expand the recorded visual information base: diagramming, photo-interviewing, photo-sorting, mapping, notation, simulation, videotaping, and so forth.

Observing physical traces is a valuable visual method for obtaining qualified data as well. As Zeisel (2006) states, “Traces may have been unconsciously left behind (for example, paths across a field), or they may be conscious changes people have made in their surroundings” (p.159). Observing physical traces gives “an idea of what the people who use that place are like—their culture, their affiliations, and the way they present themselves” (Zeisel, 2006, p.159). The visual techniques used in this study were photographs, drawings, physical traces, and annotated diagrams. All materials were observed and recorded through field study at the sites, and 18



**Table 1.** Example of analysis table for visual data.

Family Code	Family Structure	Type of Plan	Place for Daily Activities	Place for Eating	Place for Sleeping	Place of Cushion Use
2201FE						
2201MA						
2301KZ						

EH: Entrance Hall L: Livingroom SR: Sleeping Room T: Toilet B: Bathroom K: Kitchen S: Storage

**Figure 3.** a. Example of housing with the plan scheme of an entrance hall. b. Example of housing with the plan scheme of a corridor.

families were visited in their residences. The photos were filtered, and video and audio recordings were not taken to ensure the personal privacy, rights, and security of the participants. Besides configuring family structure and composition, schematic plan drawings were created to define the floor-plan typology, spatial use and organization, furniture layout, activities, privacy thresholds and personalization, and the identification of the space through display of self (Figure 2). In addition, Zeisel's (2006) classification of physical traces used to analyzed the obtained data.

### 3.4. Analysis and findings

The data obtained through visual research methods were analyzed, interpreted, and evaluated in two steps:

- The first step involved the analysis and findings of visual data regarding family structure, floor-plan

type, space use and organization, and furniture layout.

- The second step involved the analysis and findings of visual data regarding physical traces.

#### 3.4.1. Analysis and findings of visual data regarding family structure, floor-plan type, space use and organization, and furniture layout

In the first step, the data, which were collected from 18 houses, were recorded with the help of analysis tables (Table 1), and the following information was obtained:

- Family structure and compositions were schematized,
- Floor-plan types were categorized either "plan schema with entrance hall" (EH) or "plan schema with corridor" (C),
- The daily living space was determined,

- The eating area and its equipment (i.e., dining table or ground sofa) were defined,
- The bedroom(s) were determined in terms of family structure, relationship, roles, gender, and privacy thresholds, and
- The use of ground cushions and floor mattresses was determined.

According to the findings obtained from the study, the families (nine of them had extended family structure, five of them had nuclear family structure, and one consisted of multi-nuclear families) had large households and crowded living habits whether they were living in extended or nuclear families. Since Sultanbeyli has been an old slum area, the floor-plan typology has traces of the traditional housing schema with “intermediary space”, that is, an entrance hall; 11 of the 18 houses had a floor-plan schema with “entrance hall” and 7 of them had a plan schema with “corridor.” (Figure 3 a&b).

The plan schema with “entrance hall” best supports the Syrians’ living habits. The term “mamak” in the Syrian native language, is used to describe this space. This room is used as an intermediary space into which other rooms’ doors open and a daily living room for the household’s different activities. In three of the houses visited during the field study, the daily activities took place in this space, while in other houses the daily living area was still the living room.

Meals were eaten in the living room and at the ground table in 15 families. The other three families can be considered exceptions. In this case, one family ate in the entrance hall at the dining table, whereas the other two families ate in the entrance hall at the ground table.

The visual data for identifying the bedroom(s) show that, in most cases, family members of different ages slept together according to factors such as hierarchy, gender, and privacy. The individual bedroom seen only in one family consisted of a widowed mother and her son and daughter. In three cases, the parents had a separate room for sleeping, whereas the children slept together.

The use of ground cushions and floor mattresses, identified as cultural fittings, was seen in most residences (in 12 of 18 families). One of the 12 families used the ground cushions for sleeping, two used them for sitting, and the other nine families used them both sleeping and sitting. In addition, it was determined that these families used ground cushions in their daily living room but the floor mattresses in their bedroom. Additionally, the ground cushions used for sitting were not stacked, whereas the floor mattresses used for sleeping were stacked neatly, mostly in the bedrooms. This indicates that there is a difference between day and night use of ground cushions and floor mattresses.



**Figure 4.** Example of analysis chart for recording physical traces.



**Figure 5.** Ground cushion usage in daily living area.

The data obtained in this step show that the Syrians studied, whether they have an extended or nuclear family structure, have large households and a crowded family life. Families, living in housing with a similar plan schema to that found in Syria, use their residences in accordance with their own living habits. The daily living room is a core place within the household for socializing and engaging in different activities. The majority of families have a tendency to eat their meals at the ground table in this room. In addition, it is quite common to use ground cushions for sleeping, resting, and sitting activities in the daily living room and to use floor mattresses for sleeping in bedrooms. Family roles, hierarchy, gender, and privacy are important factors for organizing spaces as well.

### 3.4.2. Analysis and findings of visual data on physical traces

In the second step, the physical traces observed from the field study were showed on the schematic plan drawings. In addition, the physical traces were shown with the help of the photographs

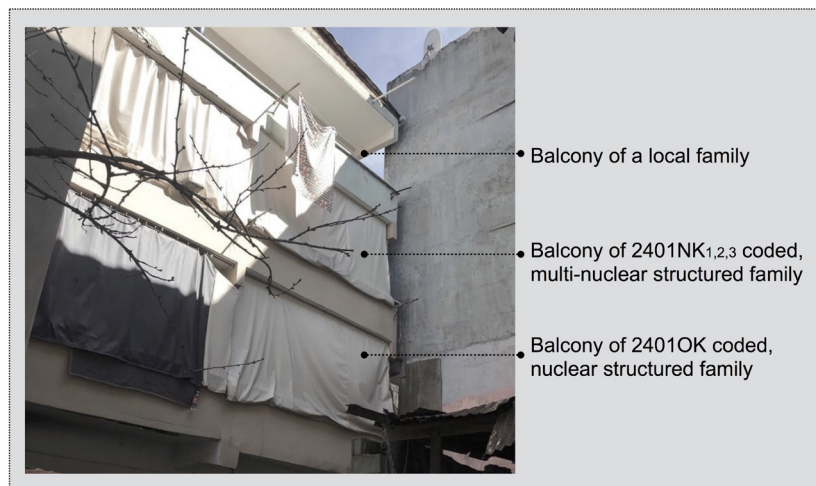
and descriptive notes on the analysis chart created for each single house visited during the site visit (Figure 4).

The spatial use (living space, bedrooms, kitchen, wet areas like bathroom and toilets, etc.) was marked and the furniture layouts were drawn on the schematic plans. Thus, data about the living habits and the means of self-expression of the Syrian families were obtained through observing and recording physical traces. The data obtained were analyzed according to Zeisel's (2006) classification of physical traces as follows:

- By-products of use
- Adaptations for use
- Display of self
- Public messages

By-products of use were quite visible in the use of ground cushions, which can be considered a cultural fitting. It showed that this fitting could be used for sitting, sleeping, and so forth in the day time, whereas it was used for sleeping at night. It also proved that the living room was used for multiple activities, which occurred in this space day and night (Figure 5). Additionally, due to religious beliefs, some toilets were not used because they were facing towards Qibla (the direction faced when praying in Islam religion). In addition, it was observed that most of the families, even if they had dining table in the kitchen, ate at the ground table in the daily living room.

*Adaptations for use* is a very broad category. For example, the use of a curtain both ensures the household's need for privacy is met and separates spaces. In some residences, the wet areas open to the entrance were separated by a curtain, and the wet spaces, if the bathroom and toilet were located in the same



**Figure 6.** Use of curtain for providing privacy and storage area in balconies.





Figure 7. Use of entrance for a daily living space.

space, were divided with a curtain as well. In the field study, it was observed that the transparent parts of a room's doors were closed by using curtains or hanging various items. Curtains were used in outdoor spaces to provide privacy and increase storage capacity as well. Additionally, the exterior windows and doors of the residences were painted or coated with layers of film to ensure individual and family privacy (Figure 6).

Syrian families converted appropriate areas into storage areas that can also be evaluated in this category. Interventions made by Syrian families to increase storage areas in their home interiors were not limited to the kitchen space. Existing furniture was also used for storage purposes other than its usual functions (e.g., using the display case as a wardrobe, using the cradle as storage for quilts and pillows, and so forth). Shelves were also added to the walls for maximizing storage capacity. The propositions made according to life habits can also be considered in this category. Syrians, who are used to living in a warm climate, used balconies as a living space, especially in the summer season. More specifically, the use of the entrance as a living area is a spatial proposition that can be considered a reflection of the living habits in Syria (Figure 7).

The data obtained within the scope of *displays of self* are seen in the use of ground cushions for sitting, reclining, sleeping, eating and drinking, and so on. It can be considered a cultural non-fixed fitting element for maintaining the seating habits of the Syrians on the ground. In addition, the mementos (Arabic handwritings, family photos, drawings, jewellerys, toys, kitchen equipments, etc.) and the objects (calendars, religious objects, laces, vases, flowers, bird cages, and various other orna-

ments), which are symbols of pleasure, appreciation, and belonging, express both individual and cultural examples of display of self. It was quite common to see personal care products, dressing and making up items, and cosmetics in the bedrooms of Syrian women (Figure 8). The use of mirrors (sometimes with the comb and other cosmetics) in the kitchen space is another remarkable example of displaying of self.

Some Syrian families reflected their desires, wishes, and expectations through *public messages*. In one family, newspaper clippings showing the pictures of the youngest girl of the family with Turkish politicians could be considered in the categories of personalization and public message. In this family, the large-sized photographs of Turkish politicians were also remarkable. Another example of public message is the use of the Turkish flag. It can be said that the Syrian families use the Turkish flag in indoor and outdoor spaces of their residences to avoid negative discrimination and to be accepted by the locals (Figure 9). In other words, it should be



Figure 8. Display of personal items.





**Figure 9.** Using Turkish flag at indoor and outdoor surfaces.

taken into account in public messages as an indicator of the desire for adaptation and living together with the host society. Additionally, the Syrian teenage girl who wrote Descartes's statement, "I think; therefore, I am" on the wall board conveyed a message about herself at the same time.

The data obtained in this step show that the daily living room is used for both day and night and that privacy is an important need in spatial organization as well as for the household. Privacy within the house is provided by division of wet areas, bedrooms, and other spaces. It was also observed that appropriate areas are used for storage purposes and places such as balconies and entrances are converted to other types of use according to previous cultural and living habits. In addition, the use of objects, furnitures and accessories are related to display of self. As Boccogni and Brighenti (2015) stated, the deployment of a range of objects imported or brought back from the country of origin recall the homeland. In this sense, these objects, furnitures and accessories provide display of self through personalization, enable identity, and convey messages in both indoor and outdoor spaces. In contrast, it was observed that there were limited interventions to the fixed elements consisting of walls, floor, and ceiling in the home interiors. This can be explained by the fact that Syrians are tenants and that most have a low income.

#### **4. Conclusion and future recommendations**

Turkey has become the new home for millions of displaced and forced migrated Syrians. The home interior re-making practices of Syrians are related to the life lost and left behind. In this sense, this study focuses on this

issue through the Sultanbeyli case. The field study was conducted within the borders of Fatih Neighborhood, between Seyhan and Şalgamlı Streets with 45 adults belonging to 18 Syrian families, who voluntarily participated in the study and were visited in their residences. The data were obtained through visual research methods through the techniques of photographs, drawings, physical traces, and annotated diagrams.

In this study:

- Family compositions of participating families were determined and floor-plan type, spatial use and organization, and furniture layout were shown on schematic plan drawings; and
- Physical traces were observed, visualized, and grouped.

The results obtained from the study shows that the Syrian families made new propositions to the existing living environment and they organized their home environments and its interiors according to their needs. It was determined that the family roles, hierarchy, gender, privacy and living habits are very effective factors influencing spatial use and space organization. These factors are also a strong bond to the cultural and behavioral codes (i.e., living habits) of Syrians. In addition, non-fixed and semi-fixed furniture and fittings are very important elements for appropriation of space in home re-making processes and practices. Regarding display of self, objects and culturally based furniture and accessories are considered as important physical traces for identification and personalization for displaced and forced migrated Syrians.

Besides being a physical structure, the home is a meaningful entity and a relationship between people and

space that helps construct place attachment and a sense of belonging and identity. These issues are also tightly connected to the passage of time. In this sense, home re-making is a process of cultural hybridization, depending on the relationship with the new settled place and with the local culture in time. In this sense, it is important to keep track of changes in residential areas as well as those conveyed from the previous way of life and to conduct new studies at regular intervals with the target groups regarding the home re-making practices of displaced and forced migrated people. In this way, it will be possible to obtain data regarding cultural hybridization over time through visual research methods as well as a combination of ethnographic methods for further studies.

The data obtained from this field study and the analysis of these findings are intended to produce new research inquiries and studies for construction of space and its meaning based on 'sense of belonging', 'place attachment' and 'identity' regarding the home environments and home re-making practices of displaced and forced migrated people. In addition, the findings of the study are to contribute to various departments and units of the Sultanbeyli Municipality, especially the Sultanbeyli Refugee Community Center, Sultanbeyli Refugees and Asylum Seekers Assistance and Solidarity Association (RASAS) and other NGOs, relevant stakeholders such as architects, interior architects and designers, developers, furniture designers and producers, academician, researchers, politicians, private and public institutions and organizations, and Syrians in Turkey for ensuring peaceful adaptation and co-existence between displaced Syrians and their host communities and societies.

## Endnotes

<sup>1</sup> Data collection has been obtained through with visual and ethnographic methods and the technic of questionnaire in the research project, which was funded by The Scientific and Technological Research Council of Turkey (TUBITAK). Within the scope of the mentioned research, this study focus-

es on the data collection with visual research methods and accentuate the data through it.

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# Evaluating effectiveness of LED and OLED lights on user visual comfort and reading performance

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## Abstract

In interior architecture, one of the main purposes of light is to create comfortable and functional spaces according to user needs. Light provides individuals to understand, get information for visual tasks and it affects how they experience and behave in the environment. Desired illuminance levels are required for visual comfort and task efficiency. This study analyzes the effects of different illuminance levels of light emitting diode (LED) and organic light emitting diode (OLED) lights on user visual comfort and reading performance. An experiment was conducted with eighty interior architecture students at Çankaya University. Six lighting scenarios were created with LED and OLED lighting sources that assessed six visual comfort criteria. The experimental setting consisted of three different illuminance levels, as 200, 500 and 800 lx. The results revealed that different illuminance levels were found more comfortable for different visual comfort criteria, but the illuminance level of 500 lx was visually more comfortable than the other illuminance levels. The illuminance level of LED 200 lx was visually more comfortable than LED 800 lx. OLED light was found visually more comfortable than LED light. In addition, participants read slower under the illuminance level of LED 200 lx. It was concluded that illuminance levels of light effect user's visual comfort and reading performance. This study provides a basis to recommend the preferred illuminance level for LED and OLED light during a reading performance.

## Keywords

Illuminance level, LED, OLED, Reading performance, Visual comfort.

## 1. Introduction

Light is the application and energy that supports user – environment interaction through natural and artificial light sources. It is an essential requirement for users that affect their motivation of work-related tasks, health and well-being. In interior spaces, one of the main purposes of light is to create comfortable and functional spaces for users to do their daily activities. Optimal levels of light increase the performance, comfort, motivation and interpersonal communication of users (Borisuit, Linhart, Scartezzini & Münch, 2015).

Since 1990s, a good qualified lighting has been a fundamental criterion for interior spaces; it has been provided for users and evaluated during tasks as naturally and/or artificially. Optimal levels of light for visual performance have been investigated (Bellia, Bisegna & Spada, 2011). When natural light is insufficient in a space, artificial light systems are additionally used in order to obtain the comfortable levels. With the technological developments, light has been researched with respect to its qualitative and quantitative characteristics (Shen, Shieh, Chao & Lee, 2009). These studies have increased the realization and the usage of artificial light systems. By changing the colour temperature, colour rendering, luminous flux of light, or lamp type, various light fixtures have been manufactured that offer diversity to satisfy user needs. However, some researches have considered the effects of illuminances on visual comfort and user performance. Boyce et al. (2006a) found no effects and Veitch and Gifford (1996) found that giving personal control over lighting conditions led to slower working and lower productivity. Aries (2005) found that higher illuminance, especially a high vertical illuminance (at the eye), have a positive effect on these aspects and are associated with less fatigue. In the work of Smolders, de Kort and Cluitmans (2012), higher illuminance at eye level can induce vitality and improve performance on a task.

According to European standards (TS EN 12464-1), a convenient illuminance for a reading task is 500 lx; however, illuminance can be adjust-

ed according to user needs (European Standards, 2002). Several studies showed that illuminance have an effect on user's performance, speed and comfort (Avcı & Memikoğlu, 2016; Boyce et al., 2006b; Dubois et al., 2016). Various studies indicated that users generally prefer illuminance that is lower than recommended by the standards (Boyce et al., 2006b; Newsham, Mancini & Marchand, 2008). According to Smolders et al. (2012), one of the most important quantitative features of light is the illuminance that effects visual comfort and performance of users.

With the development of light technology, several lighting fixtures have been produced. While fluorescent and other lamp types are widely used, newer technologies such as LED lamps and OLED panels have become more advantageous. In comparison to LED, OLED has a flexible shape, low power consumption, flexibility in usage and long-life span (Hawes et al., 2012). OLED, as the next step of the Solid State Light (SSL) technology that is environmentally friendly lighting technology, has mainly been used in digital cameras, aircraft instruments, automobiles, mobile phones and television industry. Only very recently has the market began to offer OLEDs useful for lighting and not as systems for screens in electronic applications. It is important to investigate their performance in this kind of application. It is necessary to remember that the visual comfort of a lighting system consisting of artificial light sources that is linked to the luminance distribution, illuminance, directionality of light, variability of light, colour rendering and colour temperature, glare, and flicker in the work environment (BSI Standards, 2015).

Emphasis is given to SSL sources especially LED and OLED as the new research area of artificial light sources. This study considers OLED as an element in an interior environment affecting user visual comfort and task performance and compares it with LED. It aims to analyze the effects of different illuminances of LED and OLED lights on user visual comfort and reading performance. It also targets to research whether LED light or OLED light is comfortable, since there

is insufficient research on the relationship between illuminances, user visual comfort and reading performance. In addition, there is insufficient research on the correlation of illuminances of LED and OLED lights. Thus, this study intends to analyze these research topics.

Visual comfort plays an important role in the quality of users in an environment (Xu et al., 2017). In order to guarantee an appropriate visual comfort in an environment, discomfort glare should be avoided, the position of the light source should be considered and a convenient illuminance should be provided. Avcı & Memikoğlu (2016) analyzed the effects of different illuminances on visual comfort. LED and halogen lamps with illuminances of 150, 300 and 450 lx were used in the experiment. They found that 150 lx was generally uncomfortable for both LED and halogen lamps; however, 300 and 450 lx were visually comfortable for both types of artificial light sources. Studies have been conducted to analyze the productivity and performance of users in working environments (de Korte et al., 2015; Chang, Chou, & Shieh, 2013). Evaluation of the working environment is directly related to job satisfaction. As a result, visual comfort and task performance are fundamental criteria in working environments. Lighting conditions in reading environments promote a diversity of effects related to visual comfort, work satisfaction, reading performance and productivity (Borisuit et al., 2015). The light quality in reading environments is not only determined by the light on the visual task, but also the amount of light entering the eye that makes users feel healthy, causes sufficient work performance, fewer absenteeism and fewer accidents (van Bommel & van den Beld, 2004).

In reading environments, satisfaction of lighting is related to work plane illuminance, ratio of horizontal and vertical illumination, and direct glare (Borisuit et al., 2015). Visual comfort parameters are identified by the standards, but they are reluctant to change with respect to user requirements and their environments. Interpersonal preferences of illuminances have been researched and it has been reported that no more than 50% of users feel com-

fortable within 100 lx of illuminance on a reading plane (Newsham & Veitch, 2001). Fotios and Cheal (2010) found that preferred illuminances are close to the mean of available illuminance ranges that affects the overall illuminances preferred by users.

## **2. Methodology**

### **2.1. Research questions**

1. Is there a statistically significant difference between illuminances on users' visual comfort?
2. Is there a statistically significant difference between the illuminances of LED and OLED lights on users' visual comfort?
3. Is there a statistically significant correlation between illuminances on reading performance?

### **2.2. Hypotheses**

1. The difference between the illuminances is statistically significant. For both types of light sources, 200 lx is more comfortable than 500 lx and 800 lx.
2. There is a statistically significant difference between LED and OLED lights. OLED light is more comfortable than LED light for all illuminances.
3. There is a statistically significant correlation between the effects of different illuminances on reading performance. The participants read under the illuminance of 200 lx faster than other illuminances for both types of artificial light.

### **2.3. Participants**

The sample group consisted of the senior students of the Department of Interior Architecture at Çankaya University. Eighty students were chosen randomly among all students. As senior students they were familiar with physical and psychological properties of natural and artificial lights due to the course "INAR 209 Natural and Artificial Lighting" that they took during the second year of their education. The participants had normal or corrected to normal vision with glasses or contact lenses. There were 40 females and 40 males that were aged between 19 to 30 years (mean age was 22.74) in order to avoid the influences of age-related effects.

## 2.4. Experimental setting

The experiment was conducted in an office located on the first floor of block B building that faced North. The test cabin was located on the left corner of the office (see Figure 1) and measured 1.60 m x 2.60 m x 2.80 m. White curtain was used around the cabin to eliminate the effects of coloured light in the room. Except for the flooring, all the surfaces and furnishings (dimensions of white table: 1.20 m x 0.80 m x 0.80 m) in the cabin were white. A white table and a stool were used in the cabin during the test. The test cabin is shown in Figure 2.

In order to understand the effects of different illuminances of LED and OLED lights on user visual comfort, the illuminances were determined for each light source. The lower and higher illuminances were investigated. According to the European standard EN 12464-1, which is also accepted as Turkish standard (TS EN 12464-1), the standard illuminance for reading, writing and data processing in an office environment is 500 lx. The lowest illuminance is stated as 200 lx for archives and the upper level for offices is stated as 750 lx for technical drawings. Although the upper illuminance is 750 lx for offices, 800 lx was identified in order to have an equal increment of illuminances as above and below the standard. So, three illuminances were identified as 200 lx (below standards), 500 lx (as standards), 800 lx (above standards). After contacting with the suppliers about the characteristics of the products and analyzing their IES (Illuminating Engineering Society) files, DIALux Evo 6.1, which is the lighting design program used in order to decide the number of LED lamps and OLED panels. Five LED lamps and ten white OLED (WOLED) panels were utilized to obtain the mentioned three illuminances (200, 500 and 800 lx). The light setting was designed accordingly. It consisted of a white frame that was installed to carry the suspended five LED lamps, ten WOLED panels and their drivers. The illuminance level depends on luminous flux as specified by the product manufacturer and their position with respect to the surrounding environment. The light setting was

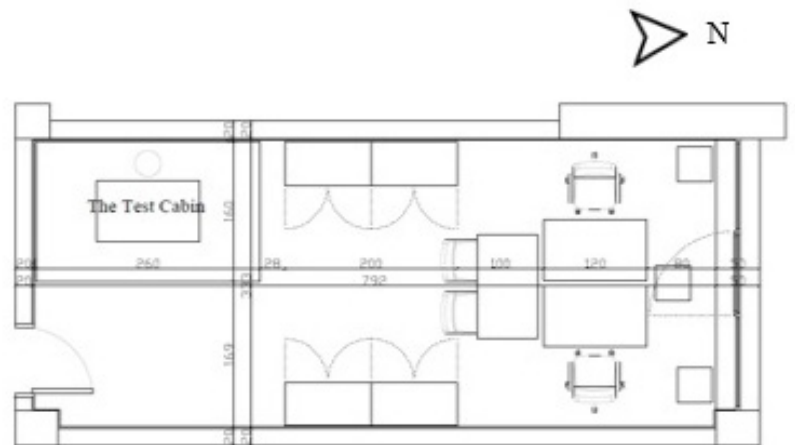


Figure 1. Plan of the office.

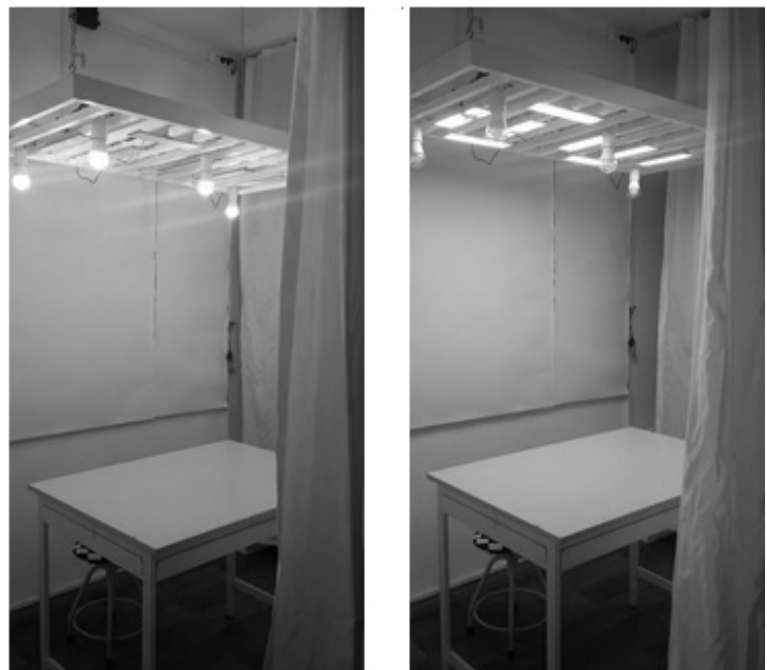





Figure 2. Test cabin (LED lamps and white OLED panels) (Avci, 2017).

suspended from four points by chains and the height from the floor was 2.20 m. All artificial light sources were placed at the ceiling level. According to the research of Ferlazzo et al., (2014), they were also placed over the center of the desk to avoid glare or reflections on the paper. Three electrical systems that were connected in series were used to turn on the lamps. LED lamps and WOLED panels were controlled by a dimmable switch separately. Two adaptors were used for the WOLED panels and their drivers. The properties of LED lamp, WOLED panel and WOLED panel driver are shown in Table 1. The WOLED has different types of materials that can adjust the emitting peak wavelength enabling it to be



**Table 1.** Properties of LED lamp, WOLED panel and WOLED panel driver.

Brand/Model	Dimension	Lumen	CCT	CRI	Product
Osram LED Star Classic A 60	11 cm x 6 cm	806 lm	2700 K	≥80	
Philips Lumiblade OLED Panel Brite FL300 L WW	24.8 cm x 7 cm	300 lm	2900 K	80	
Philips Driver D024V 10W/0.1-0.4A/28V D/A	5.8 cm x 5 cm				

a good and eco-friendly product for users (Zhang, Xia & Yan, 2016). LED lamps and OLED panels have the same technical properties. Illuminance levels inside the cabin were measured on the four corners of the table with the TES 1332A Illuminance Meter (range of 0.01 to 200.000 lx).

## 2.5. Procedure

The experiment was conducted between 3rd and 21st of October, 2016. Before each experiment, the participants were informed about the setting and the procedure. The experiment was conducted in the morning due to the cortisol (stress hormone) and melatonin hormones (sleep hormone) that play an important role on alertness and sleepiness. The cortisol hormone level increases in the morning to prepare the body for daily tasks (van Bommel & van den Beld, 2004). It remains in a high level over in the morning hours. However, there was no daylight penetration during the experiments; since it was blocked by blinds. Several studies indicated that time awake, hours of sleep, time spent outside, travelling across time zones, drinking coffee and smoking cigarettes are very important factors that affect task performance (Fortunati & Vincent, 2014; Hawes et al., 2012). Before the experiment, all participants declared that they had adequate sleep, did not travel across time zones nor spend time outside nor drank coffee or smoked cigarette.

## 2.6. Questionnaire

The questionnaire consisted of seventeen questions that were taken from “Office Lighting Survey” questions generated by Eklund and Boyce in 1996 (Sivaji et al., 2013). The reliability of

these questions was determined statistically (Cronbach Alpha = 0.928). The questionnaire was divided into three parts. The first part consisted of four questions that aimed to obtain general information about the participants.

Before starting the test, participants were told that they should pay attention to the punctuations when reading the texts. The second part was divided into six sub-parts. All the sub-parts had the same questions, but the reading texts that the participants were given to read were different. Since reading on paper is more comfortable than reading on screen-keyboard for users, this method is useful for speed reading (Fortunati & Vincent, 2014). Thus, participants read six reading texts on white A4 papers that were the abstracts of six books. The books were “Little Prince”, “My Left Foot”, “Pomegranate Tree”, “Of Mice and Men”, “My Sweet Orange Tree” and “Madonna in a Fur Coat”. These were chosen due to their popularity. In order to reduce the risk of memorization, abstracts of different books were selected. The word count of the reading texts was 380. In the sub-parts, familiarity with the books from which the reading texts were selected from were indicated. A seven-point Likert scale was used to evaluate the visual comfort criteria while reading the texts (see Appendix A). These criteria were indicated as visual distraction, visual clarity, visual fatigue, eye burning, focusing problem and glare. The questionnaire was approved by the university ethics board. The last part of the questionnaire aimed to get general information about all the illuminance levels.

Some studies have concluded that font character effects the visual performance and 12-point Times New Roman font style is comfortable (Fortunati & Vincent, 2014; Shen et al., 2009). Thus, the questionnaire and reading texts were printed in black ink on white A4 papers with the 12-point Times New Roman font style.

There were six lighting scenarios in the experiment that consisted of different illuminance levels (LED 200 - 500 - 800 lx and OLED 200 - 500 - 800 lx) and reading texts. Lighting scenarios were carried out in random to avoid the

adaption of the eye. When the participants started to read the reading text, their reading speeds were timed. After the reading, participants answered the questions related to each scenario and got out of the test cabin. In between each lighting scenario, participants had time to rest about five minutes and they continued with the next scenario in the same way. The duration time for a participant was about forty minutes. The average reading speed for each text was between 150 and 190 seconds. All of the participants answered the questions in the same order.

### 3. Results

In the analysis of the data Statistical Package for the Social Sciences (IBM Corp. SPSS) 20.0 program was used. Results from the statistical analysis were given with respect to the stated research questions. According to the results, the participants mostly rated their current physical condition on a seven-point Likert scale as being "little tired" (33.8%) and "normal" (28.8%). The second part of the questionnaire was divided into six sub-parts. The reading texts were different, but the questions were the same. The participants were familiar with the first reading text more than others, but they read the fourth and sixth reading texts slightly quicker than the others. The results of the second part of the questionnaire are presented in Table 2.

According to the second part of the questionnaire, six visual comfort criteria were evaluated with respect to the illuminances of LEDs and OLEDs (200 - 500 - 800 lx). In order to find out the effects of illuminances on users' visual comfort, ANOVA was conducted. Visual comfort criteria correlated with each three illuminances and evaluated separately by statistical data.

#### 3.1. Related to the illuminances of OLED light

Visual Distraction: The mean of participants for OLED 500 lx ( $M = 6.03$ ,  $SD = 1.28$ ) was slightly higher than that of the OLED 200 lx ( $M = 5.66$ ,  $SD = 1.68$ ) and 800 lx ( $M = 5.16$ ,  $SD = 1.90$ ). There was a statistically no considerable difference between 200 and 500 lx on users' visual comfort in this

**Table 2.** Details of the second part of the questionnaire.

Reading Text	Familiarity	Light Source	Illuminance Level	Mean Reading Speed
Little Prince	71 (88.8%)	LED	200 lx	1.90 (SD = 0.56)
Pomegranate Tree	9 (11.3%)	LED	800 lx	1.83 (SD = 0.50)
My Left Food	38 (47.5%)	LED	500 lx	1.61 (SD = 0.42)
Of Mice and Men	48 (60.0%)	OLED	200 lx	1.50 (SD = 0.45)
Madonna In a Fur Coat	69 (86.3%)	OLED	800 lx	1.69 (SD = 0.49)
My Sweet Orange Tree	62 (77.5%)	OLED	500 lx	1.50 (SD = 0.43)

criterion (Wilks'  $\Lambda = 0.78$ ,  $F(3,80) = 10.76$ ,  $p = 0.040 < 0.05$ ). However, there was a statistically significant difference between 500 and 800 lx on users' visual comfort in this criterion ( $p = 0.000 < 0.05$ ). According to these results, 500 lx is visually more comfortable than 800 lx in terms of visual distraction. Results are shown in Table 3.

Visual Clarity: The mean of participants for OLED 500 lx ( $M = 5.98$ ,  $SD = 1.38$ ) was slightly higher than that of the OLED 200 ( $M = 5.80$ ,  $SD = 1.53$ ) and 800 lx ( $M = 5.14$ ,  $SD = 1.78$ ). There was a statistically no significant difference between 200 and 500 lx on users' visual comfort in this criterion (Wilks'  $\Lambda = 0.83$ ,  $F(3,80) = 8.06$ ,  $p = 0.335 > 0.05$ ). However, there were a statistically significant difference between 200 - 800 lx and 500 - 800 lx on users' visual comfort in this criterion ( $p = 0.005 < 0.05$ ,  $p = 0.000 < 0.05$ ). According to these results, 200 lx is visually more comfortable than 800 lx; 500 lx is visually more comfortable than 800 lx in terms of visual clarity. Results are shown in Table 3.

**Table 3.** Results of visual distraction and visual clarity.

Visual Distraction		
	200-500 lx	500-800 lx
No Sig. Dif.		
Sig. Dif.	p = 0.040 < 0.05	p = 0.000 < 0.05

Visual Clarity			
	200-500 lx	200-800 lx	500-800 lx
No Sig. Dif.	p = 0.335 > 0.05		
Sig. Dif.		p = 0.005 < 0.05	p = 0.000 < 0.05

**Visual Fatigue:** The mean of participants for OLED 500 lx ( $M = 5.50$ ,  $SD = 1.59$ ) was slightly higher than that of the OLED 200 ( $M = 5.38$ ,  $SD = 1.71$ ) and 800 lx ( $M = 4.51$ ,  $SD = 1.89$ ). There was a statistically no significant difference between 200 and 500 lx on users' visual comfort in this criterion (Wilks'  $\Lambda = 0.78$ ,  $F(3,80) = 10.76$ ,  $p = 0.517 > 0.05$ ). However, there were a statistically significant difference between 200 - 800 lx and 500 - 800 lx on users' visual comfort in this criterion ( $p = 0.001 < 0.05$ ,  $p = 0.000 < 0.05$ ). According to these results, 200 lx is visually more comfortable than 800 lx; 500 lx is visually more comfortable than 800 lx in terms of visual fatigue. Results are shown in Table 4.

**Burning Eye:** The mean of participants for OLED 500 lx ( $M = 5.98$ ,  $SD = 1.47$ ) was slightly higher than that of the 200 ( $M = 5.95$ ,  $SD = 1.52$ ) and 800 lx ( $M = 5.14$ ,  $SD = 1.91$ ). There was a statistically no significant difference between 200 and 500 lx on users' visual comfort in this criterion (Wilks'  $\Lambda = 0.80$ ,  $F(3,80) = 10.00$ ,  $p = 0.893 > 0.05$ ). However, there were a statistically significant difference between 200 - 800 lx and 500 - 800 lx on users' visual

comfort in this criterion ( $p = 0.000 < 0.05$ ). According to these results, 200 lx is visually more comfortable than 800 lx; 500 lx is visually more comfortable than 800 lx in terms of burning eye. Results are shown in Table 4.

**Focusing Problem:** The mean of participants for OLED 500 lx ( $M = 5.90$ ,  $SD = 1.37$ ) was slightly higher than that of the 200 ( $M = 5.46$ ,  $SD = 1.79$ ) and 800 lx ( $M = 4.76$ ,  $SD = 1.92$ ). There was a statistically significant difference between 200 and 500 lx in this criterion (Wilks'  $\Lambda = 0.77$ ,  $F(3,80) = 12.00$ ,  $p = 0.026 < 0.05$ ). There were a statistically significant difference between 200 and 800 lx ( $p = 0.005 < 0.05$ ) and 500 and 800 lx in this criterion ( $p = 0.000 < 0.05$ ). According to these results, 200 lx is visually more comfortable than 800 lx; 500 lx is visually more comfortable than 800 lx in terms of focusing problem. Results are shown in Table 5.

**Glare:** The mean of participants for OLED 200 lx ( $M = 6.35$ ,  $SD = 1.19$ ) was slightly higher than 500 ( $M = 6.07$ ,  $SD = 1.41$ ) and 800 lx ( $M = 4.72$ ,  $SD = 2.03$ ). OLED 200 lx was more comfortable than others. There was a statistically no significant difference between 200 and 500 lx on users' visual comfort in this criterion (Wilks'  $\Lambda = 0.61$ ,  $F(3,80) = 25.17$ ,  $p = 0.074 > 0.05$ ). However, there was a statistically significant difference between 200 and 800 lx on users' visual comfort in this criterion ( $p = 0.000 < 0.05$ ). According to these results, 200 lx is visually more comfortable than 800 lx. Results are shown in Table 5.

**All Criteria:** The mean of participants for OLED 500 lx ( $M = 35.46$ ,  $SD = 6.40$ ) was slightly higher than 200 ( $M = 34.60$ ,  $SD = 7.24$ ) and 800 lx ( $M = 29.44$ ,  $SD = 9.02$ ). There was a statistically no significant difference between 200 and 500 lx on users' visual comfort generally (Wilks'  $\Lambda = 0.65$ ,  $F(3,80) = 20.62$ ,  $p = 0.234 < 0.05$ ). However, there was a statistically significant difference between 200 lx - 800 lx and 500 lx - 800 lx on users' visual comfort in general ( $p = 0.000 < 0.05$ ). As a result, 200 lx is visually more comfortable than 800 lx; 500 lx is visually more comfortable than 800 lx in general.

**Table 4.** Results of visual fatigue and burning eye.

Visual Fatigue		
200-500 lx	200-800 lx	500-800 lx
No Sig. Dif. $p = 0.517 > 0.05$		
Sig. Dif.	$p = 0.000 < 0.05$	$p = 0.000 < 0.05$
Burning Eye		
200-500 lx	200-800 lx	500-800 lx
No Sig. Dif. $p = 0.893 > 0.05$		
Sig. Dif.	$p = 0.000 < 0.05$	$p = 0.000 < 0.05$

**Table 5.** Results of Focusing Problem and Glare.

Focusing Problem			
	200-500 lx	200-800 lx	500-800 lx
No Sig. Dif.			
Sig. Dif.	p = 0.026 < 0.05	p = 0.005 < 0.05	p = 0.000 < 0.05
Glare			
	200-500 lx	200-800 lx	
No Sig. Dif.	p = 0.074 > 0.05		
Sig. Dif.	p = 0.000 < 0.05		

### 3.2. Correlations of the three illuminances of LED and OLED lights

The different illuminances were analyzed within themselves. The number of the participants who found OLED light comfortable were slightly more than LED light for all of the visual comfort criteria. To determine if there was a significant relationship between all visual comfort criteria in LED and OLED lights, paired-samples t-test was conducted.

For the 200 lx of LED and OLED lights, there was a statistically significant correlation between LED and OLED lights with respect to the criterion of visual distraction ( $t = -2.89$ ,  $df = 79$ , two-tailed  $p = 0.005$ ). There were statistically no significant correlations between LED and OLED lights with respect to the criteria of visual clarity, visual fatigue, burning eye and focusing problem ( $t = -1.75$ ,  $-1.55$ ,  $-0.76$ ,  $-1.64$ ,  $df = 79$ , two-tailed  $p = 0.08$ ,  $0.12$ ,  $0.45$ ,  $0.11$ ; respectively). There was a statistically significant correlation between LED and OLED lights with respect to the criterion of glare ( $t = -3.78$ ,  $df = 79$ , two-tailed  $p = 0.000$ ). There was a statistically significant correlation between LED and OLED lights with respect to all of the visual comfort criteria ( $t = -3.07$ ,  $df = 79$ , two-tailed  $p = 0.003$ ). The results indicated that LED and OLED lights differ with respect to criteria of visual distraction and glare but not respect to other criteria. Results are shown in Table 6.

For the 500 lx of LED and OLED lights, the participants who found OLED light comfortable were slightly more than LED light for all of the visual comfort criteria. To determine if there was a significant relationship between all visual comfort criteria on LED and OLED lights, paired-samples t-test was conducted. There was statistically no significant correlation between LED and OLED lights with respect to all visual comfort criteria (two tailed  $p$  values =  $0.15$ ,  $0.43$ ,  $0.08$ ,  $0.30$ ,  $0.16$ ,  $0.07$ ,  $0.07$ ; respectively) According to these results, LED and OLED lights didn't differ for all visual comfort criteria. Results are shown in Table 7.

**Table 6.** Correlation results for LED and OLED 200 Lx.

Visual Comfort Criteria	No Sig. Cor.	Sig. Cor.
Visual Distraction		$p = 0.000 < 0.05$
Visual Clarity	$p = 0.08 > 0.05$	
Visual Fatigue	$p = 0.12 > 0.05$	
Burning Eye	$p = 0.45 > 0.05$	
Focusing Problem	$p = 0.11 > 0.05$	
Glare		$p = 0.000 < 0.05$
All Criteria		$p = 0.003 < 0.05$

**Table 7.** Correlation results for LED and OLED 500 Lx.

Visual Comfort Criteria	No Sig. Cor.	Sig. Cor.
Visual Distraction	$p = 0.15 > 0.05$	
Visual Clarity	$p = 0.42 > 0.05$	
Visual Fatigue	$p = 0.08 > 0.05$	
Burning Eye	$p = 0.30 > 0.05$	
Focusing Problem	$p = 0.16 > 0.05$	
Glare	$p = 0.07 > 0.05$	
All Criteria	$p = 0.07 > 0.05$	

**Table 8.** Correlation results for LED and OLED 800 Lx.

Visual Comfort Criteria	No Sig. Cor.	Sig. Cor.
Visual Distraction		$p = 0.027 < 0.05$
Visual Clarity	$p = 0.80 > 0.05$	
Visual Fatigue	$p = 0.18 > 0.05$	
Burning Eye	$p = 0.17 > 0.05$	
Focusing Problem	$p = 0.91 > 0.05$	
Glare	$p = 0.77 > 0.05$	
All Criteria	$p = 0.19 > 0.05$	

For the 800 lx of LED and OLED lights, number of the participants who found OLED light comfortable were slightly more than LED light for all visual comfort criteria. To determine if there was a significant relationship between all visual comfort criteria on



LED and OLED lights, paired-samples t-test was conducted. There was a statistically significant correlation between LED and OLED lights with respect to visual distraction ( $t = -2.25$ ,  $df = 79$ , two-tailed  $p = 0.027$ ). There was a statistically no significant correlation between LED and OLED lights with respect to visual clarity, visual fatigue, burning eye, focusing problem and glare (two tailed  $p$  values = 0.80, 0.18, 0.17, 0.91, 0.77; respectively). According to all criteria, there was no statistically significant correlation between LED and OLED lights ( $t = -1.32$ ,  $df = 79$ , two-tailed = 0.192). The results indicated that LED and OLED lights differ with respect to criterion of visual distraction but not respect to other criteria. Results are shown in Table 8.

### 3.3. Correlations of LED and OLED lights with respect to reading speed

Seven physical condition types were evaluated together in all of the lighting scenarios from the point of reading speed. Correlation analysis was conducted to search the relationship between different illuminance and reading speeds.

In the first lighting scenario, there was no statistically significant correlation between LED 200 lx and reading speed ( $R = 0.053$ ,  $p = 0.641 > 0.05$ ). In the second lighting scenario, there was also no statistically significant correlation between LED 500 lx and reading speed ( $R = 0.093$ ,  $p = 0.411 > 0.05$ ). However, in the third lighting scenario, there was a statistically low significant correlation between LED 800 lx and reading speed ( $R = -0.240$ ,  $p = 0.032$ ). In the fourth lighting scenario, there was no statistically significant correlation between OLED 200 lx and reading speed ( $R = -0.127$ ,  $p = 0.260 > 0.05$ ). In the fifth lighting scenario, there was no statistically significant correlation between OLED 500 lx and reading speed ( $R = -0.064$ ,  $p = 0.571 > 0.05$ ). In the sixth lighting scenario, there was also no statistically significant correlation between OLED 800 lx and reading speed ( $R = -0.156$ ,  $p = 0.168 > 0.05$ ). The results show that only OLED 500 lx had a positive effect on the reading speed of the participants.

### 3.4. Other results related to LED and OLED lights with respect to physical condition

Seven physical condition types that were used in the questionnaire was divided into three groups as “felt tired” (very tired, tired and little tired), “felt normal” and “felt good” (very good, good and little good). ANOVA was conducted to compare the three groups from the point of illuminances of LED and OLED lights.

In the LED 200 lx scenario, the mean of the “felt good” group ( $M = 34.17$ ,  $SD = 7.15$ ) was slightly higher than the “felt normal” group ( $M = 32.91$ ,  $SD = 8.64$ ) and the “felt tired” group ( $M = 29.40$ ,  $SD = 8.89$ ). There was no statistically significant difference between the physical conditions and this lighting scenario ( $p = 0.191 > 0.05$ ). However, there was a statistically low significant difference between the “felt tired” and the “felt good” groups ( $p = 0.036 < 0.05$ ).

In the LED 500 lx scenario, the mean of the “felt normal” group ( $M = 34.87$ ,  $SD = 8.13$ ) was slightly higher than the “felt good” group ( $M = 34.25$ ,  $SD = 8.62$ ) and the “felt tired” group ( $M = 32.55$ ,  $SD = 8.36$ ). There was no statistically significant difference between physical conditions and this lighting scenario ( $p = 0.951 > 0.05$ ).

In the LED 800 lx scenario, the mean of the “felt normal” group ( $M = 30.83$ ,  $SD = 8.58$ ) was slightly higher than the “felt good” group ( $M = 29.17$ ,  $SD = 9.43$ ) and the “felt tired” group ( $M = 25.70$ ,  $SD = 9.84$ ). There was no statistically significant difference between physical conditions and this lighting scenario ( $p = 0.432 > 0.05$ ).

In the OLED 200 lx scenario, the mean of the “felt good” group ( $M = 36.67$ ,  $SD = 6.34$ ) was slightly higher than the felt normal group ( $M = 36.26$ ,  $SD = 6.14$ ) and felt tired group ( $M = 31.94$ ,  $SD = 7.89$ ). There was no statistically significant difference between physical conditions and this lighting scenario ( $p = 0.241 > 0.05$ ). However, there was a statistically significant difference between the “felt tired” and the “felt normal” groups ( $p = 0.025 < 0.05$ ) and the “felt tired” and the “felt good” groups ( $p = 0.014 < 0.05$ ).

In the OLED 500 lx scenario, the mean of the “felt normal” group ( $M = 36.65$ ,  $SD = 6.09$ ) slightly was higher than the “felt good” group ( $M = 35.88$ ,  $SD = 6.82$ ) and the “felt tired” group ( $M = 34.33$ ,  $SD = 6.30$ ). There was no statistically significant difference between physical conditions and this lighting scenario ( $p = 0.851 > 0.05$ ).

In the OLED 800 lx scenario, the mean of the “felt good” group ( $M = 30.71$ ,  $SD = 8.59$ ) was higher than the “felt normal” group ( $M = 29.87$ ,  $SD = 9.00$ ) and the “felt tired” group ( $M = 28.21$ ,  $SD = 9.45$ ). There was no statistically significant difference between physical conditions and this lighting scenario ( $p = 0.655 > 0.05$ ). As can be seen in all LED lighting scenarios, due to their physical conditions, they were not positively or negatively affected by illuminances. However, 200 lx of OLED light affected their task performance within this research.

#### 4. Discussion

The aim of this study was to analyze the effects of different illuminances of LED and OLED lights on user visual comfort during a reading task. It also aimed to research whether LED or OLED lights were visually more comfortable and identify which illuminances of LED and OLED lights were visually more comfortable than the others. Therefore, the effects of illuminances of LED and OLED lights on visual comfort were compared according to lighting scenarios that consisted of six reading texts and three different illuminances (200 - 500 - 800 lx).

In the first hypothesis, it was supposed that there would be a statistically significant difference between the illuminances that 200 lx would be visually more comfortable than 500 lx and 800 lx. For OLED light, the results indicated that 500 lx was found visually slightly more comfortable than the other illuminances with respect to visual distraction, visual clarity, visual fatigue, burning eye and focusing problem. In addition, OLED 200 lx was found visually slightly more comfortable than others with respect to glare. According to Kim and Kim (2007), as the illuminance increases

above 500 lx, brightness and glare negatively affect visual comfort. The preferred illuminances of work plane are either above or below 500 lx, but the resulting visual criteria may be different (Borisuit et al., 2015).

The results revealed that there was a statistically significant correlation between the 200 lx of LED and OLED lights according to visual distraction and glare. There was also a statistically significant correlation between them in total. Although there was no statistically significant correlation between these two light sources according to other visual comfort criteria, due to the mean scores, it can be said that the OLED 200 lx was slightly more comfortable than LED 200 lx. There was no statistically significant correlation between 500 lx of LED and OLED lights according to all the visual comfort criteria. Due to the mean scores, it can be concluded that the illuminance of OLED 500 lx was visually slightly more comfortable than LED 500 lx. For 800 lx, there was a statistically significant correlation in the visual distraction. Through the mean scores, it can be said that the illuminance of OLED 800 lx was visually slightly more comfortable than LED 800 lx. In the work of Smolders et al. (2012), it was stated that the type of light source affected users' task performance. As stated in the second hypothesis, the illuminances of OLED light is accepted more comfortable than LED light. There is not any research about the differences between LED and OLED lights with respect to the illuminances in the literature. The reason for finding the OLED light slightly more comfortable than LED light can be the features of OLED light that they are producing a pleasing visual effect and low light pollution (Eley, 2015; Kar & Kar, 2014).

There was no statistically significant difference between the 200 and 800 lx of LED light from the point of visual distraction and visual clarity. However, there was a statistically significant difference between them from the point of other visual comfort criteria. Due to the mean scores, LED 200 lx was visually more comfortable than 800 lx. For OLED light, there was a statistically significant difference between

200 and 800 lx from the point of all visual comfort criteria. According to all mean scores and p values, 200 lx of LED and OLED lights were found visually more comfortable than 800 lx. Shen et al. (2009) stated a different result that an illuminance of 300 lx was uncomfortable than 700 lx. Ricciardi and Buratti (2018) found a strong relationship between illuminances and visual comfort. The relationship is observed between increased illuminances and glare, which resulted in a decrease user visual comfort levels. A study conducted by Castaldo et al., (2017) also observed a correlation between illuminances and performance, where users were satisfied with levels less than the suggested minimum of 500 lx.

For LED light, there were statistically no correlations between the illuminances and reading speed except in 800 lx. There was no statistically significant correlation that as the illuminance increases, reading speed decreases. The mean scores of the reading speeds of 800 lx were more slower than the other illuminances. For OLED light, there were no statistically significant correlation between all illuminances and reading speeds. The mean score of the reading speed of OLED 200 lx and 500 lx was faster than other illuminances. In addition, participants found 500 lx visually more comfortable than others. It can be stated that illuminances of the light source have an effect on visual comfort and reading performance. The results are not in line with many studies (Chang et al., 2013; Lee, Shieh, Jeng & Shen, 2008; Smolders et al., 2012; Wang, Haisong, Gong & Cai, 2015). Lee and colleagues (2008) indicated that reading speeds increased as the illuminances increased from 300, 700 to 1500 lx. According to Smolders et al. (2012), higher illuminances could result in better performance for fluorescent tubes. Chang et al. (2013) proposed that illuminances of 1000 and 1500 lx supported faster reading than did those of 200 and 500 lx. Moreover, in the work of Wang et al. (2015), in the lighting scenario of the illuminance level of LED 1000 lx, participants read faster than the illuminances of LED 300 and 500 lx. However, except the technical information,

there is not any sufficient information about OLED light related to the reading task in the literature.

The results revealed that the participants read the text of first lighting scenario slower than other texts ( $M = 1.90$ ). The illuminance of this lighting scenario was LED 200 lx. LED light was found visually slightly uncomfortable than OLED light and 200 lx was also found slightly uncomfortable than 500 lx. On the other hand, the familiarity ratio of this text was the highest ratio (88.8%). Therefore, it can be stated that the illuminances of light source has an effect on reading speed, but familiarity does not have an effect on it.

There was a statistically significant difference between the “felt tired” and the “felt good” groups in OLED 200 lx scenario. According to the mean scores and p values, the “felt tired” group found visually uncomfortable than the “felt good” group for these lighting scenarios. It can be stated that when the user felt tired, they are affected from the illuminances that are below the standards more than users who felt good, and the physical condition and the illuminance are in a relationship between each other. In the LED 800 lx and OLED 200 lx lighting scenarios, there was a statistically significant difference between the “felt tired” group and the “felt normal” group. Due to the mean scores and p values, the “felt tired” group found visually uncomfortable than the “felt normal” group for these lighting scenarios in terms of all visual comfort criteria. There is not any sufficient information about OLED light related to the relationship between reading performance and physical condition in the literature.

## 5. Conclusion

The study aimed to analyze the effects of different illuminances of LED and OLED light on users' visual comfort and reading performance, and compare LED and OLED lights with respect to the different illuminances. The result of this study revealed that illuminances have a significant effect on users' visual comfort. The illuminance of LED 500 lx was generally found visually more comfortable than

the rest of LEDs; on the other hand, the illuminance of LED 200 lx was found visually more comfortable than the other illuminances with respect to the criterion of burning eye. Likewise, OLED 500 lx was generally found visually more comfortable; on the other hand, OLED 200 lx was visually more comfortable than the other illuminances with respect to the criterion of glare. Generally, OLED light was accepted visually more comfortable than LED light.

There has been no research on the effects of OLED with respect to the users' visual comfort and task performance. OLED, as the next step of the Solid-State Light (SSL) technology, has mainly been used in automobiles, mobile phones and television industry, but this study has considered OLED as an element of an interior environment affecting user visual comfort and task performance and compared it with LED. The results of this study might shed light to interior architects, psychologists, lighting designers and manufacturers. They might use the results of this study in order to create visually comfortable and innovative interiors and decide how the good qualified lighting should be manufactured. Unlike LEDs, OLEDs are flexible, transparent, sustainable, durable, produce very little heat, have a long life span and consume less energy than traditional lighting technologies. In addition, OLEDs emit the same apparent radiance when viewed from various angles and reduce the space required for light installations (Eley, 2015). It is possible that OLED will begin to be used more than other artificial light sources in indoor environment due to these advantages.

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## Appendix Appendix A

Number of Respondent:

Time:

1. Age:

2. Gender: Female ☐ Male ☐3. Usage of Eye Glass or Contact Lens: Yes ☐ No ☐

4. How do you feel now? Please choose one of them.

Very Tired ☐ Tired ☐ Little Tired ☐ Normal ☐ Little Good ☐ Good ☐ Very Good ☐

**LITTLE PRINCE** Reading Time: Lamp Type: LED Illuminance Level: 200lx

5. Have you ever heard this book which was mentioned before? Yes ☐ No ☐

6. Please specify the rates of visual comfort criterias what you feel while reading a part.

	Comp. Agree			Neutral		Comp. Disagree	
	-3	-2	-1	0	1	2	3
Visual Distraction							
Visual Clarity							
Visual Fatigue							
Eye Burning							
Focusing problem							
Glare							
Others, (please specify)							





# Vernacular architecture in the south of Portugal: The history of Mértola's houses from a rural to an urban landscape

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## Abstract

This article deals with permanence and change in the traditional architecture of southern Portugal, adopting the town and landscape of Mértola as a case study. This research conveys how the relationship between the vernacular architecture, the territory and the site is not immune to the course of history, reflecting a profound change in the ways of living over time. In methodological terms, the research focuses on surveying and characterizing architectural diversity in both the rural context (with the definition of various landscape subunits) and the urban context (delimiting the various urban subunits). This concludes that the architectural specificity, in both contexts, is subordinate to the same processes of historical change which nevertheless acquire a circumstantial dimension. These processes include the readable influences of models and ways of living arriving from abroad and contemplate: the transition of the courtyard house from the Islamic medieval period to the compact house of the Christian medieval and modern periods; the consolidation, diversification and ennobling of different housing types during the *Ancien Régime*; and the profound transformations of domestic architecture following the advent of Liberalism.

## Keywords

Cultural landscape, House typologies, Rural settlements, Urban morphology, Vernacular architecture.

## 1. Introduction

The town of Mértola, in southeast Portugal (Figure 1), represents an interesting case study for reading the importance of the physical territory to the morphology of traditional architecture. From its first settlement, this town has been located, on a promontory with pronounced slopes leading down to the Guadiana and Oeiras rivers. The uniqueness of this site has been described through the ways in which the vernacular building models itself on its surroundings even while based on different architectural solutions: the cut-out perimeters of the buildings and the public spaces so as to adapt to the steep slopes (Keil do Amaral et al., 1962: 238); the layout of buildings with each compartment located at different heights (Agostini & Vannetiello, 1999: 274); access to housing from different levels and the presence of rock outcrops inside the rooms (Varanda, 2002: 212).

In any case, most studies on Portuguese vernacular architecture tend to privilege the analysis of the rural over the urban models. In the case of Mértola, the most important research on the town's built heritage falls within the scope of its religious and military monumental heritage and, especially, the field of archaeology, with the excavation of an Islamic quarter, dating to the Almohad period (twelfth and thirteenth centuries), with nineteen houses thus far excavated, holding special relevance (Gómez Martínez, 2014).

At this level, Mértola provides a model case of applied research in which scientific knowledge has significantly contributed towards local development, in a region otherwise marked by a significant process of depopulation, through the musealization of the different expressions of material and immaterial heritage (Torres, 2014a; Espino Hidalgo, 2020). As a consequence of this work, the town has recently been included on the Indicative List of Portugal for applications to Unesco World Heritage status (Portuguese National Commission for Unesco, 2018).

However, one of the major gaps existing in the knowledge on Mértola's heritage stemmed precisely from urbanism and its housing architecture. Hence, with this framework in mind, a



**Figure 1.** Location of Mértola in the context of the southwest Iberian Peninsula. A – Alentejo region; B – Mértola and its municipality.

study of the domestic architecture was first outlined in 2013 with the specific aim of deploying scientific research in the service of heritage dissemination and its conservation (Costa, 2015). In methodological terms, this research project acquired an interdisciplinary dimension, combining fieldwork and an exhaustive survey of Mértola's dwellings, with the interpretation of archival sources coupled with archaeological research.

This article develops the themes of that project as regards the relationships between the house, the site and the territory.<sup>1</sup> Based on this core goal, and considering analysis of the different housing typologies, we proceed to answer the following questions: What are the most common architectural solutions for adapting the house to the site?; Are these solutions the same in the different subunits across the landscape and in the town's different areas or are we able to reconstitute a diatopic diversity?; Does the construction and transformation of housing architecture include identical solutions for implementation throughout history or are we again able to reconstitute a diachronic diversity?; Is there, at this level, a specificity of the town and of the urban space in relation to rural architecture?

To this end, the first section briefly defines the scope of the various landscape subunits in this area of study alongside the identification of the various typologies of vernacular architec-

ture found in each case. Next, in the second section, we shift from the rural to the urban context, taking into consideration the delimitation of the various urban subunits of Mértola and the description of the different typologies of domestic architecture present in the town. Subsequently, the third section sets out a discussion of the results before attempting to answer the research questions raised above, recognizing the importance of this territory according to the specific characteristics of its vernacular architecture in both the rural and the urban contexts and then finally depicting the patterns of their transformation over the course of history.

## 2. Vernacular architecture in the historic rural landscape of Mértola

The level of importance of Mértola has changed in cycles throughout history. In its golden periods, this site was a key point of passage between distant territories: a privileged location amidst two worlds and the interconnection between the river and land routes, linking the Mediterranean with the Atlantic. On an intermediate scale, Mértola also represents the transition between very different Portuguese territories, from the Alentejo peneplain to the Algarve

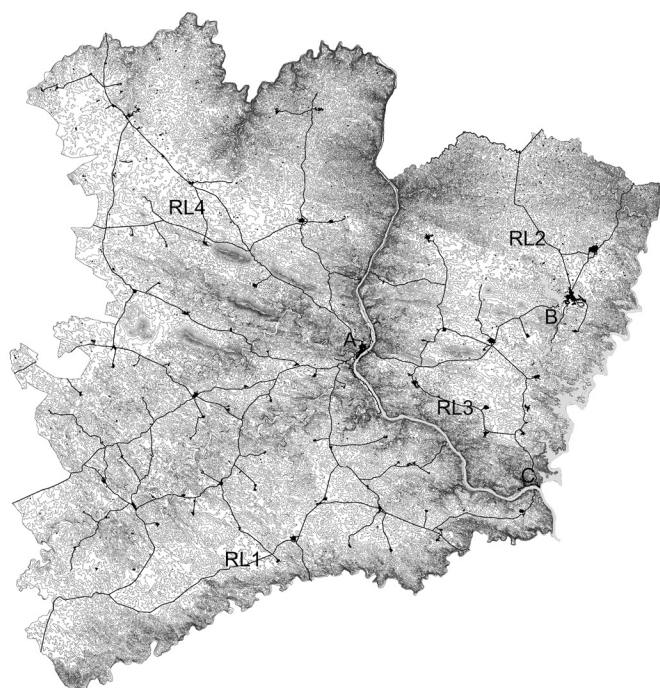
mountain range and beyond, to the Lower Algarve. In its times of hardship, with decreased commerce and greater isolation, Mértola's strengths stemmed from its connection with the nearby rugged landscape, hierarchically linking a system of rural settlements and focusing on internal production.

Mértola's landscape, belonging to south-western Iberia, falls into the dry-Mediterranean category (Lautensach, 1988: 363-7). In overall terms, the region displays significant landscape diversity, including different yet complementary means of production in the diverse geographical (sub)units. The territory is also shaped by its relative diversity, comprising of low level mountain ranges in the southern areas and the left bank of the Guadiana, with the plain and its fields extending westward in addition to the banks of the river course.

### 2.1. The rural landscape subunits

The broad and clear diversity in the biophysical characteristics of the territory reflects in the historical models of landscape construction, with repercussions for settlement, property structures and traditional architecture that require consideration across different scales (Caniggia & Maffei, 2001). The delimitation of several landscape subunits (Ribeiro, 1998; Cancela d'Abreu et al., 2004) within Mértola is, as we set out below, fundamental to any interpretation of the diversity of its rural architecture (Figure 2).

The first subunit corresponds to the southern strip of the municipality of Mértola (RL1), which integrates this mountain region of low level schist and greywacke peaks, bordering Portugal's two southern provinces: Alentejo and Algarve. The importance of surface drainage due to the impermeability of these rocks resulted in a very rugged orography poorly adapted to agriculture. In historical terms, written sources record an economy of subsistence (Stanislawski, 1963: 197-199), with irrigated crops restricting to narrow valleys and leaving the slopes to non-irrigated cereal crops (first itinerant and then in rotation) and grazing lands for small cattle or as scrubland (associated with complementary activities such as



**Figure 2.** Settlement and rural landscape subunits in the municipality of Mértola. A – Mértola; B – Minas de São Domingos; C – Pomarão; RL1/RL2/RL3/RL4 – rural landscape subunits.



bee-keeping and charcoal production). For all the reasons pointed out above, the settlement of this subunit displays very little hierarchy, restricted to a dense pattern of small villages interlinked with an extremely compartmentalized rural property structure.

A second subunit of this landscape corresponds to the moderately rugged region of the north-eastern area of the municipality on the left bank of the river Guadiana, which constitutes the former Common lands of the Mértola and Serpa mountain ranges (RL2), characterized by their preponderance of holm oak and cork oak forests. Although this area displays certain analogies, from the physiographic point of view, with the first subunit described, this represents a more circumscribed region, with its settlement resulting from the division of communal lands undertaken by the Portuguese state in the mid-1920s (Cf. Silbert, 1978: 425) that produced small, quadrangular plots, in some cases punctuated by the presence of isolated houses.

A third subunit corresponds to the Guadiana river valley with its deep profile and correspondingly sloping banks running across the study area from north to south (RL3). Unlike further downstream, where the valley widens to provide important agricultural lands, the irrigated crops here were restricted to a few well-defined vegetable gardens. Thus, the settlements along the river banks interrelate with the traditional road system not only because of the importance of the Guadiana as a transport thoroughfare connecting to the Mediterranean Sea (longitudinal axis) but also due to the former presence of vessels that provided continuity to the land routes on either bank of the river (transversal axes) (Silva, 2006; Garcia, 2018).

While also characterized by the schist and greywacke soils of the Ancient Massif, the fourth subunit (RL4) stands out according to its flatter relief and only gently undulating (corresponding to the characteristic Alentejo peneplain extending to the west and north). However, we are able to register some landscape heterogeneity here, both in terms of the arboreal substrate (different patterns of forested pasture-

land and open areas), and of hierarchical settlement (scattered buildings and settlements of differing scales). These settlements associate with very considerable contrasts in their property structures, which distinguish the very compartmentalized areas around the villages from the latifundium punctuated only by isolated farm buildings (Feio, 1993). This subunit generally coincides with the right bank of the Guadiana River, although its characteristics also feature strongly in some well-defined stretches on the left bank.

## 2.2. Historical diversity in the rural architecture of the different landscape subunits

The physiographic diversity of the territory of Mértola is fundamental to understanding the history of settlement associated with each different architectural typology (Costa, 2010: 104-9). The region's oldest standing rural settlements correspond to small villages with only a few units or several dozen houses, which sometimes get reference during the transition from the late medieval to the early modern period and are often located in the vicinity of archaeological sites that date back to the medieval Islamic period (Macias, 2005: 297). The consolidation of this land occupation model involved slow demographic growth and a process of concentration that characterized the region throughout a period that extends from the *Ancien Régime* to the early second half of the last century.

Surveys of these settlements reveal the preponderant influence of cell com-



Figure 3. Almoinha Velha village.



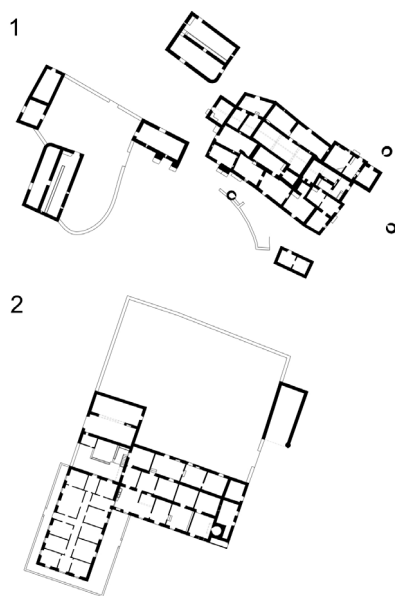
positions evident in most of the buildings. The basic building unit thus does not correspond to the dwelling as a whole but rather to each of its compartments. Rural settlements thus acquire a morphology defined by the proximity of several buildings of inconstant sizes and irregular perimeters, organized around the successive addition of compartments from the centre outwards (Figure 3). Over the course of time, the transformation of the domestic architecture very often resulted in buildings consisting of compartments for different family groups and, simultaneously, in dwellings with their compartments dispersed across different buildings.

For economic reasons, among others, the pre-existing walls were, whenever possible, reused for defining the perimeters of new building cells, thus favouring the expansion of existing edifices rather than constructing separate new buildings. When circumstances did allow, these buildings might acquire over two dozen rooms which would then in many cases correspond to several dwellings and farm annexes.

These larger buildings, found in the centre of many rural hamlets, are structured around a central alignment of gabled constructions with a ridge beam that would subsequently discipline the later additions of mo-

no-pitched roofs (type R1). This morphology corresponded to an implantation over ridges and the posterior transversal enlargements along slopes (Figure 4-1). The trend in most rural settlements is for the front door to face either eastwards or to the southeast. This ensured a very flexible system of house organization and, while each space was markedly independent, they could also be combined in many different ways through the opening and closing of doors (using stone masonry or adobe), inside the house, whenever occasions favoured sharing or enclosure.

Around these larger building complexes – or in villages where absent – we encounter smaller buildings, consisting exclusively of elementary mono-pitched roof constructions (type R2). This type is suitable to sloping locations through spanning several levels of interior flooring and incorporating steps to connect the various compartments. At the morphological level, this combines an almost always irregular external perimeter with a complex roof, resulting from the gradual enlargement process. These building typologies predominate in the oldest rural settlements of Mértola territory, mainly occurring in the landscape subunits RL1 and RL4. Furthermore, the study revealed two distinguishing aspects of these settlements in the aforementioned two subunits, reflecting the different prevailing conditions at the level of both the physical territory and the historical process of occupation. In the municipality's southern sub-regions (RL1), the more rugged orography and sparser areas agriculturally productive land resulted in: on the one hand, settlements that are on average smaller in size than the Alentejo Peneplain (RL4); and, on the other hand, in poorer and less diversified architecture associated with a much more compartmentalized property structure and the far lower level of any presence of large scale rural estate owners. Regarding the load-bearing walls, these architectures gradually transitioned from using shale masonry in the county's southern mountains (RL1) to the rammed-earth construction, predominant in the central and northern hills (RL2 and RL4).



**Figure 4.** *Almoinha Velha. 1 – Old settlement; 2 – Farmer's new house (1930s).*

The transformation of Mértola's rural architecture progressively replaced the cumulative construction process described above, with more serial and rational principles for organizing domestic architecture, which came to the fore following the end of the *Ancien Régime* and especially from the third quarter of the nineteenth century (Figure 4-2). One of the landmarks in this transformation relates to the gradual preponderance of a rectangular boundary plan almost always associated with a gabled roof. Although this morphology already featured in the constructions of earlier periods, especially for the homes of larger landowners, it was henceforth that it gradually became taken into consideration even in vernacular rural settlements.

In most cases, the new dwellings were built in a position separate to the pre-existing constructions, which itself represents a break with the already established building practices. Regarding the choice of site for these new houses, the decision was to prioritize flatter sites or to advance with larger terracing works, with the corresponding objective of eliminating the previously recurrent steps for connecting the different compartments making up dwellings. In other words, the search turned to flattened areas of land positioned far from the other constructions and correspondingly better aligned with the emergence of a progressively more individualizing culture, renouncing the contiguous expansion of pre-existing buildings, which had incorporated more collective systems of organization.

In a first phase, which we may refer to as a transition, there are no major transformations in the constructive processes, maintaining a clear preponderance of rammed earth and stone load-bearing walls combined with more indefinite ways of enacting the new principles for organizing space (type R3). With the end of the nineteenth century approaching, the establishing and crystallization of this new model was accompanied by the construction processes through the integration of more serial systems (type R4), both in terms of the roof frame and the use of light, not structural

walls for the compartmentalization of internal spaces, in some cases associated with the emergence of the corridor as a distribution space.

In addition to contributing to the expansion of the already existing settlements in subunits RL1 and RL4 throughout a period that extended into the second half of the twentieth century, this typology was also relevant to the dispersed settlements in subunit RL2 that resulted from the parcelling of the former common land of the Mértola and Serpa mountains as mentioned above. It is interesting to note that the trend to orient the main façade of the housing towards the east or southeast – a characteristic of the oldest buildings in the settlements in the prior RL1 and RL4 subunits – also persists here. Similarly, the new housing organization models also hold a decisive influence over the change in settlement organization resulting from the new cycle of operation of the São Domingos mines from 1858 onwards (Custódio, 2018).

This underlies the popular gabled roof dwellings of the mining village of São Domingos (even if here arranged in continuous alignments of dwellings), or the mono-pitched roofs dwellings of the mining port of Pomarão (where this type of roof was more adjusted to construction on slopes). In this regard, we should however note that, until the establishing of the mining port of Pomarão, the river banks (subunit RL3) in the municipality of Mértola were characterized, by their near absence of vernacular settlements. As we shall return to, this also emphasizes the exceptional importance that the village of Mértola has in the relationship with the river for its history of rural settlement organization.

### 3. Vernacular architecture in the historic urban landscape of Mértola

The town of Mértola occupies a spur on the right bank of the Guadiana River, near the mouth of a tributary (Oeiras brook). It is a typical example of a promontory settlement, with its characteristic fusiform shape, related to a first stage of occupation in the context of the ridge path system (Cf. Cataldi, 1977: 114). Settlement on this site dates back to at least the Iron Age and stems from

the importance of the Guadiana river as a link to the Mediterranean (Figure 5). The site coincides with the limit of the river's navigability (with the conditions for mooring for transfer between river and land transport routes) while benefiting from geographic characteristics that facilitated its defence.

The successive rebuilding of the castle (perched on the peak of the spur) and the defensive wall (in alignment with the prevailing physiographic contours) from the Islamic medieval period onwards (Boiça et al., 2014) established the settlement's boundaries in periods

of greater insecurity; whether before the Christian reconquest, or later with the formation and conflict over the border between the Christian kingdoms of Portugal, Leon and Castile (twelfth and thirteenth centuries). In any case, in the particular case of Mértola, the border with Spain does not coincide with the course of the river but rather crossing this territory about fifteen kilometres to the east. Thus, the ongoing relationship with the left bank of the Guadiana also shaped the town's urban development, contributing to the diversity of urban subunits that we need to appropriately define within its perimeter (Figure 6).



**Figure 5.** Aerial view over the landscape of Mértola and the Guadiana River (Source: Virgílio Lopes).

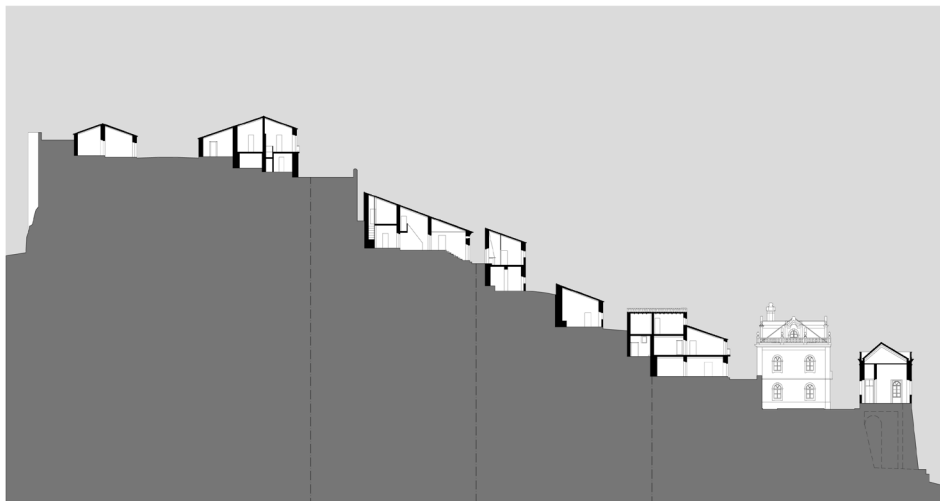


**Figure 6.** The landscape of Mértola and the different urban subunits. A – Old Town (Vila Velha); B – Urban expansion beyond the wall (Arrabalde da Vila); C – Left bank settlements (Além Rio); D – Convent of Saint Francisco; UL1/UL2/UL3/UL4/UL5 – urban landscape subunits.

### 3.1. The urban landscape subunits

Construction over this very rugged orography area ranks among the different biophysical conditions that shaped and conditioned the urban evolution of Mértola. Even within the city walls, there are significant differences in elevation, resulting in pronounced undulations in the streets running lengthwise and especially in the cross streets that, in some cases, incorporate flights of stairs between the different adjoining levels (Figure 7).<sup>2</sup>

Indeed, this morphology comprises two distinct urban landscape subunits (UL) that interrelate not only with the topography but also with the historical importance of the approach to the river and its port. In fact, the lowest subunit (UL1) is structured by the road that arrives from the hinterland, crosses through the wall passing between its two main entranceways: the gate of Beja in the north section and the gate of Ribeira in the southeast section. This lower zone has historically hosted those profiting from the goods arriving or leaving via the Guadiana. The wealth generated by the external trade became affixed in this specific area of the town, turning it into the commercial centre of the municipality of Mértola. The main street (formerly Rua Direita) faces the Guadiana at the eastern end of the wall and contains both warehouses and the residences of prominent merchants. During the *Ancien Régime*, this area underwent a process of densification that went unmatched in any other area of the town and, alongside the adjacent Largo da Misericórdia, this



**Figure 7.** Cross section of the old town passing through the main square (source: Costa, 2015).

was the area with the largest number of two or three floor dwellings (Costa, 2015: 177-9). It is hence unsurprising that this area also became the political centre of Mértola, hosting both the main square, Praça da Vila, and the Town Hall, which held great importance throughout the *Ancien Régime* and experienced major transformation during the transition from the nineteenth to the twentieth centuries.

Remaining within the intramural space, the areas at the highest elevations correspond to a second urban subunit (UL2), characterized by a more elementary urban fabric with a preponderance of single-floor buildings. These upper areas were traditionally populated with craftsmen – blacksmiths, bakers, seamstresses, weavers and shoemakers – who served the town and the nearby rural settlements through to around the 1970s. Correspondingly, several houses in this area would have simultaneously served as homes and workshops. The northwest section is the most recent area of occupation with the castle's slopes corresponding to the last buildings dating to the final quarter of the nineteenth century.

Urban expansion beyond the wall and the gate of Beja dates back at least to the beginning of the seventeenth century and constitutes a third urban subunit (UL3). The structure of Arrabalde da Vila, as this area is known, is set out in an organic manner and follows the contours of the Beja road, the paths to the churches of Santo António dos Pescadores and Nossa Senhora do

Carmo and the northern section of the town wall. The Arrabalde da Vila urban structure initially emerged out of undifferentiated constructions, primarily containing a neighbourhood of single-storey houses through to the third quarter of the eighteenth century.<sup>3</sup> Arrabalde da Vila in fact provides an area of transition, where rural themes persisted and the larger dwellings included often their own yards, vegetable gardens and barns and with even some of the smaller houses having their own pig sties or cattle sheds. It would not be until the nineteenth century that Arrabalde became the living choice of the upper classes. The low density and wide empty areas on the northern limits of this neighbourhood of small houses were ideal for constructing large residences with equally large gardens and lands, something that would be inherently more difficult inside the town's walls.

This beyond-the-walls expansion would also impact on the left bank of the Guadiana and what we may consider a fourth urban subunit (UL4). The east road arriving from Serpa, ended by the river, where a pontoon bridge established the connection with the Gate of Ribeira of Mértola. At the end of the road, there arose a two-nucleus settlement that is called the "Suburb Beyond the River" – Arrabalde de Além do Rio. Just as on the northern outskirts, this was a place of arrival for people, animals and goods and consisted mostly of single-storey houses and larger barns (Costa, 2015: 174).



Its importance would rise from the beginning of the second half of the nineteenth century with the São Domingos ore mine, located in the hinterland of the left bank, launching industrial scale operations (from 1855 to 1965).

The hilly territory around the town, shaped by different peaks, requires approaching as a fifth urban subunit (UL5), although historically characterized by only a few scattered buildings. The topography acquires great importance in the urban morphology through a network of representative constructions built at key-points and determining the surrounding scenery-scape system.

That network set the limits for the constructed urban territory and subtly indicated the ways in and out of Mértola as well as its paths of expansion. Chapels, churches and the local convent were correspondingly scattered around the aggregating territorial center: the hilltop of the walled town. Based on this contrast, the architecture of the dispersed buildings in this subunit (UL5) reveals, once again, the importance of the physical territory for the place, contributing to what Norberg-Schulz (1985: 31-41) called “figural quality” and “experience of arrival”.

In keeping with the particular characteristics of this territory, and the historic processes involved in its transformation, the town acquired significant diversity across its urban fabric and vernacular architecture as we may thus confirm by describing the various building types identified in Mértola’s urban space.

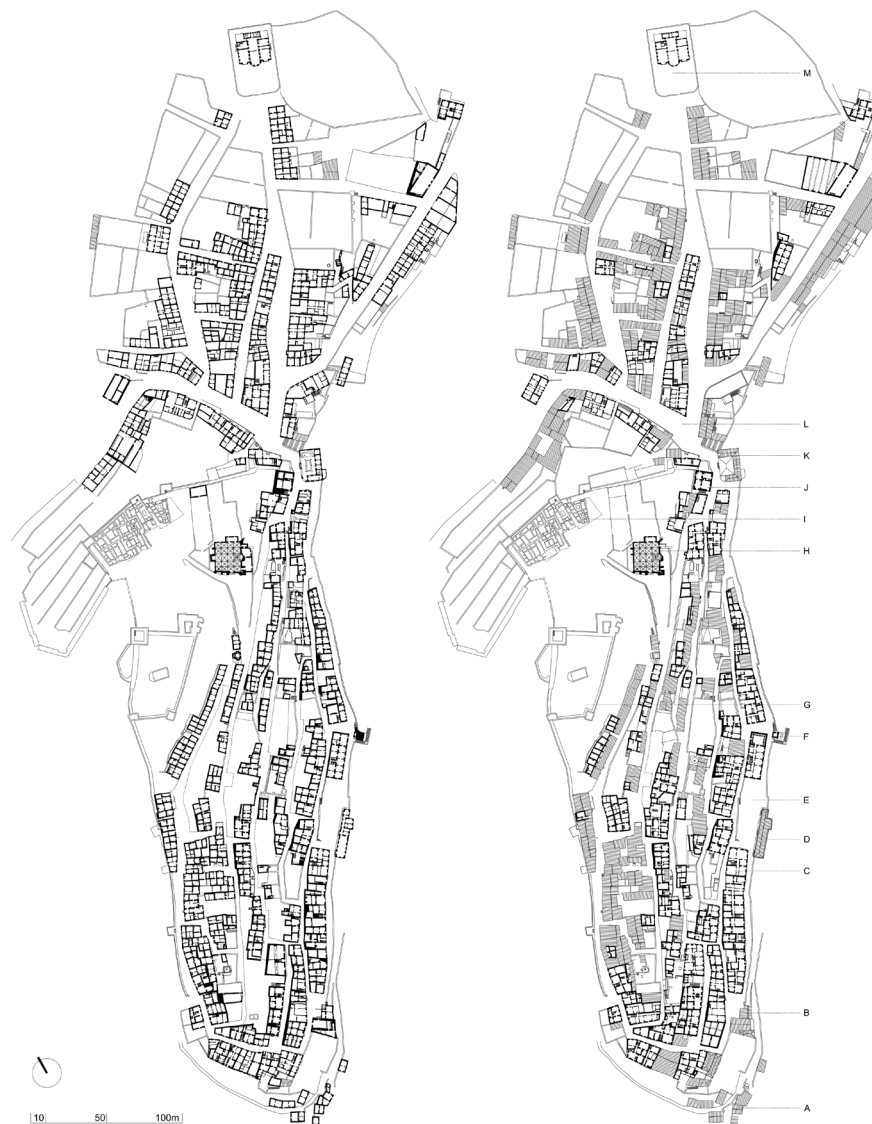
### 3.2 Historical diversity of vernacular architecture in the different urban landscape subunits

By analysing the town as a whole – considering the plans drawn up under the auspices of this research project (Figure 8) – we are able to recognize the importance of the cellular composition structures and the evolutionary dimension already described above for the rural territories. The basic typology of Mértola’s urban housing consists of the simple double-cell dwelling. Usually, these cells were arranged in depth and displayed similar sizes, rendering the houses rectangular-shaped and

mostly narrow. All the walls were load bearing and made of shale stone and rammed earth. The expressions “casa dianteira” (front room), “casa de fora” (outside room) and “casa de entrada” (entrance room) all served to designate the first room that was only illuminated by the front door (Figure 9-2). The terms “câmara” (chamber) or “casa de dentro” (inside house) were applied to the contiguous compartment that sometimes also provided access to a yard. The kitchen was not a sole division *per se* as the fireplace might be located either at the house entrance (with a chimney projecting on to the main façade) or at the rear (where there frequently was not even a chimney with the fireplace lacking any extraction system).

The lower urban densification pressure, which characterized certain areas of the historical village, resulted in the preponderance of one-storey buildings, composed of several dwellings similar to those described above (type U1). This typology is today especially evident in urban sub-units UL2 and UL4, sometimes recalling the freer layouts of the oldest buildings in rural settlements (types R1 and R2). In any case, contrary to what occurs in the rural territory, the town’s set of buildings is characterized by their absence of any central alignment of gabled cells with ridge beams to consist solely of this combination of mono-pitched roofs.

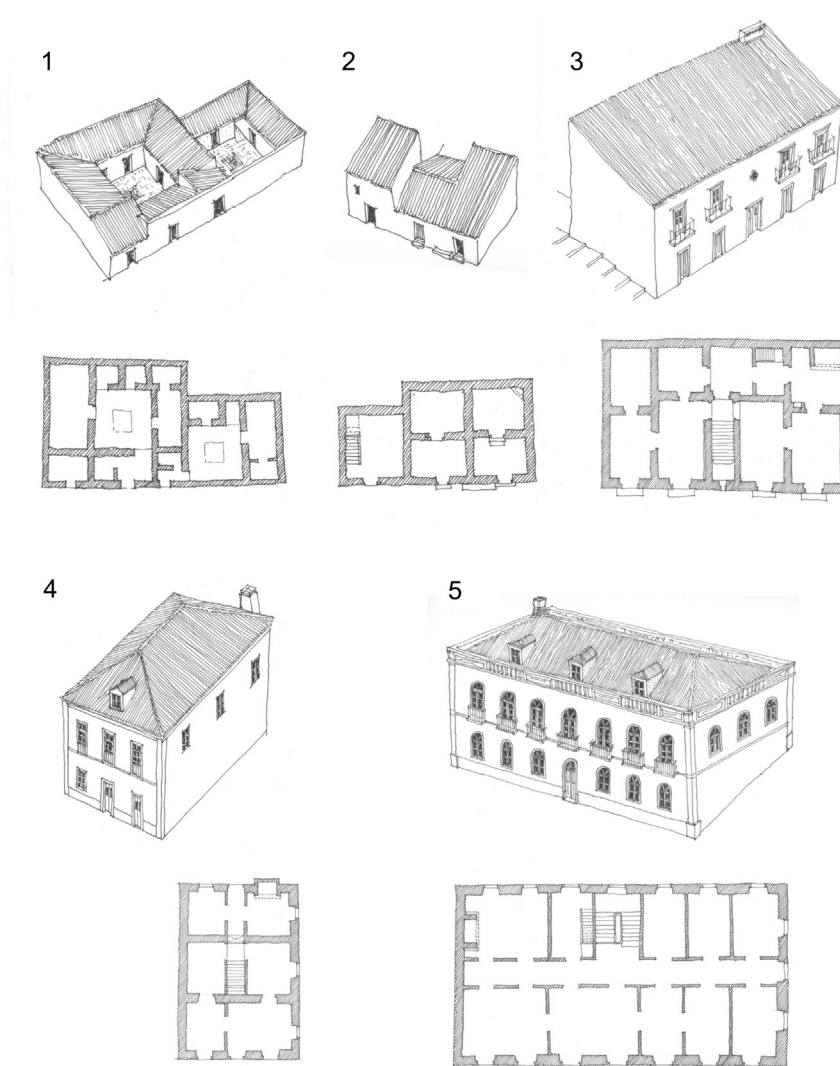
In contrast, the buildings located in the lower area of the intramural town were shaped by the port’s activities - subunit UL1 – and thus benefited from a richer and more complex typological process, involving their growth in height and surface as well as the ennobling of the residences. The narrow-fronted type houses were here submitted to three different expansion processes: the joining of buildings belonging to two or more contiguous properties; the growth in height with the integration of a second floor and, in some cases, an attic; and the backwards expansion of the building with the partial occupation of the yard (Costa, 2015: 179). The growth in building height also benefited from deployment on steeply sloping streets that allowed for entrance across different levels.



**Figure 8.** General plans of the town of Mértola (old village and Arrabalde). A – Ribeira quarter; B Gate of Ribeira; C – Town Hall; D – Old Court; E – Town Square; F – Clock Tower; G – Castle; H – Mother Church and Old Mosque; I – Old Alcaçova quarter (archaeological site of the Islamic period); J – Old Jail; K – Market and old Gate of Beja; L – Vasco da Gama Square; M – School (source: Costa, 2015).

During the *Ancien Régime*, this process of housing transformation included very diverse solutions in terms of their spatial organization, size and social representation. However, in most cases, this resulted in the affirmation of widely fronted, high dwellings (type U2), which had their main living areas on the second floor (the noble floor), and sometimes extended to an attic for servants, while the commerce, retail, warehouses, and other facilities were located on the ground floor (Figure 9-3). These buildings were organized

spatially from the axis consisting of the main door on the ground floor, an atrium (which allowed autonomous access to both floors) and the staircase (placed against a transversal load-bearing wall that accompanied the mono-pitched roof angle). On the noble floor, the most important social spaces were set to face the main façade (taking advantage of large river facing windows and balconies), with the kitchen and service areas relegated to the back section that interlinked with a small patio. From a construction point of



**Figure 9.** Schematic drawings of the Islamic house (Alcáçova quarter) and typologies U1, U2, U3 and U4 (source: Costa, 2015).

view, each room continued to be fully enclosed by structural walls (whether stone masonry or rammed earth) with only very rare recourse made to partition walls. In terms of roofing, extensive mono-pitched roofs predominate while in some cases combined with smaller gable roofs or terraces.

However, this concept of spatial and constructive organization was to lose relevance over the course of the second half of the nineteenth century following the establishment and consolidation of the Liberal State and the opening of the São Domingos mines (about 20 km from the town), which brought about an important new economic cycle on a regional scale. This process very closely resembles that characterized above for the architecture of rural territories (types R3 and R4). In construction terms, the new dwellings

began applying more complex roofing systems (including, for example, different types of trusses) that enabled the interior building span to be widened and organized mainly by partitions and other non-load bearing walls.

In a transition period, this desire for change carried repercussions reflected not only in alterations to pre-existing buildings in the intramural town (dividing the largest compartments, integrating corridors with partitions, undertaking decorative paintings and installing new doors and ceilings) but also in buildings built from scratch, especially in the extramural area which, to a greater or lesser extent, combine the characteristics of both the old and the new dwellings. One example that accurately conveys this transition typology (type U3) is the central staircase house, which is organized around

a central axis, comprising of an entrance hall, a straight flight of stairs and a second lobby or distribution corridor on the upper floor level leading on to three wings of compartments (Figure 9-4). The most important divisions – living rooms, the master bedroom – would be placed at the front with their windows opening on to the street, and with the kitchen at the rear of the plot, next to the yard. Small adobe partition walls served to structure the plot depth and combined with transversal masonry and rammed earth walls to support the timber floors. At the ground floor level, this type of housing might have included either commercial or residential purposes.

The new bourgeois dwellings of the second half of the nineteenth century and the transition to the twentieth century already heralded the great changes that would gradually become consolidated (type U4): the greater specialization of the various dwelling spaces (combined with the decrease in the average compartment size); the provision of greater privacy (especially for the bedrooms) and the growing importance of vestibules and corridors; a more rational design emerging in the planimetric composition and façade openings; and the integrating of stylistic forms and ornaments from the rich nineteenth and twentieth centuries architecture, which attest to clear influences of models imported from abroad. These new solutions feature, on the other hand, a less adaptive character, almost always trying to counteract the constraints arising from the site (Figure 9-5).

As recognized for rural buildings from the same period (types R3 and R4), there is also here an avoidance over organizing the ground floor, with spaces at different levels. Thus, from this moment on, the works started, almost always, with the terracing of the whole plot at the same level. In this context, the expansion areas of Arrabalde (sub-unit UL3) were increasingly the privileged spaces for constructing more affluent buildings, which themselves benefited from the new open roads and wider plots adjusted to such typologies. Furthermore, also within the intramural area (especially in the UL1 sub-

unit), we also encounter some affluent residences from this period with their construction requiring an even more complex set of prior operations, which ranged from the acquisition of several contiguous plots to the complete demolition of the old buildings therein existing (Costa, 2015: 184-6). The full affirmation of this new bourgeois model thus applied a blank slate approach to the pre-existing buildings, striving for a more imposing presence in the urban space, that assumed a new structural building conception attributing greater importance to the representation spaces within (entrance hall, dining room, symmetrical or asymmetrical stairs and corridors serving as core distribution spaces).

#### **4. Territory and history in the domestic architecture of Mértola**

The study of the traditional landscape of Mértola confirms the deep relationship between territory and vernacular architecture.<sup>4</sup> Moreover, when this relationship is framed in terms of the image and technologies of traditional buildings, it justifies the integration of Mértola into the Southern Iberian region (in the Mediterranean context) – as opposed to the Northern Iberia region – even when taking into account the land boarder that separates Portugal from Spain (Carver, 1981).

The link between territory and vernacular architecture clearly emerges, first of all, in terms of the house, considering, for example, incorporating the locally available materials or the constraints imposed by the respective site of construction (sometimes over very steep slopes). However, this link proves far more comprehensive and systemic as the various housing typologies result from a complex set of interdependent relationships right across the scales of urbanism and landscape. In the study area, the flatter, more even lands with more historically relevant production capacity (RL4) display greater architectural diversity as a result of their more consistent and hierarchical rural settlement (from dispersed houses to large villages) and the heterogeneity of the traditional socio-economic fabric (from rural wage earners to great landowners). In contrast, the more



mountainous areas (RL1 and RL2) correspond to more constant settlement patterns, where a given architectural typology tends to acquire preponderance (type R1 in subunit RL1 or type R4 in subunit RL2).

Contrary to what Mértola's image might suggest, its domestic architecture is characterized by relative diversity. This diversity first of all associates with the specificity of the various urban subunits susceptible to definition. However, beyond the identity of each of these subunits (linked, among other parameters, to its respective physical territory), we were able to identify the antagonistic models of adaptation these buildings applied to the pronounced slopes that characterize the Mértola landscape. In fact, we may distinguish, throughout the description of domestic architecture, between dwelling typologies with strong adaptive character, which can include the construction of the various ground floor compartments across different floor levels (types U1, U2, R1 and R2), from other typologies with more affirmative volumetric scales, whose building process began with the full levelling of the construction plot (types U3, U4, R3, R4). This diversity – in cultural expres-

sion – in reality displays a diachronic dimension that is necessarily part of any history of domestic architecture, which includes other morphological, organizational and constructive parameters. Although this study focuses on an area considered in different periods of history as peripheral and far from the main centres of change, the territory of Mértola displays historical transformations in its prevailing housing that may only be interpreted within the framework of the universal themes of the history of architecture.

Furthermore, this diachronic dimension has already been identified in archaeology in accordance with the importance of the town's relationship with the Mediterranean and the presence of residences organized around patios, displaying particular characteristics in the Roman and Islamic periods (Cf. Rafael & Lopes, 2014; Macias, 2018). Through this research, and also taking into consideration the historical written sources, we were able to confirm the profound socio-cultural transformation in the transition from the Islamic medieval period (Figure 9-1) to the Christian medieval period (Figure 9-2). This transition had a great impact on house layout, with antagonistic solutions in the separation between the private domestic spaces and the outside communal spaces.

The importance of the relationship between the public and private domains for vernacular architecture has already been recognized in several geographical and socio-cultural contexts (Rapoport, 1969: 66-68). In relation to Mértola, the archaeological excavation of the neighbourhood of the Alcáçova (Almohad period) confirmed the prevalence of safeguarding private family spaces in Islamic homes (cf. Petherbridge, 1978: 195-201), considering: the inward facing house organised itself around the central courtyard; the façade with a single opening which gave access to the L-shape entrance; and a clear hierarchy of internal spaces expressed in significant variation in room dimensions.

With the consolidation of the Christian dominance (after the conquest of Mértola in 1238 AD), the Almohad courtyard house gave way to a typology



**Figure 10.** Comparison of the urban fabric of the Alcáçova quarter (Islamic period) and a group of dwellings in the upper part of the old village.

with characteristics very closely resembling those described in late medieval and modern written sources on different regions of southern Portugal and covering both rural and urban areas (Figure 10). It is a very divergent model, in which domestic activities extended from inside the dwelling to the public space, comprising a simplified internal organisation with few rooms of identical size and shape.

This consists of a dwelling composed of two or more spaces interlinked in depth (especially in urban contexts) or width (especially in rural contexts), associated whether with the profound transformation of longstanding settlements or with the founding of new settlements on the new southwestern boundary between the Christian kingdoms of the peninsula. It was this dwelling that underwent consolidation and transformation during the *Ancien Régime*, reflected in the older constructions identified within the scope of this project although with differing levels of incidence (types U1, U2, R1, R2) across the various subunits of rural or urban landscapes.

Until the end of the *Ancien Régime*, the construction or transformation of Mértola's buildings comprised a "relative anonymity of the single house within the urban matrix" as characteristic of the Mediterranean countries (Norberg-Schulz, 1985: 105-6). With the social and political transformations that followed the establishment of Liberalism, and, in particular, over the course of the second half of the nineteenth century, there was an increased trend for bespoke housing, especially among the higher classes, who wanted their houses to stand out either by their size or ornamentation (Costa, 2015: 188). These changes were gradual and linked to the emergence of 19th century architecture, and, once again dictated by the influence of external models, that impacted across the morpho-typological, imagetic and constructive levels (types U3, U4, R3, R4). In many respects, these already heralded the great changes in contemporary architecture associated with the gradual generalization of industrial building systems.

## 5. Conclusion

The diversity of Mértola's domestic architecture results from the interlinkage of several models of housing organization, which attest to the town's integration into the generic themes of the history of architecture and urbanism with parallels to other regions in Portugal, the Mediterranean and the world. However, such diversity is also a consequence of adapting these models to quite varied circumstances, with distinct solutions for both flatter and more mountainous areas, or urban and rural settlements, so their interpretation becomes clearer through interrelating the various scales of analysis (architecture, urbanism and landscape).

The most profound societal changes resulted in significant alterations to the organisation of space at different scales, which, rather than a by-product, constituted "an intrinsic part of them and even to some extent causative of them" (Hillier & Hanson, 1984: 27). Despite the persistence of certain traditional construction techniques (support walls, rammed earth and schist masonry, lime and sand based coverings, tiled roofs, etcetera) over time, and through to the second half of the last century, research on Mértola's architecture demonstrates a temporal dimension that contradicts the ahistorical conception of vernacular architecture,<sup>5</sup> often associated with fanciful interpretations of the living conditions they provide their residents. In the case of Mértola, the housing architecture of the less privileged classes fell far short of comprising the conditions these communities desired at different moments down over time (Torres, 2014b).

Of course, the relevance of history in popular architecture and its specific ways of living cannot be interpreted by the same instruments that serve to study the history of so-called erudite architecture. Although recognizing slower rhythms of change, we nevertheless need to consider, as in the case of Mértola, the influences of erudite architecture on anonymous architecture, of urban architecture on rural architecture as well as the combination of materials arriving from abroad (as happened here along the Guadiana) with the materials sourced locally.

The preponderance of vernacular architecture studies depart from the identification of regional types and the research on the profound transformation in the housing production processes that modernism consolidated, thereby contributing to simplifying the historical process out of the contraposition between pre-industrial and post-industrial architectures. It is within this context that the architectural history of vernacular domestic housing acquires greater importance, necessarily incorporating a more integrative approach, with more circumscribed areas of study, considering the concepts and methodologies not only of architecture, geography and anthropology but also of archaeology, documentary history and landscape architecture, among others. In the case of Mértola, the importance of studying the history of domestic architecture extends beyond scientific research in seeking to contribute to a local development project based on appreciating and safeguarding the different expressions of cultural heritage and returning very interesting results in terms of combating the processes of demographic regression and human desertification that have hitherto characterized the interior areas of Portugal.

### Endnotes

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<sup>2</sup> Should we consider, for example, a cross section through the town square (see Figure 7), we rise from an elevation of 26 to that of 64 over a horizontal distance of about 100 meters. Indeed, it is the preponderance of sites with such steep slopes that has been the primary focus in the generic descriptions of architectural morphology of Mértola, including for example Gutkind (1967).

<sup>3</sup> The 1765 Livro da Décima registers about 66 houses, of which only twelve are described as 'high and low' or 'single-storey with an attic' (Arquivo Municipal de Mértola, 1765).

<sup>4</sup> Especially when considering a definition similar to that in the Encyclopedia of Vernacular Architecture of the World: "Vernacular architecture comprises the dwellings and all other

buildings of the people. Related to their environmental contexts and available resources, they are customarily owner- or community-built, utilizing traditional technologies. All forms of vernacular architecture are built to meet specific needs, accommodating the values, economics and ways of living of the cultures that produce them" (Oliver, 1997: XXIII).

<sup>5</sup> This dimension contrasts with Bernard Rudofsky's very narrow interpretation of vernacular architecture: "Vernacular architecture does not go through fashion cycles. It is nearly immutable, indeed, unimprovable, since it serves its purpose to perfection. As a rule, the origin of indigenous building forms and construction methods is lost in the distant past" (Rudofsky, 1987: 6).

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# A review on changing housing approaches and media contents in Turkey: 1930-1980 period

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## Abstract

The change in the understanding of housing in Turkey began in the late nineteenth century within the framework of modernization movements. Along with the early Republican period, modernization was treated as a nation-state policy and housing was evaluated as a spatial expression of cultural change in the process of creating the new Turkey. This was a period of transformation in which the traditional culture of living was replaced by ‘modern housing’ discourses and ‘apartment’ buildings as new form of housing production. The integration of apartment buildings into urban space as symbols of modern life also led to a redefinition of social relations with the spatial experiences it brought. In this process, which continued from the 1930s to the 1980s, the media has attracted attention as an important tool in imposing the new housing concepts on Turkish society. Media contents, which undertook the mission of educating society during the modernization in the 1930s, was replaced by rent-oriented discourses after the populist policies, large-scale urban interventions and new housing production methods of the 1950s. In this context, the article aims to examine the change in the housing approaches in Turkey through the media contents from the 1930s to the 1980s, based on the attitude of the media to guide society, which changes parallel with the dynamics of each period.

## Keywords

Housing, Media, Modernization, Living culture.

## 1. Introduction

The changes in urban space and the emergence of new housing types in Turkey began with the modernization movements after the second half of the nineteenth century. The decline of the Ottoman Empire in the face of the rapid developments in the West had a strong effect on economic and social life, and this revealed the need for reforms in both the government and society. Until this period, the city morphology of Istanbul consisted of large magnificent structures representing the empire's power and traditional houses located around them. With the new modernist approaches, 'apartment buildings' inspired by the European model began to be built in areas such as Beyoğlu and Galata, where non-Muslims and Levantines settled. These buildings, which were separate from their environment in both their materials and their construction methods, were quite different from the traditional Turkish houses and the concept of a collective life that they offered. However, the fact that these buildings were considered as symbols of Westernization and relative wealth caused them to become popular among people who were adopting a modern understanding of life. Therefore, these changes in the understanding of housing played an important role in the reconstruction of social identity as well as the urban structure. In particular, the identity struggle of the group, who wanted to have a modern image in the society with their housing preferences, was an important factor in terms of sharpening the social stratification in this period. This modernist attitude of the early Republican era was followed by the populist policies and large-scale urban interventions after the 1950s. The architectural attitude of the early Republic, which can be described as relatively naive, has been replaced by multi-storey residential block productions. In the 1980s, the neoliberal policies had great impacts on the housing approaches and the socio-spatial structure of the city in general. Therefore, in this study, the 1980s was seen as a dramatic threshold.

In this process of trying to integrate the new Turkey to the West, media outlets were an effective catalyst. Given the media's domination and directing atti-

tude in every period, its impact on the emerging society is an undeniable fact. In this context, the media played a significant role in the process of achieving the targeted culture of life in the developing Turkey. For this reason, the aim of this paper is to explain the changing of the housing understanding from the 1930s to the 1980s and to examine the contents of media reports and advertisements of the period. Since the beginning of the changes in housing approaches and modernization movements in Turkey dates back to the late 19th century, it is important to mention this process first. According to this, the second part of the study examined the understanding of modernization of the Ottoman period and the new housing concepts. In this section, apartment buildings and row houses presented with modern housing discourses were discussed. The third part focuses on the modernization project of the early Republican period with the nation-state understanding and the ideal modern housing concept. In this context, the articles in the print media of the period were examined and the media's guiding attitude towards the society was emphasized by discussing the contents. In the fourth part, the period 1950-1980, which saw significant transformation and accelerated urbanization in Turkey, was examined. State policies, planning decisions and housing production methods were emphasized. In this context, media contents of this period which have a different kind of attitude from the early Republic period were discussed comparatively.

## 2. Housing in Ottoman Empire in the nineteenth century

In order to examine the understanding of housing in Turkey's modernization process, it is necessary to first address the modernization movements in the Ottoman Empire. In the nineteenth century, factors such as the deterioration of the administrative structure, economic problems and the pressures of the big states were the beginning of modernization and reform movements in the Ottoman Empire. In addition to these, the Ottoman Empire's lagging behind the developments in the West in the scientific, cultural and industrial fields made this change necessary.

Within the scope of the reform movements in this period, there have been also important changes in urbanization, housing and property relations.

The first mid-stratification trends in Turkey emerged with employees who were working in organizations dependent on the West, and medium-sized traders, in the last period of the Ottoman Empire. These employees and traders were mostly non-Muslims (Kıray, 1998). As a result of developments such as the declaration of Tanzimat Edict in 1839, the removal of construction restrictions for non-Muslims living in Ottoman territory, and urban planning decisions made according to western principles, the first examples of apartment blocks in Turkey appeared. With the law of 1869, non-Muslims had a legal right to own property. During this period, apartment buildings began to be built in a limited area and in small numbers. It is possible to find the first examples of apartment buildings in neighbourhoods such as Galata, Pera and Tarlabası, which were mainly where non-Muslims were concentrated. Until this period, neighbourhoods in Istanbul were separated according to religious groups. After these developments, non-Muslims began to disperse to different parts of Istanbul (Öncel, 2014).

According to Simmel, individuals imitate their social environment in order to impose themselves on society and reach a certain socio-cultural status. This habit of imitation starting from clothing shows itself in likes, ideas and lifestyles over time. The person who tries to belong to a certain class accepts and internalizes almost every object or situation of that class (Simmel, 2004). At the beginning of the twentieth century, having an apartment was considered to be equivalent to being in a privileged social position in the Ottoman Empire. It was also possible to call this a kind of new 'housing fashion'. For this reason, besides their mansions and waterfront houses, some people considered that having an apartment in Beyoğlu was a sign of their reputation in society (Görgülü, 2010). Also, the incorporation of Western furniture in these elite domestic spaces reflected social changes and the desire for Westernization (Gürel, 2020). The art nouveau style Botter

Apartment in Beyoğlu is one of the first examples, with its facade features, use of the land and interior arrangements. The Doğan Apartment in Pera, which was designed as a rental apartment for distinguished non-Muslim families at the end of the 1800s, is another important example of the luxury apartment buildings of that period. In addition to these, there are also apartment buildings that differ in terms of both users and stylistic features. Efkafl Apartments, designed by Architect Kemalettin for the survivors of a major fire in 1918 that affected a wide area from Cibali to Fatih, can be given as an important sample. Later on, the name of these buildings was changed to Harikzedegan Apartments, which means 'damaged in the fire'. These apartments, which were similar to social housing projects in Europe in terms of plan schemes are also the first buildings that were built with reinforced concrete.

Another type of housing that emerged in the nineteenth century is row housing. According to some people, row houses were more suitable for Turkish families for typological and privacy reasons. These houses, which were characterized by a framework of street-plot-structure relationship and side-by-side layout, formed an urban space that was very different from the previous urban texture (Batur et al., 1979). Row houses, which could be considered to be the houses of the middle and small bourgeoisie such as tradesmen, merchants, artisans and middle-ranking bureaucrats, began to be built in many different regions of the city such as Kuzguncuk, Balat, Yeldeğirmeni, Kumkapı, Bağlarbaşı, Beşiktaş and Ortaköy. Row houses were generally separated from each other by brick walls, and gained importance in terms of bringing solutions to the problem of fires. Akaretler, constructed by Sarkis Balyan in 1875 for the use of palace servants, was one of the first examples of row housing before the Republican period.

In the West row houses and apartments became common as two main types of housing. In this period, in the Ottoman Empire, which took the West as a role model, these new forms of housing became widespread, and they joined the fabric of Istanbul with new spatial approaches, concepts and cul-

tural forms. The reasons for the changes in housing typologies and the elements that triggered diversification in this period can be summarized as follows:

- The city was crowded as a result of immigration.
- Westernization brought changes to the institutional / administrative structure and these had effects on urban management, property and professional organizations.
- Westernization had effects on social life, consumption, pleasure and value systems.
- There were changes in the structure of society: a process of transition from social groupings to organized society / from traditional family to modern family.
- The outsourced and dependent economy had effects on housing: building materials, technology and so on.
- The same changes had effects on home technology: furniture, heating, food preparation, etc.
- There were changes in transport systems and possibilities, and increased intra-city mobility.
- There were fires and post-fire redevelopment movements, and legal measures (Yücel, 1996).

When compared to apartment buildings, the row house typology designed for a single-family in a single plot became insufficient because of the increasing population. For this reason, apartments that allowed multiple families to be accommodated in the same plot became widespread. These structures soon became the starting point for a new style of housing in Turkish architecture as a brand-new typology.

### 3. Early Republican period

1923-1950 can be regarded as a transitional period for Istanbul, in which housing production was dominant for personal needs, while apartment construction continued at a certain rate. Slow urbanization, urban land that did not yet have a speculative value and therefore came at a low cost for housing, and the fact that local governments could plan adequate urban areas in parallel with the slow pace of urbanization and did not face significant constraints in providing urban

infrastructure, created the required conditions for such production to meet social needs (Tekeli, 2010).

The early Republican period was a period of change and transformation in terms of expressing the transition from the traditional Ottoman culture and life to Western and modern life. The change in the social structure was shown in the family structure as well, and a new formation process begun that strengthened the place of women in the family and society, moving away from the traditional understanding. The social and cultural changes experienced in the name of modernization led to the redefinition of the residential space, and the breakaway from the traditional structure began. This led to the replacement of the traditional Turkish house depended on the 'haremlık-selamlık' system in which men and women set in separate parts of the house, by apartments consisting of rooms located around a corridor. In a popular magazine, the following observation was proudly expressed: "For the European, the house is a private thing that belongs to a person. In our case, the house is now starting to become a rising institution and organization. The Turkish citizen has also recognized the residence in the Republican period like other good things. Most of us do not know how to make beautiful houses and settle in a beautiful way because of the fact that the idea of building and decorating a house is too new for us" (Bozdoğan, 1996).

When the media contents of the early Republican period are examined, it draws attention that most of these contents have a mission to teach the contemporary living and educate the society rather than presenting the modern housing concept as an element of choice. It is also possible to consider this approach as a reflection of the new nation-state understanding. However, in some newspaper articles the reflections of changes in lifestyle on housing, and the increase in the number of apartment buildings, were expressed as disadvantages. It was said that the new apartment buildings that started to be popular after the Republican period did not comply with the old customs and traditions and did not fit





**Figure 1.** 'Residents of newly built apartment buildings can only get air on the terraces.' (*Bahçesiz Ev: Çiğersiz Adam (House without Garden: Man without Lungs)*) (Source: Yedigün Magazine, 1934).



**Figure 2.** *Küçük Apartmanlara Mahsus Eşyalar (Furniture for small houses)* (Source: Yedigün Magazine, 1934).

with Turkish family life (Sey, 1993). In an article entitled *Bahçesiz Ev: Çiğersiz Adam (House without Garden: Man Without Lung)*, which was published in 1934, apartment buildings were described in the following sentences: "There is huge building activity on all sides. There is a lack of daily wages for labourers, cheapness of construction material and before all of these, customs. Many roofs are rising all over the world. The green fields where the lambs were grazing a few years ago, today have been invaded by apartment buildings. It is impossible to find an empty space now where we were playing football in the past. It is not just like that here, it is like that everywhere..." (Yedigün Magazine, 1934). In the article, there is a photo of a woman sitting on a terrace, and the caption states that residents cannot obtain adequate comfort as they could in a traditional house with a garden (Figure 1).

Although this new lifestyle and housing were rejected by some people, who considered that these buildings were not suited to traditional Turkish life, the new modern apartment buildings continued to take their places in the city. The Istanbul Academy of Fine Arts, where German and Austrian professors taught, was influenced by the Westernization movements, and the architects of the period, like Seyfettin Arkan, Zeki Sayar, Abidin Mortaş and Bekir İhsan, directed Turkish architecture with the projects they designed (Bozdoğan, 2012). Modern apartment buildings continued to be imposed on society as a new way of life, while the importance of the interior as well as the exterior was emphasized. Newspapers and magazines tried to describe the ideal housing concept, and it was said that the interior should be simple and modern like the exterior of the building. In an article entitled *Küçük apartmanlara mahsus eşyalar (Furniture for small apartments)* that was published in Yedigün Magazine in 1934, there was a suggestion that space could be gained in the rooms by using expandable furniture that could be transformed according to usage requirements (Figure 2). Also, in the same magazine it was emphasized that private places like bed-



rooms should be decorated with the same attention as guest rooms (Figure 3). In this way, while traditional residential architecture was replaced with modern buildings, instead of using dense and ornate furniture, simpler and modern solutions were preferred in the interiors.

When evaluated in the socio-cultural context, this process produced sharp results in terms of social stratification and the separation of classes through housing. People from different communities living together in the urban space were left to live according to their economic and cultural situations, housing styles, land prices and therefore neighbourhoods. As the production of a building in a single plot was economically high, the apartment buildings constructed in this period were in demand from socially higher and wealthier individuals such as doctors, lawyers and some well-established families. This situation became an element of prestige, and the city bourgeoisie invested their savings in these apartments and began to rent them out. The apartment buildings were usually given the name or surname of the owner in this period. Buildings were designed by the main architects of the period, and the general interior organization came under the influence of the bourgeoisie of the Republican period. The flats in these apartments were rented by people who were considered to be broadly in the same social and cultural class but did not have enough accumulated capital to build an apartment. The interview in Yedigün Magazine with Professor Behçet Sabit, who was an important doctor of that period, is remarkable in this context (Figure 4):

- Mr. Behçet don't you have an apartment?

- No. Amazing isn't it? You opened your eyes... You are right. The doctor and the apartment have been so mixed up lately that it seems very strange to see them apart. But no. I don't have an apartment. I spent my earnings not on an apartment, but on the travels that made me able to see the development of my profession in the West, and on supplying my needs. ("Profesör Behçet Sabit Bey," 1934)



**Figure 3.** Yatak odalarımızı sade yapalım (Let's make our bedrooms simple) (Source: Yedigün Magazine, 1934).



**Figure 4.** Interview with Professor Behçet Sabit (Source: Yedigün Magazine, 1934).

One of the important developments of the early Republican period was the housing loan support of Emlak Bank. Yapı Kredi Bank, which opened in 1944, brought in the idea of lending to house buyers. However, the government did not adopt the idea of solving the problem of housing finance through private banks, and chose to give this duty to a



**Figure 5.** 'Emlak Bank builds 500 houses' (Source: *Akşam Newspaper*, 1949).



**Figure 6.** Levent Mahallesi advertisement (Source: *Arkitekt Journal*, 1950).

public bank. As a consequence, with the law published on June 14, 1946, Turkey Emlak Kredi Bank was established, with a capital of 110 million TL. Thus, Emlak Kredi Bank took a monopolistic position in house financing (Ersel, 2015).

In this period, another important change in housing production in Turkey was cooperative housing. Cooperatives mainly began in the period when the Republic was first established. In the 1930s, the housing needs of Ankara's rapidly growing population, and the increases in land prices, did not allow the public to buy a house in a single lot. In order to solve this problem, the senior bureaucrats in Ankara established the Bahçelievler Housing Cooperative in 1934 for an area that was not yet opened for development. This was important in

terms of solving a problem that could not be solved by personal relations, using an institutional structure and setting an example for those who had similar problems. At the same time, lending by Emlak and Eytam Bank (which was established in 1926 to support construction and provide credit) was a facilitating factor. Factors such as the election of the minister of publicity as honorary president, the association of the governor with the project, and the presence of prominent bankers of the time among the cooperative partners increased the success of this first cooperative experience in providing cheap land and mortgage loans. This situation could be considered as the production of luxury housing by an important state group, unlike the cooperatives established by low-income groups with limited budgets in the West. The cooperative movement that started in Ankara spread to other provinces over time. Between 1935 and 1944, a total of 50 housing cooperatives were established, of which 22 were in Ankara, 8 in Istanbul and others in other cities, and 554 houses were produced. As a result of efforts such as the provision of housing loans from the funds of Emlak Kredi Bank and the Social Insurance Institution (SSK), 23,374 houses were built through cooperatives up to 1960 (Özüekren, 1996).

The first important examples of cooperatives in Istanbul were the Levent and Koşuyolu housing projects organized by the Emlak Kredi Bank based on an individual loan model. The construction of the first part of the Levent, which is the core of today's Levent district, started in 1947, and the first neighbourhood was completed in 1950. A total of 391 residential units in the neighbourhood were designed as single houses, twin blocks and row houses. In an article published in *Akşam* newspaper, it was stated that, in order to solve the housing crisis, a new project with infrastructure was being built on Levent municipality land (Figure 5). In an advertisement in one of the most important architectural magazines of that period, expressions such as 'regular asphalt roads, modern sewerage network and green fields' were used, to emphasize the concept of modern life (Figure 6).



Despite its distance from the city centre, the Levent district had been home to the middle class and civil servants for a long time. On the other hand, Koşuyolu began to be recognized as a separate neighbourhood at the time of the mass housing projects of the early 1950s. In parallel with the cheap dwelling policy of the time, a housing project and a bazaar were built by Istanbul Municipality and Emlak Kredi Bank partnership in the middle of the wheat fields and meadows of Koşuyolu (Akbulut, 1996).

Also, after 1949, banks started to organize sweepstakes for account holders to increase their deposits, and introduced the concept of 'lottery houses' to the housing literature. Therefore, in this period, houses were designed and built by the banks, and given the name of lottery houses (Görgülü, 2016b). İşbank was important in terms of being the initiator of these lottery schemes as part of saving incentives. In addition, it was possible to see the lottery house advertisements of different banks in the magazines and newspapers of the period. (Figure 7).

#### 4. 1950-1980 Period

In the 1950s, the acceleration of industrialization, the creation of new areas of employment and the migration from rural to urban areas caused an increase in the population, and thus the existing housing stock remained inadequate. On the other hand, housing production became a serious problem due to the difficulties in capital accumulation and private/public resources. This was the beginning of a period in which different types of construction methods were tried, and the structural environments of big cities were greatly changed.

The law 'encouraging construction and allowing building without permission' that was enacted in 1953 aimed to ensure that the cooperatives would benefit from the public land that was transferred to the municipalities, and would thus pioneer the development of social housing (Tapan, 1996). With this approach, which targeted middle- and low-income people, Emlak Kredi Bank designed Western-style projects by planning to build on land

**T. C. ZİRAAT BANKASI**

Vadesiz Tasarruf Hesapları

1950 yılı ikramiyeleri:

İSTANBUL ve ANKARA'da

**8 Ev,**

Ayrıca:

**200.000 Liralık**

PARA İKRAMİYELERİ.

Ev kazanan isterse bedelini alabilir.

**ACELE 150 LİRALIK BİR HESAP AÇTIRINIZ**

Her 15 lira için ayrı bir kura numarası verilecektir.

10 Mart, 15 Mayıs, çekilişlerinde yalnız para ikramiyeleri; 30 Haziran, 31 Temmuz, 29 Ağustos, 30 Eylül, 28 Ekim, 30 Aralık, çekilişlerinde ise, bazılarında iki ev olmak üzere hem ev, hem para ikramiyeleri vardır.

İkramiyeye giriş şartlarını Bankalarımızdan öğreniniz.

**Figure 7.** Ziraat Bank lottery house advertisement (Source: *Arkitekt Journal*, 1950).

located outside the city. In contrast to the houses with gardens, multi-storey and low-rise residential buildings in a mixed arrangement were envisaged. In an advertisement entitled 'Levent Mahallesi' in Vatan newspaper, information about the groundbreaking ceremony for the fourth section was given, and it was reported that in order to have an apartment an account should be opened at Emlak Kredi Bank (Figure 8).

During this period, the construction of apartment buildings and single houses continued to a certain extent. As in the example, the advertisement texts of the housing projects built in the 1950s contain details about the housing quality. In these texts in which material quality, landscape elements, location, transportation and social facilities are explained, providing information is in the foreground. In this context, this approach seems similar to the modernization attitude of the early Republican





Figure 8. 4. Levent Mahallesi advertisement (Source: Vatan Newspaper, 1955).



Figure 9. Seçim yakın, af çıkacak diyen gecekondu yapıyor (The elections are coming soon. Since there will be amnesty, everyone is making slums.) (Source: Hürriyet Newspaper, 1977).

period. In 1957 a new housing complex was built by Kredi Yapı Sandığı in Koşuyolu. The project was described in an advertisement with the following sentences:

'In a large area with fruit and pine trees in Koşuyolu, dwellings which are suitable for all tastes and needs have begun to be built. Kredi Yapı Sandığı will be happy to deliver the keys of these houses, built with first class materials and workmanship, to their customers. These houses are next to the main street. Public buses to Kadıköy and Haydarpaşa pass in front of them. It is possible to move to Üsküdar, Kadıköy and Haydarpaşa or any desired location without any problem of transportation. The houses will be able to meet the residents' needs in both summer and winter. The needs of the neighbourhood, such as roads, water, electricity, gas and telephone, are provided. There will be a big bazaar, a modern cinema and green fields. Kredi Yapı Sandığı has provided you with a good opportunity to find a cheap and beautiful home in Koşuyolu, which is one of the most prestigious corners of Istanbul' (Suoglu, 2009).

One of the important problems of this period was slums. The concept of slum has emerged from the 1950s along with the migration from villages to large cities. A slum can be defined in various ways. According to UN-HABITAT, slums are the most deprived and excluded form of informal settlements and are characterized by poverty and large agglomerations of dilapidated housing, often located in the most hazardous urban land. (HABITAT III, 2015) In another definition, slums are defined as the type of shelter inhabited by poor or low-income families whose needs are not met by the government and the city administrations, on the territory of public and private persons, without the will and knowledge of the landowner (Keleş, 1998). Until the 1950s, slums were generally located at the edge of the city or, in other words, away from the socio-cultural environment. For this reason, slum dwellers were not perceived as a major threat to the urban space. Slums, which were built out of desperation, moved away from being innocent shelters over time. After a while, they became an urban looting system in the hands of those who turned this migration into an income system, and politicians allowed and even supported this formation for the sake of their political interests. This problem was mentioned in a newspaper article, as follows: "The elections are coming soon. Since there will be amnesty, everyone is making slums" (Figure 9). This news report stated that there were two thousand slum houses being built in five districts during the religious holiday.

This was also a period in which slum dwellers' political power and organizational skills were seen in the opportunities provided by democracy (Akbulut, 1996). These rapidly increasing settlements led to the formation of a hierarchy of owners of slums, tenants of slums, and owners of slums who rented space in their own houses for the purpose of saving. The situation was out of control because of the concessions made by the political forces, and Istanbul began to grow in an unplanned and random manner. On the other hand, this situation caused problems with infrastructure, traffic and environmental pollution.

In this period, slums were rapidly growing in number in some parts of the city, while the construction of apartment buildings continued. As it was not possible to divide the ownership in land, before the flat ownership law, the housing stock problem could not be solved. For this reason, apartment buildings appealed to a certain segment of society. The middle class, who did not have enough income to live in apartments, preferred individual houses. However, after a while, increased land prices due to intensive urbanization, made the production of these houses a new problem. Public resources, which were inadequate for the infrastructure, limited the production of urban land and increased land prices in extreme terms, thus increasing the need for intensive construction (Balamir, 1996). The flat ownership law was an important turning point in terms of eliminating the problems and opening the way for new housing production. The first attempt to legalize flat ownership was made in 1948 when a notary law was enacted, but no success was achieved. The second attempt to change the land registration law was made in 1954 and succeeded. Then, in 1965, a detailed regulation was made with the flat ownership law (Tekeli, 2010).

Under the flat ownership law, the right for there to be only one owner of one parcel of land was eliminated, and this has led to a form of production based on sharing. On the other hand, the fact that Emlak Kredi Bank made loans to buyers also accelerated the tendency to buy houses. This brought together the landowner, the entrepreneur and the small investor who wanted to have a house, and thus eliminated the high investment cost for the entrepreneur. At the end of this cooperation, the share of ownership obtained from the immovable property and the rates for rights in the common land and common areas were determined in proportion to the values of the independent units (Balamir, 1996). In this mode of production called "build and sell", the number of houses to be rented was quite high. Since the owners of the land had more than one residence in each building,

**BAĞDAT CADDESİNDE VE MODA CADDESİNDE**

**Hayalinizdeki şahane daireleri sizler için hazırladık**

1. BAĞDAT CADDESİ, ÇARŞIBAŞI - DAİRE BÜYÜKLÜĞÜ 195 m²  
dört odalı, iki banyo, mutfak, 64 m² L. alan, çamaşır ve modern mutfak, ayrıca dört yatak odası. Herkes için - tel: 425.000 (vergiler dahil) Beş daire hazırlanmıştır.
2. BAĞDAT CAD. ŞİŞLİ - DAİRE BÜYÜKLÜĞÜ 140 m²  
Mayıs 1971'de teslim - tel: 275 - 300.000 (vergiler dahil)  
Altı daire hazırlanmıştır.
3. MODA CAD. BEŞİKTAŞ - DAİRE BÜYÜKLÜĞÜ 140 m²  
1970 sonunda teslim - tel: 250 - 375 - 300.000 (vergiler dahil) Beş daire hazırlanmıştır.

**MÜHİM AÇIKLAMA**

- a) Yukarıdaki fiyatlara, alıcıya ait tapu ve diğer masraflar verilmemiştir.
- b) Daire fiyatlarına tüm yapılmış işler dahildir.
- c) Tapu ve diğer masraflar ayrıca.

**EVSAN**  
EMLAK VE SANAYİ ŞTİ.  
Bağdat Caddesi  
Şişli, İstanbul, 808 Kadıköy  
Tel: 36 03 48

**Figure 10.** Hayalinizdeki şahane daireleri sizler için hazırladık (We have prepared your dream apartments for you) (Source: Milliyet Newspaper, 1970).

they decided to rent these houses for the purpose of investment at the end of the construction. During this period, the number of advertisements increased and various firms decided to share their housing projects in the printed media (Figure 10). During this period, a new kind of advertising method was used which made up of life mottos, slogans and images, instead of the 1950s' informative method with the structure, content, material and location details. It is possible to see several discourses such as 'dream apartment', 'peaceful life and 'wonderful houses' in this period.

## 5. Discussion

The perception and the meaning of housing in Turkey have changed considerably over time since the late nineteenth century. The period started with the westernization movements was followed by the Republican period with its innovative attitude. With the introduction of the apartments that represented modern life, housing broke away from its traditional context and gained a new identity. In the changing socio-cultural conditions, spatial changes were envisaged to bring living standards in line with Western conditions, and thus a

new language emerged in the area of housing. Among people who wanted to have a preeminent social status, apartment buildings became symbols of luxury living. This situation, which caused a disintegration in the urban space and affected class dynamics, was the beginning of a new period. In addition to these, like the structural forms of buildings, interior decorations also changed. In contrast to traditional concepts, a new minimal approach was developed, with functional and simple lines.

When the archives are examined, it is seen that the media had an important role in the imposition of the new housing concepts on the society in the early Republican period. Undoubtedly, the fact that modernity was seen as a prescription determined within the framework of nation-state policy had a great effect on this. In this process, the media had undertaken a civilizing mission and had been instrumental in 'teaching' the new 'ideal living space' understanding to the society. The media offered forms, materials, and furniture recommendations to give information about what a modern home should look like. This directing and sometimes imposing attitude also prevented the critical approach to housing and architecture in general. For these reasons, it would not be realistic to say that housing underwent a natural evolution during this period.

After the 1950s, there was a substantial change in housing production and presentation formats in Turkey. During this period, reasons such as migration from rural to urban, increase in urban population, slum housing and deficiencies in housing policies made the housing problem more evident. State interventions, the property ownership law, the establishment of housing cooperatives and the activities of construction companies carried the concept of housing to a different axis. During this period, the rate of urbanization has increased considerably compared to the previous period. This increase created an unqualified built environment and housing production was also negatively affected. Unlike the early Republican period, houses were produced with an

understanding based on block repetition without considering any certain design idea in this period. Although the understanding of modernization of the early Republican period is criticized with its different aspects, when the interior organization, facade and form features of the houses are examined, it is seen that the design concern was at the forefront in that period. The disappearance of this understanding after the 1950s dramatically changed the housing approaches and thus the built environment. For these reasons, it is almost impossible to talk about a quality in housing production especially after the 1970s.

It is also possible to read this change in the understanding of housing from the media texts that changed with the dynamics of the period. Media texts of the early Republican period, which were concerned about creating an ideal living space, left their place to rent-oriented discourses in this period. It is possible to see many housing advertisements and news reflecting these developments. In this context, it can be asserted that housing began to be seen in the media as a product.

## 6. Conclusion

Media is an important factor in cultural continuity with the content it offers within the framework of its feature of informing and directing the public masses. This effect creates significant changes in individuals' behaviors, desires and lifestyles with the new value systems imposed. The house, which is the most basic unit reflecting the cultural structure of the society, has been interacting with the media in every period. It is possible to say that media products are cultural texts that give clues about the economic, political and social structure, rather than just news or promotional tools. Within the framework of this research, it was read through media contents that the use value and semantic structure of the house gradually disappeared and became a commodity that could be bought and sold. It has been observed that media contents have also changed in parallel with the change in the understanding of housing with the effect of political, economic, cultural and social dynamics. All issues related to the



attitude of individuals towards housing consumption, the struggle for social hierarchy and the construction of relationships have been met in the media literature. In addition to these, examining the media contents in different periods and determining the changes in the discourses were also important in terms of evaluating the change in the understanding of housing from the modernization movements in the 1930s to the 1980s through a different discipline.

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# Urban protection and renewal dilemma: İzmir Mezarlıkbaşı

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## Abstract

At the beginning of the 21<sup>st</sup> century, efforts to preserve cultural heritage in historical settlements is a highly problematic and multi-faceted issue in Turkey. Although conservation legislation dates back to 60 years ago, heritage conservation has not been internalized and accepted in the wider part of society, and, has not established a sound political foundation. On the other, however, there is also a lack of integrated land-use planning and management.

The purpose of this study is to present the difficulties of dealing with the conservation, renewal, and regeneration for heritage areas in the historic core of İzmir, *Mezarlıkbaşı-Kemeraltı*, as well as to discuss the intrinsic physical qualities, dynamic characters and diversity of community groups with a view of new spatial agenda. The objective of the study is therefore twofold: 1) documentation of the physical characteristics and values for understanding the place; 2) to evaluate incorporating integrated strategic planning and management approach pointing the need for incorporating, leadership, partnership, integration and inclusion as a policy guideline for the safeguarding the heritage area. Our findings show that the Municipality of İzmir has made a significant attempt as TARKEM's leadership position, which has succeeded in attracting national and international interest in *Kemeraltı* and creating opportunities for the future, but partnership (operation), management (structure) and inclusion (its processes) still lack. Community groups are not seen as part of the planning activities and planning has been remote, fragmented and exclusively missing an integrated planning management approach.

## Keywords

Safeguarding cultural heritage, Conservation planning and legislation, A strategic management of cultural heritage, Policy guideline for management of cultural heritage.

## 1. Introduction

The conservation efforts of the historical environment to prevent the social, economic and cultural values of society from disappearing, along with the distinctive physical architecture, are under tremendous pressure from the social, demographic, and economic conditions of today. This requires coherent economic and social development policies that take historic core areas into account at all planning levels (Valetta Principles, 2011).

Parallel to the developments across the world, our country's efforts to develop and implement planning legislation on the protection of cultural heritage dates back 60 years. However, sufficient public participation and the development of related political mechanisms have not been achieved in the preservation of immovable cultural assets. Despite the ongoing regulations, and newly enacted conservation laws that target not only the major monuments but many other conservation areas, sites, and internationally supported conservation efforts, it cannot be claimed that conservation of immovable cultural assets is well planned and managed. Besides, the conservation attempts face a wide range of complex problems including rapid urbanization and openness to the world market due to the massive liberalization and efforts to articulate the global economy.

Moreover, there is a contrast in the nation's land-use planning system that generally encourages development, while conservation plans impose heavy restrictions and constraints upon development. Although the conservation plan is compulsory for the declared site areas, the general planning philosophy of the nation in the historical course has always been in favour of development, and in increasing and redistributing rights that rise from development (Tekeli, 1991). Furthermore, the inhabitants of the historic core areas are generally low income and have limited enabling capacity and resources to overcome the complex procedures of conservation activities. Financial and administrative implementations regarding conservation present problems.

As Turkey has opened to the world order and been interacting with the

world economy, the intense commodification of the housing and land market has resulted in a construction boom and never-ending construction facilities in Turkish cities (Erol, 2019: 732). Over the last 10 years, the field of construction has become the chief sector playing role in the country's economy (Yeldan, 2018). Massive construction activities, at the same time, create negative externalities and eventually endanger the preservation of historic core areas. The socio-spatial configuration of the big cities including İzmir has impacted most of these developments.

The city of İzmir, after İstanbul and Ankara, seems to be subjected to all these discussions. *Kemeraltı*, the historic center of İzmir, is listed as an urban and archaeological site, and also as a renewal site (Figure 1). İzmir Metropolitan Area Municipality has been leading the conservation and regeneration implementations in the site, which is approximately 248 hectares (Tekeli, 2015). In this study, a section of the mentioned site, *Mezarlıkbaşı*, is focused on considering the major commercial axis as the center of the study area and the need for intervention diversification. The key aim is to define the preservation problems of *Mezarlıkbaşı*, *Kemeraltı* with its legal, administrative, physical, and socio-cultural aspects; and to present principles for the solution of related problems. The challenge of conservation along with regeneration typically requires a new approach in planning that highlights a series of guiding policy principles, leadership, partnership, integration, and inclusion (Gallent et al., 2006) that feed into the 'place-making' of historical conservation and regeneration in the historical core areas. The implementation process regarding conservation and regeneration should be better planned. The principals indicated above will improve the management of the preservation process. As a methodology, we use these guiding principles to evaluate historic *Kemeraltı*'s conservation planning. We also take into consideration different actors of the process (Gallent et al., 2006: 185). For this, the paper follows a field research approach and uses a variety of qualitative techniques, i.e. in-depth interviews with the actors involved in



Table 1. Legal &amp; institutional structure of heritage conservation.

Legal Arrangement	Scope	Content	Jurisdictions	Institutional Structure
Conservation of Cultural and Natural Beings (Statute 2863 / 21.07.1983)	Conservation plan (Koruma Amaçlı İmar Planı)	<ul style="list-style-type: none"> <li>Preparation of a document that sets out the heritage value of a place and develops policies to guide its conservation, future use and development.</li> </ul>	Ministry of Culture İLBANK AŞ. (former Bank of Provinces, İller Bankası)	Supreme Council of Immobile Historical Assets Cultural and Natural Assets Regional Conservation Council Supreme Council of Conservation
Conservation of Cultural and Natural Beings (renewing and some addition of the Law 2863) (Statute 5226 / 14.07.2004)	Conservation plan	<ul style="list-style-type: none"> <li>Buffer zone taken into account</li> <li>Cultural and historical values must be preserved in accord with <i>sustainability</i></li> <li>Extensive studies, analysis</li> <li>Plans to address not only the conservation of <i>physical</i> environments, but also <i>cultural, social and economic dimensions</i></li> <li>Rehabilitation and renewal and their related projects</li> <li>Providing collaborative planning models, financial, organization and management models for the planning;</li> <li>New concepts such as "management area", and "management plan" Participatory management model</li> <li>New financial devices for private owners;</li> <li>Hierarchical and integrated planning</li> </ul>	Ministry of Culture and Tourism  Greater Area Municipalities  Province's Special Administration  Local Authorities (with the permission of Ministry)	Cultural & Natural Assets Regional Conservation Council KUDEP (Conservation, Implementation and Supervision Bureau) KUDEP KUDEP
The Law of Restoring and Protecting the Eroded Historical and Cultural Assets and for keeping them Alive (Statute 366 / 16.06.2005)	Designation of the <i>renewal</i> areas which are formerly declared conservation site by the Regional conservation council	<ul style="list-style-type: none"> <li>In the Law how to reconcile conservation and renewal processes are not defined clearly</li> <li>Renewal and conservation is not adequately defined under which conditions these two different strategies reconcile.</li> </ul>	Local Authorities	Renewal Council
The Law of the establishment of the Ministry of Environment and Urbanization (Statute 643 / 08.08.2011)		<ul style="list-style-type: none"> <li>The two different ministries, Ministry of Environment and Minis. Reconstruction &amp; Housing were merged into one under the rubric of Ministry of Environment &amp; Urbanization.</li> <li>The natural conservation areas, Natural Assets, National Sites and Special Natural Conservation areas were abolished under the jurisdiction of the Ministry of Culture &amp; Tourism. The Ministry of Environment &amp; Urbanization is totally responsible of declaring and conserving of the natural assets.</li> </ul>	Ministry of Environment and Urbanization	Council of Natural Assets' Conservation (Tabiat Varlıklarını Koruma Genel Müdürlüğü)
Transformation of the Areas under the Risk of the Disasters (Statute 6306 / 31.06.2012)		<ul style="list-style-type: none"> <li>Declaration and planning of the Urban Transformation areas under the risk of the disasters</li> </ul>	Ministry of Environment and Urbanization	

the management of the conservation process. Area survey and historical research are the techniques that have been combined. In-depth interviews with the community groups, which are partly or not included in the İzmir-History Project, are realized to learn the opinions for the preservation of immovable cultural assets. The paper attempts to discuss the need and applicability of the integrated planning and management for the safeguarding heritage areas in the historic area of İzmir, *Kemeraltı*, first addressing the challenges of conservation planning and related legislation and then allowing an evaluation of the policy guideline for better management of conservation and regeneration. The methodology includes site surveys taken in the fall of 2014, and in-depth interviews conducted in the fall of 2016 and the spring of 2018.

### 1.1. Planning, regulations and practice

In between the 1920s and 1970s<sup>1</sup>, the dominant idea of preserving historic assets was mainly formed by individual effort. The Amsterdam Declaration (1975) emphasized the urban site conservation concept. The Law on Old Monuments of Turkey dated 1973 (No: 1710) introduced the urban conservation site concept. This law was followed by another law specific to conservation in 1983 (No: 2863).

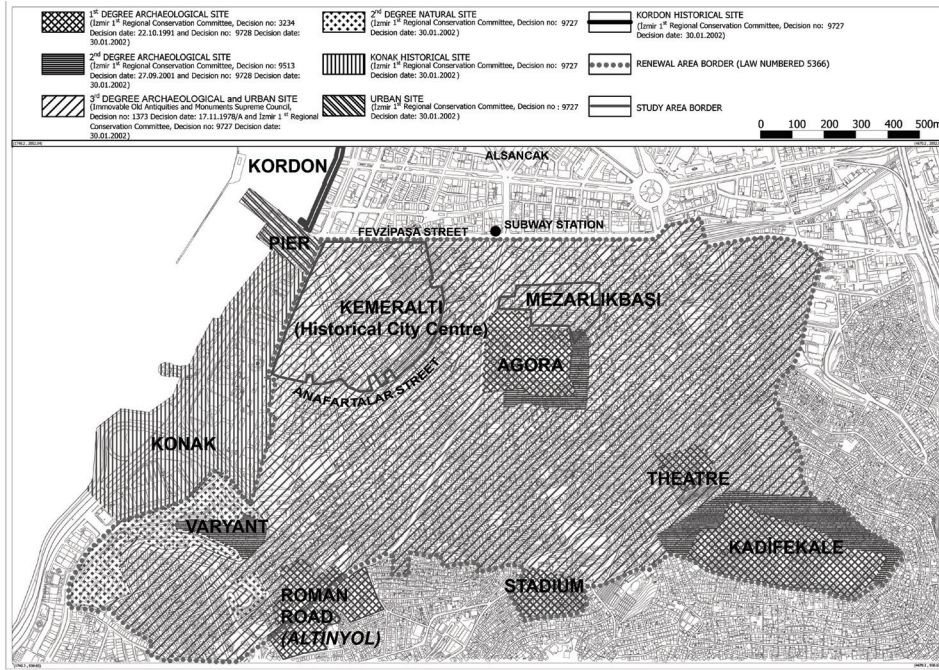
The Law dated 2004 and numbered 5226 emphasizes the planning of financial and managerial aspects of conservation<sup>2</sup>.

In the 2000s, the concept of urban transformation was given the privilege. As a result of the cooperation of local governments with the private sector, new legal orders were considered (Anlı & Osmay, 2007). The law numbered 5366 dated 2005 promoted urban renewal in urban conservation sites.

Despite all these arrangements, Turkey's conservation issues are becoming more complicated, and solutions are often criticized, and away from the definition of contemporary conservation. In addition to the difficulties of preserving, surviving, and transferring the rich historical, cultural, and natural values of the nation, the problems are more complicated by recent legal changes (Table 1). Moreover, the renewal examples introduced after the new regulations are aimed at accelerating and disseminating the reproduction processes that see the safeguarding of the cultural heritage as an obstacle to development. For these reasons, our job as planners and architects will be to develop new strategies to tackle intransigence, disputes, and tensions and thus develop a new strategy that will lead to social reconciliation, where solutions to regeneration and urban transformation can be integrated into the safeguarding cultural heritage problematic.

### 1.2. Physical structure of the Historic Kemeraltı Area

The studied site is within the borders of the historic center of İzmir, *Kemeraltı* (Figure 1, Figure 2); around the commercial axis of *Anafartalar* Street, and



**Figure 1.** Kemeraltı and its environs: Listed site renewal area relations in Kemeraltı and its nearby areas.

bordered between *İkiçeşmelik* (*Eşrefpaşa*) Street and *Hatuniye* Mosque, and includes nine building blocks of which five are at the north and four are at the south of the axis. The area juxtaposes the antique Roman Agora at its south.

### 1.3. Historical evaluation

The studied site acted as the gate of the commercial center, especially for the caravans coming from the north and east until the turn of the 16<sup>th</sup> century. It also included the Muslim graveyard. Because İzmir became an international trade center in the 17<sup>th</sup> century, *Mezarlıkbaşı* became a vibrant commercial center (Temizkan & Akan, 2013). *Karakadı* (Lüks) Bath, mentioned in the travelogue of *Evliya Çelebi*, is the oldest building of the studied site (Figure 3).

In the 18<sup>th</sup> century, Çavez, one of the former Jewish neighborhoods, grew eastward into the study area. A traditional bazaar has also entered into the interior. The Muslim cemetery has shrunk in parallel with the rise in urban density. The grave of 1708-9, which was found in the new shop structure in 360 island, 22 parcel, is an indication of the continuity of the cemetery function during this period (Figure 4).

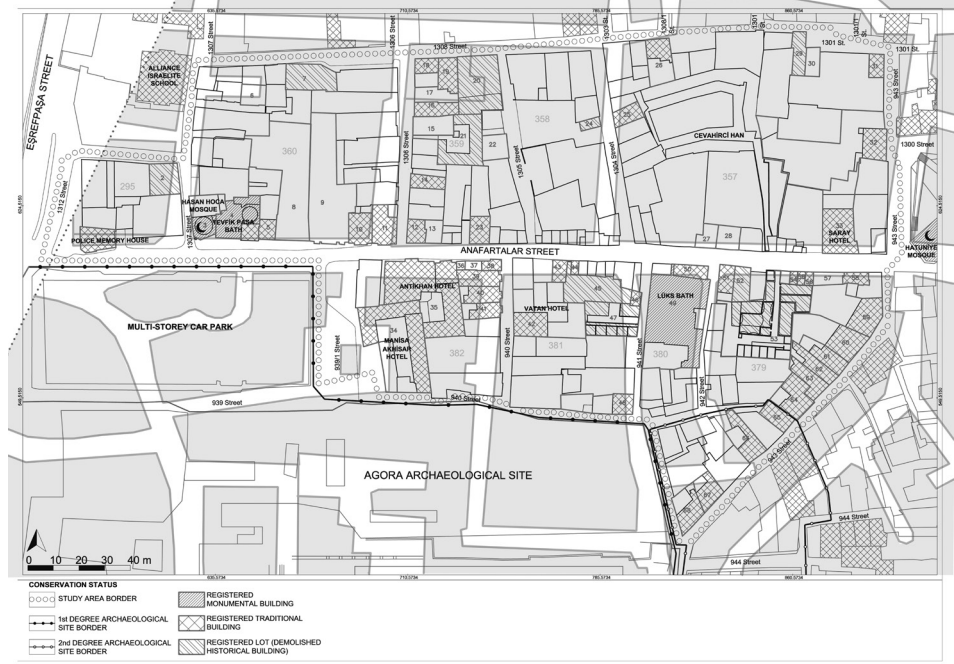
In the second half of the 19<sup>th</sup> centu-



**Figure 2.** A look towards of Kadife Kale (the Velvet Castle) from the studied site (revised from the photo of İzmir Greater Area Municipality Archive).

ry, as the Ottoman Empire declined, Muslims and Jews were obliged to leave the Balkans, Caucasia and Crimea: a big number of the population settled in İzmir (Sepetçioğlu, 2013: 120-128). Many Muslim and non-Muslim groups preferred to move to İzmir by the commercial significance of the city and the increase in the number of production facilities. The reflections of the related increase in urban density can be seen in *Mezarlıkbaşı* in the form of renovations and additions. *Hasan Hoca* Mosque was erected in 1831. The bath juxta-





**Figure 3.** The studied site overlapped with the Waterlines Map dated 1900 - 1905 (APİKAM, 2015: sheet 3, part 10 - 11).



**Figure 4.** The historic gravestone within a new building (360 island, 22 parcel).

posing it and known as *Tevfik Paşa*, a notable of the era, is also thought to be a cultural asset of this era<sup>3</sup>. The old police headquarters could have been constructed following the widening of *İkiçeşmelik* Street during the governorship of Mayor *Fehmi Paşa*, in between 1893 and 1895<sup>4</sup>. At the northwest of the borders of the study area, the remains of the modern Jewish school of the era, Alliance Israelite, can still be

observed<sup>5</sup>. The majority of the historical buildings in the site date back to the late 19<sup>th</sup> and early 20<sup>th</sup> century (Figure 5), with their modest scale, contiguous order defining rows, Neoclassical style, and double-shelled walls. In the 19<sup>th</sup> century, additions to the voids at the center of building blocks existing structures were mostly in the form of annexes, which led to insanitary conditions, unserviceable areas, and restriction of open areas (Figure 6). It is recorded that Turkish families started living in mass houses (*yahudihanes*) in this period (Pullukçuoğlu Yapucu, 2013: 159-180). The owner of the *Cevahirci Khan*, originally a family house, in block 357, lot 9, was a Muslim<sup>6</sup>. *Manisa-Akhisar* Hotel and block 381, lot 14 are evaluated as probable family houses since they are organized around central courtyards which can be reached through the narrow passages from *Anafartalar* Street.

From the proclamation of the Republic to the 1950s (Figure 5, Figure 6, Figure 7), traditional commercial activities, the entrance of horse-drawn wagons to khans, settlement of low-income immigrants arriving with the population exchange of 1922 had all continued (Kerimoğlu, 2013: 217-226; Pullukçuoğlu Yapucu, 2013: 159-180). Small hotels, old family houses, and individual houses converted into

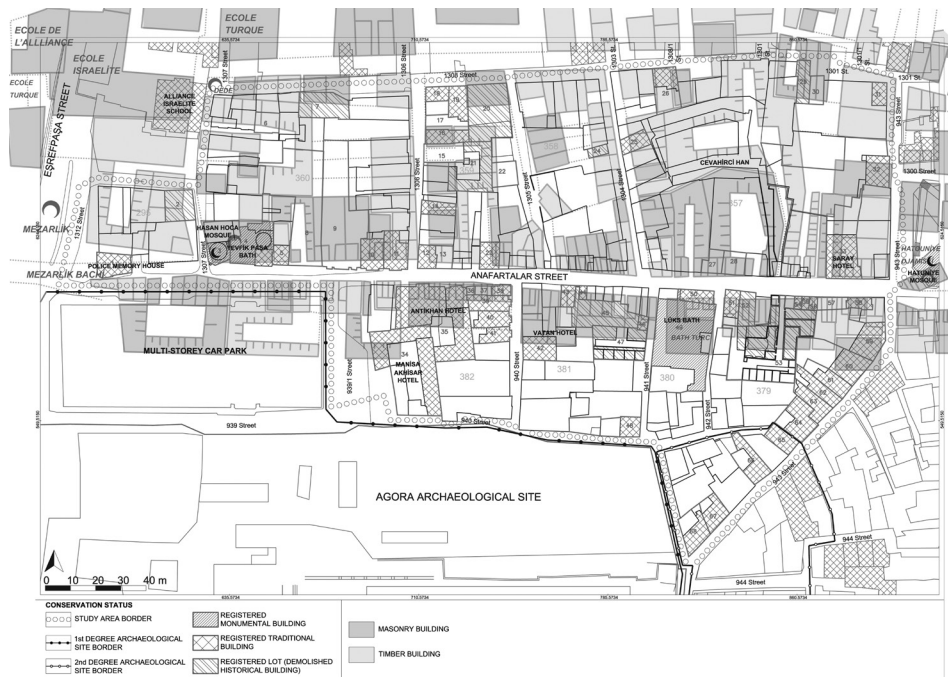


Figure 5. Study area in the map of Pervititch dated 1923 (Atay, 1998: 137, 145).

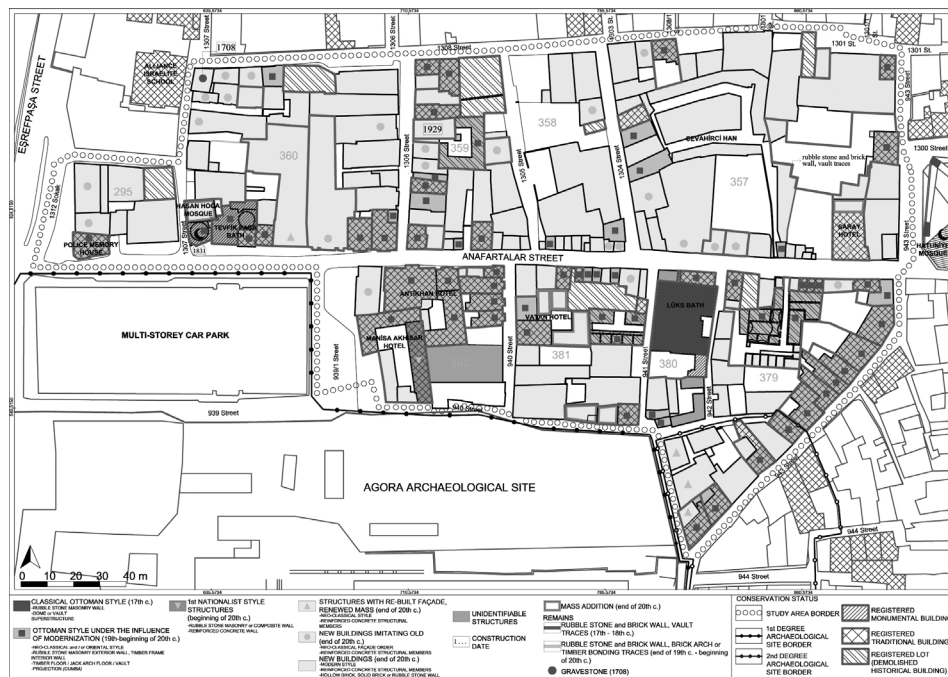


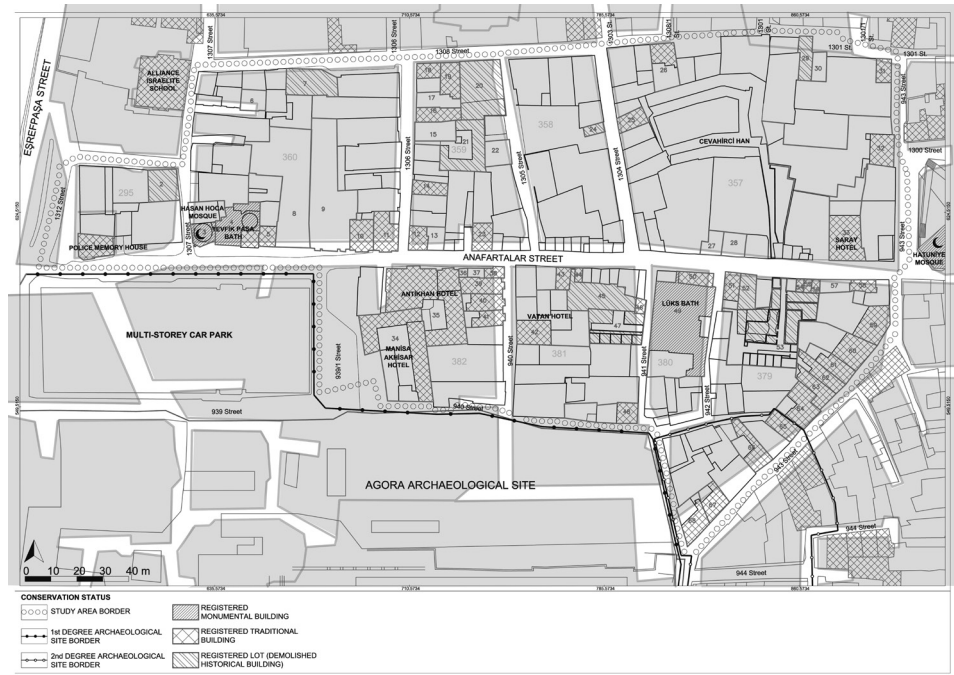
Figure 6. Classification of buildings according to their architectural styles.

hotels (e.g. Vatan Hotel) might have functioned not only for accommodation but also for communication necessary for local commercial activities, e.g. messaging, transport of small packages. About fifty percent of these hotels accepted customers from a specific settlement in the hinterland of İzmir (Kıray, 1972: 69-74). In the study area, reinforced concrete houses

for bachelors were evaluated as structures to accommodate workers in the area and the immediate vicinity (block 360, lot 18; block 359, lot 16; block 380, lot 1; block 381, lot 28; block 379, lots 9, 10 and 37).

After the Jewish population's migration to Israel in 1946, commercial activities have spread to the Jewish neighborhoods in the south of the his-





**Figure 7.** The study area in the map dated 1941 (İzmir Metropolitan Municipality, 1941: sheet 8).

torical center (Kıray, 1972: 94-96). The old *Cevahirci* Khan was demolished and a reinforced concrete workshop was built, and the family dwellings at the south of the center were abandoned or demolished during this era.

#### 1.4. Conservation state

The entire studied site is 1<sup>st</sup> degree urban site. The southeastern portion juxtaposing the antique agora is 2<sup>nd</sup> degree, and the rest is 3<sup>rd</sup> degree archaeological site. The total number of lots in the studied site is 181, while the number of listed lots is 68. Twenty-three of the listed lots have lost their buildings totally or partially. Three of these have been used as car parks, seven of them have building ruins; new buildings have been erected on thirteen of them. Three of the historic buildings on the listed lots are monuments, while forty-two of them are listed as commercial buildings.

#### 2. Materials and method

A Conservation Plan should encompass the many different aspects of heritage interest attached to a place, defined as values, which are historic, scientific, aesthetic, social, economic, and finally ecological where they occur as part of the place. The Plan

should cover every aspect of the cultural significance of the place and must aim to encompass those aspects of the place that identify local values (Kerr, 2000). For these reasons the study first documented the physical characteristics of the site and values attached to the place. This section includes both the extensive areal study and then the mapping of all that information gathered from the field research. For this part the following studies presented in the study: Topographic condition and transportation; Functions of the building and the current land use; Structural system and material usage; and finally Morphologic characteristics.

In the second part of the analysis our aim mainly depends upon the evaluation of the strategic and integrated approach which involves not only spatial planning but also social and economic policy within a management framework. In this context, a strategic approach and action guide proposal will be proposed to highlight the potentials of the strategic planning of the study area<sup>7</sup>.

We can conclude that the conventional conservation planning and project approach is insufficient for the current conservation problems

and rarely reflect the needs of the multi-layered dimension of conservation and regeneration issues. The examination and analysis of the historical, physical, and socio-economic functions of conservation together with regeneration point out that better management of the field is a prerequisite. Heritage care work should be focused on *Kemeraltı* at national and international levels. Public working and living in the site, and interest groups should be able to work together and share responsibility. A model balancing conservation of cultural asset values together with land uses desired by the interest groups should be developed. The public living and working in the site should be provided reliable consultation. Transparency of the process should be achieved through meetings, workshops, exhibitions, etc.

The principals indicated above provide an approximate guide for better management and action. By doing so this paper follows a field research approach and uses a variety of qualitative techniques, i.e. in-depth interviews with the actors involved in the management of the conservation process. In the interview, we preferred to include actors such as people living in the area, community groups, and TARKEM as the project's leadership role in the conservation process in *Kemeraltı* to detect the complex problems that threaten the cultural continuity as well as determination of development potentials. İzmir's Metropolitan Municipality and İzmir History Project are also considered as the stakeholders and the evaluation of the İzmir History project is included in the study.

In the fall of 2016 and the spring of 2018, in-depth interviews were conducted with local residents and TARKEM officials involved in heritage management and community groups.

### 3. Physical characteristics

#### 3.1. Topographic condition and transportation

The southeastern portion of the site includes the skirt of *Kadife Kale* (Velvet-Castle<sup>8</sup>). The other portions are all flat. The major axes of the city, *Fevzi-paşa*, and *İkiçeşmelik* Streets are at the north and west of the studied site, re-

**Table 2.** Main questions used during the in-depth interviews.

- Do they think they'll be displaced by the implementation of the project?
- What do you think are the problems of *Kemeraltı*?
- Do you intend to leave the field?
- Where does he prefer to live if he wants to go?
- Have we ever heard of İzmir history project?
- Have you attended project meetings?
- Have you had a chance to convey your feedback?
- How do you describe your relationships with Syrian migrants?
- Do they provide labor?

spectively (Figure 1). The site is easily accessible from the subway station on *Fevzipaşa* Street. It is also within walking distance to the contemporary commercial center, *Konak*, and the Republican development zone, *Alsancak*.

#### 3.2. Functions of the building and the current land use

Presently the dominant function in the field is the production and wholesale of textile products (~ 25000 m<sup>2</sup>). They are mainly concentrated in the northern islands. The retail sales units (~ 13000 m<sup>2</sup>) are concentrated on the ground floors on *Anafartalar* Street. Public functions in the area are bath (1017 m<sup>2</sup>), mosque (183 m<sup>2</sup>), 'mufti-ship building' (360 m<sup>2</sup>), museum (117 m<sup>2</sup>), and 'reeves office' (18.5 m<sup>2</sup>).

Accommodation function (~10000 m<sup>2</sup>) is represented with single dwellings concentrated in the southeast of the area; it consists of bachelor houses in the northeast and southeast of the area. In the area, there are hotels that concentrate on *Anafartalar* Street.

There are about 12500 m<sup>2</sup> unused lots, some are used only as basements (~5900 m<sup>2</sup>), and some (~2000 m<sup>2</sup>) are used as garbage dumps.

#### 3.3. Structural system and material usage

In historic buildings (66/204), four different wall systems are present: masonry, timber frame, shelled (masonry exterior, timber frame interior) and reinforced concrete frame (Figure 6). In three monuments (*Kara Kadı* and *Tevfik Paşa* Baths, *Hasan Hoca* Mosque) and two building ruins (block 357, lots 5 and 71; block 379, lots 37 and 9), dome and vault superstructure, and rubble stone walls are

observed. In historic buildings with accommodation, commerce, and originally headquarters functions, the interior walls are timber frame with mud-brick or rubble stone-brick infill; while the exteriors are double-shelled or totally masonry (61/66). The *cumbas* (projections) are out of timber, supported with iron brackets installed into the exterior facades. The floors are out of timber originally. Only in a single building, jack arch floor system is observed (*Manisa-Akhisar* Hotel, northern portion). In two buildings, rubble stone-brick exterior walls have been united with reinforced concrete column-beam-floor system (2/66, *Manisa-Akhisar* Hotel, eastern portion; block 380, lot 1). The new buildings are constructed using reinforced concrete with hollow brick infill.

### 3.4. Morphologic characteristics

New multi-storied buildings (4-7 stories) are at the north of the studied site, while maximum three stories are present in the south. When immovable cultural assets are grouped according to stylistic qualities, a Classical Ottoman monument (*Kara Kadi* Bath), an indefinite building ruin (block 357, lots 5 and 71), an Ottoman gravestone (block 360, lot 22); 63 buildings (*Hasan Hoca* Mosque, *Tevfik Paşa* Bath, houses and commercial buildings) and three building ruins in Neoclassical style, one building in orientalist style (the old headquarters/police memory house today), one building in First Nationalist Style of the early Republican Era (*Manisa-Akhisar* Hotel, eastern portion) are present. Modernist style is dominant in the new buildings (115/204), but replication of historic styles is also possible (23/204).

### 4. Conservation planning process of the historic Kemeraltı area

The Department of City and Regional Planning of Dokuz Eylül University had developed the existing Conservation Plan of the *Kemeraltı* area in 2000 (Zeybek Çetin, 2012: 80-81). In 2005, the revision plan of the conservation plan was approved. In the plan, in *Kemeraltı* area as a whole, the ways of possible contributions by

all actors to the planning process were defined (Aydoğan & Ecemiş Kılıç, 2009). The planning work including *Mezarlıkbaşı*, namely, 2<sup>nd</sup> phase, 1<sup>st</sup> region, 1/1000 scale plan, was completed in 2009 by İzmir Metropolitan and *Konak* Municipalities (Zeybek Çetin, 2012: 87).

In 2007, *Kemeraltı* was declared as a renewal site within the frame of the new law numbered 5366. The related intervention program including various projects was approved in 2008 (IMM & KM, 2008: VI). To guide the developments in *Kemeraltı* Renewal Site, İzmir Metropolitan Municipality had brought to discussion İzmir-History Project; a participation platform was established including primarily the bureaucrats of the Municipality; and a conservation-regeneration strategy was developed for the historical urban center (Tekeli, 2015: 68-69). The organization model proposed at the report of İzmir-History Project, Design Strategy Report has similarities with the model proposed for the management of listed sites (Madran and Özgönül, 2005: 95-99): the coordination of the Municipality of İzmir and *Konak* (sub-region) Municipality was realized; related non-governmental organizations, universities, public institutions, construction firms and representatives of the inhabitants of the site were brought together to discuss the regeneration strategies.

The intervention program of 2008 approved after the declaration of *Kemeraltı* as a renewal site accepted *Kemeraltı* as a slum area (IMM & KM, 2008: 1). In turn, social and economic development, and preservation of cultural assets were targeted. İzmir-History project has re-evaluated this intervention program (IMM & KM, 2009: 131; Tekeli, 2015: 94-95), and renewal projects have been prepared for each sub-region of the site<sup>9</sup>.

İzmir-History Project is based on its law planning strategies numbered as 5366, known as the law of renewal. It attempts to define a municipal approach for urban transformation project content development. The project is supposed to act as a pilot work that will guide similar issues including conflicts over conservation-regeneration.

Touristic and cultural activities are underlined for regeneration purposes.

#### 4.1. In-depth interviews with the stakeholders

*Kemeraltı* area is in constant decay economically, physically, and demographically due to many central activities relocating to the new city center (*Alsancak*) and loss of manufacturing activities. Medium-high income homeowners have also left the area and relocated to newly constructed residential areas such as *Karataş-Göztepe*. All these developments have caused a major transformation of the area, and the physical, economic, and demographic decay have continued since then. Despite all the conservation efforts the study area's deprivation and destitute is continuing and for these reasons, the dynamics which cause physical, economic, social, and environmental decay can be understood fully. To prevent the ongoing collapse and slummization of the area, not only preservation but also regeneration, and economic revival is required. We detected a large number of abandoned houses, a rising number of tenants and low-income groups settled increasingly in the area, however, their presence cannot be easily interpreted as the problem, they can be consequences. And recently, the large wave of immigrants from Syria<sup>10</sup> is another factor that should be taken into account for all conservation-regeneration activities in the *Kemeraltı*. Syrian visitors have settled in the area because of the locational advantages of the center, low rents, and availability of the refugee association in the area<sup>11</sup>. This community will not participate in conservation since the permanency of their occupancy is not clear. Their budgets are limited. In addition, they are not familiar with the language and the laws of the country.

The immigration from Syria in particular and all the mobility of the immigration which takes place all around the world are the trademarks of globalization and accompanied by the political conflicts, invasions, and rising inequalities. While the problem has to be solved globally, it is still placed on the back of governments in the host countries. The upper-scale policies

both global and national should be generated for the Syrian visitors. Their temporary situation makes it difficult that they might be considered as part of long-term solutions and take a stance as a stakeholder in any conservation activities. We realized that Syrian migrants were never mentioned in İzmir-History Project and that they were not seen as one of the components of the project. However, ignoring migrants is not the solution, the Municipality must first work on them, even work with them together for the project.

In an interview, the president<sup>12</sup> of the 'Syrian Refugees Solidarity Association' said that all the newcomers appreciate the area's central location and job opportunities. Recently 12 shopping units have opened after having the commercial licenses eased with the legal regulation and tax exemption to open and sustain commercial units. Besides this, a majority of the refugees work for various textile manufacturing units in or around the area with very low income. Therefore, policies related to Syrian migrants are needed to be developed, official institutions should produce solutions accordingly and ensure their inclusion in the project processes. However, their inclusion is not easy, for this reason as a non-governmental body, the 'Syrian Refugees Solidarity Association' may be considered as the representative of the immigrants in collaboration with the Municipality to handle all negotiation activities.

In an interview, the president of the İzmir Historic *Kemeraltı* Craftsmen Association<sup>13</sup> (*İzmir Tarihi Kemeraltı Esnafı Derneği*), presented the problems facing the historic bazaar. The confrontation between the shopping malls built all over the city center and the historic bazaar is a well-known fact that the shopping malls attract an increasing number of customers and tenants whereas historic bazaars have generally been faced with a lower amount of potential customers.

The president added that with the advent of the İzmir-History Projects, some progress obtained; peddlers were not allowed into the area, control of goods and services in and out of the area was established banning the trucks



to enter the area. Moreover, there are 12,000 registered shopkeepers and almost 65,000 employees in the Historic *Kemeraltı* area. This magnitude cannot be ignored for urban governance. The social interaction and diversity in the area offer a very intrinsic quality, which cannot be easily found elsewhere. The head of the association is pleased to see that the potential offered by the area is appreciated by local bodies and the İzmir-History has been initiated. He also indicated that the TARKEM<sup>14</sup>, which was established as a real estate investment trust, would convert the area into a horizontal shopping mall, but the shopkeepers did not accept becoming part of it at the beginning. However, the scope of TARKEM was changed as it interacted with the other actors of the İzmir-History Project. So, it evolved into a *Kemeraltı* Craftsmen Association, and the shopkeepers decided to become part of it so that they can have a voice in the Directorial Board.

The last interview for this study was conducted with TARKEM<sup>15</sup>. They indicated that the problem for the İzmir-History Project stemmed from the inconsistency between the project and the conventional Conservation Plan. Another problem is the existence of the many unlicensed buildings in the area. In the time interval after our interview, it was observed that TARKEM became more and more responsible for conservation activities at the site, giving way to differentiation from its initial task definitions. The company involuntarily engaged in the leadership of the negotiation process. It carries out its activities widely ranging from the promotion of the project to the coordination of civil society organizations and dealing with the problems of tradesmen in the field. However, the artisans in the study area do not have enough information about the İzmir-History Project. Leadership, rather than private investors, is vital to push the project into urban political agenda, gain popularity and community involvement.

Lastly, we conducted causal, daily interviews with the shopkeepers, employees of the hotels and manufacturing units, local people, etc. Their com-

mon complaints converged into the one fact about the loss of clients and decrease in the vitality as compared to 50 years ago. The loss of population coincided with the decrease of their profit margins and difficulty to sustain their workplace in *Kemeraltı*. Very few of them have information about the ongoing project for the area.

## 5. Critical evaluation of the conservation, regeneration and a pathway to integrated management

A general evaluation of the cultural heritage of the area, with its historical, scientific, aesthetic, economic and social values, indicates that the study area has always been a significant part of the commercial life of the city since the establishment of the İzmir around Velvet Castle. *Mezarlıkbaşı* area, as the living heritage of İzmir's vibrant commercial activities since the 17<sup>th</sup> century, with monuments such as public baths, mosques on *Anafartalar* Street, must be preserved, renovated for future generations.

Historic structures, such as homes, family houses (*cortejos*), hotels, police station, etc., were developed between the 19<sup>th</sup> century and the turn of the 20<sup>th</sup> century. All of these physical structures have authentic, architectural, historic, and documentary values, while at the same time being vital representations of the 19th-20th century architecture and urban pattern that must be well recorded, maintained, and preserved.

### 5.1. Project leadership

The Municipality of İzmir has shown its determination in solving the preservation problems of *Kemeraltı* with its various plans and management strategies. Different actors have come together for creating solutions. Nevertheless, satisfactory development could not be achieved so far.

TARKEM<sup>16</sup> (Historical *Kemeraltı* Construction Investment Trade Inc.) was established to increase investments in *Kemeraltı* in 2012. It is a private-public organization, including various governmental and non-governmental organizations of the city.

The formation of TARKEM is a very unique and interesting way to resolve the conservation issues of heritage ar-

eas in the Turkish context so its success may give way to new insight and opportunities for heritage conservation in the Nation. The main objective of TARKEM<sup>17</sup> is to establish heritage real estate projects along with cultural heritage services and organizational projects within *Kemeraltı* and surrounding urban renewal area, which were declared in 2007, focusing on needs in the designated area, especially in the areas of collapse, and covering all target groups in the city.

Nevertheless, with the interview with TARKEM<sup>18</sup>, we realized that the company has to deal with outside of its initial objectives and original obligations. The organization must include numerous activities, ranging from project financing to organizing civil society organizations, the everyday issues of small shopkeepers and even reconciling the contradictions between the İzmir-History Project and the current conservation plan.

Despite all these challenges, with the attempts of TARKEM<sup>19</sup> *Kemeraltı* area has been included in the Tentative List of UNESCO World Heritage in 2020. This can be taken as an opportunity to obtain more economic return for the future of the heritage area however we think more action should take place.

Another issue should be emphasized that the Municipality's efforts to rebuild and improve the *Kemeraltı* area, in general, are mainly carried out in the historic commercial center (*Hisarönü*) rather than in the entire region. In the *Kemeraltı* area, restoration work is carried out with a strong emphasis in *Hisarönü* on the basis of a single building and the scale of the building's monuments. The areas of *Mezarlıkbaşı* where the field of research is situated are increasingly collapsing and presenting serious problems. Nevertheless, TARKEM seems to have all the skills necessary to be involved in land management in particular and in heritage conservation leadership in general.

## 5.2. Partnership, integrated management, and inclusion

İzmir Municipality has tried to conserve, rehabilitate, and increase the quality of life in the historic *Kemeraltı* area by employing various planning ef-

forts and projects. A variety of groups such as civil societal associations, investors, universities, NGOs, have all come together to solve the problems and re-created the development potential of the area. However, it remains unclear how effective the İzmir-History projects were. Attention has to be drawn to the relationship between the planning and local dynamics. The modernist planning<sup>20</sup> has failed to overcome the in-depth transformational problems of the area. All planning activities to date must be considered unsuccessful to put an end to the region's ongoing physical, social, and economic decline. The İzmir-History projects also directly influenced the transformation.

The project also lacked an inclusive spatial analysis. The resources used and the work of the various contributors for the project and their contributions are important, but no meticulous fieldwork was carried out to create a slogan of 'innovative' and 'make a difference' for the society as a whole. The living heritage of the site is not well documented. Today's traditional trade, intense neighborhood relations, the place in the memories of the people of İzmir, is all lacking. Although the project is in the implementation process, if an urban transformation model to create a change in İzmir is to be stressed, it is a question of how this transformation will be carried out without investigating the socioeconomic characteristics, enabling capacities and resources of the households living in the larger part of the area.

In our interviews, we think that small tradesmen who are carriers of traditional trade need new tools to increase their capacity to direct the project and to influence it. It is unclear how the traditional trade function, which has existed for centuries, will resist increasing business values with limited profit margins after the urban transformation to which the area will be exposed. If it is desired to undertake a transformation without displacement and the traditional trade function is one of the basic elements of the 'living heritage', how the local economic revival will be realized, what resources will be mobilized, this is uncertain.

**Table 3.** Past problems, conservation planning and project approach.

<i>Planning at the historic Kemeraltı</i>	<i>Issues / Problems</i>	<i>Municipality's responses</i>
Lack of integrated management  There is insufficient integration between agencies and policy areas	<ul style="list-style-type: none"> <li>İzmir Municipality History Project disrupted the overall nature of the plan and also broke the holistic quality</li> <li>Project can destroy the Plan's Integrity</li> <li>Planning / design controversy: Urban design projects independent from the legal Plan</li> </ul>	<ul style="list-style-type: none"> <li>It means creating a core management team for the conservation and regeneration of <i>Kemeraltı</i></li> <li>Long term strategic vision, short term action plans</li> <li>Action plan, pilot project for various parts taken from the whole <i>Kemeraltı</i> area in accord with Integrated Planning process can help to bridge the gap between Project and Plan duality</li> </ul>
Planning lacks clear vision	<ul style="list-style-type: none"> <li>İzmir history project lacks a strategic focus</li> <li>İzmir history projects lacks an integrated management approach</li> <li>The project excludes the former planning efforts</li> </ul>	<ul style="list-style-type: none"> <li>All kinds of planning activities and projects related with the collaboration of the integrated management model ensure active involvements of all communities living in the area including Syrian societies</li> <li>Many commercial activities take place in the area by Syrian visitors and enhanced the area's commercial activities</li> <li>Syrian Association can involve in the management process</li> </ul>
It is rather an <i>exclusive</i> process that fails to engage communities and other stakeholders	<ul style="list-style-type: none"> <li>Planning is remote, hard to understand and difficult to access</li> <li>Communities feel detached from the planning process</li> <li>Lack of partnership, many respondents have no knowledge of the ongoing projects or planning activities</li> </ul>	<ul style="list-style-type: none"> <li>Conservation - regeneration of the historic <i>Kemeraltı</i> and its planning has to work with strategic local partnership to establish mechanism for involvement</li> <li>Create opportunities to engage more active role and be part of the management process</li> <li>Partnership will bring people and interest groups together for consensus building</li> </ul>
Clear leadership	<ul style="list-style-type: none"> <li>TARKEM, as a mediator resolving many problems beyond its scope and objectives</li> <li>TARKEM carries out its activities in a wide range of ways; civil society organizations, the daily problems of local traders and, unexpectedly, addressing the contradictions between the İzmir - History Project and the Traditional Land - use Plan</li> </ul>	<ul style="list-style-type: none"> <li>The TARKEM leadership position should be re-designed</li> </ul>
<b>Active and passive conservation</b>	<ul style="list-style-type: none"> <li><i>Passive conservation:</i> implementation including registration, strict limitations on the rights of the ownership, planning, banning, controlling and punishments</li> </ul>	<ul style="list-style-type: none"> <li><i>Active conservation:</i> sharing and participating and collaborating responsibilities and cost of conserving, via directing, supporting, purchasing, transferring, expropriating, planning and projecting and acting where necessary</li> </ul>
Lack of an <b>inclusive</b> spatial analysis	<ul style="list-style-type: none"> <li>Tangible as well as intangible values have to be involved and enhanced in the integrated management</li> </ul>	<ul style="list-style-type: none"> <li>Existence of neighborhood solidarity, cooperation, traditional neighborhood culture</li> <li>Existence and prevalence of craftsmen solidarity, <i>ahilik</i></li> <li>Intangible values should have sustained and maintained</li> <li>Syrian commercial activities and emerging restaurants can aid to revival of the commercial activities</li> </ul>

Syrian visitors have emerged as a new component of the İzmir-History Project as a result of the country's policies. In this context, the İzmir-History Project needs to be renewed, including them as a component of the area since they have been living there for quite a long time and many of them have opened numerous commercial ventures. Although there are no visible conflicts between the local people and the commercial business owners, their assets are a major concern for the local users and owners of the area. The immigrants' hardships and unfavorable conditions have

forced them to find a solution for their survival and hold on to their daily life in the new country. Therefore, policies related to Syrian migrants should be developed. The official institutions should develop solutions accordingly and ensure that they are incorporated into the project processes. However, their inclusion is not easy because of the Syrians' temporary status. As a non-governmental body, the 'Syrian Refugees Solidarity Association' can be considered as representative of the immigrants in collaboration with the Municipality to participate in the integrated management process.

While *Kemeraltı*'s entry into the list of world heritage sites has enhanced its visibility and appreciation, it would involve local residents who play a key role in turning the region into a more contextual urban strategy, rather than national or global gentrification. To do this, a certain level of control should be given in the management process, as well as the opening of areas to facilitate interaction between citizens. While the status of the Syrian guests is difficult due to their transient status, it is necessary to count those who have lived for a long time in the area and have businesses as the residents of the place.

Finally, the needs of the community of *Kemeraltı* should be better responded in the planning and management work. This includes not only the residents but also the traders. (Table 3).

## 6. Final remarks

The Metropolitan Municipality of İzmir has long engaged some valuable initiatives for the protection of the heritage area however we think not enough has been done. More action should take place and better alternative ways should be researched. The municipality's desire of being a pioneer with its applications for this site and similar sites is very meaningful. A possible application presenting solutions for the two contradicting interventions, conservation, and regeneration, sounds exciting. The success of the project will depend on a form in which the planning and preservation can meet or contradict the re-enactment requirements.

Municipality of İzmir has long sought alternative ways of attracting developers for the conservation of heritage sites and make investments therefore TARKEM was created. With the attempts of TARKEM *Kemeraltı* area has been included in the UNESCO World Heritage Tentative List. This can be considered as an opportunity to obtain more economic return for the future. TARKEM has played a prominent role, *clear leadership*, in the project very effectively, and has succeeded in drawing both national and international attention to the *Kemeraltı* area and creating opportunities for the future.

The existence of a variety of community groups can be seen as an indis-

pensable part of the diverse way of life in the *Kemeraltı* area. The physical layout of the site together with its historic background and diversity of its living traditions play role in its uniqueness. The area's power stems from its diversity and dynamism which are molding *Kemeraltı*'s socio-spatial temporality. As a result of the in-depth interviews, we discovered that community groups are not seen as part of the planning activities. Planning has to provide a local strategic partnership and constitution of 'vision' or aspiration for the future of the area. The diversity of the presence of various groups has to be considered in the integrated management approach in planning instead of remote, fragmented, and exclusive formal planning or detached project activities. And lastly, present communities should all be regarded as actors of conservation planning since they are all part of the *Kemeraltı* site. Although İzmir Metropolitan Municipality's attempts and efforts are worth mentioning, there is still a lot to accomplish. To do all these things, İzmir must look at its rich history in which many innovations have been accomplished very often.

## Endnotes

<sup>1</sup> The first Conservation Law was dated back to 1710, however the conservation legislation in modern sense begin in the 1960s.

<sup>2</sup> The management plan can be defined as a new system that brings together all the different sectors in the collaborative planning process (Madran and Özgönül, 2005).

<sup>3</sup> Although Ürer (2002: 43) dates the building to late 18<sup>th</sup>-early 19<sup>th</sup> century; it is not present in the historical maps dating earlier than the 20<sup>th</sup> century. In this study, the relation with *Tevfik Paşa* who was the elected member of the city of İzmir's General Board in 1912, the intricate relation of the bath lot with the neighboring lots, and the Neoclassical style of the bath are taken into consideration (quoted from Tabak 1997: 81-82). The bath is not present in the historical maps dating earlier than the 20<sup>th</sup> century.

<sup>4</sup> The increasing crime rates with the increasing population at the beginning of the 19<sup>th</sup> century and the beginning



of the 20<sup>th</sup> century were tried to be controlled by increasing the number of police stations in the city (Tabak, 1997: 56). Kerimoğlu (2013) states that the station in the area is a work of *Rahmi Bey* Period. However, Tabak (1997: 56) did not equate this structure with Rahmi Bey's period. It is an articulated corner structure that combines oriental and neoclassical styles.

<sup>5</sup> There was a Turkish school at the northwest; and a Jewish orphanage at the northeast of the studied site, as revealed in Bora (1995: 159-162; 2015: 66) and the map of Pervititch. This Turkish school is also available on Saad map of 1876. According to Bora, there should have been two Jewish primary schools in the vicinity.

<sup>6</sup> The owner was *Cevahircizade Hacı Mehmet Efendi* according to the records of 1890-1908 (Bora, 1995: 37; 2015: 45). The original lot-building relationship can be seen in the map of Pervititch. As learned from the responsible of the new *Cevahirci* Khan, the lot is visited by Israeli tourists interested in seeing their old homes.

<sup>7</sup> We took this framework from the Gallent's et al. book (2006: 181 - 200) "Planning on the Edge", from the section "Planning Reform and the Spatial Agenda".

<sup>8</sup> Pagos Mountain in the ancient time.

<sup>9</sup> E.g., Region of the Synagogues, Regeneration and Development Project (TAMİKAM, 2016).

<sup>10</sup> In accord with the Directorate General of Migration Management, the number of Syrian Refugees staying in 'Temporary Sheltering Centers' is 142,676 and the number of Syrian refugees staying outside of the 'Temporary Sheltering Centers' is 3.501.666. In total officially 3,644,342 Syrian refugees live in Turkey. The real number may be over this number. In İzmir, the number of Syrian Refugees is 142.989, which is about 3,9 % of the total number. This number indicates that substantial amount of refugees live in İzmir (Odatv, 2017; Göç İdaresi Genel Müdürlüğü, 2019).

<sup>11</sup> With the help of French based organization, Women and Health Alliance International (WAHA), 'Syrian Refugees Solidarity Associa-

tion' was opened in 2016 at the 1306 Street. Several charity associations and NGOs like *Deniz Feneri Derneği*, Humanitarian Relief Foundation (*İnsani Yardım Vakfı İHH*), and *Cansuyu Yardımlaşma ve Dayanışma Derneği*, also give hand to the Association providing foods, goods and services. A hundred and fifty women refugees have been attending Turkish Courses. There is a gynecologist serving women and children health (WAHA, 2016; İHH, 2016; Deniz Feneri, 2016; Cansuyu, 2016).

<sup>12</sup> Personal communication, January 18, 2017.

<sup>13</sup> Personal communication, January 11, 2017.

<sup>14</sup> TARKEM, 'Historic *Kemeraltı*, Company of the Construction, Investment and Commerce'.

<sup>15</sup> Personal communication January 25, 2017.

<sup>16</sup> TARKEM is a public-private partnership building and investment company which is 38 percent public, 62 percent private.

<sup>17</sup> <http://www.tarkem.com/kurumsal/hakkimizda/>.

<sup>18</sup> Personal communication January 25, 2017.

<sup>19</sup> <https://whc.unesco.org/en/tentativelists/6471/>.

<sup>20</sup> Modernist planning necessitates long term research and analysis which is followed by planning phase and, in the last phase the plan is implemented. The entire process requires long periods of time and excessive bureaucratic sanctions so the project-based approach is preferred because it is more flexible and produce results quickly. However, this project-based approach is criticized due to the loss of its legitimacy (Özdemir, 2003: 394).

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# Regenerating traditional houses facades of old Mosul city by Shape Grammar

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## Abstract

The urban facades of the traditional dwellings in the old city of Mosul are part of a dense structure of the homogeneous urban fabric. These facades are characterized by a distinctive architectural style that gives a sense of place and local identity. Their design depends on the organization of architectural elements in syntactic characteristics, which are restricted by topological, geometrical, and dimensional relationships that responded to social, technical, and environmental requirements. Those restrictions made a special style in the local architecture that reveals the social and cultural influences of the residents. Shape Grammar is an effective system in analyzing the architecture structures because it combines both morphological and dimensional values In the analyzing.

Shape Grammar regulates the architectural elements and their relationships in specific rules to conserve these traditional facades and their values. In the conservation of built heritage, organizing these elements and defining their rules is essential. This paper seeks to derive the standard and parameters of shape grammar to regenerate the damaged traditional facades of Mosul Old City as a case study (especially after the great damage as a result of the last war in 2017), by determining the rules that restrict the relationships and the transformations in the structures of these elements in the virtual reconstruction of urban heritage according to principles of traditional architecture. The research analyzes and classifies the elements of the case study to obtain its shape grammar that enables the regenerating of these facades in the same architectural language and characteristics.

## Keywords

Facade regeneration, Local architecture, Mosul Old City, Shape Grammar, Urban facades.

## 1. Introduction

Most of the traditional houses in the Mosul old city – MOC date back to 1850, these units are characterized by a unique style as a result of climatic, religious, cultural, economic, and construction requirements (Al-Tayib, 2008). This traditional architectural style depends on its architectural language and elements (such as entrances, windows, and other) by syntactic rules in Topological systems to achieve unity and aesthetic as well as privacy and functional competence that distinguish it as a style with a distinct identity, which reflects the thought of society (Maan & Idrees, 2013). Traditional housing shares basic components include the courtyard, Iwan, rooms, corridors, and entrances. The idea of its planning depends on dividing the plan into functional parts that are linked to organizational relationships according to its function, the courtyard is the active part because it is the social space and the movement distributor in addition to its environmental function (Mustafa, Dazhizhong, & Hong, 2010). In general, these housing units share several characteristics, including:

- The housing units were organized in the urban fabric in a compact and organic composition (Dewachi & Ismaeel, 2010 ).
- Using the unity principle in the facades, which led to the coherence of the urban landscape by employing the repetition of the elements of the facade that include openings, entrances, details, and others, in addition to horizontal and vertical lines in a specific rhythm (Albotani & Alani 2010).
- Harmonious and specific relationships were used in urban facades to achieve climatic, social, and construction requirements and this is a unique feature for the vernacular architecture in Mosul, Which made it an integrated architecture at the exterior and interior scope in architectural and urban design (Albotani & Alani 2010)
- Gradient: By dividing the overall composition into harmonious parts to achieve the balance and the homogeneity in the mass, elements and details in the facades, this indicates the awareness in the design process (Albotani & Alani 2010)
- The traditional facades are distinguished by the variety of architectural treatments in addition to the variety of architectural elements, which gave the facade visually richness (Maan & Idrees, 2013).



**Figure 1.** Top row scenes from the old Mosul before the destruction (Source: Researcher). The low row is destruction in some areas of old Mosul (Source: Profile Mosul, UN, 2016, p 46).

Recently, MOC was severely damaged as a result of the military operations in 2016-2017, which led to the destruction of a large part of the urban fabric, amounting to 80%, and the damage ranged from destruction to partial damage for about 5,000 out of 15,000 housing units (Habitat, 2016) (Figure 1). Many Problems occurred to deal with the damaged parts of these buildings because of the absence of restrictions and rules that determine and restrict restoration operations led to deformation in the urban scene as a result of the intervention process by non-specialists, therefore, the importance of this study aims to determine the restrictions in the restoration as a Shape Grammar for these facades to preserving the urban facades, in addition to providing a database for the specialists in the reconstruction in MOC to preserve the local architectural language.

On the other hand, Shape Grammar was employed in many studies that dealt with language analysis of architectural productions due to its advantages to combining mathematical and morphological values in architecture, so Shape Grammar was used in several scopes of the built heritage as follows:

- Facades Scope: Traditional houses São Paulo (de Godoi & Celani, 2008) - Bali Traditional houses (- Di Angelo, Fersch, & Paskaleva, 2013) - Traditional Greek Housing (Kitsakis, Tsiliakou, Labropoulos, & Dimopoulou, 2017) - The Brick patterns in Anatolia facades (Yavuz, 2016).
- Plans Scope: Villa Palladio (G. Stiny & Mitchell, 1978) - Traditional Chinese houses (Chiou, 1997) - Traditional Turkish houses (Çağdaş, 1996), Traditional Damascene houses (Eilouti & Hama-mieh Al Shaar, 2012) - Traditional Bosnia houses (Colakoglu, 2000) - Palladian villa, Malagueira houses, and Prairie housing (Benros, 2018) - Traditional Pol residences in Ahmedabad (Lambe-2019) - Traditional Suakin housing (AbdulRaheem, 2017) - Plans of Vernacular houses in Mazandaran (Yousefniapasha, 2019)

- Sections Scope: Traditional Taiwanese houses (Chiou & Krishnamurti, 1995) - Traditional Malay dwellings TMH in Malaysia (Said & Embi, 2008).
- Masses Scope: Components of the Ottoman mosques (Şener & Görgül, 2008), Components of heritage Churches (Tepavčević & Stojaković, 2013).

## 2. Shape Grammar

Shape Grammar is a production system that automatically generates 2D or 3D shapes based on a set of specific rules, invented by Stiny and Gips in 1972 as a production system that defines the rules of a set of designs. Its cognitive importance is embodied in the analysis of the architectural structures and its reproduction in the same language. Shape Grammar is similar to grammar rules, and it is used in architecture as a tool for classification, characterization, generation, and evaluation of the productions in terms of morphological, functional, and structural characteristics of the same architecture, in addition to being a tool for creating new designs (G. Stiny & Mitchell, 1978). Shape Grammar does not seek to reproduce the architecture language in all its detail, but rather describes it in its essence, and aims of forming other designs in the same architectural language (de Godoi & Celani, 2008).

### 2.1. Shape Grammar structure

The basic elements of Shape Grammar include (G. Stiny, 1980):

- a) Shapes (S): represent a specific set of configurations, which represents an arrangement of lines in two or three dimensions.
- b) Rules (R): A specific set of Rules in the form  $\alpha \rightarrow \beta$ , which consists of an alphabet of shapes and a set of spatial relationships between shapes.
- c) Initial Shape (IS): The Shape to which the rule is applied.
- d) Labels (L): Represent a group of signs that restrict the application of the rules, including:
  - State Labels: Control the sequence of applying the rules, and the number of repeating the rule.

- Spatial Labels: Control where and how rules should apply by adding Labels to the shapes, and it owns its specific Position defined by a point.

## 2.2. Types of Shape Grammar

### 2.2.1. Standard Shape Grammar

This type consists of two parts separated by an arrow that points from left to right, the left side (LHS) represents the initial shape and its labels, and the right side (RHS) that defines the rule to generate the shapes, these rules deal with topological relationships that determine design characteristics regardless of the size of those parts (G. N. Stiny, 1985).

### 2.2.2. Parametric Shape Grammar

This type depends on parameters, which lead to the diversity of shapes that have the same topological characteristics that differ in dimensions. Specific length and angle parameters are used for expanding and diversifying secondary shapes groups. The parameter inside a rule is the key to generating many derivative shapes, and the number of times the rules are used depends on the complexity of the shape (Sayed, Ugail, Palmer, Purdy, & Reeve, 2016).

## 3. Hypothesis, objectives, and methodology of the research

### 3.1. Research hypothesis

The traditional dwellings units in MOC were built cumulatively at different periods during 200 years, and the construction of these units was carried out by constructional, social, economic and cultural requirements which reflected as restrictions and rules in the construction which led to unify the urban scene and form modularity in the architectural language Local. These restrictions can be determined as a Shape Grammar to rebuild the old city in the same architectural language to preserve the city's identity.

### 3.2. Research objectives

Defining the local architectural language for traditional housing in Mosul TMHo by Shape Grammar to create a methodology that generates several alternatives according to the local language.

1. Analyzing the structure of facades by determining the restrictions of elements in the traditional façades.

2. Formalizing the local architectural language and its principles to represent the style of dwelling units.

3. Establishing a knowledge and information base for future studies related to the adaptation and development of housing units in Mosul by contemporary requirements.

### 3.3. Research methodology

The study adopted the morphological, mathematical, and Topological analysis of the traditional facades to extract typical rules and restrictions by Shape Grammar as follows:

1. Data collection from documents, records and field documentation by the researcher.

2. Analyzing the information and data.

a) Determining the into functional, spatial, and morphological.

b) Classifying the architectural elements of the facades into nine main categories.

3. Analyzing the classified elements to derive the rules according to:

a) Morphological Analysis to determine the evolutionary series of genes for each element.

b) Topological Analysis to determine the rule that controls the placement of the element in the facade and its relationship with other elements.

c) Mathematical analysis to determine the parameters of dimensions, location, and proportions for each element.

4. Creating a database that includes the classified elements and their rules.

5. Applying: Evaluating the ability of Shape Grammar to generate designs belonging to the local architectural language by creating an algorithm (Flow-chart) to determine the steps for applying derivative rules.

## 4. Applying the methodology

### 4.1. Data collection

Two types of data were collected for analysis:

1. Data of the architectural elements: About 4000 samples were selected for the architectural element to extract the evolutionary gene of the elements, and their components.



2. Data of the facades: About 250 facades were field documented by photography using a digital camera, with describing and recording the elements information to derivate Shape Grammar for topological analysis.

#### 4.2. Classifying the architectural elements

The ability to perceive patterns is through categorizing elements with similar syntax into groups, and these elements represent the vocabulary for the architectural language (Oxford, 2010). The elements will be categorized into major groups based on the concepts of mass, space, and surface, so the element has a measurable physical meaning (Norberg-Schulz & Schulz, 1966). Accordingly, the architectural elements in the case study are categorized into the following:

1. The Wall: The walls are the main element that is as a background for other architectural elements, and it is distinguished by different heights and proportions according to climatic and functional purposes.

2. Entrance: It is the most important element in the urban facades, and it is distinguished by unique structures and rich details, its shapes are varying from simple to complex according to the details and using various techniques in the construction.

3. Opening and Windows: The shape and Position of windows are related to the level of the interior space according to the various functions that include lighting and ventilation, in addition to using various techniques in construction.

4. Frieze and Cornice: A prominent element (strip) formed according to a specific geometry along the façade.

5. Skirting Marble - Madamic: An element covering the lower part of the exterior wall of the facades for covering the joint between the wall and the floor to protect the walls.

6. Arches: A structural element that is repeated on the facades of buildings, its main function is to carry the prominent parts of the floors, in addition to its aesthetic functionality.

7. Corners: This element is located in the buildings corner; its function is to connect the two facades of the building.

8. Corbels: It is an element that takes many forms and works as a structural element that supports the extension above, in addition to its aesthetic functionality.

9. Shanashel: An extension (addition) on the top floor. It has aesthetic, climatic, and functional roles, working to handle the acute angle in spaces.

#### 4.3. The analysis phases

##### 4.3.1. Genotype analysis

The morphological characteristics can identify the architectural language to produce models that belong to the same language (Bonta, 1980). The structure of the architectural language is determined by two parts, the first is the Vocabulary of the language and the second is the set of Rules that determined the spatial relations (Koning & Eizenberg, 1981). In general, the (Vocabulary) visual shapes can be classified in terms of characteristics and topological relationships such as convergence, similarity and continuity, and the similarity is two types (Cha & Gero, 1998):

1. Phenotypic Similarity: It is based on the physical characteristics of the shape.

2. Structural Similarity (deep): It is based on the relational structure.

##### 4.3.2. Analysis element as a structure

To analyze the structure of architectural elements, it must be divided into components with properties that distinguish them from others, then define the relationships between them, the fragmentation process must define the components, to a certain extent to form generic forms, by this way, the formal organization can be understood and perceived, and this component can also be divided into elements with secondary relationships to standardize the component and its relationships into higher-ranked components.

In this part of the study, the detailed components and components will be classified according to the evolution lines of the element. The beginning of the line represents the main components, and the more complicated element is forming by adding secondary components to it. The primary components are used to design new models belonging to the same group.

Then the elements are classified in a hierarchical way that begins from the simplest (which includes the primary components) to more complex (which includes the secondary components) to determine the evolutionary line of the gene for each element, and categorize them into patterns that share a basic characteristic. The analysis is carried out by fragmenting the element into main components (Figure 2).

After the analysis process, the genotype of each element will be determined sequentially: Entrances, Arches, Madamics, Friezes Opening and Windows, The Corners, Shanashesels, and Crobles (Figure 3).

#### 4.3.3. Relational analysis

The architectural facade contains components (elements) that are organized in a specific system of a conceptual or physical nature, these elements are interconnected with each other by mutual relations, in addition to their relationship with the whole with other relationships, and these relations are subject to coordinated rules and foundations to achieve the principle designer (Abel, 2007).

The term Relation refers to the organization of the elements, and these relationships are either 3D (Tri-Dimensional), which depend on Masses and spaces, or are 2D (Bi-Dimensional), which determine the relationship in a plane to analyses of the facades (Abid Yahya Al-Hiali & Al-Tayib, 2006). In "Intention in Architecture", Schulz classified relationships into Topological Relation, and Euclidean Relation (Norberg-Schulz & Schulz, 1966):

a) Euclidean Relation: These relationships are based on concepts of quantitative engineering, and they organize the relationship between the elements in three ways, organizing according to a reference point, organizing according to the line, and organizing according to the coordinates system. These relationships analyze the principles of Centralization, Axiality and Coordinates (Norberg-Schulz & Schulz, 1966).

b) Topological Relation: This relationship is based on non-quantitative engineering concepts, and it is a type of mathematics that analyzing the Position of a thing according to other things,

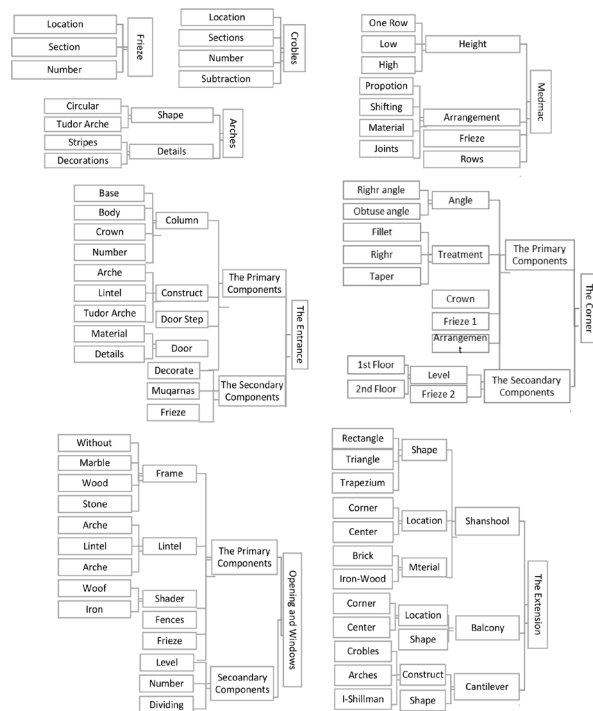


Figure 2. The primary and secondary components of the architectural elements in the case study (Source: The Researcher).

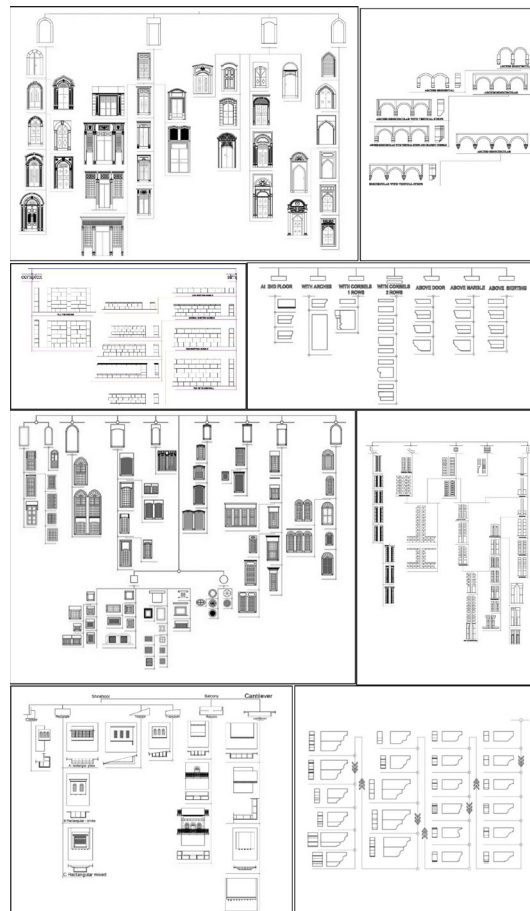


Figure 3. The Genotype of the elements from left to right in sequence: Entrances, Arches, Madamic, Friezes Opening and Windows, The Corners, Shanashesels, and Crobles (Source: The Researcher).

without dealing with size or distance. These relationships deal with spatial characteristics regardless of their type or geometric shape (Schulz, 1996, p. 141).

Thus, the analysis of the elements will take place on two levels, as follows:

1. Euclidean Relations: This type of relationship will be used to derive the rules for placement of architectural elements in the facade using the coordinate system in two levels, (H) Horizontal, and Vertical (V) by parameters for each element as follows:

A. Vertical Parameter V: This parameter determines the position of the element along the facade (on width W), in three basic Position:

- Corner Position: Determined by the VC parameter.
- Center Position: Determined by the VCe parameter.
- Mid Position: Set to the VM parameter.

B. horizontal parameter H: This parameter determines the horizontal element level on the facade (on the height H), in the following locations:

- Under the road level: It is determined by the parameter H-, it is specific for the entrances and the basement windows.
- With the road level: It is determined by the parameter H0, it specific is for the entrances and the basement windows.
- Above the road level: It is determined by the parameter H +for all elements that include a range of values to determine the level of the element in the floor level.

#### 4.4. Deriving Shape Grammar

##### 4.4.1. Euclidean Shape Grammar of the facade

The process of analyzing the facades was done mathematically in two phases, the first to determine the facade proportions of the ground, first floor, and the parapet, followed by defining the skyline for the building .then the parameters were defined, which included two types, the first determines the width of the facade represented by the parameter RW and the other determines the height of the floor that is rep-

**Table 1.** The Euclidean Shape Grammar of the facade.

Facade Proportions					Façade Sky Line			
S	Floor	Dim.	Rule	Value	S	Type	Dim.	Rule
1	Ground Floor	Width	• R W1: $2.3 \leq W1 \leq 20$	2.3-20	1	Straight	Width	• R W3: $W3 \equiv W1(W2)$
		Height	• R H1: $2.7 \leq H1 \leq 4.1$	2.7-4.1			Height	• R H3: H3
2	First Floor	Width	• R W2: $1.3 > W2 \leq W1$	1.3-H1	2	Right-Angled	RA1	Width • WA1: $WAa + WAb$
		Height	• R H2: $2.8 < H2 \leq 5.3$	3.0-5.3			RA2	Height • HA1: $HAa < HAb$
3	Parapet	Width	• R W3: $W3 \equiv W1$	H1	3	Sloped	RS1	Width • WS1: $WSa + WSb + WSc$
		Height	• R H3: $0.8 \leq H3 \leq 1.2$	0.8-1.2			RS2	Height • HS2: $HSa < HSb (< HSc)$

resented by the parameter RH. Shape Grammar is formulated based on these parameters and their range of values (Table 1).

#### 4.4.2. Euclidean Shape Grammar of the element placement

In this part of the study, the facades were analyzed mathematically and morphologically to determine the placement of each element in the facade (Table 2). Two types of parameters were used to determine the placement of the element, the first is the H parameter that determines the horizontal placement, and the second is the V parameter that determines the vertical placement. Each parameter symbolizes by a code to refer a specific element such as (Eh), which refers to the horizontal placement of the Entrance element.

#### 4.4.3. Relational Shape Grammar (Topological analysis)

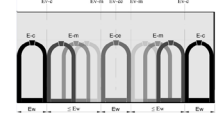
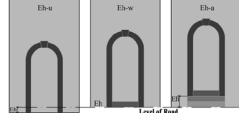
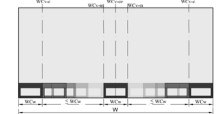
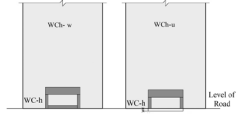

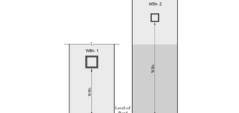
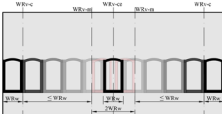

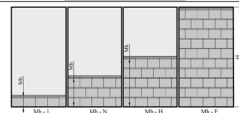
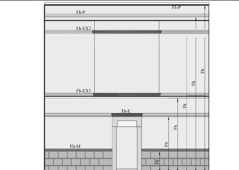
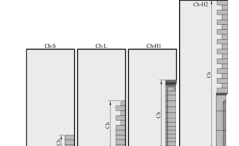
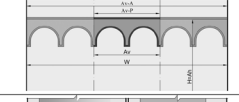

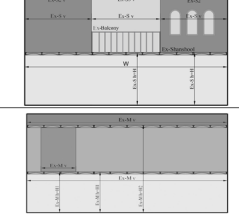
In the relational analysis, the priority of placement the elements in the facade was determined in sequence to formulate the grammar of its relationship to the other the element to prevent conflicts in applying of these grammars. So the priority of the elements was determined in sequence as follows, Entrance, Opining -Window, Extension, Madamic, Frieze, Corner, arches, and finally Corbels (Table 3).

#### 4.5. Determine the priority of applying Shape Grammar

To apply the derived Shape Grammar, an algorithm will be determined to prioritize the applying of grammar to avoid the clash between grammars (Figure 4). These grammars are applied in thirteen stages, as follows:

- The First Phase: It begins with the initial shape by determining the facade proportions by its parameters.
- The Second Phase: Inserting the Entrance by applying its rules.
- The third phase: Inserting the Corners by applying its rules, if any.
- The Fourth Phase: Applying the rules of Madame, if any.
- The Fifth Phase: Inserting Windows and Openings according to its types, the cellar windows, the bath windows, and the room windows.

**Table 2.** The Euclidean Shape Grammar for determining the placement of the architectural elements in the facade (Source: The Researchers).

Element	Vertical Level	Value	Horizontal Level	Value
Entrance (E)	• Corner Position (Ev-c) R1: $W \leq 3 * Ew$	Left Right	• Under the road level (Eh-a) R4: $Eh > \text{Level of Road}$	0.15-1.0
	• Centre Position (Ev-ce) R2: $\frac{1}{2}W \approx \frac{1}{2}Ew$	$\frac{1}{2}W$	• With the road level (Eh-w) R5: $Eh = \text{Level of Road}$	0.0
	• Mid Position (Ev-m) R3: $\frac{1}{2}W - Ew \leq Ew$	$\frac{1}{2}W - Ew$	• Above the road level (Eh-u) R6: $Eh < \text{Level of Road}$	0.15-0.4
				
W. Cellar (WC)	• Corner Position (WCv-c) R7: $W \leq 3 * WCw$	Left Right	• Under the road level (WCu) R4: $Eh > \text{Level of Road}$	0.2-0.4
	• Centre Position (WCv-ce) R8: $\frac{1}{2}W \approx \frac{1}{2}WCw$	$\frac{1}{2}W$	• With the road level (WCw) R5: $Eh = \text{Level of Road}$	0.0
	• Mid Position (WCv-m) R9: $\frac{1}{2}W - WCw \leq WCw$	$\frac{1}{2}W - WCw$	---	---
				
W. Cellar (WC)	• Corner Position (WBv-c) R1: $W \leq 3 * WBw$	Left Right	• Ground Floor Level (WBh-1) R15: $1.7 > WBh \leq 3.2$	1.7-3.2
	• Centre Position (WBv-ce) R13: $\frac{1}{2}W \approx \frac{1}{2}WBw$	$\frac{1}{2}W$	• First Floor Level (WBh-2) R16: $> 4.3 WBh \leq 10$	4.3-10
	• Mid Position (WBv-m) R14: $\frac{1}{2}W - WBw \leq WBw$	$\frac{1}{2}W - WBw$	---	---
				
W. Room (WR)	• Corner Position (WRv-c) R1: $W \leq 3 * WRw$	Left Right	• Ground Floor Level (WRh-1) R21: $1.0 > WRh \leq 2.8$	2.8-1.0
	• Centre Position (WRv-ce) R2: $\frac{1}{2}W \approx \frac{1}{2}WRw$	$\frac{1}{2}W$	• First Floor Level (WRh-2) R22: $4.3 > WRh \leq 10$	4.3-10
	• Mid Position (WRv-m) R3: $\frac{1}{2}W - WRw \leq WRw$	$\frac{1}{2}W - WRw$	---	---
				
Madamic (M)	• Low Madamic level (Mh-L) R23: $1 \text{ Row} \leq Mh < 2 \text{ Rows}$	0.3-0.7		
	• Normal Madamic level (Mh-N) R24: $Mh = 3 \text{ Rows}$	1.0		
	• High Madamic level (Mh-H) R25: $4 \text{ Rows} \leq Mh < 5 \text{ Rows}$	1.3-1.6		
	• Complete Madamic level (Mh-N) R26: $Mh = H$	H		
Frieze (F)	• Frieze of Madamic (Fh-M) R27: $Fh = Mh$	H-0.3		
	• Frieze of Entrance (Fh-E) R28: $Fh = Eh$	Eh		
	• Frieze Down Extension (Fh-EX1) R29: $Fh = Exh1$	Exh1		
	• Frieze above Extension (Fh-EX2) R30: $Fh = Exh2$	Exh2		
Corner (C)	• Frieze of Parapet (Fh-P) R31: $Fh = Ph$	Ph		
	• Simple Corner (Ch-S) R32: $1 \text{ Unit} \leq Ch < 2 \text{ Unit}$	0.3 0.6		
	• Low Corner (Ch-L) R33: $3 \text{ Unit} \leq Ch < 6 \text{ Unit}$	0.75 1.0		
	• High Corner (Ch-H1) R34: $7 \text{ Unit} \leq Ch < H1$	2.2 H1		
Arches (A)	• Complete Corner (Ch-H2) R35: $H1 \leq Ch < H2$	H1-H2		
	• Partial Arches (Av-P) R36: $\frac{1}{2}W \approx \frac{1}{2}Av$	$\frac{1}{2}W$		
	• Complete Arches (Av-A) R38: $Av = W$	W		
	• Ground Floor Level (Ah-F) R39: $Ah = H$	2.5-4.4		
Corbels (R)	• Arches (Rv) R40: $Rv = Exv$ (Rectangle EX) R41: $Rv = Exv$ (Triangle EX)	W- Exv		
	• Ground Floor Level (Rh) R42: $Rh = Exh$	2.4-5.7		
	• Extensions (Ex-S v) R43: $Ex-v = W$ (Along) R44: $Ex-v = W$ (Side) R45: $\frac{1}{2}Ex-v \approx \frac{1}{2}W$ (Central)	W <W $\frac{1}{2}W$		
	• Ground Floor Level (Ex-S h) R46: $Ex-h = H$	2.7- 5.1		
Extensions (Ex)	• Partial Extensions (Ex-Mp v) R48: $Ex-v = W$	<W		
	• Along Extensions (Ex-Ma v) R49: $Ex-v = W$ (Floor) R50: $Ex-v = W$ (Parapet)	W		
	• Extensions Level (Ex-M h) R51: $Ex-h = H$	2.7- 10.2		



- The Sixth Phase: Inserting the Frieze within the ground floor by applying its rules
- Either:
  - The Seventh Stage A: Inserting the Extension (Parapet or first floor) by its parameters.

**Table 3.** The Relational (Topological) Shape Grammar for the elements.

Element		Rules	%			
Window	Cellar Window	• RE2: if $Eh1 > \text{Level of Road}$ , then $WCh \equiv \text{Level of Road}$	100%			
	Bath Window	• RE2: if $Eh2 > \text{Level of Road}$ , then $WBh \equiv Eh1$	80%			
	Ventilation Window	• RE3a: $WVv \equiv \frac{1}{2} WVv \equiv \frac{1}{2} Ev$ • RE3b: $WVh = Eh + (0.1-0.6)$	100%			
	Extension					
Entrance (E)	Shanshool-Balcony	• RE4: if $EX-S \leq W$ , then $EX-S \equiv Eh$	100%			
	Mass (Bath)	• RE5: $EX-Mh \neq Eh$	100%			
	Frieze (F)	• RE6: $Fh1 = Fh2 = Eh1$ • RE7: $Fh2 = Eh1$	100%			
	Arches (A)	• RE8: $\frac{1}{2} Ew \equiv \frac{1}{2} Ad$	100%			
Window and openings (W)	Entrance with Window	Entrance with Extension	E with Arches	Entrance with Frieze		
	Extension (EX)	• RW1: $\frac{1}{2} WRw \equiv \frac{1}{2} EX-Sw$			100%	
	Madamic (M)	• RW2: $WRh2 \equiv Mh$ • RW3: $WBh1 \equiv Mh$			50%	
	Frieze (F)	• RW4: $WRh1 \equiv Fh3$ • RW5: $WBh1 \equiv Fh3$			85%	
	Arches (A)	• RW6: $\frac{1}{2} WBw2 \equiv \frac{1}{2} Ad$			100%	
	Window with Extension	Window with Madamic	Window with Frieze	Window with Arches		
	Madamic (M)	• R EX1: $EX-h1 \geq Mh$			40%	
	Arches (A)	• R EX2: $EX-h1 \equiv Ah$			100%	
	Corbels (R)	• R EX3: $EX-h1 \equiv Rh$			100%	
	Frieze (F)	• R EX4: $EX-h1 \equiv Fh3$ • R EX5: $EX-h1 < Fh4 > EX-h2$ • R EX6: $EX-h2 \equiv Fh5$			100%	
Corner (C)	• R EX7: $EX-h1 \geq Ch1$ • R EX8: $EX-h2 \geq Ch2$			100%		
Extension (EX)	EX with Madamic	EX with Arches	EX with Corbels	EX with Frieze	EX with Corner	
	Frieze (F)	• R M1: $Mh = Fh1$				100%
	Corner (C)	• R M2: $Mh \leq Ch$				100%
	Arches (A)	• R M3: $Mh \leq Ah2$				100%
	Madamic with Frieze	Madamic with Corner	Madamic with Arches			
	Corner (C)	• R F1: $Fh2 \equiv Ch$				100%
	Arches (A)	• R F2: $Fh3 \equiv Ah$				100%
	Corbels (R)	• R F3: $Fh3 \equiv Rh$				100%
	Frieze with Corner	Frieze with Arches	Arches with Corbels			
	Corner (C)	Arches (A)	• R A1: $Rh \leq Ah2$			100%

Or:

- The Seventh Phase B: Inserting Arches, if any.
- The Eighth Phase: Applying the rules of the Corbels, if any.
- The Ninth Phase: Determining the proportions of the first floor by the width and height parameters.
- The Tenth Phase: Inserting the extension, which includes Balconies, Shanshools, and Masses.
- The Eleventh Phase: Inserting the parapet.
- The Twelfth Phase: Determining the skyline of the facade by determining its type.
- The Thirteenth Phase: termination by erasing all labels and signs.

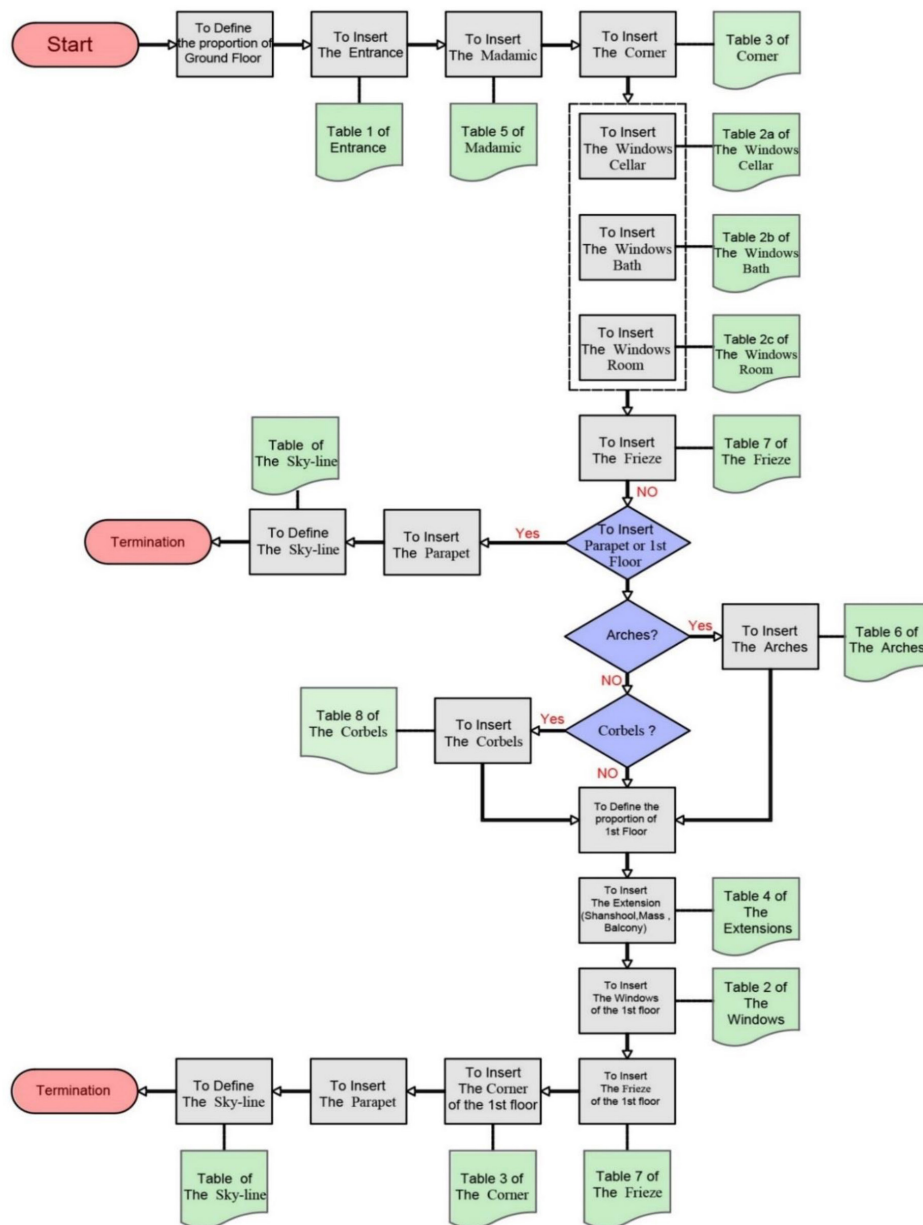
#### 4.6. Applying Shape Grammar on the case study

Finally, to test the accuracy of the derived Shape Grammar, their rules were applied to generate a facade that belongs to the local architectural language of the ancient Mosul depending on the algorithmic scheme that determines the phases of applying these rules. The position and sequence of applying the rules in the facade were determined by State and Spatial Labels (Table 4).

#### 5. Results

The study presented about 120 architectural elements distributed in eight groups which represent the vocabulary of the morphological formation of the architectural language including Entrances, Windows, Extensions (Shanshools, Balcony, and Cantilever), Crobles, Corners, Friezes, Madamic and Arches.

Also, 120 rules were derived which represent restrictions and rules of the facades, including three basic types, the first is the rules to determine the proportions of the facades and it contains 15 rules for the ground floor, the first and the parapet, and it has two basic parameters, the height, and the width parameter, the second is the rules of placement of the elements in the facades which contains 48 rules with 19 Parameter distributed on the eight-element, and the third is the relational rules to determine the relationship between the elements with 30 rules and 19 Parameter.



**Figure 4.** Algorithm for applying the Shape Grammar of the facades in the case study (Source: Researcher).

## 6. Discussing the results

The percentage of the element placements in the facade was calculated to verification of the mathematical and Euclidean relations of derived Shape Grammar of the architectural elements, then discuss this grammar and restrictions to determine the functional, constructional, and climatic requirements (Figure 5).

### 6.1. The proportions of the facade

- The width of the facade: The width of the facade ranges between (2.3-20) m, this great diversity in the width of the facades indicates the irregular planning of urban because of the organic planning in the city.
- The height of the facades: The variation of the height is related to the variation of width, so the skyline of the old Mosul is diverse and rich.
- The proportions of facade:
- For large façades, the proportion of the width of the façade to the height is (5:1-4:1), While the proportion of small facade range between (1:3-1:2).
- The facades characterized with a human scale, because the facades with a width less than (12) m have reached (91.4%), and the height did

Table 4. Applying the Shape Grammar in the case study.

Phase 1-Proposition	Shape Grammar		Phase 8-1st Floor	Rule W2: $1.3 \leq W2 \leq W1$	Rule H2: $2.8 \leq H2 \leq 5.3$
	Rule W1: $2.3 \leq W1 \leq 20$	Rule W1: $2.3 \leq W1 \leq 20$		Rule H2: $2.8 \leq H2 \leq 5.3$	Rule H2: $2.8 \leq H2 \leq 5.3$
Phase 2-Entrance	Rule 3: $\frac{1}{2}W-Fw \leq Fw$	Rule 5: $Eh = \text{Level of Road}$	Phase 9-Windows Bath	Rule 14: $\frac{1}{2}W-WBw \leq WBw$	Rule 16: $4.3 > WBh \leq 10$
	Rule 24: $Mh = 3 \text{ Rows}$	Rule 24: $Mh = 3 \text{ Rows}$		Rule 20: $\frac{1}{2}W-WRw \leq WRw$	Rule 22: $4.3 \leq WRh \leq 10$
Phase 3-Madame	Rule 34: $7 \text{ Unit} \leq Ch > H1$	Rule M2: $Mh \leq Ch$	Phase 10-Frize	Rule 30: $H1 \leq Fh \leq H2$	Rule 30: $H1 \leq Fh \leq H2$
	Rule 14: $\frac{1}{2}W-WBw \leq WBw$	Rule 15: $1.7 > WBh \leq 3.2$		Rule W3: $W3=W1$	Rule H3: $0.8 \leq H3 \leq 1.2$
Phase 4-Corner	Rule 14: $\frac{1}{2}W-WBw \leq WBw$	Rule 15: $1.7 > WBh \leq 3.2$	Phase 11-Farapet	Rule A1w: $WA1-WAa+WAh$	Rule A1h: $HAa+HAh$
	Rule 20: $\frac{1}{2}W-WRw \leq WRw$	Rule 21: $1.0 > WRh \leq 2.8$		Rule F: Delete All the Label	Rule F: Delete All the Label
Phase 5-Windows-Room	Rule 20: $\frac{1}{2}W-WRw \leq WRw$	Rule 21: $1.0 > WRh \leq 2.8$	Phase 12-Skyline	Rule F: Delete All the Label	Rule F: Delete All the Label
	Rule W3: $WBh1=Mh$	Rule W3: $WBh1=Mh$		Rule F: Delete All the Label	Rule F: Delete All the Label
Phase 6-Frize	Rule E3a: $WVv = \frac{1}{2}WVv = \frac{1}{2}Ev$	Rule E3b: $WVh = \frac{1}{2}WVh = \frac{1}{2}Ev$	Phase 13-Termination	Rule F: Delete All the Label	Rule F: Delete All the Label
	Rule 27: $Fh=Mh$	Rule 28: $Fh=Fh$		Rule F: Delete All the Label	Rule F: Delete All the Label
Phase 7-Arches	Rule 38: $Av=W$	Rule 39: $Ah=H$		Rule F: Delete All the Label	Rule F: Delete All the Label
	Rule W6: $\frac{1}{2}WBw2 = \frac{1}{2}Ad$	Rule E8: $\frac{1}{2}Ew = \frac{1}{2}Ad$		Rule F: Delete All the Label	Rule F: Delete All the Label

not exceed (8) m by (91.5%), also the height to width ratio ranges (1: 3.22) of the small facade to (1: 0.912) as a maximum which indicates the human scale in these facades.

## 6.2. Entrance

- The percentage of the facade that included one entrance about (96.6%), while secondary entrances were added to other facades as a result of the modification the plan of the housing according to new functional purposes.
- The entrances that are located on the central axis of the façade is about 16%, which indicates an awareness of the principles of symmetry in the design, while the ratio of the corner entrances is 22.8% due to the boundaries of the land and the restrictions of functions. while the majority of the entrances are in mid-position between the corner and central axis.
- The horizontal position of the entrance: The entrance level is related to the level road of the alley, some of

the entrances are below the road level due to the paving of the road that raises its level which led to removing some entrances due to non-functional efficiency which were replaced by new entrances.

## 6.3. Windows

It includes three types.

### 6.3.1. Ventilation windows

These windows are used in the bathrooms that are located often on the ground floor because it requires plumbing services that are difficult to provide on the upper floors.

- Vertical position: Most of these windows are located in the mid-position of the facade, then the corner position.
- The horizontal position: These windows are found in 58% of the facades and distributed in the ground floor by 48%, and the first floor by 14.2% (in the bathroom mass), so these windows are often on the ground floor close to the entrance or the cor-

ner by the internal configuration of the spaces to achieve privacy.

### 6.3.2. Cellar window

Its presence about (8.5%) out of the total housing in the Mid position, its height ranges between (0.4-1.6) m.

- Vertical location: Most of these windows are located on the mid-position of the facade, also located in the center with if these windows are along the facade.
- The horizontal position: The lower level of these windows is usually above the road level, but sometimes it is lower than it because of the paving works.

### 6.3.3. Room windows

The percentage of facades without any windows is (4.2%), most of the room Windows located on the first floor by (70%), while the ground floor contains this type of windows by (30%). This varied ratio between the two-floor attributed to privacy.

- The Vertical position: A small percentage of windows is located in the corner position due to the difficulty in employing these parts in the plan as rooms, most of these windows are located in the Mid position of the facade.
- The Horizontal position: The level of these windows on the ground floor is between (1-2.8) m, and the windows are enclosed for protection and privacy purposes, while the level of the windows of the first floor is between (4.3-10) m.

### 6.4. Madamic

It is found in (45.4%) of the facades, and its height ranges from simple Madamic with two rows of stone with a height of (0.3) m to the Madamic that completely covers the facade with a height of the floor.

### 6.5. The arches

Its presence is correlated with the extensions as a structural element, (2.1%) of the facades are contain the arches, its height is between (2.5-4.4) m.

### 6.6. Extensions

The facades that contain Extensions are about (65.2%) as follows:

- Shanshool: It is the most important element in the extensions of the facade. It extends over the façade by 40% or partially over the entrance by 60%.
- The Balcony: it is found on the facades overlooking a relatively wide alleyway, and it is located in the central position above the entrance.
- The Masses: mostly employed as a bathroom, and it is located in the corner position away from the entrance.

### 6.6.1. The structural elements

The structural system is related to the extensions as a structural and decorative determinant, this was reflected in the three types of extensions as follows:

- Crobles: their presence is related to small extension relatively by 10%.
- Arches: these elements are employed to load the fully or partially floors and the Arches are located mainly above entrances by 10% of the total extension.
- Beams: This beam is locally called "Shilman", it is made of iron in I section, this Beams are the most used structural system by 83% in the balconies, Shanshool, floors, and other extensions.

### 6.7. The corner

They are found in the corner facades, their height ranges from the simple corner (0.3) m to the high corner that has the same height of the ground floor or the first floor.

### 6.8. The frieze

The Frieze is distributed on the ground floor by (54.2%), and on the first floor by (27.5%). The reason for the high presence of Frieze on the ground floor is for two reasons, the first is its association with the Madamic that is only on the ground floor, and the second is a confirmation of the horizontal rhythm of the facades.

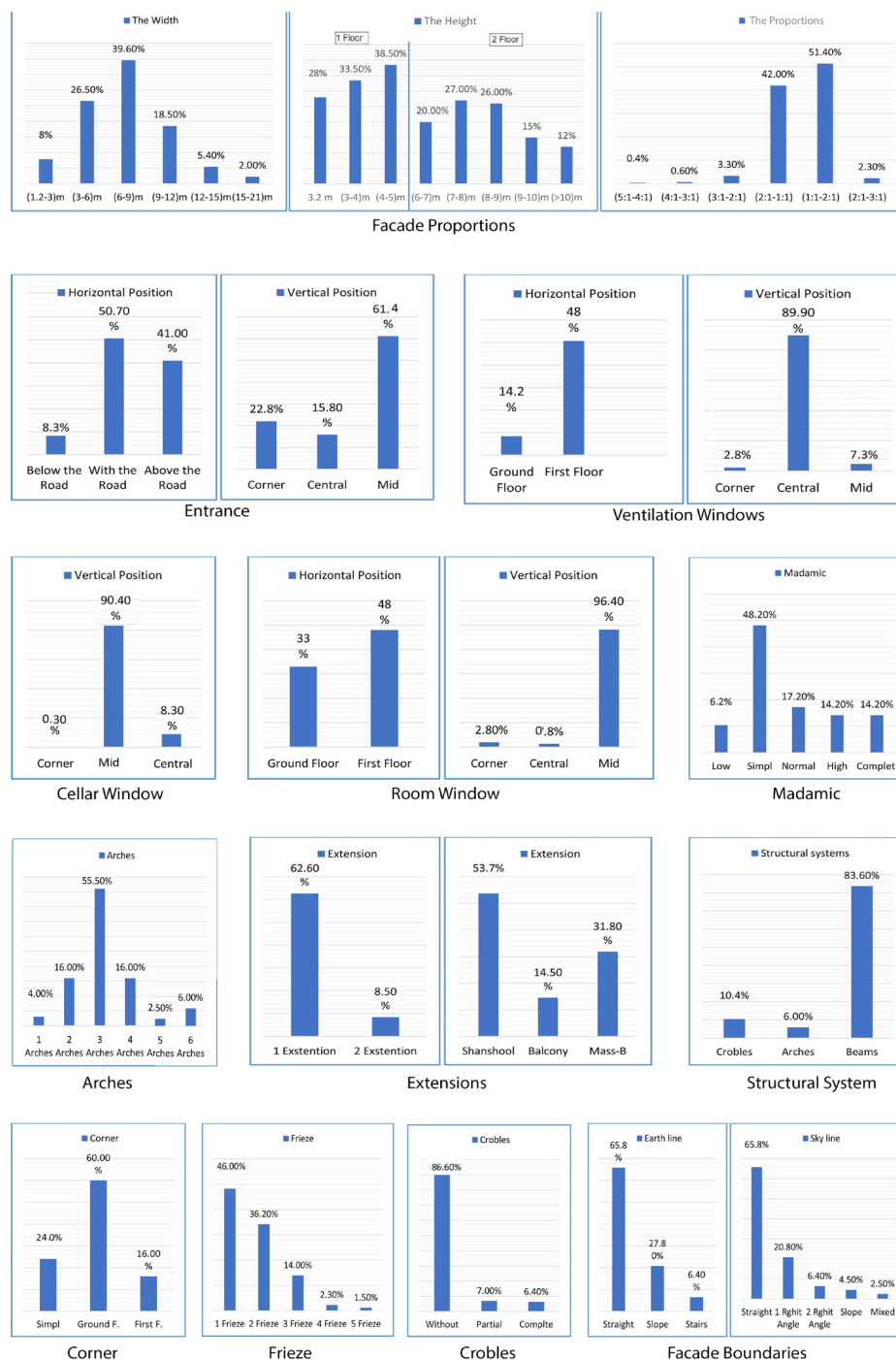
### 6.9. Crobles

This element is located in some facades as a structural and decorative element and its height is the same as the height of the first-floor ranges between (2.4-5.7) m.



### 6.10. Facade boundaries

- The Skyline: There are several types of the skyline of the facades, some of which are related to the straightness of the alley, and the other is related to the functional characteristics as follows.
  - The straight skyline: it is found in most dwellings at a rate of 65.8%.
  - The skyline with a right angle: the change in the horizontal skyline is attributed to changing in the height
- due to the presence of prominent elements, or because of the sloping alley.
- The diagonal skyline: this type of skyline due to the stairs element and its ratio is about 7%.
  - The Ground line: Most façades have a level close to straightness by 78%, and if the alley with a sloppiness, the ground of the alley is divided into steps, which is reflected on the facade.



**Figure 5.** The results of Mathematical and Euclidean Relations Analysis of the architectural elements (Source: Researcher).

### 6.11. The relational (topological) analysis

In the relational (topological) analysis, some elements are related to each other (Table 5) for functional, structural, aesthetic, or climatic reasons as follows:

- The Entrance: The entrance is related to the basement windows with the lower horizontal level, it is correlated with the Bath windows with the upper horizontal level, and it is correlated to the ventilation windows with the same central axis of the entrance. The entrance is correlated with the extensions (shanshools and balconies) due to climatic and aesthetic requirements, while the extension mass (bathroom) does not locate on the entrance for technical purposes.
- The Openings and windows: The windows correlated with the Shanshool by locating it in the central position of Shanshool to achieve symmetry as an aesthetic purpose.
- The Extensions: The extensions are correlated with arches and corbels by determining the height as a structural purpose, and the Madamic and Frieze as a design purpose.
- The Madamic: It is always correlated with the presence of the Frieze above, and it is always the lowest level of arches, mostly with the level of corners.

- The Friezes are correlated with the corners, arches, and Crobles at the horizontal level, so that it is above these elements.
- The Corners are correlated to the arches by the horizontal level.

### 7. Conclusion

The current research sought to find out the deep structure that characterized the facades in the case study, it is clear from the results of the morphological, mathematical and Topological analysis of the facades which there is a hidden structure adopted to achieve the climatic, social and constructional requirements that reflected on the unification of the urban scene with uniform characteristics regardless of the difference of housing units in size and area as a result of the variation of the economic level of the residents and their requirements, which formed a unified architectural language for the city despite the different periods of the housing units that reach up to 200 years. Due to the advantages of Shape Grammar as an analytical, and generative system, in addition to its capabilities to deal with morphological and mathematical characteristics, It was used to analyze traditional facades and its architectural elements to determine the patterns and its structure to assign the vocabulary of the local architectural language, So the Standard and parametric Shape

**Table 5.** The Results of the Topological analysis of the architectural elements.

Croble	Arches	Corner	Friezes	Madamic	Extensions			Windows				Entrance	Elements		
					Bathroom	Balcony	Shanshool	Cellar	Bathroom	Ventilation	Room				
-	100%	-	41 %	18 %	%100	88 %	97%	55%	65%	100%	17.5%		Entrance		
-	100%	-	12.4%	72 %	-	-	100%	-	7.3 %	-		17.5%	Room	Windows	
-	100%	-	-	47%	-	-	-	-	-		-	100%	Ventilation		
-	100%	-	36%	15%	100%	-	-	-	-	-	7.3 %	65%	Bathroom		
-	-	-	80 %	75%	-	-	-	-	-	-	-	55%	Cellar		
32%	-	67%	95%	-	-	-	-	-	-	-	100	97%	Shanshool		
-	-	13%	12%	-	-	-	-	-	-	-	-	88 %	Balcony		
12%	-	30%	-	-		-	-	-	100%	-	-	%100	Bathroom	Extension	
23%	65%	88%	100%		-	-	-	75%	15 %	47%	72 %	18 %	Madamic		
78%	100%	85%		100%	-	12%	95%	80%	36%	-	12.4%	41 %	Friezes		
23%	73%		85%	88%	30%	13%	67%	-	-	-	-	-	Corner		
-		73%	100%	65%	-	-	-	-	100%	100%	100%	100%	Arches		
-	-	23%	78%	23%	12%	-	32%	-	-	-	-	-	Croble		

Grammar were used to define the basic rules, with the potential for diversification in these rules using parameters.

The analysis process revealed deep structure used in the facades that can be defined as rules and restrictions and represented by three types, the first is a morphological structure which determined the genotype of each architectural elements and their evolution from primary components, the second is Euclidean rules that determine the placement of these elements in the facade, and the third is mathematical rules that represented by specific parameters to specify the possibilities of placing of these elements in specific values range. These rules and restrictions of the facade and its architectural elements indicate the impact of the construction technique, in addition to the social and climatic requirements that led to the creation of a stable structure in the architectural composition, which indicates the designer's awareness of the principles design such as repetition, rhythm, symmetry, and balance which united the urban facade with a distinct architectural language and constant. The importance of the study is to provide information, restrictions and rules for specialists in the field of conservation to rebuild the city, especially after the great damage as a result of recent military operations, which led to the destruction of large parts of the urban fabric, the study also presented the possibilities of employing the rules of form to generate interfaces that carry the same heritage values without copying them directly. The paper proposes several recommendations including:

- Adopting the same methodology in analyzing other traditional functional styles in old Mosul, such as religious buildings (mosques and churches), Service, and commercial buildings.
- Generating new (creative) architectural elements from the same basic and secondary architectural components using Shape Grammar.
- Remodeling the dilapidated parts of the heritage buildings using Shape Grammar by the procedural modeling methodology which uses the computerized Shape Grammar.

- Using Shape Grammar in analyzing the urban fabric of the Mosul city to derive rules and restrictions for the virtual reconstruction.
- Using the derived Shape Grammar in this study in digital reconstruction by converting these rules into digital formulas in the procedural modeling process.

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# Investigation on evacuation scenarios according to occupant profile in mosques through different fire regulations

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## Abstract

Structural fires cause excessive life and property loss. The reduction of life and property loss in fire, risk management is achieved by evacuation scenarios and occupant profile in proper and real manner. Assembly buildings should be considered and evaluated as areas of intensive use, especially for evacuation scenarios and occupant profile. Within the scope of the study, the occupant profile for mosques as an assembly building with independent exits created with single space was analysed, fire safety risks were identified and evacuation scenarios were determined. The occupant profile and evacuation scenarios are crossed and evacuation risk combinations are created for mosques. Within the context of evacuation risk combinations, the building occupant load was calculated according to the occupant load coefficients of the fire regulations of Turkey, USA, UK, New Zealand, Singapore and Australia via the Canik Central Mosque sample. Building occupant loads were calculated according to regulations and evacuation times were calculated through Pathfinder simulation program. It was found that there were large differences between the resulting evacuation times. The study concluded that differences in occupant load coefficients found in fire regulation greatly affected evacuation times. In mosques whose floors have independent exits, especially the upper floor (mahfil) is the determinant of evacuation times. The need to design alternative exits where two exits are not sufficient for the mahfil has been determined. As the transition to performance-based fire regulation systems has accelerated, it has been determined that occupant load coefficients are an important parameter in calculating evacuation times for mosques.

## Keywords

Evacuation time, Evacuation scenario, Occupant load, Assembly buildings, Fire regulations.

## 1. Introduction

Structure fires pose a great threat to the life safety of occupants. Fires cause great casualties in buildings due to the high occupant density and the presence of large amounts of combustible materials in the environment. It is necessary to eliminate the possible threats and fire causing factors and to create fire safety precautions in buildings (Sun & Turkan, 2020). According to the International Association of Fire and Rescue Services (CTIF) 2019 World Fire Statistics Report, thousands of people die due to structure fires (Table 1). The statistical results, which we encounter with large numbers in different countries, reveal the necessity of researches on fire safety precautions.

Turkey is located in the 500-1000 range (the result of a fire casualties in 2016). The fires that occur are far above casualties. Istanbul, where most of the population in Turkey, revealed the structure fire statistics confirm this situation. When the structure fire statistics for Metropole Istanbul have been examined, fires increase the risk factor even further. Although they have decreased in number from the various periods to the present, fires continue to be a major threat to human life (Istanbul Fire Department Report, 2020). Building fire safety precautions and effective evacuation planning in buildings where occupant density is high are effective in reducing the number of injuries/deaths.

The creation of fire safety precautions in buildings is assured by fire regulations. The recent fires and results revealed the need to reconsider and evaluate the fire regulation during the building design and construction pro-

cess. There are passive and active fire safety precautions created within the framework of fire regulations. Passive fire safety precautions cover the principles set up during the design process and require integration with the architectural project. It includes fire safety precautions that must be taken at the context of the settlement, building, building elements and building materials. Design of escape routes, identification of occupant profile and creation of evacuation scenarios are sub-topics of passive fire safety precautions. Active fire safety precautions constitute the whole of mechanical systems that contribute to passive fire safety precautions in the architectural project. It provides the most appropriate and effective solutions to support passive fire safety precautions by setting them up at the design process such as adding them to the existing project later. Smoke detection and warning systems, emergency guidance systems, smoke control and automatic extinguishing systems are the sub-topics of active fire safety precautions (Demirel et al., 2017; Rahardjo & Prihanton, 2020). In the architectural design process, it is important to create passive and active fire safety precautions together within the framework of fire safety precautions. However, in the architectural design process expected from the designer (architect), the passive fire safety precautions are designed to be at the highest level and in all possible evacuation scenarios, it is aimed to provide appropriate evacuation conditions and evacuation time.

Today, although the fire regulation requirements of the countries have been created over a certain period of

**Table 1.** Distribution of casualties caused by fire (2016).

Deaths from Fire (2016)	Surveyed Countries
10 000 - 50 000	China, India
7 000 - 10 000	Russia, Nigeria
3 000 - 7000	USA, Pakistan, Congo
2000 - 3000	Sudan, Côte d'Ivoire, South Africa, Uganda, Tanzania
1000 - 2000	Ghana, Burkina Faso, Chad, Japan, Angola, Niger, Myanmar, Kenya, Somalia, Mozambique, Cameroon, Brazil, Yemen, Iran, Bangladesh, Ukraine, Indonesia, Egypt
500 -1000	Poland, Sri Lanka, Benin, Mexico, Malawi, Guinea, Iraq, Belarus Haiti, Saudi Arabia, Algeria, Turkey, Zimbabwe, South Sudan, Zambia, Burundi, Madagascar, Philippines, Mali, Thailand
400 - 500	Germany, Vietnam, Kazakhstan, Nepal, Sierra Leone, Uzbekistan, Afghanistan, Rwanda, Morocco, Senegal, Peru,
300 - 400	DPR of Korea, Republic of Korea, United Kingdom, Togo, Chile, Cambodia, France, Argentina, Romania

(Source: World Fire Statistics Report, 2019)

time (occupant access to the safe area), various differences have been observed in building evacuation times. It is important to create building specific evacuation risk combinations by occupant based evacuation scenarios in buildings (Hadjisophocleous & Bénichou, 2000). For this purpose, the transition from prescriptive-based systems to performance-based systems is accelerated in fire regulations in developed countries in the field of fire safety and project specific-occupant based evacuation scenarios are created within the framework of building fire risk assessments (Hall & Watts, 2008; Meacham, 2010). Some prominent countries such as the United States of America, the United Kingdom, Canada, Sweden, New Zealand and Australia are at an advanced phase in the development and application of performance-based fire regulation systems. Evacuation scenarios, fire and smoke models are developed in the creation of performance-based fire safety precautions (Tavares & Galea, 2009).

Turkey's Regulation on Fire Protection (TRFP) as part of structure fire safety precautions in Turkey came into force in 2002 and has undergone several revisions to its current use (TRFP, 2015). It is clearly stated that the rules contained in the regulation are binding and that their provisions are decisive, except for the specific building groups (in the areas of metro, marina, heliport, tunnel, stadium, airport and similar use areas, in case there are not sufficient provisions in the regulation). In this case TRFP, prepared as a prescriptive-regulation; limits the use, adoption and dissemination of performance-based approaches to a certain extent.

In occupant based evacuation scenarios within the framework of passive fire safety precautions, it is important to define the building occupant profile and develop evacuation scenarios. The evacuation time of occupants in the building during the fire is largely positively correlated with building occupant load. When the building occupant evacuates the building within the appropriate time under normal conditions, this time increases greatly depending on the situation of escape and panic as the occupant density in-

creases. The impact of occupant load on evacuation time poses a major threat, especially in assembly buildings. It should be aimed to address the risks such as intensive use in assembly buildings, involving different age groups, occupant's recognition of the building and performance concentration requirements, and to create performance-based fire safety precautions specific to the project. (Kucera & Strakosova, 2013).

When the fire regulations are examined, as a comprehensive class for assembly buildings cover places of worship, eating and drinking facilities, entertainment venues, museums, exhibition halls, gymnasiums, conference and concert halls, terminals, including airports and ports. Within the scope of fire regulations, mosques are evaluated in the category of assembly buildings. When searching at the Turkish mosque building stock, a lot of mosques have been built within the borders of Turkey recently and are still being built. There are no regulations that contain occupant based evacuation scenarios for performance-based fire safety precautions. Given the intensive use of mosques, it is necessary to determine the occupant profile and to design evacuation scenarios. It is necessary to examine the occupant profile for mosques, especially with the occupant load coefficients determined in the fire regulations of countries. It is very important that the occupant load in the building is analysed correctly and transferred as input to the project in order to create performance-based fire safety precautions.

## 2. Methodology of the study

Passive fire safety precautions for mosques as an assembly building have been addressed and occupant based evacuation scenarios have been emphasized. Within the scope of the study, occupant profiles for mosques were determined and evacuation scenarios deemed necessary within the framework of fire safety were determined. Two main components, identified as occupant profile and evacuation scenarios, were crossed and evacuation risk combinations were created. In order to calculate the evacuation times

of the evacuation risk combinations, a mosque project within the borders of Turkey with independent exits in building has been discussed. Evacuation times were determined using the Pathfinder Simulation Program within the framework of fire regulations for the Canik Central Mosque, which is considered as a sample (Pathfinder, 2012; Pathfinder, 2017).

In determining of the occupant load, Turkey-Turkey's Regulation on Fire Protection (TRFP, 2015), United States of America-NFPA Life Safety Code 101 (NFPA 101, 2018), United Kingdom-BS 9999 Fire Safety in the Design, Management and Use of Buildings, Code of Practice (BS 9999, 2017), New Zealand-Acceptable Solutions and Verification Methods (NZBC, 2017), Singapore- Code of Practice for Fire Precautions in Buildings (SCDF, 2018) and Australia-National Construction Code Volume 1 (NCC, 2019) fire regulations, standards and codes have been reviewed. In the framework of the mosque, which is considered as a case study, evacuation times were determined and evaluations have been made depending on the occupant load coefficients found in the fire regulations. Comparing the evacuation times in evacuation risk combinations, it was determined that major differences were observed, and the differences were due to the occupant load coefficient taken from fire regulations. Assessments on evacuation times have been made in the creation of performance-based fire safety precautions for mosques. Proposals have been developed about the planning of the evacuation of mosques with independent exits in buildings created with the design of single space.

### 3. Risk assessments for fire safety precautions in mosques

Mosques are places of worship arising from the orientation of the general form decision to the Qibla. In the period from the past to the present, mosques are used as wide volumes where different functions are performed for worship, education and gathering (Rasdi & Utaberta, 2010). As an intensive use area, mosques gather different age groups in single space. The single space planned is called

harim. In today's mosque planning, the harim is followed by a gallery floor connected with the side walls and back walls. This gallery floor is defined as mahfil. Considering the burden of the occupant depending on the mosque planning, it is inevitable that an environment of chaos will occur in a possible fire. Especially for mosques, there is a high rate of accumulation at the exit after worship and the occupants cause clutter at the exit doors.

The most important factor in the emergence of the fire in mosques is arson. As a worship building, fires occur in mosques with the effects of various gains and ideologies. Arson has become the main problem, especially in mosque fires that occur in different countries (Akyön & Özcan, 2017). According to Anadolu Agency data, Denmark in 2020, the US state of Connecticut in 2019, Germany in 2019, the US state of Florida in 2017, France in 2016, Canada in 2015, Sweden in 2016, the capital of Sweden, Stockholm in 2014 fires emerged as a result of arson. Turkey borders of arson in the period up to the present from the past caused many mosques have emerged with fire (Anadolu Agency, 2020). A lot of people were injured and died as a result of mosque arson. Fires caused by arson, especially in mosques, require the provision of necessary safety precautions and evacuation risk combinations of appropriate evacuation times.

Mosques are designed and constructed in similar schemes in functional form. However, connections between floors and escape route designs are changing; this situation requires the creation of different evacuation scenarios. In order to determine the evacuation times by designing evacuation scenarios, the relationship between the harim and mahfil floor should be examined (Berksan, 2015). Different evacuation scenarios arise in the mosques designed independently from each other in the planning of harim and mahfil escape routes and mosques designed using interconnected, common entrance/exit. Mosques with different entrances/exits for the harim and mahfil floors give more appropriate evacuation results during evacuation times to prevent accumulation.



The architectural form of the mosque did not change much during the period from the past to the present. Mosques produced from similar forms have valuable examples that can survive to date as an important cultural heritage. Especially in huge mosques with high occupant load, the risks for fire safety precautions increase more. Different fire safety precautions have been adopted in national and international fire regulations, especially for historical buildings. However, it should not be forgotten that mosques are at high risk as an assembly building. It is appropriate to make a different risk assessment for mosques in historical buildings and the suggestions that can be applied should not be against the restoration principles of the historical building.

In the event of a possible fire in mosques, all occupants are exposed to fire and smoke in the same way. In this case, it becomes necessary to evacuate all the occupants in the building within the same period. Within the framework of national and international fire regulations, it is appropriate to carry out simultaneous-full evacuation planning in mosques as an assembly building in case of emergency (Chow, 2007). This situation arises from the fact that the architectural form of the mosque has been created with single space building. Fire risk assessments determined in mosque planning are as follows:

- The fact that there is a single space design in interior planning facilitates the alternative of escape route design. Having alternative escapes to each other facilitates risk management, and this contributes to shortening the evacuation time. At the same time, the evacuation time takes place more quickly with the effectiveness of fire detection, warning and guidance systems. However, single space causes fire and smoke to spread rapidly indoors. This situation makes it difficult for compartment and horizontal evacuation possibilities in buildings.
- With the adoption of traditional construction technique in mosques, main entrance doors are generally opened towards the interior. This

situation creates an accumulation in the last exit doors during the fire and causes the evacuation time to be extended (Topraklı et al., 2019). In this study, the opening direction of all doors was excluded in determining the evacuation times.

- The use of carpets in the interior changes the occupants' behaviour at the last exit in the fire evacuation. Occupants may tend to take their shoes. This situation causes the evacuation time to be extended (Nassar & Bayyouni, 2012). In this study, the tendency to take shoes was excluded in determining the evacuation times.
- Mosques should generally be handled over the neighbourhood or settlement. It is thought that the mosque occupants are generally from the close environment and fixed individuals. Due to religious and historical aspects or settlement, some important mosques are preferred for all city users or tourists. In the light of these data, the familiarity of the mosque changes. However, in mosques produced with single space design, the familiarity factor is not considered as a determinant in the evacuation time.
- Considering the occupant load in the mosques, the use of elderly/disabled individuals is in the majority that needs attention. Individuals with limited mobility (elderly/disabled) cause prolonged evacuation time. On special days and nights, the use of the mahfil floor in the mosques is realized by women. In these cases, it is important to define and evaluate a different occupant profile in mosques.
- Structural elements, architectural components and interior design used in mosques should be examined within the scope of fire safety precautions risk assessment. In historical mosques, the construction of a wood structure system, the number and position of vertical structure system elements in the mosque, the fire reaction of floor and wall finish materials should be investigated and their effect of occupant behaviour should be known during the evacuation process.

**Table 2.** Occupant load coefficients for mosques within the fire regulations.

Types of Building	Turkey (TRFP) m <sup>2</sup> /person	United States of America (NFPA) m <sup>2</sup> /person		United Kingdom (BS 9999) m <sup>2</sup> /person		New Zealand (NZBC) m <sup>2</sup> /person	Singapore (SCDF) m <sup>2</sup> /person	Australia (NCC) m <sup>2</sup> /person
Mosque (Places of Religious Worship)	Assembly Buildings <sup>1</sup>	Assembly Buildings		Standing Areas		Risk Group CA	Place of Public Resort	Assembly Buildings
		Concentrated Use <sup>2</sup>	Less Concentrated Use <sup>2</sup>	Normal	High	Area Without Seating or Aisles	Prayer Hall/ Gallery	Church / Multi-Purpose Hall
	1,5	0,65 net	1,5 net	1 <sup>3</sup>	0,5 <sup>3</sup>	1	1,5	1

<sup>1</sup> it has been recognized as multi-purpose hall / seminar hall.  
<sup>2</sup> without fixed seatings  
<sup>3</sup> typical and higher or lower factors might be more appropriate depending on the circumstances of the intended use and nature of the occupants

- Active fire safety precautions in mosques affect evacuation time. Fire/smoke detection and warning systems, emergency lighting-routing systems, smoke control systems, automatic fire extinguishing systems, such as the presence of an effective evacuation planning fire safety precautions allows.

Mosques have been evaluated in different ways as occupant load in national and international fire regulations. In the framework of fire regulations, specific designations for mosques are not detailed. In the fire regulations, passive and active fire safety precautions for mosques are given under the title of assembly buildings. There are requirements for fire safety precautions according to building height and plan square meters as an assembly building. In the fire regulations, occupant load coefficients that can be taken from the assembly buildings are investigated and are given in Table 2.

When national and international fire regulations are examined, it is important to determine the occupant load depending on the building class. However, in the fire regulation, occupant load coefficients for mosques are not generally included. There are also assessments such as seatless settlement/standing areas/more or less intensive use within the scope of assembly buildings. The occupant load of mosques is calculated in different ways depending on the occupant load coefficients within the framework of the evaluations and this results in the acceptance of the occupants in mosques to be evacuated with different evacuation times. In fire risk assessment, it is especially important to realize fair

evacuation scenarios in order to minimize and eliminate loss of life and property.

#### 4. Creation of evacuation risk combinations in mosques

In fire evacuation planning, it is especially important to identify fire risks within the scope of passive fire safety precautions, to calculate the occupant load of the building and to create evacuation scenarios. In determining evacuation times, the occupant profile and the occupant density in the building should be determined and design different evacuation scenarios. For this purpose, occupant profiles and evacuation scenarios should be created for mosques within the scope of the study.

Occupant profile in mosques is considered as a community of people offering a wide range for different age groups. This community also includes many older people and individuals with reduced mobility. However, in the comparison of the occupant load coefficients presented by the fire regulations, there are no refinements within the framework of individuals with limited mobility. In fire regulations, the number of occupants is taken as the basis for the determination of occupant load. Within the framework of these data, two main occupant profiles were identified in evacuation scenarios for mosques:

- The harim and mahfil is composed of middle age male occupant profile (P1),
- The harim is composed of middle age male occupant profile; the mahfil is composed of middle age female occupant profile (P2).

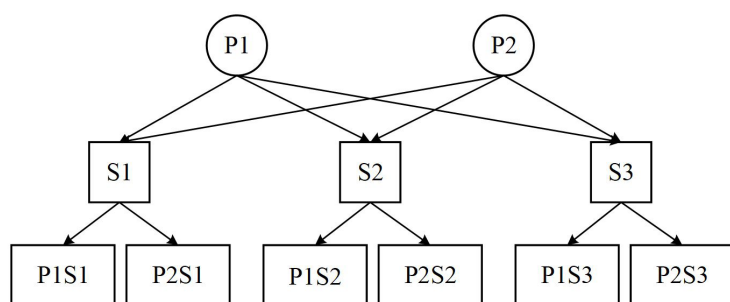


Figure 1. Creation of evacuation risk combinations.

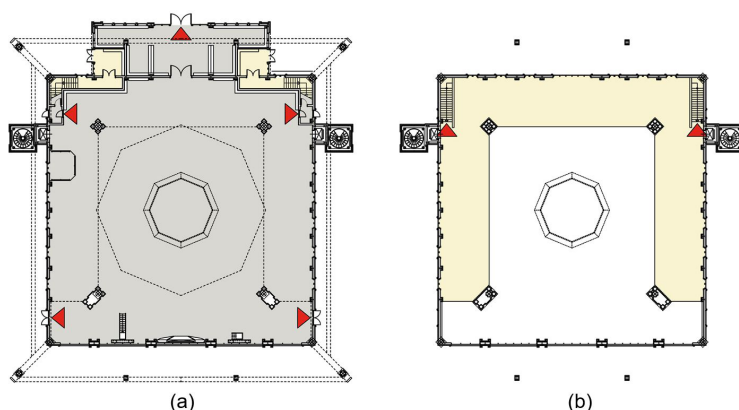


Figure 2. Location of emergency exits in mosque plans, (a) harim; (b) mahfil.

The creation of evacuation scenarios in mosques should be created within the framework of fire safety precautions risk determinations. Possible risks should be identified and occupant behaviour should be known and appropriate evacuation times should be calculated within this framework. Three different evacuation scenarios were discussed in the simultaneous-full evacuation assessment:

- Evacuation scenario (S1) under unobstructed and normal conditions,
- Evacuation scenario (S2) in case the harim main exit door is blocked,
- Evacuation scenario (S3) if any of the mahfil exit doors is blocked.

Within the scope of the study, the occupant profile and evacuation scenarios determined for the mosques were matched by crossing and evacuation risk combinations were created (Figure 1). P1 and P2 selected as different occupant profiles; S1, S2, S3 selected as different evacuation scenarios created for mosques are crossed. The resulting evacuation risk combinations; evacuation scenarios were created for each occupant profile. Evacuation risk combinations created are coded as evacua-

tion scenarios (PXSX) depending on the occupant profile. Evacuation times for each risk combination created were calculated separately through the computer simulation program.

Canik Central Mosque in Samsun province of Turkey was taken as a case study to evaluate the evacuation risk combinations in mosques. In the mosque case, harim and mahfil floors are designed independently of each other in the planning of escape routes. The basement floor used as a car park is located in the mosque design project. However, it has been excluded from the scope of the study due to its lack of relationship with the upper floors and its occupant load is very low. In the planning concept of the mosque, the setting of a single space has been preferred. On the harim floor, 5 different emergency exits (two on the side walls and one on the back wall) are designed in such a way as to be alternative to each other. On the mahfil floor, 2 different emergency exits are designed to be alternatives to each other (Figure 2). However, it is thought that having a one-way escape distance of 25 m on the floor could prolong the fire evacuation time during a possible fire. As part of the project, there are two elevators next to the minarets. However, elevators were not considered appropriate to use within the framework of fire safety precautions and was disabled and not used in mosque evacuation planning.

Within the framework of the national and international fire regulations, mosque, which is considered as a case study, the occupant load was calculated depending on the occupant load coefficients (Table 3). Within the scope of the study, four different occupant loads determined by fire regulations were calculated. Four different occupant load groups have been identified as the Turkey, Singapore and United States (Less Concentrated) (1); United Kingdom (Normal) and New Zealand (2); USA (Concentrated) (3); United Kingdom (High) (4). Mosque occupant load determinations indicate that the occupant load profiles of the countries differ widely in fire regulations. This situation affects the total evacuation times in the sample mosque, causing passive and active fire safety precautions to be designed in different ways.

## 5. Result and evaluation

Occupant based evacuation risk scenarios were identified in the creation of passive fire safety precautions in mosques. For the mosque, the occupant loads were calculated according to the occupant load coefficients of the fire regulations of Turkey, United States of America, United Kingdom, New Zealand, Singapore and Australia. Sample mosque evacuation times according to the occupant load calculated for each regulation were determined through the Pathfinder simulation program (Table 4). The evacuation times of evacuation risk combinations created in the mosque, which are considered as a sample in the Pathfinder computer simulation program, are simulated. In the determination of evacuation times, the sample building was completely emptied. In evacuation process, especially evacuation of the mahfil floor has been determinant in evacuation times. The Pathfinder computer simulation program uses Steering Mode behaviour for occupants. Steering mode analyses complex occupant behaviours with natural motion algorithms (Pathfinder, 2017). With the mode used, the occupants of the building are properly delivered to the emergency exit and controlled transitions are provided for the occupants at the exits in case of density. In the simulation program occupant profiles, the speed of male occupants is

1,19 m/s and the speed of female occupants is 1 m/s. Uniform occupant placements were made as the position of the occupants for worship in mosques.

Evacuation times according to occupant load were calculated based on fire regulations of evacuation risk combinations created within the framework of occupant profile and evacuation scenarios for mosques, and fire regulations were compared in this context. Four different occupant loads were identified in the fire regulations examined in the scope of the study and evacuation times were evaluated with these occupant load. Within the framework of the fire regulations examined, the occupant load coefficients of Turkey, the United States (Less Concentrated Use) and Singapore were treated as 1,5 m<sup>2</sup>/person and evacuation times were determined to be equal. Similarly, in the United Kingdom (Normal), New Zealand and Australian Country fire regulations, occupant load coefficients were treated as 1 m<sup>2</sup>/person and evacuation times were found to be equal. When the fire regulations are examined, the maximum occupant load coefficients that can be determined for mosques are the United States (Concentrated Use, 0,65 m<sup>2</sup>/person) and the United Kingdom (High, 0,5 m<sup>2</sup>/person). Within the framework of two different occupant load coefficients, evacuation times have been achieved to be the longest (Figure 3).

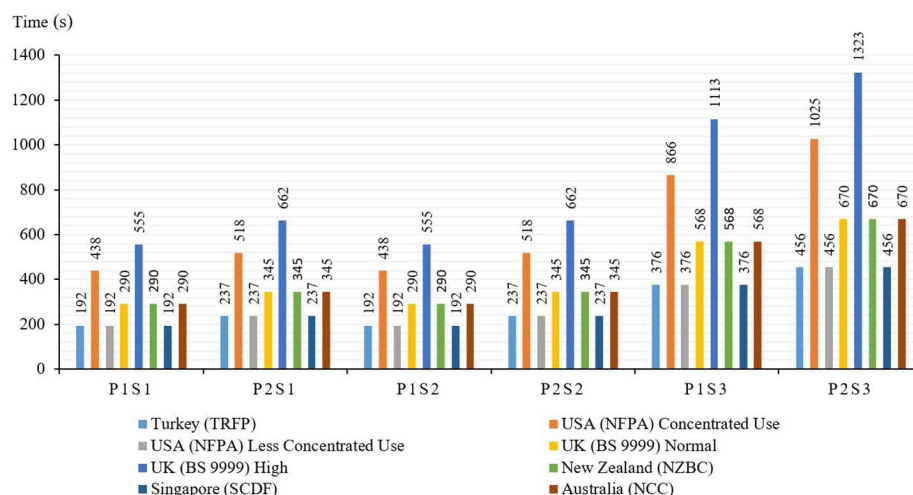
**Table 3.** Occupant load of the mosque selected as a sample according to the fire regulations.

Occupant Load / Net Area (m <sup>2</sup> )	Turkey (TRFP)	United States of America (NFPA)		UK (BS 9999)		New Zealand (NZBC)	Singapore (SCDF)	Australia (NCC)
		Concentrated Use	Less Concentrated Use	Normal	High	Area Without Seating or Aisles	Prayer Hall / Gallery	Church / Multi-Purpose Hall
Harim / 1152 m <sup>2</sup>	768	1772	768	1152	2304	1152	768	1152
Mahfil / 545 m <sup>2</sup>	363	838	363	545	1090	545	363	545
Total / 1697 m <sup>2</sup>	1131	2610	1131	1697	3394	1697	1131	1697

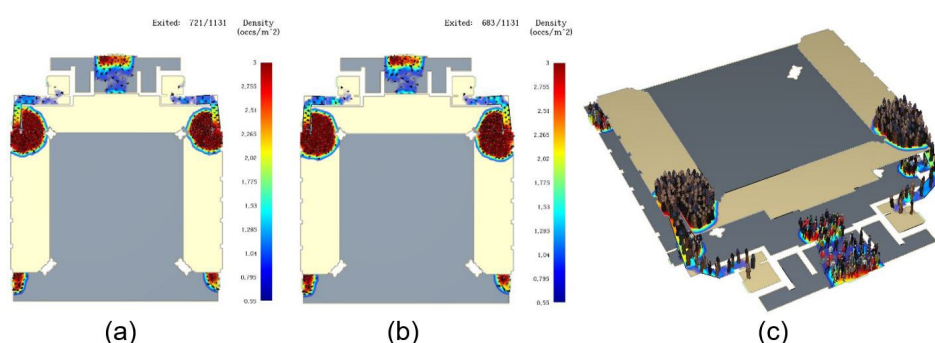
**Table 4.** Evacuation times of evacuation risk combinations.

Evacuation Risk Combinations	Turkey (TRFP)	United States of America (NFPA)		UK (BS 9999)		New Zealand (NZBC)	Singapore (SCDF)	Australia (NCC)
		Concentrated Use	Less Concentrated Use	Normal	High	Area Without Seating or Aisles	Prayer Hall / Gallery	Church / Multi-Purpose Hall
P1S1	3 m 12 s	7 m 18 s	3 m 12 s	4 m 50 s	9 m 15 s	4 m 50 s	3 m 12 s	4 m 50 s
P2S1	3 m 57 s	8 m 38 s	3 m 57 s	5 m 45 s	11 m 2 s	5 m 45 s	3 m 57 s	5 m 45 s
P1S2	3 m 12 s	7 m 18 s	3 m 12 s	4 m 50 s	9 m 15 s	4 m 50 s	3 m 12 s	4 m 50 s
P2S2	3 m 57 s	8 m 38 s	3 m 57 s	5 m 45 s	11 m 2 s	5 m 45 s	3 m 57 s	5 m 45 s
P1S3	6 m 16 s	14 m 26 s	6 m 16 s	9 m 28 s	18 m 33 s	9 m 28 s	6 m 16 s	9 m 28 s
P2S3	7 m 36 s	17 m 5 s	7 m 36 s	11 m 10 s	22 m 3 s	11 m 10 s	7 m 36 s	11 m 10 s

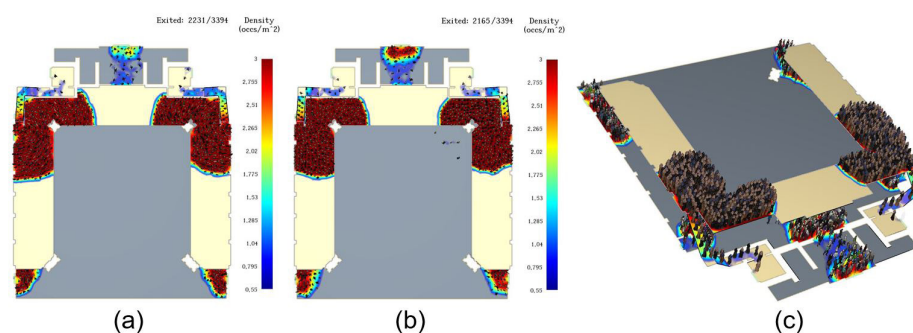




**Figure 3.** Comparison of evacuation times within the framework of fire regulations.



**Figure 4.** Evacuation risk combinations on Turkey fire regulation (2 minute), (a) P1S1 (721/1131 person); (b,c) P2S1 (683/1131 person).

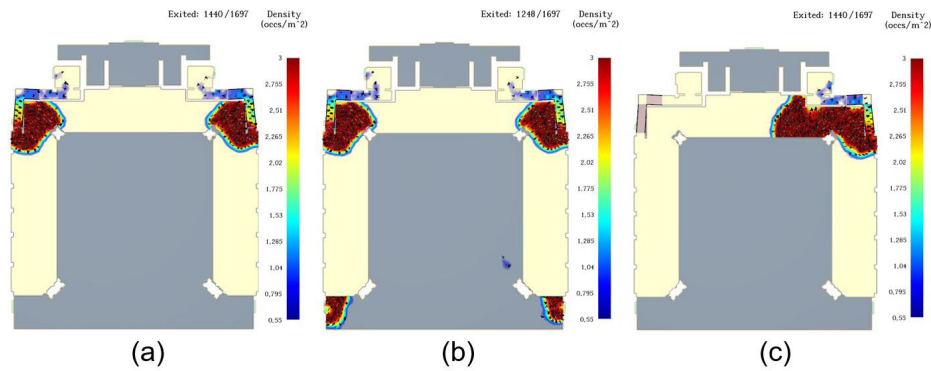


**Figure 5.** Evacuation risk combinations on United Kingdom (High) fire regulation (3 minute), (a) P1S1 (2231/3394 person); (b,c) P2S1 (2165/3394 person).

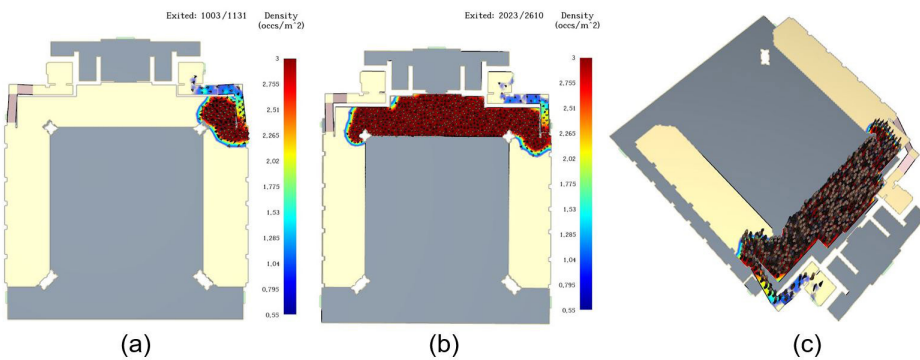
The variable profile of the occupant profile greatly changes the evacuation time. The fact that female occupants move more slowly than male occupants supports this situation. If the occupant load is low in the evaluation to be made based on the occupant profile in determining the evacuation time, less difference; If the occupant load is high, more difference arises. As a result of this situation, the presence of female occupants in evacuation risk combinations increases the total evacuation time due to

their speed of movement. Comparisons of P1S1-P2S1 evacuation risk combinations in Turkey, one of the lowest number of occupant loads, and in the United Kingdom (High) fire regulations, which determine the most number of occupant loads, reveal the result of different occupant profiles (Figure 4 - Figure 5).

When the evacuation times obtained from evacuation risk combinations are examined, evacuation scenarios can be evaluated. Within the scope of the national and international fire regulations



**Figure 6.** Evacuation risk combinations on New Zealand fire regulation, (a) P1S1 (1440/1697 person) (2,5 minute); (b) P1S2 (1248/1697 person) (2,5 minute); (c) P1S3 (1440/1697 person) (5 minute).



**Figure 7.** Evacuation risk combinations on United States (Less Concentrated) fire regulation (5 minute), (a) P2S3 (1003/1131 person); Evacuation risk combinations on United States (Concentrated) fire regulation (5 minute), (b,c) P2S3 (2023/2610 person).

examined, 5 emergency exits on the harim provide an effective fire evacuation. Regardless of the occupant profile, blocking the riskiest exit (main entrance door) does not prevent the evacuation from happening quickly and in a short time and does not affect the total evacuation time. However, in the event that one of the emergency exits on the mahfil floor is blocked, the evacuation time reaches 2 times of the unobstructed evacuation time and greatly increases the fire safety risks. The New Zealand fire regulation P1S1-P1S2-P1S3 evacuation risk combinations are an example of this situation, as is the case with the fire regulations of all countries examined (Figure 6). As a result of this situation, it is important to design and construct alternative exits, increase exit widths, create unobstructed exits and evaluate these approaches in the context of evacuation risk scenarios, especially for the mahfil floor in rooms created with single space design. In addition, the vertical structure systems elements placed on the stair line in the sample mosque,

which was handled within the scope of the study, narrowed the escape distances and caused the evacuation time to be extended.

The United States and the United Kingdom fire regulations (BS 9999, 2017) have created different risk groups for mosques within the scope of assembly buildings and occupant load coefficients are presented as an alternative. According to the United States of America fire regulation (NFPA 101, 2018), finding Concentrated Use / Less Concentrated Use occupant load coefficients is an appropriate sample for this situation (Figure 7). According to the risk scenarios determined by the designer within the framework of fire safety precautions, finding alternative approaches is very important in terms of obtaining the most realistic and detailed results.

Within the framework of national and international fire regulations, major differences were detected in evacuation times calculated according to the occupant load coefficients. As a result of the calculations on the project of the

mosque sample, a difference of 18 m 51 s was determined according to the fire regulation data (the shortest time was 3 m 12 s/1131 occupants the longest time was 22 m 3 s/3394 occupants). The resulting evacuation time difference represents a very risky time in terms of fire safety. Considering the rate of fire spread and the reaction time of smoke on the human, it is important to design the occupant profile and evacuation times for mosques in a way that will be the most appropriate, and to evaluate the regulation that gives the maximum occupant loads and use it within the scope of the project. According to the occupant load coefficients in the fire regulations of Turkey and Singapore, which determine the minimum occupant load within the framework of the fire regulations examined, evacuation times of evacuation risk combinations occur in very short periods of time. The United States and United Kingdom fire regulations, which determine the highest occupant load and provide alternative approaches within the framework of the fire regulations examined, have been found more appropriate in terms of precautions to be taken against fire safety risks. Increasing the occupant load also increases passive and active fire safety precautions. In this case, reducing the occupant load coefficient in the fire regulation is planned as a factor to increase the occupant load and supports the performance-based fire safety precautions that can be taken within the scope of the architectural project for mosques. The purpose of building evacuation planning is to enable the most occupants to evacuate the building as soon as possible.

## 6. Conclusion

Structure fires cause excessive loss of life and property. Fire safety precautions should be provided in assembly buildings where the occupants are concentrated, especially passive fire safety precautions should be created. It must be ensured that fire evacuation conditions, which form the basis of passive fire safety precautions are created correctly and truthfully. The 100% occupancy rate for mosques as an assembly building for in a short time makes it necessary to provide fire safety design

and provide performance-based solutions in terms of risks that may arise. It is important to analyse the occupant profile specific to mosques and create evacuation scenarios. Possible fire scenarios and occupant behaviour and realistic alternative solutions should be developed.

Occupant profile and evacuation scenarios components and evacuation risk combinations for mosques need to be established within the framework of fire regulations. Different occupant load coefficients in national and international fire regulations for mosques lead to different evacuation times due to variable evacuation risk combinations. When the fire regulations were examined, considerable differences were found in evacuation times due to evacuation risk combinations. Although there are different concentrations in different evacuation times for mosques, it is very important criterion to identify the riskiest and to develop precautions to stay on the safe side. Individuals with limited mobility that are excluded from the scope of the study are also more at risk when considered within the scope of the occupant profile. Setting up alternative exits, treating occupant load as the most critical level determined in the fire regulations, increasing the number of exits and expanding the exits results in optimum evacuation times obtained from evacuation risk combinations.

The fact that the riskiest door for the harim floor is blocked in evacuation scenarios built within the framework of national and international fire regulations did not affect the evacuation time by finding alternative escapes. However, the fact that any of the exits constructed as an alternative to the mahfil floor is blocked has doubled the evacuation time. It was determined that evacuation of the mahfil of the mosque has higher risks in the planning of the mosque, which was created with single space design and has independent exits on the floors, and insufficient exits extend the evacuation time too much even though the occupant load is low. Attention should be paid not to narrow the escape distance when positioning vertical structure elements in escape corridors and stairs. In the United

States and the United Kingdom fire regulations within the framework of fire regulation systems, different occupant load coefficients have been found to be alternative, in terms of risk assessment. Turkey and Singapore in terms of occupant load factor for the mosque fire investigated in fire regulations and evacuation time regulation have been identified as low risk in terms of comparison with other countries to put forward regulation. In the transition period of fire regulation to performance-based systems, it was put forth that it is necessary to establish detailed information mechanisms for occupant load coefficients, especially through occupant based evacuation scenarios and evacuation times. Fire regulations should be created for real use and considering building performance requirements. It should be noted that fire regulations create minimum limit conditions and that the designer (architect) can increase precautions to remain on the safe side in creating fire safety precautions, based on evacuation risk combinations. Within the framework of passive fire safety precautions, stricter precautions are required for occupant load coefficients. What is decisive in the study is that the fire regulations, which provide the most occupant profile according to occupant load coefficients, are on the safe side. It is important to control escape routes in mosques that are in the high risk group as assembly buildings, to analyse fire and smoke propagation, and to investigate fire safety precautions that can be taken in historical mosques.

As a result of the study, it has been concluded that the occupant load coefficient greatly affects the evacuation time for mosques that are built with single space and have independent exits. The necessity of occupant based evacuation scenarios has been demonstrated in creating performance-based fire safety. It is recommended that the fire regulations of the countries are handled within this framework and the occupant load coefficients for mosque design are determined, and the fire regulation is detailed and developed within the scope of the fire safety.

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# Analysis of the Turkish tulip-shaped tea glass's emotional design features using Kansei Engineering Methodology

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## Abstract

The traditional tulip-shaped tea glass is considered to be a widely used, culturally valued and emotion laden industrial product in everyday lives for people living in Turkey and it continues to inspire designers for contemporary adaptations. The aim of this study is to identify the emotional design features of the renowned tea glass. The conceptual background of this study pertains to the visceral and behavioral levels of emotional design. The methodology of the study is Kansei Engineering which was developed in the 1980s in Japan to translate consumers' feelings and perceptions of a product (Kansei) into design elements. In the current study initially an online survey with 573 participants was conducted to understand the feelings of people towards the tea drinking experience and tea glass. Kansei of the users were collected. Based on the interviews with expert designers, relevant Kansei words and the essential product characteristics for the study were selected. The products with distinct design features were collected from the market and photographed. Using a semantic differentials scale with 9 Kansei words and 18 product samples, an online survey was conducted with 90 participants. Statistical analysis used as a part of the Kansei Engineering methodology included principal component analysis and ordinal logistic regression. Based on the findings of the proposed model, the relationship between the feelings of people and the design features were determined and prepared for the use of industrial product designers and design researchers.

## Keywords

Emotional design, Industrial product design, Kansei Engineering, Turkish traditional tulip-shaped tea glass.

## 1. Introduction

The tulip-shaped tea glass is considered to be a widely used, culturally valued and emotion laden industrial product for the everyday lives of people living in Turkey. The glass design and manufacturing company Şişecam has been producing the variations of the tulip-shaped design since 1935. "The basic form continues to inspire designers for contemporary adaptations while it remains affordable and accessible to all segments of society." (Sağıroğlu, 2014, p. 15). The high demand on the market for the tulip-shaped design has not diminished throughout the years. It is possible to see one variation in almost every household in Turkey. Furthermore, it encompasses a socio-cultural and emotional meaning indicating psychological attachment (Timur Öğüt, 2009; Ger & Kravets, 2009).

Norman (2004) in developing the concept of "emotional design", argues that people do not just use products, they are emotionally involved in them. He conceptualizes the human-product relationship in three levels of design as visceral, behavioral, and reflective. Visceral level is about the physical features of the design and its immediate emotional impact on people. Behavioral level is about the usage and performance of the design. Reflective level is about the self-image of the user and its presentation to others through the product itself. The visceral level design is concerned with attraction, which is an immediate response to a stimulus, hence, a subconscious behavior. It evolves from basic instincts, common to every human being. For a product to be perceived as attractive, it should trigger physiological activities in the human body. The behavioral level is quite significant in its own right. While functional characteristics of the product as usability and ergonomics should meet the requirements, other characteristics should also be considered for a successful product. As Norman (2004) claims "attractive things work better" (p. 17). Hence, for industrial design discipline focusing on attraction, all senses and emotions of people is crucial.

According to the research conducted by Townsend & Sood (2014), people intend to buy the products that seem

more beautiful and visually attractive than the products that function better, although when asked they claim to prefer the products that are more functional rather than visually attractive. When it comes to deciding on which products to buy and use, we see that people are not quite aware of their own decision-making processes. Tversky & Kahneman (1981) have shown how preferences of individuals are inconsistent when faced with alternatives, depending on how those alternatives are framed. Kahneman (2011) uses the analogy of two systems in the brain, to explain the decision-making behavior of people for different situations. System 1 is imagined working fast, automatically, and subconsciously in an emotional way, whereas system 2 works slow, effortful, and consciously in a logical way. Examining the decision-making experiments, it is stated that people are not always consistently rational decision makers (Kahneman, 2011). The purchasing decision of industrial products is also made emotionally rather than rationally.

Accordingly, one can conclude that attractiveness is essential, and the real process of decision-making occurs on an emotional level, subconsciously, and fast. Therefore, it would be beneficial to use methods which are able to extract users' subconscious preferences. After examining people's emotions towards an industrial product, next step would be establishing a strategy to implement those needs into the design process. One method developed to answer the question of how to design a product in order to trigger people's emotions is the Kansei Engineering (KE) (Nagamachi, 1995).

Kansei Engineering was originated in Japan. Its applications are used for new product development cases commonly in the automotive, construction machinery, electric home appliances, office machinery, house construction, costume and cosmetic industries (Nagamachi, 2002). Since frequently used in engineering and production companies, KE applications are more focused on high-tech complex product groups. However, it is applicable to every kind of consumer product (Tama, Azlia & Hardiningtyas, 2015). Lévy (2013)



claimed “for over three decades, Kansei Engineering has expanded greatly and has become a significant discipline both in the industrial and the academic worlds” (p. 83).

The purpose of this study was to analyze the emotional components of the Turkish tulip-shaped tea glass. The design of this traditional product evolved throughout many decades accumulating corresponding collective emotions. Hence, assessing and evaluating the form characteristics which affect people’s perceptions was found to be crucial for this iconic design. For this study, the Kansei Engineering method was chosen since it enables modelling the relationship between the design features and the corresponding feelings of the users empirically with quantitative data analysis.

## 2. Study

### *Kansei Engineering*

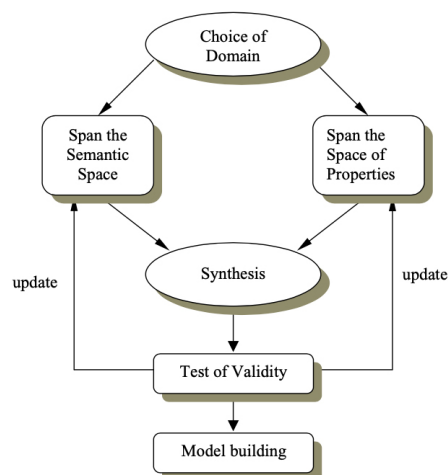
Kansei Engineering is a method designed by Mitsuo Nagamachi, which “... was developed as a consumer-oriented technology for new product development. It is defined as translating technology of a consumer’s feeling and image for a product into design elements” (Nagamachi, 1995, p. 3). The word Kansei generally refers to sensitivity, sensibility, feeling and emotion. It has also been used as the translation of Immanuel Kant’s philosophical concept of the German word *Sinnlichkeit* (Yamanaka, 2017). “According to Nagamachi, the closest interpretation of Kansei is psychological feeling people have with product, situations or surroundings” (Lokman, 2010, p. 3) and since Kansei is a latent feeling, it cannot be measured directly. It is only possible to observe the causes and consequences of the Kansei.

Kansei Engineering has been conceptualized in a model by Schütte, Eklund, Axelsson & Nagamachi (2004) in Figure 1.

In the initial *choice of domain* step of the model, the target group of the product of concern is defined and all kinds of representations of the product concept are collected. In the *span the semantic space* step the Kansei of the domain is determined. According to Lokman & Nagamachi (2009), people’s

physiological or behavioral responses can be measured via neural or body reactions, and psychological responses can be measured by linguistic tests. According to the product and usage scenario, researchers can decide on the method for reaching the human Kansei and measuring the appropriate expressions. Data can be collected through self-report instruments, focus groups, ethnographic techniques etc. For the analysis of Kansei Words (KW); Correlation Coefficient Analysis, Principal Component Analysis (PCA) and Factor Analysis could be employed in order to obtain the most essential Kansei (Lokman, 2010). In the *span the space of properties* step important design elements which have possible effects on the consumers’ Kansei for the product (such as color, size, shape etc.) are determined. In the *synthesis* step a statistical “analysis is performed to discover how the design of a product influences consumer’s Kansei” (Lokman, 2010). After the analysis, if the validity tests are carried out and have satisfactory results then it is possible to build a model for explaining the KW with the product properties.

In this study, which aims to identify the relevant design elements which are important for the associated feelings of consumers in terms of guiding industrial product designers, KE methodology was used with several modifications and implemented in three phases. The first phase corresponds to the *choice of domain* step of KE which includes the tea drinking experience survey. The



**Figure 1.** The model of the Kansei Engineering concept by Schütte et al. (2004).

second phase corresponds to the *span the semantic space* and *span the space of properties* step of KE which includes expert designer interviews. The final phase corresponds to the synthesis step of KE which includes the Kansei survey analyses. Every phase is detailed in two subsections including the method and the corresponding analysis and results parts.

### 2.1. Phase I: Choice of domain, tea drinking experience survey

Since the industrial product in this study is the tea glass, the *choice of domain* step of KE methodology is the tea drinking experience. In order to understand Turkish people's attitudes towards the tea drinking activity and their opinions and preferences concerning the tea glass designs from the market a survey was prepared.

#### 2.1.1. Phase I: Method

An online survey was prepared using a professional online survey software. The main purpose was identifying people's values and emotions and determining their thoughts and habits about tea drinking activity and their interaction with the tea glass. The survey link was distributed through the researchers' social media contacts who volunteered to participate. Participants were asked to share the link with their contacts who enjoy drinking tea frequently. In total 573 people from Turkey completed the survey. The sample consisted of people who enjoy drinking tea, with 88% who have reported drinking tea at least once a day. 60% of the participants were women, 40% were men. They were the inhabitants from 41 different cities of Turkey with a high participation from Istanbul 76%, followed by Izmir 5%, Ankara 4% Bursa 2%. The ages of the participants varied between 15 and 83 with the mean value of 34 years.

The participants were asked to respond to questions under two themes. Apart from the demographic questions there were in total 10 items in the questionnaire. The first theme with 4 items consisted of the emotional concepts of the tea drinking experience. Sample questions include: When you think of tea, what comes to your mind first?

How would you describe the ambiance around you when you think of your happiest moment as you drink tea? The second theme with 6 questions was for understanding the physical aspects regarding their tea glass design preferences. Sample questions would be: Would you describe your favorite tea glass design in detail? (form, material, functions etc.). Which materials do you prefer for drinking tea? (multiple choice from; glass, porcelain, plastic, paper, metal, wood, other[ ]). Which of the following glasses would you like to use for drinking tea? (multiple choice)

The 20 different tea glasses in various forms and materials were shown to participants and they were expected to choose the designs they liked and from which they would prefer to drink tea. They are given in Figure 2.



Figure 2. Tea glasses tested, with 5 highest preference.

#### 2.1.2. Phase I: Analysis & results

Top 5 products which were preferred at least by 25% of the participants are shown in green boxes in Figure 2. They all possess similarities to the tulip-shaped form.

In terms of the preferences pertaining to the physical aspects described, which corresponds to the behavioral level of design, there are several conclusions. The material preference was mostly glass with 92%, followed by 32% china/porcelain. The fact that glass is transparent and allows people to see the color of the tea was mentioned. When asked about the handles 55% of the people preferred forms without handle, 45% said that they would rather

er have tea glass with handles. However, as they were asked to make a choice from the existing designs in the market, it was observed that they preferred designs without handles. Regarding usability the most frequent comments were summarized as follows: “one has to hold the glass by the rim for saving the fingertips from burning because it’s served boiling hot”, “the tulip-shaped tea glasses’ curvy shape keeps the tea warm”, “it enables for the palm of the hand to warm up when needed in cold places”. The results of this part of the survey had the following implications: It became clear that people prefer glass as material for drinking tea. Turkish people are quite used to the traditional tulip-shaped tea glass. Hence for the *choice of domain* it was decided to include only the glass material and tulip shaped tea glass samples for the study.

The emotional content from the text which came from the open-ended questions; such as the free association and the request for describing the feelings when imagining oneself drinking tea in the most comfortable situation; were analyzed. The most frequent words that came up in the responses with reference to emotions were determined: happiness, pleasure, peace, comfort, sincerity, joy, love, thankfulness, warmth, friendliness, tradition, family, relaxation, hospitality, deliciousness, value, dialogue, taste, morning, familiarity, delight, affordability, good health, appreciation, indispensability, passion, nostalgia, importance, wealth etc. Those words used by people as they described their tea drinking experiences were found to reflect their emotions as they enjoy their tea.

The above-mentioned implications concerning characteristics of the tea glass and the emotional concepts resulting from the tea drinking experience survey formed the input for the next phase.

## **2.2. Phase II: Span the semantic space and span the space of properties, expert interviews**

After the *choice of domain* phase, the results of the survey were discussed with three industrial product design experts with experience in designing tea glasses.

### **2.2.1. Phase II: Method**

Semi-structured interviews were conducted individually with three industrial product design experts with the aim of deciding on the KW and determining the important product properties affecting the tea glass design. The reason why three experts were consulted was to obtain ideas from experts with different perspectives and experiences from the academia and industry. Two of the experts were eminent university professors and the other expert worked at one of the top Turkish furniture and product design companies. They all had their designed products on the market. In each interview their personal know-how regarding glass design process was discussed.

The expert designers were introduced with the tea survey results which included all the keywords addressing the emotional concepts about tea drinking and tea glass. They were asked to select the most important ones among them. With their directions, the collected words were selected and grouped to represent the Kansei which cover the visceral and behavioral levels of design. The KW were prepared for the semantic differentials scale to be used in the KE survey. Also, the important product properties affecting the tea glass design were examined. The properties which are crucial, and which can be identified by the users were listed and the possible design characteristics were determined. The products available on the market were reviewed and 18 of them with different properties were selected to be included in the next step.

### **2.2.2. Phase II: Analysis & results**

The concepts discussed were summarized in the following nine words which the expert designers agreed on for capturing the Kansei regarding the visceral and behavioral level designs of tea glasses. The concepts regarding the reflective level design such as expensive/cheap, traditional/modern were especially excluded from the KW list. KW were selected and a semantic differentials scale with 5-points was prepared (Osgood, Suci & Tannenbaum, 1957). It is given in Table 1.

The products from the market were examined with expert designers and the product categories regarding the crucial product design properties were analyzed. The important features were summarized to be; having a handle or not, rim's width, rim's finishing, the place of the thinnest part, the width of the thinnest part, volume, weight, glass thickness, base thickness. It was also pointed out that the most important features pertained to the ratios between the rim and the thinnest part and also between the thinnest part and the below part of the glass rather than the actual measures. Although all of those features were important in perceiving the design as a whole, some of them were deliberately excluded. Because they are not easily perceivable during an online survey just by seeing the image of the glass. The weight, volume, glass thickness concepts were excluded from the list. The chosen design features to be included in the next step was reduced to 8 items with 18 categories. The final item/category classification list which was developed as a result of the interviews with expert designers is given in Table 2, while the visual representation of the items is shown in Figure 3.

### 2.3. Phase III: Synthesis, Kansei Engineering survey

In the synthesis stage participants were asked to evaluate the products based on their perceptions regarding the KW. The goal was to find the relationship between the KW and the design features of the tea glass designs with statistical analyses.

#### 2.3.1. Phase III: Method

For the survey, products with mutually exclusive design characteristics were purchased from the market. They were the variations of the tulip-shaped tea glass including the first five designs which were the most highly preferred in the previous tea drinking experience survey. In total, 18 glasses from the market were selected to be used in the survey.

In order to conceal the effects of the marketing related concepts such as the brand image and pricing, the packaging and the saucers were removed.

**Table 1.** Semantic Differentials scale with 5-points.

	1	2	3	4	5	
Ugly						Beautiful
Exhausting						Relaxing
Not easy to grip						Easy to grip
Tasteless						Delicious
Insincere						Sincere
Cold						Warm
Dull						Joyful
Useless						Useful
Unpleasant						Pleasant

The glasses were professionally photographed in a studio from three different angles. The same spoon was used for height reference. Tea was poured into the glasses in order to demonstrate the authentic usage of a tea glass. The selected samples were mutually independent in terms of the categories for the 8 items, with no two glasses having the same characteristics in all items. The products are displayed in Figure 4.

An online survey with a semantic differentials scale using 9 KW was prepared. The survey link was shared with the researchers' social media contacts. Participants were asked to share the link with their contacts. Participants responded to the 9 questions for each of the 18 different product samples. The order of the products was displayed randomly each time the survey was accessed; also, the ranking of the KW list was displayed in random order each time. In total, data from the 90 people who claimed to enjoy drinking tea and who responded to each and every question in the survey, were used. The participants were from 13 different cities of Turkey with a high participation from Istanbul 73%, followed by Ankara 7%, Izmir 4%, Bursa 3% etc. 68% of the participants were women, 32% were men. The ages of the participants varied between 18 and 65 with the mean value of 38 years.

#### 2.3.2. Phase III: Analysis & results

The KW for each product sample were evaluated by every participant. To be able to see the dimensions of the KW from the data, Principal Component Analysis (PCA) was run on IBM SPSS Version 24. According to PCA results Kaiser-Meyer-Olkin measure was



Table 2. Item/Category Classification List.

#	Item	Category	Value Labels
1	Handle	no	0
		yes	1
2	Line (form)	convex-concave	0
		convex	1
3	Height	short (shorter than 80 mm)	1
		medium (between 80 and 90 mm)	2
		tall (taller than 90 mm)	3
4	Rim's Finishing	no	0
		yes	1
5	Base Thickness	thin	1
		medium	2
		thick	3
6	Ratio of the top to shortest radius	$\leq 1,3$ (straight)	0
		$> 1,3$ (thin waist from the top)	1
7	Place of the shortest radius	1/2 and below	0
		above 1/2	1
8	Ratio of shortest and longest radius below	low ratio (large belly)	0
		high ratio (straight belly)	1

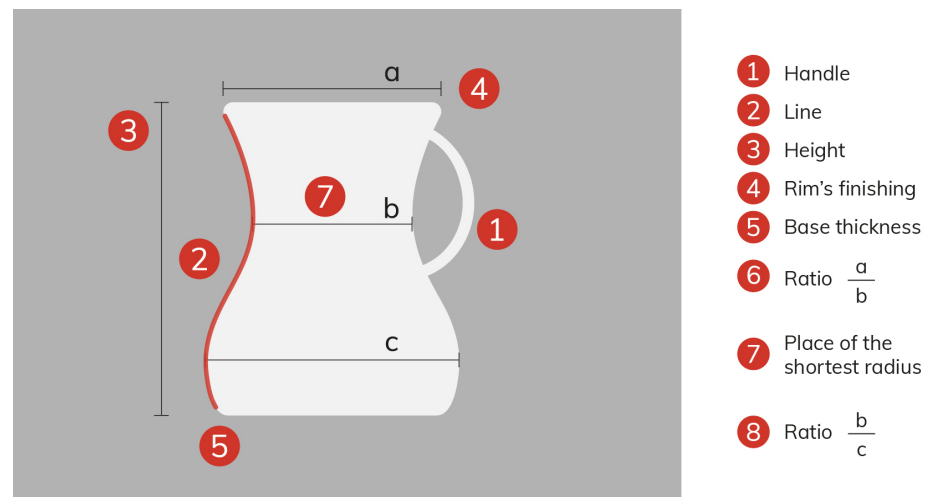


Figure 3. Visual representation of the items.

0.958, which indicates there is adequacy of sampling, (Laerd Statistics, 2015). With the rotation method using Varimax with Kaiser Normalization, PCA has grouped the KW *pleasant, beautiful, joyful, sincere, warm, delicious* and *relaxing* to the first component and the KW *easy to grip* and *useful* to the second component. The PCA rotated component matrix is given in Table 3.

PCA result of the two components corresponded to the Kansei referring to Norman's (2004) visceral and behavioral emotional design levels as hypothesized. The result of the PCA not only confirms the expected emotional design levels but also makes it possible to calculate average scores of the Kansei components as visceral and behavioral level Kansei scores for each product sample if one wishes to compare the products.

In terms of explaining the relation of each KW (dependent variable) with the independent design features (item/category), ordinal logistic regression (OLR) analysis was used since the dependent variable is ordinal with 5 categories and the design features are nominal. In ordinal logistic regression the dependent variable has to be ordinal whereas the independent variables could be continuous, ordinal or categorical (Kleinbaum & Klein, 2010, p.635). Although several different multivariate analysis methods are used in KE, there is growing popularity for logistic regression with evidence of better performance (Alves, 2018; Marco-Almagro & Schütte, 2014; Erdoğan, Koç & Ayhan, 2011).

In this study the design features, independent variables, are all categorical

where six of them are dichotomous variables with 0 and 1 values and two of them have categories of three as seen in Table 2. To be able to conduct the necessary analysis for the two independent variables with three categories dummy variables were produced as dichotomous variables with values 0 and 1. Although there are two major components found from PCA, OLR model was run for every KW for checking the results. For every KW the corresponding model which relates each KW to the design features were identified separately.

For using the OLR analysis, 2 assumptions were checked. First the assumption of no multicollinearity and the assumption of proportional odds. From the multicollinearity test results for the KW *beautiful* the Collinearity Tolerances were found to be greater than 0.1 which suggested that there was not a multicollinearity problem in the data.

Next, the assumption of proportional odds was checked by the test of parallel lines from OLR. The assumption of proportional odds was met, as assessed by a full likelihood ratio test comparing the fit of the proportional odds location model to a model with varying location parameters,  $\chi^2(30) = 40.528$ ,  $p = 0.095$ . As this assumption was not violated, each independent variable could be treated as having the same effect for each cumulative logit (Kleinbaum & Klein, 2010). Since its two assumptions were met, the cumulative OLR with proportional odds model was ready for interpretation. Also, according to the likelihood-ratio test for model fitting, the final model statistically significantly predicted the dependent variable over and above the intercept-only model,  $\chi^2(10) = 139.684$ ,  $p < 0.001$ . The estimated parameters for the KW *beautiful* are given in Table 4.

The interpretation of each independent variable's effect on the dependent variable KW *beautiful* is explained below:

1. The odds of glass designs without handle ( $X1\_Handle=0$ ) to be considered as more *beautiful* was similar to the glass designs with handle, with the odds ratio of 1.294 (95% CI, 0.974 to 1.719), Wald  $\chi^2(1) = 3.150$ ,  $p = 0.076$ .

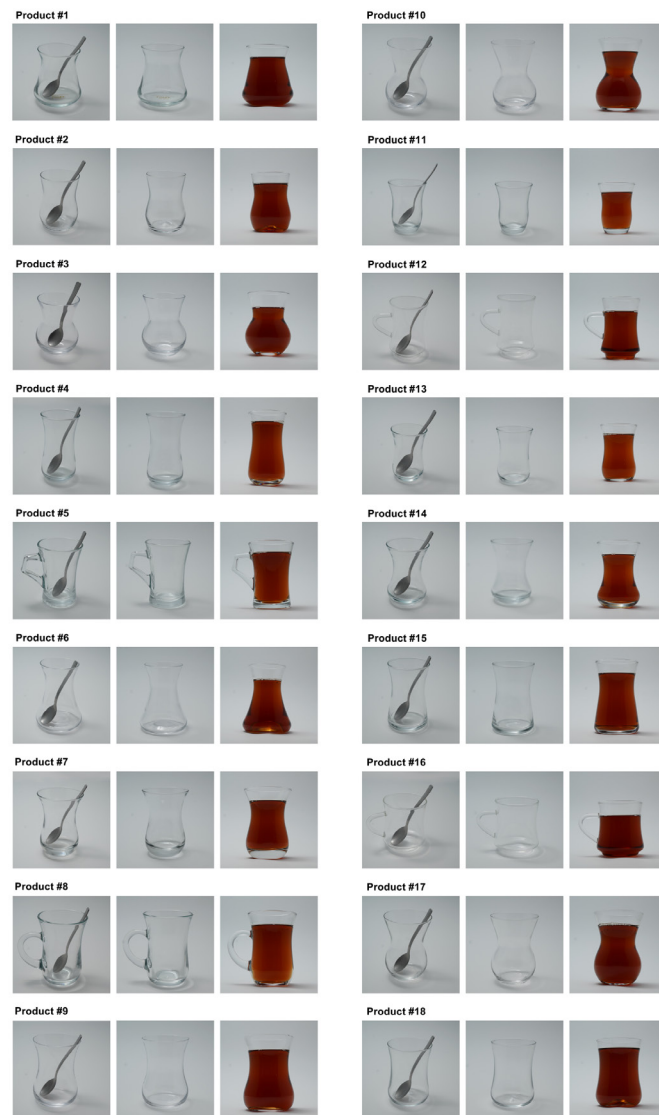


Figure 4. 18 sample products from the market.

Table 3. PCA rotated component matrix.

	Component	
	1	2
Pleasant	0.859	
Beautiful	0.859	
Joyful	0.825	
Sincere	0.805	
Warm	0.787	
Delicious	0.786	
Relaxing	0.719	
Easy to grip		0.898
Useful		0.763

Since this is not a statistically significant effect ( $p > 0.05$ ) we cannot conclude for the handle to be affecting peoples' decision regarding the KW *beautiful*.

2. The odds of convex and concave shaped ( $X2\_Line=0$ ) tea glass designs

**Table 4.** Parameter Estimates for the OLR model for the KW beautiful.

Parameter		B	Hypothesis Test			Exp(B)
			Wald Chi-Square	df	Sig.	
Threshold	[Beautiful=1]	-0.579	9.479	1	0.002	0.561
	[Beautiful=2]	0.516	7.610	1	0.006	1.675
	[Beautiful=3]	1.773	85.509	1	0.000	5.886
	[Beautiful=4]	3.040	225.404	1	0.000	20.898
[X1_Handle=0]		0.257	3.150	1	0.076	1.294
[X1_Handle=1]		0				1
[X2_Line=0]		1.200	79.934	1	0.000	3.319
[X2_Line=1]		0				1
[X33_Height=1]		-0.274	4.936	1	0.026	0.760
[X33_Height=2]		0.396	6.246	1	0.012	1.486
[X33_Height=3]		0				1
[X6_Rim=0]		-0.844	29.318	1	0.000	0.430
[X6_Rim=1]		0				1
[X77_Basethickness=1]		0.807	18.619	1	0.000	2.242
[X77_Basethickness=2]		0.607	12.098	1	0.001	1.836
[X77_Basethickness=3]		0				1
[X10_Ratioofthetoptoshortestradius=0]		-0.021	0.019	1	0.891	0.980
[X10_Ratioofthetoptoshortestradius=1]		0				1
[X11_Placeofhteshortestradius=0]		0.125	1.628	1	0.202	1.133
[X11_Placeofhteshortestradius=1]		0				1
[X12_Ratioofshortestandlongestradius=0]		-0.566	10.884	1	0.001	0.568
[X12_Ratioofshortestandlongestradius=1]		0				1
(Scale)		1				

to be considered more *beautiful* was 3.319, 95% CI [2.551, 4.317] times that of only convex shaped tea glasses, a statistically significant effect,  $\chi^2(1) = 79.934$ ,  $p < 0.001$ . We can conclude that tea glass designs with convex and concave form are 3.319 times more likely to be found more *beautiful* than the ones with only convex form.

3. The odds of the glasses between 80 and 90 mm (X33\_Height=2) to be considered more *beautiful* was 1.486, 95% CI [1.089, 2.028] times that of the glasses longer than 90 mm, a statistically significant effect,  $\chi^2(1) = 6.246$ ,  $p = 0.012$ . Hence, the tea glass designs with heights between 80 and 90 mm are 1.486 times more likely to be found *beautiful* than the ones with longer than 90 mm. When we compare glasses shorter than 80 mm (X33\_Height=1) with glasses longer than 90 mm, we see that the odds of glass designs which are shorter than 80 mm to be found more *beautiful* was 0.760 times of the designs which are longer than 90 mm, which means a lower probability. We can conclude that tea glass designs with heights between 80 and 90 mm perform better considering the KW *beautiful*.

4. X6\_Rim=0 means no rim on the top part. X6\_Rim=1 means glasses

with rim. The odds of tea glass designs with no rim (X6\_Rim=0) to be considered more *beautiful* was 0.430, 95% CI [0.317, 0.584] times that of designs with rim (X6\_Rim=1) a statistically significant effect,  $\chi^2(1) = 29.318$ ,  $p < 0.001$ . Hence, we conclude that designs with rim are  $1/0.430=2.326$  times more likely to be considered *beautiful* than the designs without rim.

5. The odds of tea glass designs with a medium thick base material (X77\_BaseThickness=2) to be considered more *beautiful* was 1.836, 95% CI [1.304, 2.585] times that of designs with thick base material (X77\_BaseThickness=3) a statistically significant effect,  $\chi^2(1) = 12.098$ ,  $p = 0.001$ . Also the odds of tea glass designs with a thin base material (X77\_BaseThickness=1) to be considered more *beautiful* was 2.242, 95% CI [1.554, 3.236] times that of designs with thick base material (X77\_BaseThickness=3) a statistically significant effect,  $\chi^2(1) = 18.619$ ,  $p < 0.001$ . We can conclude that the thinner the base material, the glass design is more likely to be considered *beautiful*.

6. The odds of glass designs with the ratio between the rim and the thinnest part to be small indicating a rather straight upper part's image (X10\_Ratioofthetoptoshortestradius=0) to be

considered as more *beautiful* was similar to the glass designs with a larger ratio between the rim and the thinnest part indicating a rather thin waist upper part's image (X10\_Ratioofthetop-to-shortestradius=1), with the odds ratio of 0.980 (95% CI, 0.730 to 1.315), Wald  $\chi^2(1) = 0.019$ ,  $p = 0.891$ . Since this is not a statistically significant effect ( $p > 0.05$ ) we cannot conclude for this design feature to be affecting the peoples' decision regarding the KW *beautiful*.

7. The odds of glass designs with the thinnest waist in below or equal to the 4/8 portion of the glass (X11\_Placeoftheshortestradius=0) to be considered as more *beautiful* was similar to the glass designs with the thinnest waist in above the 4/8 portion of glass, with the odds ratio of 1.133 (95% CI, 0.935 to 1.374), Wald  $\chi^2(1) = 1.628$ ,  $p = 0.202$ . Since this is not a statistically significant effect ( $p > 0.05$ ) we cannot conclude for the place of the thinnest waist to be affecting the peoples' decision regarding the KW *beautiful*.

8. The odds of tea glass designs with a large belly (the ratio of the middle part of the glass with the shortest radius to the part with the longest radius below is low, X12\_Ratioofshortestandlongestradius=0) to be considered more *beautiful* was 0.568, 95% CI [0.405, 0.795] times that of designs with a straighter belly, a statistically significant effect,  $\chi^2(1) = 10.884$ ,  $p = 0.001$ . Hence, it is concluded that designs with a straighter belly are  $1/0.568=1.761$  times more likely to be considered *beautiful* than the designs with a larger belly.

The OLR model tested for the KW *beautiful* which was interpreted above was repeated for all the remaining KW as well. Similar results were found for seven of the nine KW whose data met the assumptions of OLR. In Table 5, the coefficients for interpretation of Kansei words *beautiful*, *pleasant*, *relaxing*, *delicious*, *warm*, *joyful* and *useful* are given since they all covered the test of parallel lines for proportional odds assumption. Kansei words sincere and easy to grip were left out because they did not meet the assumption of proportional odds.

Those coefficients indicate the odds ratio showing the likelihood of consumer preferences. The highest prefer-

ences are highlighted in Table 5. The following results for the eight design items representing the design features are listed below:

1. The design item having a handle or not was only significant for the KW *useful*, which belonged to the behavioral level. Designs with handle were found to be 1.7 times more likely to be considered *useful*. Although the coefficients for the designs without handle were higher for the visceral level Kansei, they were not significant, hence the odds were similar for designs with or without handle.

2. The tea glass designs with both convex and concave form were approximately 3 times more likely to be found more *beautiful*, *pleasant*, *relaxing*, *delicious*, *warm*, *joyful* and *useful* than the ones with only convex form.

3. Tea glass designs with heights between 80 mm and 90 mm performed better than designs that were longer than 90 mm considering the Kansei words *beautiful*, *delicious*, *warm* and *useful*. Tea glass designs that were longer than 90 mm performed better than the designs, which were shorter than 80 mm considering the Kansei words *beautiful*, *pleasant*, *relaxing* and *joyful*.

4. The designs with rim were approximately twice more likely to be considered *beautiful*, *pleasant*, *relaxing*, *delicious*, *warm*, *joyful* and *useful* than the ones without rim.

5. It was observed that the thinner the base material, the more likely the glass design was to be considered more *beautiful*, *pleasant*, *relaxing*, *delicious*, *warm*, *joyful* and *useful*.

6. The ratio between the rim and the thinnest part (upper part's image) of the glass did not show any significant difference in any of the KW.

7. For the Kansei words *relaxing*, *delicious* and *warm* the place of the thinnest waist (belly's place) being 4/8 and below was approximately 1.2 times more likely to affect peoples' preferences.

8. The designs with straighter bellies were approximately 1.8 times more likely to be considered *beautiful*, *pleasant*, *relaxing*, *delicious*, *warm*, *joyful* and *useful* than the designs with larger bellies.



### 3. Discussion

Kansei Engineering methodology has proven to be a successful tool in converting consumers' desires into product design elements. From the most famous KE based design of Mazda Miyata car (MX-5) from 1990s until currently KE has been widely used in industry for products in many areas such as textile, electronics, cosmetics, food and home appliances. Moreover, research on KE continues to grow in engineering, experience design, ergonomics, statistics, computer science, branding and business (Levy, 2013).

Although KE methodology is widely used in designing of products it has not been studied extensively in the traditional industrial product design discipline. One reason for this could be the rigorous statistical analysis required in order to be able to use KE which may be beyond the scope of design curricula. However, currently multi-disciplinary attempts and collaborations are proposed in design education (Meyer & Norman, 2020). The collaborations from the disciplines such as engineering, economics, psychology and marketing may encourage design educators to make more use of KE and train designers to use KE in analyzing the relationship between the products and the corresponding emotions of users and thus designing more attractive products.

The tulip-shaped design was found to be crucial when it came to the tea drinking experience for Turkish peo-

ple. They seem to have an emotional attachment to this particular design. Literature exists on the use, cultural meaning and historical roots of the tulip shaped tea glass (Sağıroğlu, 2014, Timur Ögüt, 2009; Ger & Kravets, 2009). This study, which aimed to introduce the emotional design features of the tulip-shaped tea glass gained through Kansei Engineering contributed to the literature by providing quantitative evidence on the relationship between emotions and design features. For each emotional perception of the consumers that were represented by the Kansei words beautiful, pleasant, joyful, relaxing, delicious, warm and useful it was possible to find a statistical model fitting the data.

Interpreting the results with the focus on the visceral and behavioral levels from Norman's (2004) emotional design framework led to the following conclusions. The visceral level Kansei words pleasant and joyful corresponded to the same design feature choices. Similarly, Kansei words delicious and warm were related to the same design features. The KW useful, which reflects the behavioral level was related with similar design features as the visceral level KW beautiful where its only distinction was identified in the design feature of having a handle or not. It was interesting to see the design choices which would lead to better performances for the Kansei words beautiful and useful were similar to each other with the only exception of the han-

**Table 5.** Parameter Estimates of OLR model comparison for each KW.

			visceral level							behavioral level
#	Items	Categories	Beautiful	Pleasant	Relaxing	Delicious	Warm	Joyful	Useful	
1	Handle	X1=1 with	ns*	ns	ns	ns	ns	ns	1.664	
		X1=0 without	ns	ns	ns	ns	ns	ns	1	
2	Line	X2=1 convex	1	1	1	1	1	1	1	
		X2=0 convex-concave	3.319	3.096	3.595	3.099	2.866	3.324	3.494	
3	Height	X33=1 <80 mm	0.760	1	1	ns	ns	1	ns	
		X33=2 80-90 mm	1.486	ns	ns	1.518	1.417	ns	1.473	
		X33=3 >90 mm	1	1.377	1.325	1	1	1.333	1	
4	Rim	X6=1 with	2,326	2,358	2,169	1,992	1,859	2,193	2,188	
		X6=0 without	1	1	1	1	1	1	1	
5	Base thickness	X77=1 thin	2.242	2.379	2.034	2.021	1.953	2.151	2.043	
		X77=2 medium	1.836	1.817	1.715	1.548	1.539	1.657	1.687	
		X77=3 thick	1	1	1	1	1	1	1	
6	Upper part's Image	X10=0 straight	ns	ns	ns	ns	ns	ns	ns	
		X10=1 thin waist	ns	ns	ns	ns	ns	ns	ns	
7	Belly's Place	X11=1 up	ns	ns	1	1	1	ns	ns	
		X11=0 middle or lower	ns	ns	1.260	1.217	1.229	ns	ns	
8	Belly=Lower part's image	X12=1 straight	1.761	1.764	1.712	1.681	1.667	1.961	1.795	
		X12=0 large	1	1	1	1	1	1	1	
* indicates not significant for 95% confidence interval										

\* indicates not significant for 95% confidence interval

dle. This may be explained by the fact that the tulip-shaped design evolved throughout the years so that it was collectively internalized and the preferred design features were considered both as beautiful and useful at the same time. Apparently, the tulip-shaped tea glass's special emotion laden characteristics will be studied and redesigned for years to come.

As to the limitations, concerning Norman's (2004) emotional design framework only the concepts regarding the visceral and behavioral levels of design were included and the reflective design was left out of the scope of this study. Although consumers' purchasing decisions are known to be affected by the price, packaging, and brand image as well (Townsend & Sood, 2012) the focus was deliberately on the design form. Moreover, two methodological limitations exist. The KW choice section which corresponds to the span the semantic space phase in the KE model was limited to the expert designer opinions. Literature indicates that determining KW in the span the semantic space phase could also be achieved by an additional survey and factor analysis for the Kansei words reduction (Lokman, 2010). Likewise, the data collection of the research was realized as an online survey therefore some tactile sensory information had to be disregarded. In the literature there are other methods such as eye tracking and neuroscientific tools used for data collection (Köhler, Falk & Schmitt, 2014).

#### 4. Conclusion

As the Turkish traditional tulip-shaped tea glasses' design features were analyzed with the Kansei Engineering methodology, the results pointed out several design features/choices to be effective in terms of the emotional evaluation of tea drinkers' choices in Turkey. The results can be used in the industry for designing tea glasses which would lead to desired emotional responses from the consumer.

The results can also be used in design education. The findings can be introduced to novice designers as additional information which comes from quantitative data during the research phase of their design process.

Apart from carrying out this research in a theoretically more comprehensive way by including reflective level aspects of Norman's (2004) emotional design framework, the study may be carried further by research that may validate the KW and the corresponding design features. Tea glasses which are designed with the results of the KE can be tested for performance which will complete the KE methodology's validation step. Cross-cultural research may also be conducted especially with the British, Chinese or Japanese cultures where tea is an important part in cultural ceremonies.

KE provides tools for evidence-based research for designers during their research phase in their design process. This study was a demonstration of using such data and analysis. This procedure can be used for different products. Additionally, research studies can be carried out in implementation of KE in industrial product design and other design disciplines.

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