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

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

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

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Research Article

Effective Environmental Factors for Reducing Children's Fear in Children's Hospital: Using Parent's Attitudes

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Abstract

Purpose

Getting sick and getting into an unfamiliar environment in the hospital makes children fear, discomfort and is considered as a very common stressor in such setting. Poor design of hospital environments can exacerbate behavioral disorders, as well as fear and anxiety in individuals. The main purpose of this study is to investigate and address the needs and preferences of children regarding the design of therapeutic environments.

Design/Methodology/Approach

The desk research method was used and data was collected through a questionnaire given to the parents of children in 17th Shahrivar Children's Hospital in Rasht city, Northern Iran. After the data of the questionnaires was collected, it was analyzed through spss22 software. Descriptive statistics (charts, mean ...) were used to analyze the data. Due to the nonparametric nature of the data, Spearman test was used in order to measure the correlation of variables.

Findings

The results showed that the components of entertainment and play, natural light, the presence of green space, cheerful atmosphere and the presence of family are among the most important environmental

Keywords: *Children, children's hospital, fear reduction, environmental factors*

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elements affecting the reduction of children's fears from the perspective of their parents.

Research Limitations/Implications

the lack of direct involvement of the child in the study process as well as the cultural and economic differences are the main limitation of this study.

Originality/Value

This study is the first study on the design of children's medical environment using the opinion of their parents in Iran and in this regard.

INTRODUCTION

Common stressors during childhood are sickness and hospitalization (Del Nord, 2006). For children, hospital settings stimulate different emotions, such as fear, anxiety, anger, sadness, loneliness, which can have adverse effects on children's physical, mental and social health (Birch et al.,2007; Bsiri-Moghaddam et al., 2011; Norton-Westwood, 2012; Wilson et al., 2010). There is ample evidence that children's anxiety increases during hospitalization and, in consequence, their health can be subconsciously affected (Dise-Lewis, 1988; Varni & Katz, 1997). Children suffer from a variety of considerable concerns and fears during their stay: fear of being away from family; fear of being in an unknown place; treatment stage's fear as well as loss of privacy (Coyne, 2006). Anxiety and fear, in terms of children' unconsciousness can affect the children's behavior throughout their life. As e result, researchers are more interested to study negative emotions, such as fear, anxiety, and stress-related concerns which occur during illness (Thompson & Venon, 1993). According to previous researches, being a fun place, Hospital can attract children. children want an environment where they can make friends and engage in entertaining activities (Fletcher et al., 2011). In addition, the presence of peers and parents alongside sick children gives them a sense of security and comfort (Norton-Westwood, 2012). Previous studies about parents' perceptions of children's hospital environments have shown that one of the key elements is the physical quality of that environment, which should be quiet, clean and convenient while also providing adequate space and privacy (Pelander et al.,2007).

In the last fifty years, advances in medical technology have increased the level of design competence in the therapeutic spaces. Complexity in such buildings have increased. This complexity is the result of the multiplicity of units, abundance and the diversity of users and increase in the quality of medical technologies (Aydın, 2009). Now, in Iran, the situations of children's hospitals present a number of problems including lack of environmental facilities, inattention to the needs of children and the impact of the environment on their health condition.

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Today, children's hospitals acknowledge that they must provide support for the whole family. Compared to adult patients, the whole family will be involved when the child is hospitalized. Parents suffer as a result of their role as guardians and supporters of their child. Brothers and sisters of the child will also suffer because parents' attention is focused on the other. Since the mental state of children in the hospital is very important to help the healing process, identifying the elements of the children's hospital environment that lead to stress reduction can be an effective step in their recovery as well. Additionally, as the parents of children are directly involved in the treatment of their children, the purpose of this paper is to ask parents' opinions about their children's preferences for the ideal physical design of hospital built environments. The knowledge generated from this study helps designers and healthcare creators providing data that can be used in their design and operations decisions. And also it may improve the ability of healthcare providers to create environment that is congruent with the needs of parents and their children. This study will therefore address the following research questions.

- How important is the existence of environmental factors, such as; color, light, spatial layout, green space, scale and shape of hospital?
- How effective is the existence of amusement spaces in reducing child's fear?
- How important is the presence of the family next to the child?

LITERATURE REVIEW

By the 1960s, hospital buildings had focused more on hospital performance than patient experience (De Wilde & Muylle, 2012). Until the 1990s, little information was available about hospital design, but through the decade, architects and interior designers tended to design based on existing information and knowledge based on research achievements in this field (Rubin, 1998). Kellman (1987), focuses on the scale structure (outer structure and interior design, vertical dimensions, furniture size and handle height), play areas, environmental issues (color, texture, light and acoustic). Eriksen (2000), reviewed some children's opinions about the hospital environment during study at a children Hospital. In this study, factors such as the ability to play, the use of cheerful colors, attractive decoration, the presence of green space, the proper dimensions of the furniture, the presence of private space are considered. Previous studies illustrated the influence of Parental involvement and partnership in healthcare environment on treatment of child patients as assistants (Coyne, 1995; Dudley & Carr, 2004; Ygge &Arnetz,

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2004). Ha and Park (2016) worked on a study with the aim of designing user-oriented children's hospital. In this study, user's needs were examined, especially by the help of their mothers and the nurses. The findings indicated that to improve the satisfaction of the mothers of ill children and the nurses, factors such as privacy, safety, accessibility should be considered.

In another study, children who used deviant techniques such as watching cartoons or listening to music reported less pain and anxiety (Sinha et al., 2006). A joint study about group play therapy impact on the rate of depression in children with cancer in Mahak Hospital in Tehran, showed that the game could be used as an effective solution by healthcare team members to help hospitalized children so that they could be helped in order to be prepared and tuned with the process of difficult treatments and tension associated with hospitalization procedure (Zareapour et al., 2009). In another research in a children hospital in Iran, children perspectives about ideal physical environment were extracted. The results of this article expressed that ill children prefer a hospital environment that provides appropriate recreational facilities for them. And at the same time, other environmental design factors such as light, green space, appropriate color and the possibility of parent's presence were important (Nasab et al.,2020). Below, some factors influencing children's perceived stress and fear in the environment of the hospital are summarized with their sources (Table 1).

Table 1: Factors influencing children's environment and stress in hospital

References	*Factors*
(Rollins, 2015)- (Shirani et al., 1986)	*Family Partnership*
(Malkin, 1992) - (Bettelheim, 1976)	*Access to the outside environment*
(Carpman & Grant, 2001) - (Topf, 2000)	*Routing and Readability*
(Kellman, 1987)	*Scale*
(Malkin, 1992) - (Bettelheim, 1976)	*Feel under control and care*
(Rubin, 1998) - (Kellman, 1987) - (Rollins, 2015) -(Lee et al., 2007)	*light*
(Rollins, 2015) - (Topf, 2000)- (Ulrich et al., 2008) - (Mour, 2010)	*Effect of green space design*
(Shirani et al., 1986) - (Lee et al., 2007) (Barlas et al., 2001)	*Create privacy controls and privacy*
Malkin, 1992) - (Bettelheim, 1976)	*Coordination*
(Frampton & Charmel, 2009)	*See artistic and positive images*
(Lee et al., 2007)	*Availability and order*
(Shirani et al., 1986)- (Rollins, 2015)	*Human interactions*
(Topf, 2000) - (Kellman, 1987)	*Prevent unwanted sounds*

In the following, the theoretical framework is expressed, on which the research method is written.

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Stress and Child's Fear in the Hospital

Seeing hospital settings of any size and form provides a frightening experience for each person (El Marsafawy, 2006). The unfamiliar environment of hospitals can be destructive and harmful to children which, in consequence, causes stress. For example, the problem of losing privacy due to the presence of multiple room (Larsen et al., 2014). According to Lee et al. (2007), "the physical environment affects the person's behavior, and positive experiences can help the person to overcome stress". The outcome of admission to hospital is anxiety for children, in which case, children react in three ways: protest, disappointment, and denial. Reduced interest in playing and collective activities, avoiding collapse and isolation, mischief, anger and lack of satisfaction are the responses of children admitted to hospital (Malkin, 1992). For children, stress signifies by stomach pain, sleeping problems, stools and infections (DeBord & Sawyers, 1996). The following five main factors can boost stress in a child: 1- Disease, 2- Hospital admission, 3- Physical – social environment of the hospital, 4- repetitive treatment processes, 5- pain Experience (Del Nord, 2006). A research in the environmental psychology field indicates that architectural factors such as motivation, plurality, diversity, complexity, novelty, sound, light, odor, colorization, crowding, apparent, visual, proximity, neighborhood, communication, readability, organization, Predictability, Signs, Paths, Distinctions, External Perspectives, Land Operations, Ambiguities, coordinated alignment of furniture and refreshment are perceptually related to both positive and negative stresses (Lee et al., 2007).

Desirable Environmental Components for Children in Hospital Environment

In the context of effective factors in the design of medical environments, in 1859, Florence Nightingale, in her book entitled "Hospital Writings," stated that design, lighting, ventilation are critical elements for accelerating patient recovery and reducing pressure (Ebneshahidi et al., 2011). In 1960, interior design was introduced as a major factor in hospital environmental planning (Morelli et al., 2007). The needs of hospitalized children include healthy eating, proper sleep in good conditions, and basic needs such as personal hygiene and physical care. Hospitalized children may not feel comfortable not only because of their illness, but also because of being away from their families. Also, they may respond to their disagreement over their age group (SilavUtkan, 2012).

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The Importance of Light and Color in Children's Hospital Design

Factors such as color and light can affect people's perceptions and responses to the environment in which they are present. In particular, these factors are important in the treatment environment and the patient's recovery process. Light can improve the quality of the overall experience of staff, visitors and especially patients in the hospital environment (Dalke et al., 2006). Kellman in his research emphasized on the effect of natural light on children's recovery and the reduction of effective feelings (Ebneshahidi et al., 2011). A research showed that the proper coloring of the environment is effective in creating a person's positive mood and comfort (Tofle et al., 2004). J. Coad and N. Coad (2008), conducted a research through interviews on children's preferences in the design and color of the hospital environment. They questioned some children's views in three color ranges: Pink-purple, Blue-Green and Orange-Yellow. The color mostly selected by children was between the color range of green and blue. Children over the age of 11 years had a darker range. Warm yellow-orange colors as well as the pink-purple colors had the lowest number of choices. Park (2009), in his research, concluded that, based on gender, girls were more likely to enjoy red and purple colors. Apart from the gender perspective, sick children often preferred blue and green, and had the slightest tendency to the white color.

Positive Distractions' Role in Children's Hospital

Positive distractions are related to environmental features that create "positive emotion and attract people's attention and their disturbing thoughts may be declined by that" (Devlin & Arneill, 2003). Positive distractions help people overcome their stresses and tensions. Positive distraction involves distraction potential, including static stimuli such as pictorials, posters or nature paintings, active stimuli such as animals, music and elements that make people happy (Berman et al., 2008). The impact of positive distraction on the activity of children in two clinic waiting areas is examined by Pati and Nanda (2011). They concluded that distraction leads to a gentler behavior of children, which reflects its significant sedative effects. Also, the data indicated that the waiting time for children in hospitals can be risen by improving the environmental attractiveness.

The Effect of Green Space in Children's Hospital

A research has shown that the simulation of nature creates stress-reducing effects similar to what there is in nature (Berman et al., 2008). The most effective of these distractions is the ability of nature to improve and repair stress (Raanaas, 2012;

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Salonen et al., 2013). It was shown in a study that patients undergone surgery who could see the plants through window, when compared to those who couldn't, had a shorter hospital stay and reported more positive hospital experience (Ulrich et al., 2008). Also, the views of the windows that opened to the green space could have reduced the hospital's post-operative stay by 8.5 percent. In US hospitals, they are increasingly focusing on trees and taking care of them in order to improve their patients' recovery faster (Mour, 2010).

The Importance of Way Finding in Children's Hospital

Researchers found that stress due to losing one's path loss can contribute to frustration, increased blood pressure, headache, physical stress and fatigue (Carpman & Grant, 2001). Hence, creating a readable environment can enhance the cognitive inhibition of users in terms of perceiving environmental results in better treatment outcomes. Due to complexity of their paths, hospitals, as a public place, have problems about way finding (Rousek & Hallbeck, 2011). Proper way-finding in hospital design can be effective in increasing user satisfaction such as employees, visitors and, most importantly, the patient (Cooper, 2010). Being aware of surrounding environment leads to ease and safety (Cutting, 1996). By utilizing graphics and tactile communication way finding can be improved (Arthur & Passini, 1992).

The importance of family presence

For decades, parental involvement has been considered as a supported philosophy for the continuity of care for children (Power & Franck, 2008). The presence of parents can grow the sense of security of children (Norton-Westwood, 2012). Children's resources point to the fact that if one parent or both can be with their children, it is the most important factor that helps children to cope with a mental illness due to hospitalization. Parental presence also helps the child to more easily accept the daily work process of the hospital (Malkin, 1992).

RESEARCH METHOD

This research is purpose-oriented, applied. In terms of collecting data, it is a non-test descriptive study. Also, it was carried out as a sample case study. The measurement tools include: questionnaire and the software of social package for statistical analysis (SPSS22). The questionnaire consisted of 26 questions classified into 5 categories entitled "Mental relaxation, comfort, attractiveness, positive distraction and security." When developing the questionnaire, it was tried not to make them

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unobtrusive, ambiguous, directional, complex, duplicate, negative, and the concept of questions was completely clear.

Hivdah Shahrivar Hospital which is the only specialized pediatric children hospital in Rasht, is selected for this research. To estimate the sample size for the questionnaire the Morgan table is used (Krejcie & Morgan,1970). Given the fact that about 140 people were visiting Hivdah Shahrivar hospital every day, and with respect to this table, 103 parents were being examined. The type of questionnaire is Questions in Closed Ended Format. This is an ideal format for calculation of statistical information which can be helpful in obtaining opinions about a subject. The format of Questions is Likert Questions which is helpful in analyzing Customers' feelings about a topic. Based on the theoretical foundations of the study, the effective variables in reducing environmental stress in hospital such as color, light, structure, green space, presence of parents, etc., were selected and used in designing the questions. After the questionnaire was developed and the sample size was determined, next step was to enter the field. After entering the field to reach the best solution and generalizability of the responses, 103 parents of the patients were randomly selected. In this way, first they were given a letter in which the purpose of data collection, needs for their cooperation in providing the required data, and confidentiality of the responses, were expressed. Then the questionnaires were distributed and each respondent helped in the response process.

RESULTS

Shahrivar Hospital is a Children's Specialized Hospital located in Rasht. This hospital has 170 beds. The only specialized medical unit of Rasht is this hospital. The spatial relationships and positioning of the building are shown in Figures 1, 2, and 3.

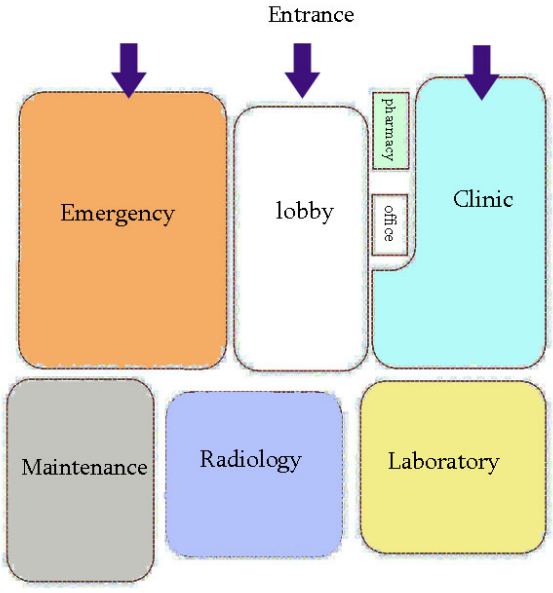

Figure 1. Ground floor space relations diagram (Authors).

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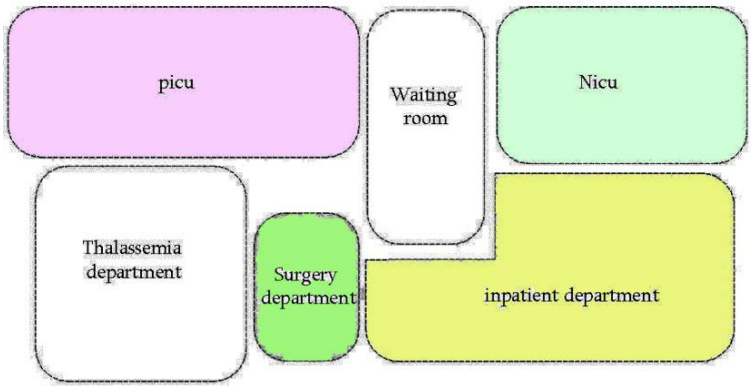

Figure 2. First floor space relations diagram (Authors).

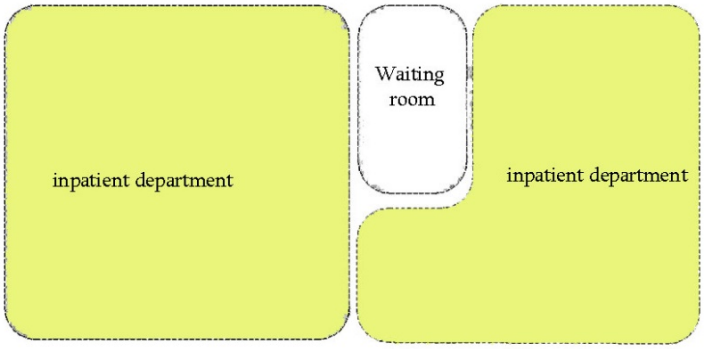

Figure 3. Second floor space relations diagram (Authors).

The current visual form of this hospital is illustrated in Figures 4, 5 and 6. No use of happy colors and green space in the environment, scattered space layout and inappropriate furniture can be seen in the pictures.

Figure 4. Waiting room (Authors).

Figure 5. Patient room (Authors).

Figure 6. Patient room (Authors.)

In order to measure the reliability of the research tool, the most popular instrument used by many researchers to assess the validity of the questionnaire is the Cronbach's alpha coefficient. Cronbach's alpha is one of the best analyzes for the reliability of research in the social and organizational sciences (Bonett & Wright, 2015). This criterion was calculated by SPSS22 software and the questionnaire had a reliability of more than 70 % which indicates a satisfactory level of reliability. So, it can be said that the questionnaire has been able to measure the subject. Therefore, the research has a good internal consistency. Depending on the type of research and its data, the method for data analysis is logically based on inductive method. Descriptive statistics (charts, mean ...) were used to analyze the data. For this purpose, the answers of the questions were entered into SPSS22 software and the graphs and statistical results were extracted and analyzed. The most important option in the subset of the factors are the question 2 and the 21st question, namely the presence of at least one of the parents at full time (question 2) and the possibility of having a game room in each part of the hospital (question 21) with an average of 4.5. The least important question is question 5 expressing presence of religious elements with an average of 3.2 (Table 2).

Table 2: The effect of environmental components on reducing children's fear in the hospital from parents' perspectives, with the questions separated

Factor: Mental relaxation	
Question 1	*Average= 4.6 Mode=5*
Question 2	*Average= 4.6 Mode=5*
Question 3	*Average= 4.6 Mode=5*
Question 4	*Average= 4.6 Mode=4*
Question 5	*Average= 4.6 Mode=3*
Factor: comfort	
Question6	*Average= 4.3 Mode=4*
Question7	*Average= 4.4 Mode=4*
Question8	*Average= 4.3 Mode=4*
Question9	*Average= 4.3Mode=4*
Question10	*Average= 4.3 Mode=4*
Factor: attractiveness	

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Question11	*Average= 4.3 Mode=4*
Question12	*Average= 4.2 Mode=4*
Question13	*Average= 4.3 Mode=4*
Question14	*Average= 4.3 Mode=4*
Question15	*Average= 4.1Mode=4*
Question16	*Average= 4.2 Mode=4*
Factor: Positive distraction	
Question17	*Average= 4.4 Mode=4*
Question18	*Average= 4.2 Mode=4*
Question19	*Average= 4.4 Mode=4*
Question20	*Average= 4.4 Mode=4*
Question21	*Average= 4.5 Mode=5*
Question22	*Average= 4.4 Mode=4*
Factor: security	
Question17	*Average= 4.3 Mode=4*
Question17	*Average= 4.2 Mode=4*
Question17	*Average= 4.2 Mode=4*
Question17	*Average= 4 Mode=4*

According to the descriptive statistics, among five factors of mental relaxation, comfort, attractiveness, positive distraction and security, comfort and positive distraction with the average of 4.3 were more important than other factors (Table 3 and Figure 7).

Table 3: The effect of environmental components on reducing children's fear in the hospital from parents' perspectives

Factor: Mental relaxation	*Average=4.1 mode=4*
Factor: comfort	*Average=4.3 mode=4*
Factor: attractiveness	*Average=4.2 mode=4*
Factor: Positive distraction	*Average=4.3 mode=4*
Factor: security	*Average=4.2 mode=5*

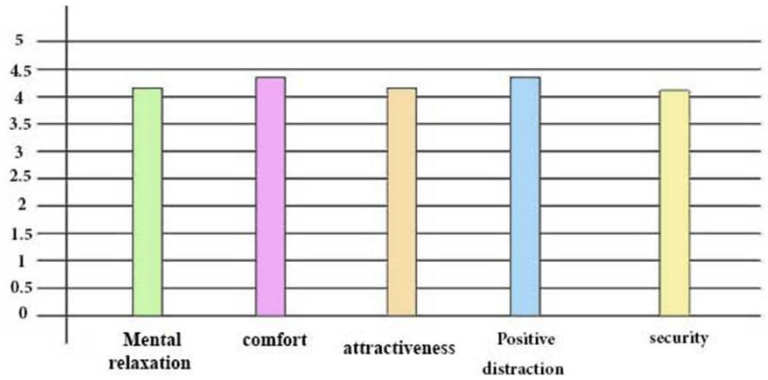

Figure 7. The average impact of environmental factors on reducing the children's fears in the hospital from the perspective of parents (Authors).

The Kolmogorov–Smirnov test which is a much used goodness-of-fit test, is often employed to test normality (Steinskog et al., 2007). In the following, with the Kolmogorov-Smirnov test, the value of "P" was less than 5 hundred, suggesting that the distribution of data is not normal. Hence nonparametric testing should be used. Due to the rank of variables, Spearman test is used to measure the correlation of variables. Spearman's Rho is a

non-parametric test which is appropriate method to examine the strength of association between two variables, where the value r = 1 means a perfect positive correlation and the value r = -1 means a perfect negative correlation (Allen, 2017). According to Spearman's analysis, by which the correlation between the variables is determined, there is a high correlation between the mental relaxation factor of the happy colors and the green space, which means that the more increase the values of these two factors, the more increases the calmness. The factor of religious elements has had the least correlation value (Table 4). For comfort element, the presence of sufficient lightning had the highest correlation (Table 4). For the factor of attractiveness, elements hanging from the ceiling and the Hospital Curve structure were highly correlated, which suggest these factors are more important (Table 5). For distraction, the presence of artificial light had a high degree of correlation, and the creation of art workshops and the existence of television had a small correlation. For security, the readability was more correlated (Table 6). In general, the factors of artificial light, play room, water elements, elements hanging from the ceiling, outdoor play, hospital curve structure, ventilation, adequate lighting, green spaces and happy colors were more important ones. The factors of religious elements, noise reduction, television and art workshops were weaker factors.

Table 4: Correlation between variables of mental relaxation and standard spaces factors

Factor: Mental relaxation	
Religious elements	*correlation coefficient=* 0.*043* *sig= 0.666*
Happy colors	*correlation coefficient=* 0.*8* *sig=* 0.*003*
green space	*correlation coefficient=* 0.*73* *sig=* 0.002
The presence of family	*correlation coefficient=* 0.*212* *sig=* 0.*032*
Factor: comfort	
Proper ventilation	*correlation coefficient=* 0.64 *sig=* 0.046
Enough lighting	*correlation coefficient=* 0.71 *sig=* 0.032
Furniture with scale and size of the child	*correlation coefficient=* 0.523 *sig=* 0.063
Noise reduction	*correlation coefficient=* 0.186 *sig=* 0.06

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Table 5: Correlation between variables of attractiveness and positive factors

Factor: attractiveness	
Children Handcrafted	*correlation coefficient= 0.601* sig= 0.051
Hospital Curve structure	*correlation coefficient= 0.854* *sig*= 0.018
The playing field is outdoors	*correlation coefficient= 0.666* sig= *0.044*
Elements hanging from the ceiling	*correlation coefficient= 0.842* sig= *0.020*
Water elements	*correlation coefficient= 0.665* sig= *0.041*
Factor: Positive distraction	
Art workshops	*correlation coefficient*= 0.*154* *sig*= 0.*141*
Game room	*correlation coefficient*= 0.*627* *sig*= 0.048
Computer Game Features	*correlation coefficient*= 0.*512* *sig*= 0.*065*
Existence of television	*correlation coefficient*= 0.*141* *sig*= 0.*138*
Artificial light	*correlation coefficient*= 0.*954* *sig*=- 0.*06*

Table 6: Investigating the correlation between security factor variables

Factor: Security	
Readability and wayfinding	*correlation coefficient*=0.334 *sig*= 0.094
The closeness of the nursing station to the hospital room	*correlation coefficient*= 0.206 *sig*= 0.037
Independent admission room	*correlation coefficient*= 0.214 *sig*= 0.117

DISCUSSION

The findings demonstrate that factors like adequate lighting, play room, water elements, outdoor play, hospital structure, ventilation, green spaces and happy colors, can be ideal environmental elements providing suitable environment for children.

In this study, comfort and positive distraction with an average of 4.3 are more important than other ones. Previous studies have also highlighted the significance of positive distraction. Other research done by Pati and Nanda (2011), has also expressed that positive distraction leads to gentle behavior of children.

The use of happy colors is the most important factor for the subjective sense of mental relaxation. Other studies have also suggested that the use of happy color in the environment can lead to positive effect on children's mood (J. Coad and N. Coad, 2008).

Lighting as an environmental factor in this research, is indicted by other researchers in hospital environment as well. Light improves the quality of patients, staff and visitor's overall

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experience in the hospital environment (Dalke et al., 2006). Readability is another important environmental element. Other studies have also suggested that readability have positive effect on stress reduction in hospital environment (Lee et al., 2007).

CONCLUSION

This study was conducted as a scientific research to transform children's needs into design by examining their parents' responses about their children's needs in hospital setting. Considering the results of the attitude screening questionnaire from the parents of the sick children as well as library studies done through desk research method, the elaboration of the features that can be considered for designing children's hospital environments is as follows:

- Of the four factors of mental relaxation, attractiveness, positive distraction and security, comfort and positive distraction with an average of 4.3 are more important than other ones.
- The most important factor for the subjective sense of mental relaxation is the use of happy colors in the environmental design of hospital.
- The most important factor for the environmental comfort is the presence of adequate light in the environment.
- The most important factor for the subset of attractiveness is the use of curve structures in the design of the environment.
- The most important factor for the subset of positive distraction is the use of artificial light.
- The most important factor for the security subset is readability in routing.

In conclusion, according to the findings, the presence of happy colors, sufficient lighting, elements hanging from the ceiling, hospital curve structure and artificial light, had a correlation of more than 0.7, suggesting that these factors are more important. However, the relative importance of factors may vary (for example, by culture).

This study provides nurses, architects, clinicians and other stakeholders with insight into what an ideal healthcare environment should constitute, from the perspective of parents. And if these design strategies are used, it seems to affect the quality of life of hospitalized children.

An important limitation of this research is the lack of direct involvement of the child in the study process. In other words, there may be differences between parents and children view. Another major limitation of this study is the cultural and

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economic differences as well as the existence of different living conditions in different societies. Each of these factors can be effective in prioritizing environmental factors. It seems that in future research, the impact of culture, economy and living conditions of people in different geographical areas can be examined.

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Research Article

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An Approach to Evaluate Exhibition Lighting Alternatives: The Case of Museum of Palace Collections

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Leyla Dokuzer Öztürk**

Abstract

Purpose

Museums collect, preserve, analyse, and exhibit works of art and historical values. There are numerous publications that offer guidance on museum lighting to balance exhibition and preservation requirements.

Some guidelines such as the way of control of illuminance on three-dimensional artefacts, the acceptable illuminance uniformity, and the limiting values for direct glare are missing in literature on museum lighting. The aim of this study is to suggest limiting values for the mentioned lighting requirements, describe the way of lighting control on 3D objects, and to present an approach to evaluate different lighting alternatives in terms of conservation, accurate perception of artworks, and energy consumption.

Design/Methodology/Approach

The evaluation of various lighting alternatives was carried out by reference to the Museum of Palace Collections. The lighting alternatives that can be applied in the exhibition hall of the museum were investigated in the first phase of the study. Twelve lighting

Keywords: *Energy efficiency, glare, illuminance, museum lighting, showcase lighting*

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arrangement alternatives have been design ed and modelled by means of DIALux lighting software and the results were obtained in terms of preservation, lighting design criteria, and energy consumption. An approach has been developed in which all considered criteria were assessed separately. The results of twelve lighting arrangements were compared according to the presented approach. The number of lighting design criteria that met the requirements and their degree of fulfilment were considered in comparison. Subsequently, the optimal lighting alternatives were determined.

Findings

The results acquired in the twelve arrangements designed via the lighting program were compared with respect to illuminance level and uniformity, direct glare, reflected glare, shadow properties, perceptibility of the hall, and energy efficiency. Taking into account all the mentioned criteria the optimum lighting arrangements for the conditions of this study were determined as 'indirect general lighting and showcase lighting with horizontal linear luminaire behind the upper metal profile', followed by 'indirect general lighting and showcase lighting with horizontal linear lamp behind the opal glass '.

Research Limitations/Implications

So as to limit the conditions of the study, the existing showcase types and the exhibition design were kept constant. It is obvious that more lighting alternatives can be created by considering other types of showcases and exhibition design in addition to the existing ones.

Practical Implications

The evaluation process proposed in this study and discussed using the Museum of Palace Collections as an example can be followed to make the most rational decision regarding the illumination of other exhibition halls.

Social Implications

One of the main objectives of museum lighting is to assure the visitors perceive the properties of exhibited objects comfortably and completely. The perceptibility of the exhibition hall itself can also be important especially if it has historical value and/or exceptional architecture. Rational decisions for artificial lighting ensure that the hall and the artefacts displayed within it are fully and comfortably perceived and consequently visitors can benefit as much as possible from the exhibition.

Originality/Value

In this study, some missing guidelines for museum lighting are proposed and an approach is presented to evaluate possible different lighting alternatives for exhibition halls. Finally, the importance of simultaneous architectural-, interior-, lighting- and display design is emphasized.

INTRODUCTION

It is important to ensure that works of art and historical values inherited from the past and safely to be handed over to the future generation are perceived correctly and comfortable without being damaged. There are guiding standards and publications published by international organizations to balance

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the exhibition and preservation requirements. The cultural property exhibited in museums are classified by International Commission on Illumination (CIE) and European Committee for Standardization (CEN) in four category as insensitive, low sensitivity, medium sensitivity, and high sensitivity in terms of light sensitivity classification and limiting illuminance, annual exposure time, and upper limit of annual luminous exposure are determined for each category (CIE, 2004; CEN, 2014). The average illuminance and illuminance uniformity values for various areas, tasks or activities are provided in the European Standard EN 12464-1 (2011). The possible contrasts between the exhibited artwork and its vertical background are divided into three separate groups as 1: 1, 3: 1, and 10: 1 in the European Standard EN 16163 (2014). Feltrin et al. (2017) and Wilson (2006) investigated the impact of the background colour on the appearance of the exhibits. Information on the ultraviolet radiation content of various light sources, which should be taken into consideration in lamp selection, is found in the literature (CIE, 2004; IESNA, 1996). In the literature there is also information on the choice of colour temperature of the lamp to be used for museum lighting (CIE, 2004). Various studies have been performed to determine the preference of the subjects about the perceived appearance of objects at different colour temperatures (Feltrin et al., 2017; Csuti et al., 2015; Garside et al., 2017; Luo et al., 2016; Vidovszky- Németh & Kosztyán, 2016; Scuello et al., 2004). Kılıç (1985) suggests that the exhibition rooms in a museum building should be designed to allow visitors to walk starting from the rooms with lowest illuminance and finishing at the end with the rooms of highest illuminance. The necessity to prevent glare (Druzik & Michalski, 2011) or glare by reflection (Wilson, 2006) is pointed out in the previous studies. The literature also includes precautions that can be taken to avoid direct glare and glare by reflection in display halls (CEN, 2014; IESNA, 1996). International Council of Museums recommends 15°-25° C temperature and 50 % relative humidity as set point or annual average in general museums and art galleries (ICOM, 2004). Great importance is attached also to energy consumption in museum lighting and advantages of LED lighting compared to traditional light sources are emphasized (Csuti, et al., 2015; Garside et al, 2017; Druzik & Michalski, 2011).

Although there are numerous publications which offer guidance on how to illuminate museums, the way in which the illuminance and uniformity on three-dimensional sensitive artefacts are controlled by museum professionals is not documented. A recommended uniformity value with regard to the illuminance distribution on two or three dimensional artefacts could not be

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found in literature. Particular attention in lighting control deserves the case when 3D objects of different dimensions and sensitivity categories are placed side by side. Another theme that is not particularly highlighted in museum lighting is the shadows that play a role in perceiving the properties of objects such as form and texture. Although the importance of controlling direct glare is emphasized, the limiting values for the general lighting of the exhibition hall as well as for the showcase lighting are not specified in the literature. While precautions of reflected glare caused by windows in the daylit rooms are provided in literature, information to prevent veiling reflections of luminaires or illuminated showcases are insufficient. Three main factors to be taken into consideration in museum lighting are the preservation of artworks, the visitor's perfect perception, and energy efficiency. If the conversion of a historical building into museum is the case or the museum building has a remarkable architecture, the perceptibility of the exhibition hall itself can be considered as a fourth factor that should be considered in lighting. When it is impossible to achieve the aimed conditions for all four factors entirely, making an order of precedence is a rational approach. The need to compromise on the preservation and good perception of works of art is often emphasized in the literature. A compromise is an agreement reached by mutual concessions of conflicting claims. Concession from conservation requirements can not be accepted if we consider artworks as borrowed from the next generation and not just as our cultural heritage to the future. In this context, the preservation of artworks should come first; the visual comfort of visitors should rank second. According to the historical and artistic characteristics of the exhibition hall, the third rank should be assigned to either the energy consumption or the perceptibility of the hall.

There is a number of lighting design criteria involved in the comfortable and accurate perception of objects, and the required conditions for all of these criteria may not be obtained in a lighting arrangement. How should be the priority ranking among the criteria to be considered in the museum lighting? In addition to the lighting design decisions, are there other factors that are determinant in generating appropriate conditions for all criteria? The aim of this study is;

- to develop proposals for the missing guidelines in museum lighting,
- to present an approach to evaluate different lighting alternatives in terms of conservation, perception of artworks precisely, and energy efficiency,
- to design different lighting alternatives for the exhibition hall of a museum, and to classify these lighting design

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alternatives according to the presented approach with regard to the preservation of works of art, the visual comfort of visitors, the energy consumption, and the perceptibility of the exhibition hall.

It was decided to conduct this study on an existing museum and Museum of Palace Collections was selected (Çelikmez, 2017). In order to introduce the approach to the evaluation of lighting alternatives of a museum, first the features of the examined exhibition hall, the designed lighting alternatives and their investigation with respect to lighting design criteria are explained.

FEATURES OF THE EXHIBITION HALL

The ground floor of the Museum of Palace Collections located in Istanbul consists of the art gallery displaying temporary exhibitions, the permanent exhibition hall and the depot. The permanent exhibition hall displaying objects used in the last period Ottoman palaces is handled in this study. The load bearing structure of the exhibition space consists of stone masonry. The hall with an area of 1100 m^2 has a plastic-based floor coating. The great part of the hall has a hipped-gable roof whereas a small part is covered by a dome roof. The wooden structure bearing the roof is dark brown. The height of the space is 8.00 m under the hipped-gable roof and 6.30 m under the dome roof. Window openings and skylights in the dome roof are covered with a dark panel, preventing the daylight penetration. Plan and section of the exhibition hall are given in Figure 1. The photographs in Figure 2 show the general appearance of the hall, the view directions of the photographs are shown on the plan in Figure 1. As of August 19, 2018, the Museum of Palace Collections displays, as listed on its website, inter alia, palace child's dresses, furniture, calligraphy art and writing sets, porcelain, embroidered artworks, lighting, heating, health and industrial tools, paintings, watches, music instruments, crystal, porcelain, silver sets of table, crystal offering sets, toys, and books. The exhibits are displayed to a great extent in closed wall- or freestanding showcases (28 pieces). Seventeen wall showcases with one glass surface are located either leaning against the wall or in pairs leaning against each other. Showcases with two glass surfaces (2 pieces), three glass surfaces (4 pieces), and four glass surfaces (5 pieces) are located freestanding in the exhibition hall. The objects in the back part of the hall near the depot are displayed behind a glass partition. Additionally are freestanding displays on five platforms in the hall.

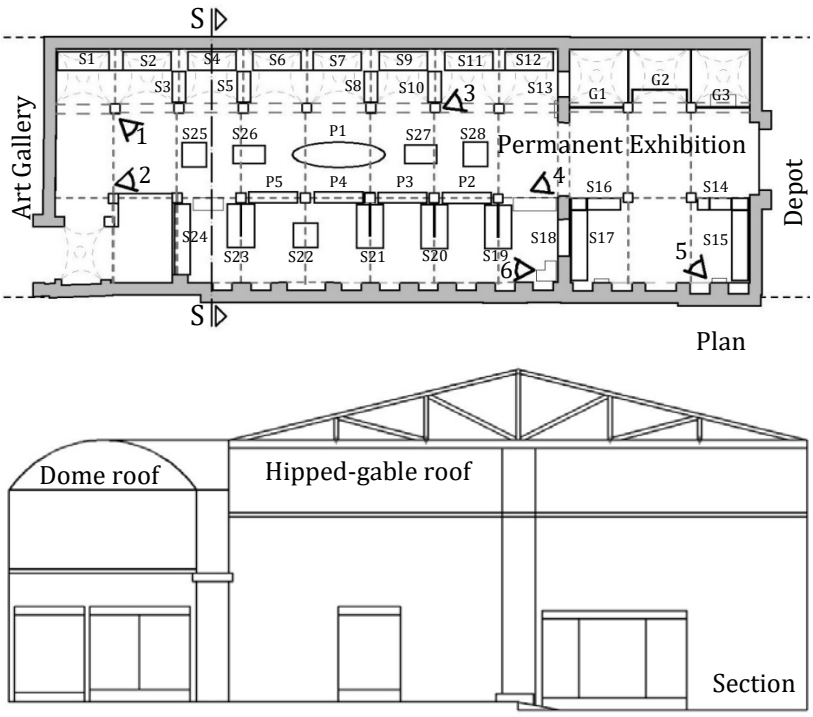

Figure 1. Plan and section of the Museum of Palace Collections
S: showcase, P: platform, G: glass partition, 1-6: viewpoints

The objects exhibited in showcases are not grouped according to the light sensitivity classification, rather the periods or persons they belonged to or the type of subjects is taken into account when grouping. Objects of different sensitivity categories are displayed within the same showcase. Examples of showcase types are shown in Figure 3.

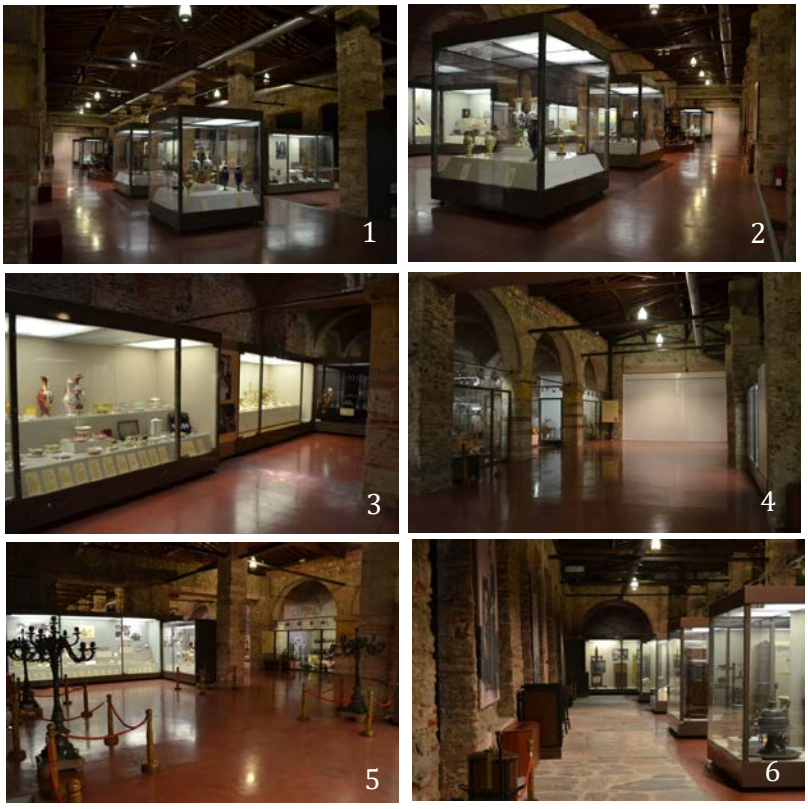

Figure 2. Views of permanent exhibition from six various directions

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Showcase with one glass surface


Showcase with two glass surfaces


Showcase with three glass surfaces


Showcase with four glass surfaces

Figure 3. Examples of showcases in the exhibition hall

DESIGN OF LIGHTING ALTERNATIVES

Different lighting alternatives to be applied in the exhibition hall are investigated. The existing showcases, furnishings and exhibition order in the hall are kept constant in order to limit the scope of the study. The lighting arrangement alternatives, aimed to reveal possible different results in terms of preservation of artefacts, visitors' comfortable perception, energy consumption, and perceptibility of the exhibition hall consist of general lighting, dome lighting, and showcase lighting. Three alternatives for general lighting (1, 2, 3), four alternatives for showcase lighting (A, B, C, D), and one alternative for dome lighting were created. Lighting alternatives were modelled by the DIALux lighting program. Using AutoCAD drawings, on-site observation and measurements, taken photographs, it is ensured that the model hall reflects as accurate as possible the real hall. The properties of the dome lighting are the same in all alternatives. The same luminaire and lamps have been assigned in all three general lighting alternatives. Similarly, the linear lamp used in three showcase alternatives was the same. Although the intent was to use only LED lamps, fluorescent lamps were used for general lighting because the required light intensity distribution could not be found among LED equipped luminaires.

General Lighting

The decision on the type and location of the appropriate luminaire for general lighting was made taking into consideration the architectural and structural characteristics of the exhibition room and the display order. Large floor and the associated large circulation area, freestanding displays on the platforms, metal bars between the columns were the data that

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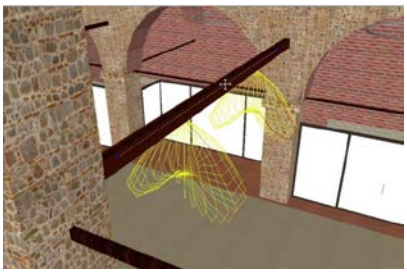
influenced the basic design decisions. The luminaires are fixed to the existing metal bars between the columns. The same linear luminaire was used in all three lighting alternatives for general lighting, with the difference between the alternatives being the type of lighting. These alternatives are direct lighting (General lighting alternative 1), indirect-direct lighting (General lighting alternative 2) and indirect lighting (General lighting alternative 3). As known, direct lighting is the most economic choice, while indirect lighting is the most expensive in terms of energy efficiency. Moreover, as light coloured as possible and matte ceiling is required when applying indirect-direct or indirect lighting types. However, the economic aspect should not be necessarily put in the first place when it comes to the perfect perception of the displayed objects and the interior of a historical building converted into museum. The increase of energy consumption should be kept in mind when regarding indirect-direct and indirect lighting as general lighting choices in a space with a high and dark ceiling. On the other hand, it will be useful to reveal the effect of these lighting types on visual comfort. It is sufficient to be aware that visual comfort can be achieved with less energy consumption, when the interior surfaces, especially the ceiling, are light coloured. The luminaires are mounted under, over and under, and over the metal bars for direct, indirect-direct, and indirect lighting, respectively (Figure 4). The position of the luminaires on the metal bars is appointed with regard to the furniture.



General lighting alternative 1: Direct lighting

General lighting alternative 2: Indirect-direct lighting

General lighting alternative 3: Indirect lighting

Figure 4. Luminaire position for general lighting alternatives

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Dome Lighting

Approximately one-third of the ceiling is composed of domes and the dome ceilings are emphasized by indirect lighting. The contribution of reflected light from the dome ceiling to the general lighting is also aimed by indirect lighting. Ring shaped luminaires, suspended from the centre of each dome, are used and the height of the luminaires is kept in the height of the metal bars in the hall (Figure 5).

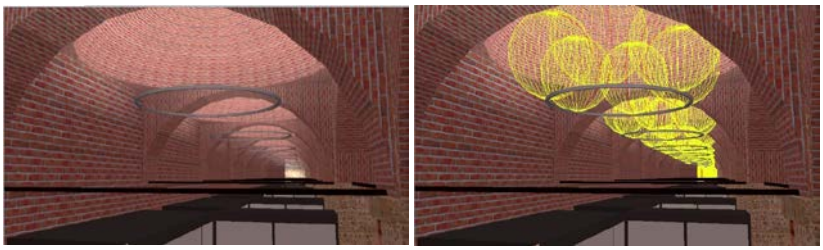


Figure 5. Dome lighting

Three domes above the artworks exhibited behind the glass partitions (Figure 1; G1, G2, G3) are illuminated by indirect-direct lighting, so that the visibility of the dome surfaces are ensured and the objects underneath are illuminated. The features of the luminaires used here are similar to those luminaires illuminating the other domes indirectly; the difference between them is just the lighting type (Figure 6). Ring shaped luminaires with indirect-direct lighting are also used in the entrance section of the exhibition hall to meet the need for general lighting in this area. The lighting arrangement related to the display behind the glass partitions, the entrance, and the domes throughout in the hall are the same in all lighting alternatives.

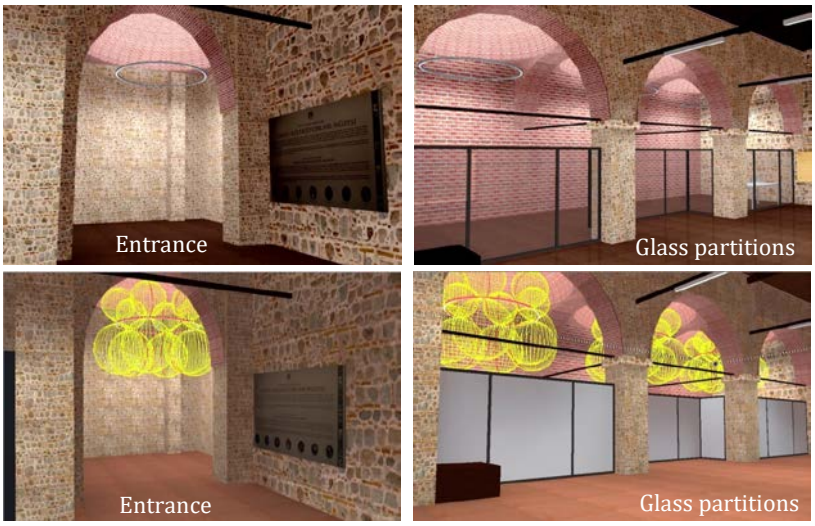
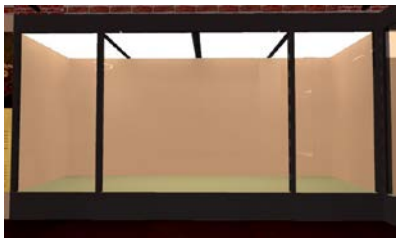


Figure 6. Lighting of the entrance section and the glass partition zones

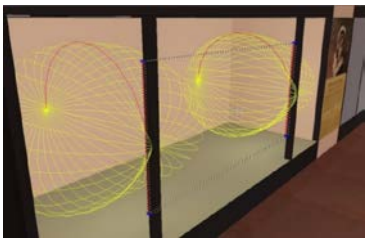
Showcase Lighting

Lighting the showcases from inside is considered as the most appropriate attitude taking into account the showcase types and their location in the hall. Four alternatives are established for showcase lighting:

- **Alternative A:** Linear lamps fixed horizontally on the showcase ceiling and covered by an opal glass (Figure 7a).
- **Alternative B:** Linear luminaire fixed vertically behind the metal profiles at the front glass surface of the showcase (Figure 7a). This alternative has not been applied to freestanding showcases with two, three, or four glass surfaces, but to the showcases leaning against the walls. Because, linear lamps can be hidden behind the vertical profiles in showcases with one glass surface and kept out of the visual field, while being in the observers' field of view in other types of showcases. Accordingly, 16 showcases with one glass surface were illuminated according to Alternative B described; other showcase types were illuminated according to Alternative A.
- **Alternative C:** Linear luminaire fixed horizontally behind the metal profiles at the junction of the front glass and the showcase ceiling (Figure 7b). This alternative could not been applied in the freestanding showcases due to the same reason explained for Alternative B. Therefore, 18 showcases with one glass surface were illuminated according to Alternative C, lighting of other showcases were conducted according to Alternative A.
- **Alternative D:** Small luminaires fixed at certain intervals behind the metal profiles at the junction of the front glass and the showcase ceiling (Figure 7b). The implementation of this alternative is similar to Alternative C. Alternative D could not been applied in the freestanding showcases due to the same reason explained for Alternatives B and C. Eighteen showcases with one glass surface were illuminated according to Alternative D, lighting of other showcases were performed according to Alternative A.



Alternative A: Horizontal linear lamp behind the opal glass



Alternative B: Vertical linear luminaire behind the metal profile

Figure 7a. Showcase lighting alternatives

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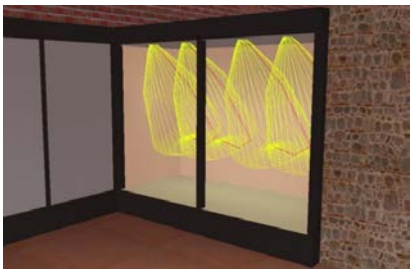
Alternative C: Horizontal linear luminaire behind the upper metal profile



Alternative D: Small luminaire behind the upper metal profile

Figure 7b. Showcase lighting alternatives

Lighting Arrangement Alternatives

Twelve different lighting arrangements (LA) were produced as a result of the combination of three general lighting and four showcase lighting alternatives (Table 1). The appearance of the simulated exhibition hall as a whole differs mainly upon to the general lighting alternatives and the showcases do not contribute much to the appearance of the hall in this scale. Therefore, three lighting arrangement examples are submitted in Figure 8 representing 'direct', 'indirect-direct', and 'indirect' general lighting alternative.

Table 1. Properties of luminaires in the exhibition hall

Lighting arrangement (LA)		Symbol-Type for general lighting	Symbol-Type for showcase lighting
No.	Symbol		
1	1A	1-Direct lighting	A-Horizontal linear lamp behind the opal glass
2	2A	2-Indirect-direct lighting	A-Horizontal linear lamp behind the opal glass
3	3A	3-Indirect lighting	A-Horizontal linear lamp behind the opal glass
4	1B	1-Direct lighting	B-Vertical linear luminaire behind the metal profile
5	2B	2-Indirect-direct lighting	B-Vertical linear luminaire behind the metal profile
6	3B	3-Indirect lighting	B-Vertical linear luminaire behind the metal profile
7	1C	1-Direct lighting	C-Horizontal linear luminaire behind the upper metal profile
8	2C	2-Indirect-direct lighting	C-Horizontal linear luminaire behind the upper metal profile
9	3C	3-Indirect lighting	C-Horizontal linear luminaire behind the upper metal profile
10	1D	1-Direct lighting	D-Small luminaire behind the upper metal profile
11	2D	2-Indirect-direct lighting	D-Small luminaire behind the upper metal profile
12	3D	3-Indirect lighting	D-Small luminaire behind the upper metal profile

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Lighting arrangement 1 (1A)


Lighting arrangement 5 (2B)


Lighting arrangement 12 (3D)

Figure 8. Examples of lighting alternatives in the modelled hall

Lighting arrangement 1 (1A):
1: Direct lighting
A: Horizontal linear lamp behind the opal glass
Lighting arrangement 5 (2B):
2: Indirect-direct lighting
B: Vertical linear luminaire behind the metal profile
Lighting arrangement 12 (3D):
3: Indirect lighting
D: Small luminaire behind the upper metal profile

COMPARISON OF THE LIGHTING ARRANGEMENT ALTERNATIVES

The comparison of the results obtained in twelve lighting arrangement alternatives was conducted for general-, showcase-, platform-, and glass partition zone lighting in terms of illuminance and illuminance uniformity, direct glare, glare by reflection, shadow attributes, and energy consumption.

Illuminance and Uniformity of Illuminance

Since no reference to the illuminance uniformity (U_o=$E_{min}/\bar{E}_m$) was found in the literature for museum lighting, EN 12464-1 standard was referred to and the highest value among recommended uniformities for various activities, that is 0.7, was considered as reference value for exhibits ($U_o \geq 0.7$).

General lighting: No reference to the illuminance and uniformity related to the circulation area around the exhibits was found in the literature. Therefore, traffic zones inside buildings in EN 12464-1 was referred to and the values for circulation areas as $\bar{E}_m \geq 100$ lx and $U_o \geq 0.40$ appropriated under the circumstance that the targeted illuminance and uniformity on the exhibits are not negatively affected. The average illuminance was below 100 lx for indirect general lighting (LA-3, LA-6, LA-9, LA-12) whereas this value was ensured for the other general lighting alternatives. As expected the most uniform illuminance was acquired at indirect general lighting, followed by indirect-direct and direct lighting (LA-1, LA-4, LA-7, LA-10).

Dome lighting: The illuminance on the inner surface of the domes could not be calculated by means of the lighting program. Because, the domes are constituted by bringing together a number of small plane segments and it is very difficult if not impossible to assign each segment to the related dome and to

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define the size of lots of segments. Another limitation is that curved calculation surfaces (CS) are non-producible in the lighting program. Due to this, the illuminance and uniformity on the dome surface could not be calculated, so an approximate assessment was made by means of the false colour rendering property of the program. The fairly uniform illuminance on the inner surfaces of the domes was about 100 lx at all lighting alternatives, which enabled the perception of its architectural features comfortably and accurately (Figure 9).

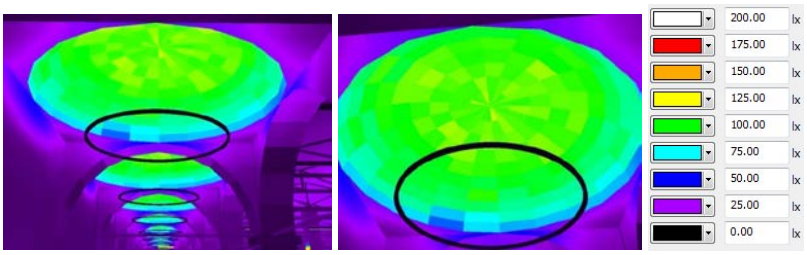

Figure 9. Illuminance uniformity on the dome surface

Showcase lighting: Artefacts are illuminated by taking into consideration their features such as size, shape, position, and light sensitivity category. When lighting two-dimensional objects, such as pictures, graphics, maps, mounted on a wall or a vertical display panel, it is sufficient to provide the required uniformity of illuminance on the exhibition area and to ensure the maximum illuminance in this area is lower than the allowed limit value. Uniform illuminance distribution on the display surface does not alter the original luminance contrasts of artworks. In contrast, non-uniformity in illuminance would cause the lightness-darkness of colours is perceived differently from the original coloration of artworks. This may lead visitors to interpret the exhibits differently than intended. As specified below, there are additionally issues to consider when illuminating three-dimensional objects such as sculptures, vases, and costumes:

- Two-dimensional objects are displayed on plane surfaces, and the evenly distributed illuminance on plane surfaces is mainly related to the selection of the appropriate luminaire and its positioning. Successful results can also be achieved by direct lighting consuming the least amount of energy compared with the other lighting types. It is more difficult to ensure uniform illuminance on the surface of three-dimensional objects, and the main requirements for this are light coloured interior surfaces and indirect lighting.
- Display surfaces for two-dimensional objects may be predominantly vertical, but horizontal or inclined surfaces are also common. Depending on the position of the display surface, the illuminance on a vertical, horizontal or inclined

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calculation surface is determined. For three-dimensional objects, cylindrical or semi-cylindrical illuminance as well as vertical, horizontal or inclined illuminance can be calculated according to the properties and position of the object and the view direction to the object.

- When organizing an exhibition in a museum, periods and/or people may be targeted in grouping of objects. Another approach in grouping is considering the various properties and place of use of the objects. A further approach to the grouping is the light sensitivity category of the objects. Where a group includes objects of different sensitivity categories, limiting illuminance and annual exposure time should be defined considering objects of highest sensitivity. Two dimensional objects of different sizes can be put side by side on the vertical, horizontal or inclined display panel and it is easy to ensure the required uniformity of illuminance along the panel. If three dimensional objects of different sizes and shapes are displayed together, it should be decided on which calculation plane the required illuminance should be provided. For example, if insensitive and small objects are displayed on the floor of a showcase, the required illuminance and uniformity can be produced on the floor of the showcase. If the objects in question are of high sensitivity, the illuminance calculation surface should be at a distance parallel to the bottom of the showcase that covers all underlying objects. If additionally large objects are displayed in the same showcase, calculation surfaces should be defined in accordance with their sizes and locations to control the provided illuminance. If the objects are of the sensitivity category low, medium or high, calculation surfaces should be positioned in front of the objects. For objects of the insensitive category, an average position for the calculation surface can be determined by leaving half of the object behind and the rest in front of the surface.

Depending on these explanations, each showcase was considered separately and the calculation surfaces were determined horizontally, inclined or vertically according to the properties of the objects. The average- and maximum illuminance and the uniformity of illuminance on the defined calculation surfaces were calculated. It was aimed not to exceed the maximum illuminances (for category 3, medium sensitivity: $E_{max} \leq 50$ lx; for category 2, low sensitivity: $E_{max} \leq 200$ lx) allowed according to the sensitivity category of the objects (CIE, 2004; CEN, 2014). The calculation surfaces (CS) defined for three showcases are shown as examples in Figure 10 as the simulation by the lighting program (right) and the visualization on the photographs (left).

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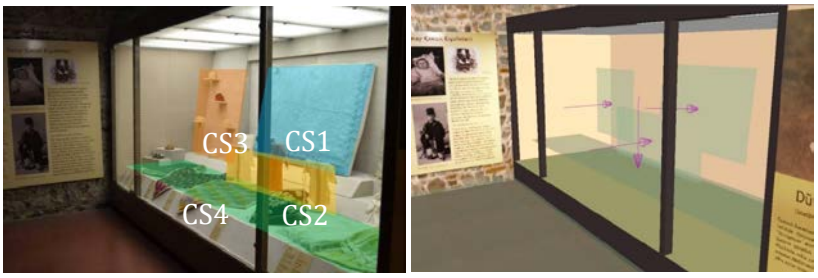
Each calculation surface in a showcase is stated by a different colour.

Targeted illuminances and uniformity on a total of 120 calculation surfaces defined in 28 showcases were obtained in all lighting alternatives to a great extent. The upper illuminance limit for sensitive objects exceeded a little on a small number of calculation surfaces in showcases numbered 20, 22, 23, which are located in the middle of the hall and have three or four glass surfaces. Hence, the interreflected light and light from other showcases penetrate these showcases. Some precautions can be taken to control the illuminance like to shorten the annual exposure time, relocate these showcases or put partitions between them. On some of the calculation surfaces in showcases 14 and 15, the limit illuminance exceeded in the showcase lighting alternatives C and D. The reason for this is that the top of large objects is very close to the showcase ceiling and consequently to the lamps. For these, showcase lighting alternatives C and D should not be applied or the annual exposure time should be shortened. For objects of low sensitivity, the limit value of 200 lx was not exceeded on any calculation surface. The uniformity of illuminance was $0.60 \leq U_o < 0.70$ in most showcases and $0.50 \leq U_o < 0.60$ in a significant number of showcases. The uniformity was below 0.50 in a small number of showcases. The most unfavourable results in terms of illuminance distribution have emerged in showcase alternative D, which was followed by B and C.



Showcase no. 1

Showcase no. 10

Figure 10a. Calculation surfaces for some showcases

Showcase no. 20

Figure 10b. Calculation surfaces for some showcases

Platform lighting: The minimum, maximum, average illuminances and uniformities on the calculation surfaces assigned to the objects displayed on the platforms were calculated. For low sensitive wooden objects exhibited here, a maximum illuminance of 200 lx (sensitivity category 2) was targeted; for metal objects, no limitation was imposed on the illuminance (sensitivity category 1). For one of the platforms, the calculation surfaces defined in the model room and visualised on the corresponding photograph is shown as an example in Figure 11. The maximum illuminance regarding to low sensitivity objects was under 200 lx. The targeted value in terms of illuminance uniformity has been ensured completely when indirect lighting was the case and to a great extent when the other lighting types were applied.

Figure 11. Calculation surface for platform 1

Glass partition zone lighting: Insensitive objects are displayed behind three glass partitions. One of the groups of artworks exhibited behind the glass partition is shown in Figure 12. The acquired results related to illuminance and uniformity are the same with the platform lighting.

Figure 12. Calculation surfaces for glass partition zone 2

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Direct Glare

The indirect-direct and direct general lighting alternatives have been investigated in terms of direct glare. For this purpose, UGR_L calculations were performed at various points in the circulation area and at observation points of showcases where general lighting luminaires could be in the visitor's field of view. The highest calculated values were 22 and 21 for Lighting Arrangement 1 and 2, respectively. Because the limiting value for the general lighting of exhibition halls is not specified in the literature, the recommended limit value of 28 for circulation areas and corridors in EN 12464-1 is considered for evaluation. These values below 28 show that general lighting will not lead to direct glare. It has been also ascertained that dome, platform, and glass partition zone lighting do not cause direct glare. Direct glare analyse was conducted for showcases of different length and height related to Alternative A. The approach in glare analyse is shown on a typical showcase section representing the majority of showcases (Figure 13). There are guiding values in the literature in terms of the average view distance to the vertical display surface (IESNA, 1996; IESNA, 2000; FGL, 2018). On the other hand, it is obvious that the distance required will vary depending on the dimension and position of the objects displayed in the showcase. An average distance of 50 cm from the glass surface of a showcase was judged appropriate by in-situ observations in order to perceive the features of the displayed object comfortable. IESNA suggests an eye height of 155 cm from the floor considering the average human height (IESNA, 1996; IESNA, 2000). The UGR_L value was 17 for the observer standing 50 cm away from the glass surface of a showcase. An UGR_L limit value, which should not be exceeded in museums, has not been found in the literature. Limit UGR_L values in the European Standard EN 12464-1 are specified as 19 for art rooms, offices, and several working conditions, 16 for colour inspections, technical drawings, manufacture of jewellery, etc. Taking into account these values, $UGR_L \leq 19$ can be accepted for showcase lighting. Under this assumption, it can be concluded that the observer will not be affected by direct glare.

In the case of showcase lighting alternatives B, C and D, where the luminaires are arranged behind metal profiles, no direct glare occurs. The UGR_L values for these showcases have varied between 0 and 11 for different viewing directions.

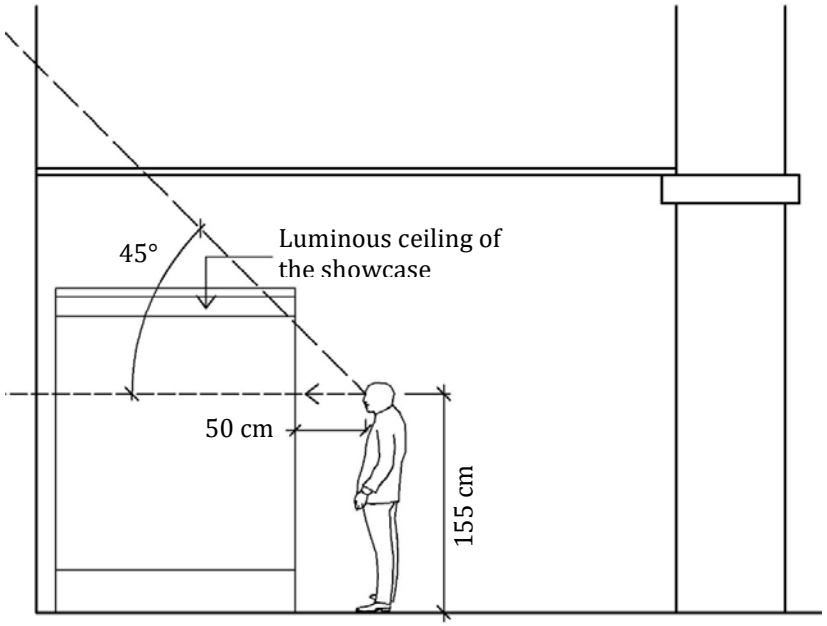

Figure 13. Investigation of showcase lighting according to direct glare

Glare by Reflection

The showcases are positioned opposite or perpendicular to each other in the exhibition room. Accordingly, the luminous ceiling of other showcases will cause reflected glare on glass surfaces of showcases lit according alternative A as shown in Figure 14. Apparent from Figure 14, the showcase 19 (S19) is in the reflection area of showcase 18 and the visitor observing the showcase 18 perceives the reflected image of showcase 19 and its luminous ceiling. The luminous ceiling of the S19, which is below the viewing angle of 45°, may make it difficult to perceive the artefacts. Measures such as using anti-reflection coatings on showcase glass surfaces, repositioning of showcases to avoid each other's reflection areas or putting partitions between them can be taken to avoid reflected glare.

On the glass surfaces of showcases lit according to alternatives B, C, and D, only the reflected images of other showcases' structure may be perceived, while the luminaires within them would not be in the viewing area. The reflected images of the outer surfaces of some luminaires, but not their openings used for general lighting and dome lighting, can be perceived on glass surfaces of some showcases that do not degrade the perception of the displayed objects.

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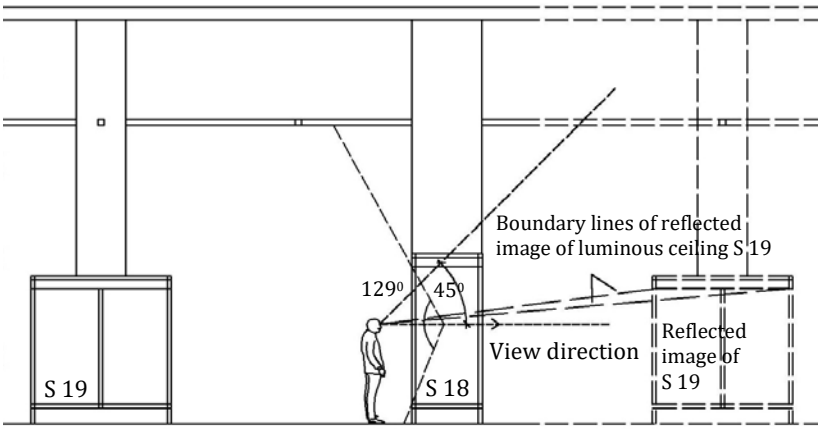

Figure 14. Reflected glare on the glass surface of a showcase caused by other showcases

Shadow Attributes

Showcase lighting alternatives have been examined in terms of the effects of the self- and cast shadows of the artefacts on their visual perception. For this purpose, the showcase 7 (S7) was treated as an example (Figure 15) and the objects in the S7 were modelled in a simplified way (Figure 16).

The shadow properties of objects differ according to the lighting alternatives. Soft shadows, similar to those in the photograph of the showcase in Figure 15, are expected to be produced in Alternative A. However, due to the nature of the lighting software program, the visualization of soft shadows could not be good enough. In Alternative B, the cast shadows of objects clearly perceived on the floor and on the walls of the showcase are soft in one direction and harsh in the other direction due to the nature of the used linear lamps. The properties of cast shadows in Alternative C are similar to Alternative B. In this alternative, however, the shadows remain primarily behind the objects due to the position of luminaires and objects and therefore do not appear in the field of view. Harsh shadows created separately by each luminaire overlap partially, and as a result, multiple harsh shadows are perceived in Alternative D. Except for special circumstances, the preferred shadow features are 'soft and light' in every space. In this regard, it can be concluded that the shadow attributes are most positive in Alternative A and acceptable in Alternative C.

Figure 15. Photograph of showcase 7

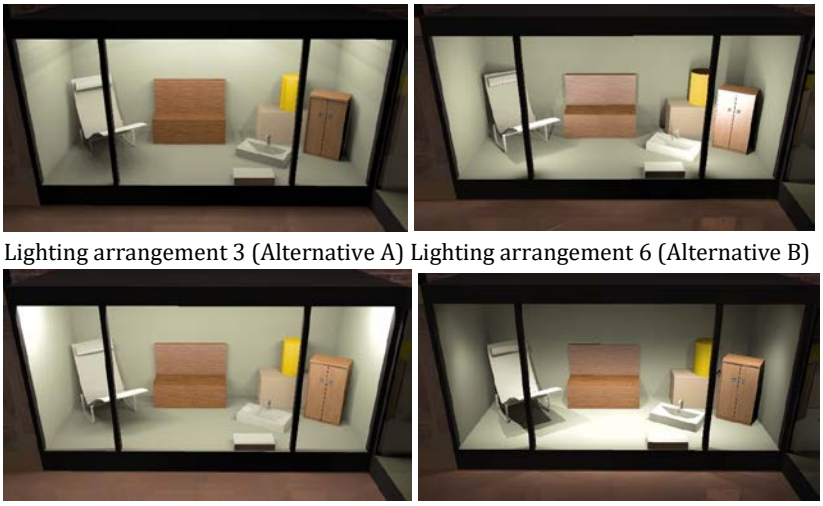

Figure 16. Comparison of showcase lighting alternatives in terms of shadow properties

Energy Consumption

The twelve lighting arrangements discussed were compared in terms of energy consumption. As known, low energy consumption depends on both the luminous efficacy of the lamp and the luminaire efficiency. Factors such as the luminous intensity distribution and the location of the luminaire also play a role in energy consumption. It is impossible to consider numerous options for lamp and luminaire types for comparison purposes. Thus, the total luminous flux emitted by all the installed luminaires has been taken into account to avoid that the luminous efficacy of lamps and the light output ratio of luminaires play a role in this comparison. In this way, data is generated for comparison purposes only, without reference to a product available on the market. In practice, the luminous efficacy of the lamp and the luminaire efficiency, thus the total power consumed should be taken into account in comparison of alternatives. The effect of design decisions such as luminaire shape (small, linear), lighting type (direct, indirect, etc.), and luminaire position on energy consumption were evaluated whereby the same luminaires and lamps were used in all general lighting and showcase lighting alternatives. According to the calculations, the order of the lighting arrangements discussed was determined from the most expensive to the most economical as follows: LA-2, LA-8, LA-11, LA-5, LA-3, LA-9, LA-1, LA-12, LA-6, LA-7, LA-10, LA-4. In other words, the amount of luminous flux emitted from all the luminaires installed was the most in 'indirect-direct general lighting and showcase lighting with horizontal linear lamp behind the opal glass (LA-2)' and the least in 'direct general lighting and showcase lighting with vertical linear luminaire behind the metal profile (LA-4)'.

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AN APPROACH FOR EVALUATING LIGHTING ARRANGEMENT ALTERNATIVES

In order to determine the most suitable lighting arrangement alternatives, it was examined to what extent the requirements according to the lighting design criteria in each alternative were met. For this purpose, for each lighting arrangement alternative, the illuminance and its distribution on the defined calculation surfaces were calculated with the DIALux program for general lighting, showcase, platform and glass partition zone lighting. In addition, detailed investigation was performed concerning direct glare and glare by reflection for each alternative. This examination was also carried out in terms of the shadow properties in the showcases and the overall perceptibility of the hall. Comprehensive calculation and study results could not be included in this article (Çelikmez, 2017). Considering the results of the detailed calculations and etudes for the regarded criteria, the lighting arrangement alternatives are classified in four grades as presented in Table 2. The most positive results are stated with Grade 1. It is obvious that this classification applies to the studied Museum of Palace Collection as an example for the implementation of the suggested evaluation process. For example, the maximum illuminance in showcases was controlled best in the indirect general lighting alternatives (LA-3, LA-6, LA-9, LA-12). So, lighting arrangements (LA) 3, 6, 9, and 12 are classified as Grade 1 according to the 'maximum illuminance' criterion (Table 2, line 4, column 3). To keep the maximum illuminance below the allowed limit for objects of low and medium sensitivity was taken as the most important criterion to be met. Also the properties of the historical exhibition room can be perceived best in the indirect general lighting alternatives. The most positive results in terms of illuminance uniformity and shadow properties in showcases were acquired in the Alternative A (LA-1, LA-2, LA-3), followed by the Alternative C (LA-7, LA-8, LA-9). Thus, lighting arrangements 1, 2, 3 are rated with Grade 1 (Table 2, line 5, column 3) while lighting arrangements 7, 8, 9 are assigned with Grade 2 (Table 2, line 5, column 4) in relation to the criterion 'illuminance uniformity'. The maximum illuminance regarding freestanding displays on the platforms and behind the glass partitions was controlled successfully in all lighting alternatives. Nevertheless, the allowed illuminance of 200 lx could be reached easily in the indirect-direct general lighting alternatives (LA-2, LA-5, LA-8, LA-11) while the produced illuminance was lower in the other lighting alternatives.

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Table 2. Grading of lighting arrangements in terms of the criteria being considered

Lighting design criterion		Grading			
		Grade 1	Grade 2	Grade 3	Grade 4
General lighting	Average illuminance	2, 5, 8, 11	1, 4, 7, 10	3, 6, 9, 12	-
	Illuminance uniformity	3, 6, 9, 12	2, 5, 8, 11	1, 4, 7, 10	-
Showcase lighting	Maximum illuminance	3, 6, 9, 12	1, 4, 7, 10	2, 5, 8, 11	-
	Illuminance uniformity	1, 2, 3	7, 8, 9	4, 5, 6	10, 11, 12
Platform lighting	Maximum illuminance	2, 5, 8, 11	1, 4, 7, 10	3, 6, 9, 12	-
	Illuminance uniformity	3, 6, 9, 12	2, 5, 8, 11	1, 4, 7, 10	-
Glass partition zone lighting	Maximum illuminance	2, 5, 8, 11	1, 4, 7, 10	3, 6, 9, 12	-
	Illuminance uniformity	3, 6, 9, 12	1, 5, 8, 11	2, 4, 7, 10	-
Direct glare	General lighting	3, 6, 9, 12	2, 5, 8, 11	1, 4, 7, 10	-
	Showcase lighting	7, 8, 9, 10, 11, 12	4, 5, 6	1, 2, 3	-
Glare by reflection	General lighting	3, 6, 9, 12	1, 2, 4, 5, 7, 8, 10, 11	-	-
	Showcase lighting	7, 8, 9, 10, 11, 12	4, 5, 6	1, 2, 3	-
Shadow attributes	Showcase lighting	1, 2, 3	7, 8, 9	4, 5, 6	10, 11, 12
Perceptibility of the hall		3, 6, 9, 12	2, 5, 8, 11	1, 4, 7, 10	-

The following arrangements can be considered optimum regardless of energy consumption and only taking into account the criteria listed in Table 2:

- LA-2: Indirect-direct general lighting and showcase lighting with horizontal linear lamp behind the opal glass
- LA-3: Indirect general lighting and showcase lighting with horizontal linear lamp behind the opal glass
- LA-8: Indirect-direct general lighting and showcase lighting with horizontal linear luminaire behind the upper metal profile
- LA-9: Indirect general lighting and showcase lighting with horizontal linear luminaire behind the upper metal profile

However, the number of high or medium sensitive objects displayed in showcases is much more than the freestanding medium sensitive or insensitive objects. Precaution of light-induced damage can be ensured well in showcases in the alternatives LA-3 and LA-9. On the contrary, the aimed illuminance of 200 lx for freestanding objects can be acquired in

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the alternatives LA-2 and LA-8, while the illuminance on these objects is lower in the alternatives LA-3 and LA-9. LA-3 and LA-9 should be preferred given the priority to the conservation of the objects rather than to the lower as aimed level of illuminance. Direct general lighting is the most economical choice if only the energy consumption is considered. The most economical showcase lighting option among alternatives treated in this study is Alternative B, followed by Alternative D, C, and A, respectively. However, appropriate lighting solutions should be determined in accordance with the features of the exhibited objects and the display technique, taking into account the main objectives of museum lighting. Afterwards, the most economical way can be chosen to implement the solutions in practice. In this context when also energy conservation along with the design criteria is taken into consideration, it can be concluded that the optimal lighting arrangement for the conditions of this study is LA-9, followed by LA-3.

The main objectives of artificial lighting in museums are to ensure the visitors perceive the properties of exhibited objects completely and comfortably, to protect these objects from being damaged, and energy efficiency. A further objective can be the perceptibility of the exhibition hall if it has historical characteristics and/or exceptional architecture. The purpose of this study is to suggest some missing guidelines in museum lighting, to compare different lighting alternatives in terms of conservation, visual comfort, and energy consumption, and to present an approach to evaluate different alternatives. The Museum of Palace Collections was dealt with in order to apply different approaches that will be the basis for comparison. To illuminate the exhibition hall, three alternatives for general lighting and four alternatives for showcase lighting were created and twelve different lighting arrangements were obtained with various combinations of these alternatives. In order to limit the conditions of the study, the existing showcase types, furnishings, and the exhibition design were kept constant. It is obvious that more lighting alternatives can be developed by taking into account other types of showcases, furnishings and exhibition design in addition to the existing ones. For the dome ceiling and the glass partition zone, a single lighting design was developed that was used for all lighting alternatives. Since the required illuminance for the platforms were attained by general lighting, no additional local lighting is planned. The aim was not to exceed the maximum permissible illuminance according to the sensitivity category of the objects in the showcases, on the platforms, and behind the glass partitions in all lighting alternatives. Thus, the effect of photochemical reaction was

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limited and the objects were protected with regard to illuminance.

The results achieved in the twelve arrangements were compared in terms of illuminance level and uniformity, direct glare, reflected glare, shadow properties, perceptibility of the hall, and energy efficiency. The number of lighting design criteria that met the requirements and their degree of fulfilment were considered in comparison. When the lighting arrangements suggested were evaluated in terms of the lighting criteria considered in this study, it was ascertained that the optimum lighting arrangements were indirect-direct general lighting and showcase lighting with horizontal linear lamp behind the opal glass (LA-2), indirect general lighting and showcase lighting with horizontal linear lamp behind the opal glass (LA-3), indirect-direct general lighting and showcase lighting with horizontal linear luminaire behind the upper metal profile (LA-8), indirect general lighting and showcase lighting with horizontal linear luminaire behind the upper metal profile (LA-9). The comparison in terms of energy consumption revealed the following order aligned from the most economical to the most expensive: LA-4, LA-10, LA-7, LA-6, LA-12, LA-1, **LA-9**, **LA-3**, LA-5, LA-11, **LA-8**, **LA-2**. It is meaningful to apply indirect or indirect-direct lighting types in spaces having light coloured and matte ceiling. The application of indirect and direct-indirect lighting as general lighting alternatives in the exhibition hall with dark ceiling has caused energy consumption to be high in the related alternatives. The reason for considering these lighting types in this study was to bring out other options than direct lighting to avoid direct glare and/or reflected glare. Besides, the perception of this specific historical exhibition hall can be ensured best in the indirect general lighting alternatives. When the results obtained are evaluated together from the viewpoint of lighting criteria and energy consumption, the optimum lighting arrangements for the conditions of this study were determined as 'indirect general lighting and showcase lighting with horizontal linear luminaire behind the upper metal profile (LA-9)', followed by 'indirect general lighting and showcase lighting with horizontal linear lamp behind the opal glass (LA-3)'. The evaluation process suggested in this study and discussed via the Museum of Palace Collections as an example can be followed in making the most rational decision regarding the illumination of other halls.

Architectural-, interior-, lighting-, and display design should be performed simultaneously in order to protect the artefacts exhibited in a museum, to ensure the perception of these in a comfortable and complete manner, and to assure the energy efficiency. Otherwise, it is inevitable to compromise at least one

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of the subjects mentioned, namely the conservation of objects, the provision of visual comfort and the energy savings.

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Resume

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Research Article

Evaluation of the Dormitories in the Physical and Psychological Requirements: The Case of Karabük Province

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Abstract

Purpose

The aim of this paper is to investigate the problems of meeting students' housing needs in many cities that could not adapt to this change with its infrastructure against the rapid increase in the number of Turkish universities and students, who are educated in these institutions, in recent years. In addition, it is to develop alternative suggestions concerned with design criteria for increasing qualifications of the dormitories as one of the primary housing alternatives for students.

Design/Methodology/Approach

Users' preferences and their management are very important for especially multi-user design processes. Hence, through a survey, it was planned to determine the physical conditions and the spatial characteristics of the existing dormitories beside their conformities in terms of the users' satisfaction. At the end of the extensive literature research, the evaluation criteria which included basic psychological

Keywords: *Dormitory, housing, physical and psychological requirements, Planning principles.*

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(privacy, sense of crowded, belonging and socializing, etc.) and physical (dorm rooms, social and service areas in the dorms and the dorms' environment, etc.) factors were prepared for the survey. Then their validity was tested via the survey questions and the SPSS software. The obtained findings in the study were discussed in the frame of previous literature researches and their results. Evaluations were made in terms of the development of architectural planning principles of dormitory buildings.

Findings

Some outstanding findings and evaluations were listed as increasing the more customized using areas in the rooms, rehabilitation of study areas, multiplying variations of study and socializing areas, organizing social areas as partial units instead of the only central space for different functions, avoiding large-scale dormitories for decreasing the perception of crowded sense, creating flexible environments according to the conditions, etc. Besides, although the spatial planning of the dormitories was commonly compatible with the standards, the organization disorders like overcapacity and change of functions have been found to cause dissatisfaction. Many of these are thought to be innovative inputs for the design stages of dormitory buildings even if design contexts are different.

Research Limitations/Implications

The survey is conducted in Karabük with 250 students from different faculties in Karabük University whose development process has significantly affected the city and the city life in the last decade. So, the conditions of dormitories in Karabuk are examined.

Practical Implications

it is necessary to consider the users' opinions and expectations about these buildings in the frame of their changing lifestyles and thus to review the criteria and approaches in designs of such buildings.

Social Implications

The fast and immediate solutions which have been done without considering in detail are often not useful. So, on behalf of solving this rapidly growing problem which has encountered in many cities in similar ways, improving them in line with the current user needs and thus increasing qualities in the students' education and life standards, it is important to examine the conditions of the dormitory buildings which have been constructed or will be constructed.

Originality/Value

In this study, unlike the other dormitory studies, the design problems and user interactions have been evaluated with a more holistic approach from interior organization to the decisions on an urban scale.

INTRODUCTION

Besides producing scientific, cultural and artistic studies by providing academic education to young people in terms of their basic aims, universities contribute to the knowledge level of the society in different fields by supporting the cities, in which they are, economically. However, the rapid growth of the cities, in which the newly established universities are in recent years, is remarkable. With this growth, as the increase in the numbers of

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students and instructors has effects on the construction facilities, it leads to significant changes in city planning. Karabük province, which is chosen as a research area, shares a similar process with the sample cities which have newly established universities, in Turkey. Since the establishment of Karabük University in 2007, the city has shown rapid development and a change in a short time. As a result of its positive relationships with the city, the university has made a lot of contributions from social, cultural and economic aspects. Nevertheless, because the city is not ready for this rapid development, various problems have emerged. The most important one is the housing problems for the students who have to get an education away from their families. In parallel to the number of students, the intense increase in the demand for housing and dormitory is the main factor in the transformation of housing to this problem. Especially, the rapid development, which doesn't take care of environmentalist data and has proceeded in an uncontrolled manner due to the need, caused to loss of the qualification in the dormitory buildings where the students spend most of their time out of the school. However, in the design of the dormitories, the ignorance of factors that support students in many ways socially or culturally and should be considered with all aspects has given rise to negative effects on the students' academic success. All these reasons demonstrate that the research area is a region worth examining. In this study, the survey has been made on users of these buildings with data which was obtained in the result of examining architectural projects of the dormitories in Karabük and reviewing the literature, and its results have been evaluated and discussed.

LITERATURE REVIEW

In literature, there are many studies made with different perspectives concerning this subject. Some of the prominent criteria which were obtained from these studies have been used in the evaluation and interpretation of the physical conditions and physiologic effects of the dormitories in Karabük. Dormitories are the spaces where the students from different cultures and with their different characters come together. Therefore, the design process of these buildings should be evaluated both in detail and in a holistic view. It is possible to see reflections and the requirements of this approach in the chosen samples.

The physical environment where students live has different effects on their cognitions. In dormitories which are temporary accommodations, it is expected to make solutions that will increase students' sense of belonging. The extreme formalism is one of the most important obstacles to the sense of belonging.

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İnceoğlu (1995) criticized that a large part of the dormitories was in the form of having a linear corridor and a series of rooms that aligned at both two sides of this corridor. He suggested that the arrangements of the rooms around the halls instead of the corridors with small units could reduce the formal effects (İnceoğlu, 1995). On the other hand, Rodger and Johnson (2005) found that the sense of belonging among students living in suite-style dormitories whose rooms include sleeping, socializing, cleaning, eating-drinking areas together was more than among the students living in the traditional dormitories with the corridor. Similarly, Khozaei et al. (2014) emphasized that suite-style rooms were commonly preferred and the presence of living/using areas that were determined clearly in the spaces was in demand.

Kaya and Erkip (2001) concluded that the students felt that the room sizes were larger and less crowded on the upper floors compared to the lower floors. Middle flats are the most preferred for use due to ease of accessibility and fewer noise problems (Khajehzadeh & Vale, 2014). In addition to building floor organizations, interior designs and density of the used furniture elements in the room's effect on students' satisfaction (Yildirim & Uzun, 2010). In dormitory room organizations, ergonomics and material preferences play an important role in students' perceptions (Çağatay et al., 2014)

In their studies which examined intercultural privacy criteria in the context of Turkey and America, Kaya and Weber (2003) found that American students needed more privacy than Turkish students. They correlated this result with the fact that Turkish people can adapt to the socially intensive environment due to the strong intrafamilial ties and friendships of Turkish society which differentiated from Western society with its culture. Devlin et al. (2008) gave some pieces of advice on the development of social sense by the means of design. In the study, they stated that the organizations where the rooms were located around a center were more successful in the development of socialization, but large-scale dormitories left behind in this subject with the effects of noise and sharing spaces. Similarly, Demirbilek (2012) pointed out that friendship relations in the dormitories were affected by social grouping and the physical conditions like noise and loss of privacy areas due to increasing numbers of the person in the rooms.

In the examined studies, it is observed that the focus is usually on the problems of general floor plan organizations, however, the review of the design of sub-spaces and space in floor plan and room design has not been handled adequately.

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METHOD

In literature, when the studies related to dormitories are observed, it seems that the effects of space have been researched on subjects like senses of belonging, privacy, and crowd which are based on psychology. In the other studies which examined the physical qualities of dormitory buildings, the subjects such as the area-volume needs of spaces, space organizations and the adequacy of the units in these organizations according to their service have been the titles of the research. By the aim of evaluating the architectural qualities of the dormitories in Karabük, in a holistic approach, this research is based on the expectations and satisfaction of the students educated in Karabük University in the 2017-18 academic year about the dorms they stayed. In this study in parallel with the researches on the subject, the problems of the dormitories in Karabük, whose design planning principles have been previously examined in detail, were determined (Öztürk, 2017). In the research, in the frame of the previous researches in the field, the assessment criteria on the designs of the dormitories in Karabük were determined to measure the effects of the psychological and physical qualities of the spaces on the students. The following criteria were tested:

- C_1: The existence of the specialized sub-spaces which are successful in meeting the sense of belonging and privacy is a reason for the students' preference.
- C_2: The increase in numbers of users in rooms and dormitory buildings affects negatively students' preferences.
- C_3: Besides the numbers of furniture/equipment in the rooms, their organization is also effective on satisfaction.
- C_4: Designs of common/service spaces (cleaning area, laundry, etc.) in dormitories have an important effect on students' satisfaction.
- C_5: Designs of social spaces (restroom, study hall, TV room, garden, etc.) in dormitories have an important effect on students' satisfaction.
- C_6: Besides interior space organizations building façade designs also affects students' preferences.

Frequency analysis was used to test the criteria. When starting the survey study, the information about numbers and capacities of the dormitories in Karabük was obtained from Higher Education Credit and Hostels Institution (YURTKUR) and Ministry of National Education (MEB) which are the supervisor of these institutions. According to the obtained data in 2017, while there were seven public dormitories in the control of YURTKUR, the numbers of private dormitories supervised by

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MEB were 19. Karabük city and Safranbolu town were chosen as study areas, while 6741 students benefited from accommodation services in the private dormitories in the control of MEB, 9128 students stayed in the public dormitories, which belong to YURTKUR. The survey sampling consisted of 250 participants who were selected randomly among the students who were educated at Karabük University and stayed in the dormitories. The participants were predominantly the students in faculties of Architecture, Safranbolu Fine Arts and Design and Engineering (Department of Civil Engineering); and Safranbolu Vocational School (Department of Restoration).

The survey included the questions which were prepared to determine the students' expectations from a dormitory building and to evaluate their reviews of the dormitories, in which they stay, for use in the design of a dormitory in the future. There are three sections in the survey. In the first section, there were multiple-choice questions aimed at obtaining students' socio-demographic characteristics and the basic information about the dormitories, in which they stayed. The content of the second section is concerned with the determination of students' expectations and reviews about the spaces which should be in a dormitory. The third section contains students' evaluations of the organizations of existing and active dormitories. In the second and third sections, a five-point Likert scale was used in the evaluations of students' expectations and existing conditions of the dormitories except for the questions about dormitory building and numbers of people in a room.

In the result of the survey, the obtained data were evaluated by SPSS software (statistical package for social sciences). In the analysis, the questions were discussed respectively, and the frequency, percentage and standard deviations were calculated for students' participation level in the questions. The data was presented in the tables.

FINDINGS

The statistical analysis method was applied to the survey which was conducted on the students at Karabük University and the results were discussed. As stated before, in the first section demographic information about students is given. While table 1 is viewed, the results are as follow:

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Table 1. Demographic information about the students participating in the study

Section I: Personal Information

		F	%
1. What is your gender?	Female	110	44
	Male	140	56
2. What is your cumulative grade point average?	Under 2.00	56	22,4
	Between 2.00-2.50	92	36,8
	Between 2.50-3.50	102	40,8
	Between 3.50-4.00	0	0
3. How many years have you been living in the dormitory?	Less than one year	142	56,8
	Between 1-2 years	62	24,4
	Between 3-4 years	29	11,6
	More than four years	18	7,2
4. What is the type of dorm you stay in terms of administration?	Public Dormitory	115	46
	Private Dormitory	135	54
5. How many people do you stay in the room?	One person	18	7,2
	Two people	78	31,2
	Three people	59	23,6
	More than four people	95	38
6. Where would you prefer to stay if you had a chance to choose or your budget was available?	With my family	97	38,8
	Private Dormitory	24	9,6
	Public Dormitory	15	6
	Student Home	114	45,6
7. What is your reason for staying in a dorm?	Being economic	108	43,2
	Being Close to school	67	26,8
	Being comfortable	27	10,8
	Being secure	36	14,4
	My friends stay	12	4,8

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- In the evaluation, the answers of 250 students (110 male and 140 female) were examined. According to this, 44% of the participants are male and 56% of those are female students.
- 46% of the participants stayed in the public dormitories and 54% of them lived in the private dormitories.
- Considering the duration of life in dormitories it seemed that many of the students stayed in these buildings for less than one year (56,8%).
- When the numbers of people in the rooms are examined, it is observed that the participants commonly lived in the rooms with two people (31,2%) and the rooms with four and more people (38%).
- In terms of the types of accommodation buildings which participants can choose to stay if they have a choice, it was observed that the most preferred options were that of "student house" (45%) and that of "their family houses" (38,8%), but the options of "public dormitories" (6%) were the least preferred.
- While asking reasons for staying in a dormitory to participants, it is noteworthy that most of them chose to stay in these buildings because of economic conditions (43,2%).

In the second section, the questions about students' expectations about dormitory buildings were asked. While Table 2 is examined, the obtained results can be explained as follow:

- In response to the question "how many people does the crowd sense starts to be felt with in a dormitory" when 40,8% of participants pointed out "More than 100 people", 40% of that signed "more than 500 people" in the survey. Considering the conditions of public dormitories whose capacities have changed between 750 and 3000 people, this result is important and supports C_2 criteria.
- It is noteworthy that 50.4% of the students stated that they should have double-dorm rooms. This result is concerned with the criteria in C_2.
- In this section, the questions prepared on the 5-point Likert scale are related to the separation of rooms and flats into the spaces, which have sub-functions, by aiming at determining students' needs of privacy. Regarding spaces that are expected to be in the room and are necessary for students, the rates of participants' answers of "I agree completely" were listed as 79.2% about the private bathroom, 50.8% about the resting-living area, 72.4% about the work area. Furthermore, in terms of the spaces which are expected to be in common use and are necessary for students in a flat, the rates of participants' answers of "I agree completely"

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resulted as 42,8% about the kitchen, 45,2% about studying areas, 37% about resting area. These results support the criteria proposed in C_1.

Table 2. Information on participants' expectations from a dormitory building.

Section II: Expectations From A Dormitory Building

		F	%
8. How many people does the crowd sense start to be felt with in a dormitory?	After 100 people	102	40,8
	After 500 people	100	40
	After 1000 people	38	15,2
	After 2000 people	10	4
9. How many people a dorm room should have	One person	60	24
	Two people	126	50,4
	Three people	48	19,2
	Four people	16	6,4

		Never	Partially	Medium	Generally	Completely
10. A private bathroom should be located in the room.	**f**	15	7	14	16	198
	%	6	2,8	5,6	6,4	79,2
11. There should be a resting area in the room.	**f**	18	10	46	49	127
	%	7,2	4	18,4	19,6	50,8
12. There should be a special study area in the room.	**f**	11	8	13	37	181
	%	4,4	3,2	5,2	14,8	72,4
13. A common kitchen should be located in a dormitory building.	**f**	25	29	46	43	107
	%	10	11,6	18,4	17,2	42,8
14. A common study space should be located in a dormitory building.	**f**	16	17	55	49	113
	%	6,4	6,8	22	19,6	45,2
15. A common resting space/area should be located in a dormitory building.	**f**	13	27	64	53	93
	%	5,2	10,8	25,6	21,2	37,2
16. Bathroom and WC should be in common use within the building.	**f**	155	34	25	8	28
	%	62	13,6	10	3,2	11,2

In the third section, students were expected to evaluate the dormitories where they resided. When table 3 is examined;

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Table 3. The information about students' opinions concerned with the dormitories where they live.

Section III: Opinions About The Dormitory		Never	Partially	Medium	Generally	Completely
17. I'm pleased with the number of people in the room.	**f**	42	24	78	34	72
	%	16,8	9,6	31,2	13,6	28,8
18. I think that the study area is adequate in the room.	**f**	72	72	49	21	37
	%	28,8	28,4	19,6	8,4	14,8
19. I'm pleased with the location of the study area in the room.	**f**	71	54	67	24	34
	%	28,4	21,6	26,8	9,6	13,6
20. The numbers of furniture (table, cupboards, etc.) are consistent with the numbers of users.	**f**	42	31	58	41	78
	%	16,8	12,4	23,2	16,4	31,2
21. I think that the size of the room is sufficient in terms of numbers of people.	**f**	66	50	59	37	38
	%	26,4	20	23,6	14,8	15,2
22. I think that the social areas where I can spend my free time in the dormitory are enough.	**f**	93	67	44	24	22
	%	37,2	26,8	17,6	9,6	8,8
23. The study area is not enough in the room	**f**	46	43	53	40	68
	%	18,4	17,2	21,2	16	27,2
24. I'm pleased with the organization of furniture in the room.	**f**	50	39	93	45	23
	%	20	15,6	37,2	18	9,2
25. Service units (laundry, shared bathrooms, etc.) in the dormitory are sufficient.	**f**	53	54	74	41	28
	%	21,2	21,6	29,6	16,4	11,2
26. I can benefit from the garden of the dormitory building adequately.	**f**	58	44	72	44	32
	%	23,2	17,6	28,8	17,6	12,8
27. The dormitory building generally meets the expectations of a university student.	**f**	116	50	38	28	18
	%	46,4	20	15,2	11,2	7,2
28. The façade features of the building (color, material, shape, etc.) are effective in choosing this dormitory.	**f**	33	66	87	45	19
	%	13,2	26,4	34,8	18	7,6

- For the statement "I think that the area of study is enough", 28,8% of students responded as "I disagree" and 28,4% of that stated as "I agree little". It is known that there is a study

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area in rooms in all the dormitories which were examined before. In this case, the obtained results are thought to be related to the positions of these areas and the insufficiency of their functional area in the rooms. Accordingly, these results support the criteria proposed in C_3.

- While for the statement "I'm pleased with the location of the study area in the room" 28,4% of the students answered as "I didn't agree"; for the same statement, 37,2% of them said that they agree partially. As stated before, these results are concerned with the criteria in C_3.
- In terms of the adequacy of the service areas in the dormitory buildings, students answered at the rate of 21% for the statement of "Not enough at all" and at the rate of 21.6 for the statement "Less than enough". These results support the criteria proposed in C_4.
- It is considered that the dormitory building should not only have a sleeping area but also the areas where students can perform their social and cultural activities. So, in the survey, one of the statements was related to the sufficiency of social areas for spending the students' free time. About the statement, 37,2% of the participants had a negative opinion. These results support the criteria in C_5.
- The statement "The façade features of the building (color, material, shape, etc.) are effective in choosing this dormitory" was asked by expectations that façade features are effective on the preference of dormitory buildings. 34.8% of the students at intermediate level and 26.4% of them at less level concurred with this opinion. These results don't support the criteria proposed in C_6.
- Finally, the responses are interesting for the statement "The dormitory building generally meets the expectations of a university student" because 46% of students said that they disagree.

RESULTS AND SUGGESTIONS

Dormitory buildings are the type of building where the other different needs of the student who are away from their family are met in addition to that of accommodation. In this context, the design solutions of a dormitory with good planning are important for providing the support, which a student needs in the phase that they start to acquire new experiences by themselves.

In this study, students' expectations from a dormitory building and their satisfaction with the dormitory where they reside were investigated. In the previous researches, it was pointed out that the physical properties of a dormitory building affected students' physical and psychological requirements. In the consideration of

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that meeting these requirements is directly effective on the satisfaction, it was also important to analyze the criteria which affected them. By using the obtained results from the survey for analyses of them the attention was drawn to develop the qualifications of existing spatial elements in the dormitory buildings. Accordingly, from the results of survey and literature studies the evaluations can be explained as follow:

In most of the case studies presented in this paper, it seems that there is a general tendency on suite-style dormitories. In Karabük, this tendency is also supported by the preferences of 45% group on student home and the answers to questions concerned with using specialized and common spaces for students' basic needs.

Taking care of the answer to the question of "Crowd" sense and the case of that public dormitories were the last choice in the survey, as stated before, it is considered that sense of belonging is weak in these dormitories due to their high capacities and their locations away from the city center despite the positive architectural planning in their rooms. Besides, it is known that the increase in numbers of people may cause to existence of an environment where students do not like to live. Therefore, a more formal environment is another important obstacle to the acquisition of a sense of belonging (Adler, 1999).

In the recent regulations, students are permitted to stay in the rooms, the capacities of which consist of one, three, four, five and six people. However, it is interesting that students usually preferred the room with two people in the survey. This case may be concerned with the existence of social relationships in Turkish society, unlike Western societies (Kaya & Weber, 2003). It is considered that students' desire to have at least one other person in the room may be related to fear of loneliness and to a certain level of socialization.

While architectural plans of dormitories are examined, it is seen that studying areas for students are defined (Öztürk, 2017) However, about 57% of participants (28,8% of participants disagreed and 28.4% of them agreed partially) said that studying areas are insufficient in the survey. Additionally, almost half of the participants stated their displeasures about the placements/positions of their studying areas (28,4% of participants disagreed and 21.6% of them agreed partially). Here the significant part of the participants in the survey was comprised of the students who were educated in the departments of painting and architecture and architectural restorations. For these students, when the content of the curriculums of the departments is examined in detail, the need for special study areas emerges. This situation is effective in the results. So, in the designs of these buildings, as in the study of

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Filiz and Çemrek (2007), it should be considered that different spatial requirements can be needed for the students educated in different fields.

As another result, while the answers to the compatibility between numbers of furniture and numbers of people in a dorm room are positive (31,2% of participants agreed completely and 16.4% of them mostly agreed), the rate of satisfaction in settlement organization of furniture is lower (9,2% of participants agreed completely and 18% of them mostly agreed). Accordingly, in the scale of Karabük, it is possible to conclude that both quantitative and qualitative values should be considered. In this way, as Yildirim and Uzun (2010) pointed out before, it is necessary to pay attention to defined personal using areas and physiological processes.

In the dormitory buildings, it is important to support students in terms of their socialization needs as well as meeting the personal basic requirements. Besides, most of the students stated that there should be resting areas as common spaces in the dormitories. However, they pointed out the insufficiency of the social activity areas that are designed for leisure times. In the dormitories in Karabük and their design briefs, the spaces like rest-TV room, multi-purpose hall, indoor and outdoor areas for sports activities are generally taken place (Öztürk, 2017). Nevertheless, it is considered that this contradiction exists due to users' different demands, lack of diversity in this aspect and insufficiencies of size and physical conditions of the spaces for this aim.

Besides the design problems of the dormitories, it should be remembered that some dissatisfactions are originated from the emergence of some administrative mistakes like the increase in the numbers of the users and positioning the spaces in the places in the building out of initial planning. Regarding the issue, it is known that physical opportunities at first and administrative satisfactions later are preferential in student' service purchasing decisions (Ayaz & Başdağ, 2016).

In spatial analyses of dormitory buildings, the focus is generally on the sleeping areas. Naturally, in the ranking of design criteria, the arrangements of the social areas remain in the background. Therefore, in the design of social areas, by taking care of that these areas are changeable according to the conditions, their solutions should be more qualified, flexible, sustainable, and suitable for their functions. Additionally, the control of the spatial qualities in these areas should be supported by rules of the regulations.

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Research Article

Design Thinking to Familiarize Hearing-Impaired Architectural Drafting Students with Human-Centered Design Concept

Meltem Özten Anay*

Abstract

Purpose

Developing a human-centered design understanding in built environment-related professions and enabling them to encompass diversity are crucial for the improvement of more inclusive environments. Considering the value of guiding experiences of people with disabilities for more inclusive design practice and increasing the awareness of professionals with disabilities in design and building practice plays a key role in achieving this goal. There is a growing effort to implement inclusive and universal design issues to the educational programs of design and related disciplines for about two decades. Contrary to the developments in the pedagogy of "core" design disciplines, human-centered design perspective seems not to be widespread enough in the education of so-called "peripheral"

Keywords: *Architectural design, human-centered design, architectural drafting, design thinking, hearing-impaired students*

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occupations of design, like architectural drafting, especially in Turkey. Design Thinking (DT) approach, which is defined as a way of thinking, is in fact widely used in the design-related fields. In such a need of human-centered and creative problem solving, the approach seems to provide a potential to raise awareness about user-oriented design in such peripheral occupations like architectural drafting education. Considering the widening use of strategies of DT also in non-design fields, the research out of which this article comes from involves a special adaption of the approach. Departing from the ultimate aim "to raise awareness of hearing-impaired architectural drafting students about user oriented architectural design," it applies the strategies of the DT to this special case and reports the process and its findings, hence not only providing a special instance of the model but also revealing its potential contribution to peripheral or non-design disciplines.

Design/Methodology/Approach

Since it particularly focuses on understanding of human behavior, provides flexible and holistic tools to investigate such phenomena and since it is based on a systematic and reflective process, the present research was carried out through qualitative research approach and its tools.

Findings

Study showed that in relation to hearing-impaired students' underlined need for getting familiarized with the process of architectural design and focusing on human-centered design approach, present application of Design Thinking strategy worked effectively to provide basic information about architectural design, design process, and related tasks and user needs as well, as part of design process for hearing-impaired architectural drafting students with a certain level of hearing loss and language ability.

Research Limitations/Implications

Since the research was embedded within the existing educational system, data collection and observation processes had to be defined according to these boundaries. Also the students' level of language abilities and their limited background about their field of study, because that they were first year students were the main limitations of the study. Apart from its aforementioned outcome, the research was a means of expanding the application of the initial DT model, and it could be seen as a contribution to the existing studies concerning the education of the hearing-impaired students. In general, the research illustrated that DT, as a carefully developed approach to be employed particularly for non-design occupations, could also be effectively used to teach design process for disabled design professionals. Consequently, it is thought that it could be applied to the formulation of courses such as; environmental design, design for all, inclusive design, as well as be utilized for students developing empathy with users, familiarizing with observation and interview techniques, and as a means of quick and systematic problem solving sessions.

Practical Implications

As it might be expected the study primarily contributes to the education of the hearing-impaired students. It helped students to develop an understanding of design process as well as develop their

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professional schemata (i.e. their conceptual vocabulary). As a research it provides a foundational knowledge concerning application of DT strategies in a specific field of study.

Social Implications

By nature, one of the basic problems confronting students with disabilities is to make them an integrated part of the society, from daily life to some specialized situations such as professional life and their education. Researcher strongly believes that this study has had implications as such although it was not primarily involved with such a goal.

Originality/Value

As it might be guessed the present study might be considered as a part of and a contribution to a larger research tradition evolving around the Design Thinking approach, i.e. its application and adaptation to different areas and field, and development of the strategy itself. On the other hand, since it adapts and applies DT to a specific case, and an original problem situation, actually a very rarely addressed one. As such, while it might be considered as a special contribution to that specific tradition, at the same time its primary contribution is to the education of the hearing-impaired students, and its pedagogy.

INTRODUCTION: THE THEORETICAL AND CONCEPTUAL FRAMEWORK

The social concerns of disability have been the central issue within the disability studies both in United States and in Great Britain, since 1970s. They both share the same goal of eliminating environmental barriers either in social or in physical spheres. It could be claimed, “everyone is disabled,” to a certain extent, given the (poor) physical environment, by poorly designed products, services and by the (straining or incompatible) social environment. This is the “social model” of disability as it was differentiated from the so-called “medical model,” which defines disability as a medical condition of an individual that defines a person’s identity (UPIAS, 1976; Owen & Johnston, 2003; Shakespeare, 2010).

The United Nations Convention on the Rights of People with Disabilities (CRPD) is the first comprehensive treaty establishing the right of people with all types of disabilities to equality, dignity, autonomy, and full participation in society (United Nations, 2008). Based on this perspective, controlling the enabling, or disabling power of environmental factors and making design process more inclusive for everyone are underlined as the main issues of designers (Ostroff, 2010). This requires developing in-depth understanding about diverse conditions of users. In addition to improve designer’s abilities and tools to search for user experience, it is emphasized that, not only active participation of users to design process as user/experts and sharing their experiences with designers, but also increasing the representation of designers with different

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abilities in design professions is critical to develop more inclusive environments for everyone (Ostroff, 1997; Manley et al., 2011).

In the last few decades, studies strongly indicate the importance of developing a human-centered design understanding in disciplines and occupations concerning the built environment, in order to eliminate environmental barriers and formation of more inclusive environments for all users (ResAP, 2001); Morrow, 2002). The Committee of Ministers of the Council of Europe provided a regulation for vocational and higher education, on the introduction of inclusive design approach to the curricula of occupations working on the built environment (ResAp, 2001). Considering the importance of developing a human-centered design understanding among the built environment related occupations, improving awareness of built environment professionals with disabilities about human-centered design and encouraging them to contribute their experience and perspective to the design and building practice are crucial (Manley et al., 2011). As it is understood from the above emphasis, this transformation will begin with the education of built environment-related occupations and with the implementation of human-centered design approach to their educational programs.

In addressing abovementioned situation, Design Thinking (DT) approach seems to be a plausible model to embrace. This is because apart from its major application in design-related fields, it is becoming more recognized in non-design areas, since it offers that ability of design can be learned by anyone to solve problems in an innovative and human-centered way (Dorst, 2011; Tschimmel, 2012; Shapira et al., 2017). Among the major approaches for the application of DT, IDEO's concept of DT is underlined, which provided detailed steps of their process and cases to disseminate their methods for people in non-design fields, like management, education, health (Kimbell, 2011; Tschimmel, 2012; Johansson-Sköldberg et al., 2013). Essential aspects of DT are defined as empathy, ideation, and experimentation, which reflect a user oriented design activity. Providing a useful process that is based on emphasizing with users, DT has a great potential to extend the issue of human-centered design perspective towards the education of non-design occupations of built environment and familiarize architectural drafting students with human-centered design process.

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THE PROBLEM SITUATION

Architectural design and its major application in building sector operates through cooperation of diverse professions from architects, engineers, architectural drafters to construction workers. Although their fields of study and responsibilities are very different, a human-centered design understanding as a common framework seems to be plausible in order to support the design process properly, participate the teamwork efficiently, and establish effective communication as a team member. It is obvious that gaining awareness about inclusive design approach is necessary for peripheral occupations of design to contribute the creation of inclusive environments and the removal of barriers.

Architectural drafting is one of such occupations, whose education requires covering "architectural design culture" as one of the important issues in its curriculum, since an architectural drafter work with architects and engineers by preparing detailed drawings of architectural and structural features of buildings. This job description involves knowledge about drawing techniques, building types, building materials, and construction, as well as knowledge about architectural design process. The emphasis is not on learning architectural design but on being acquainted with design process, how architects doing design, gaining awareness about human-centered architectural design activity.

However, despite remarkable progress in the education of design disciplines towards more inclusive design approach (Welch, 1995; Preiser & Ostroff, 2001; Morrow, 2002; Manley et al., 2011), there is no adequate development in the education of peripheral occupations of design, like architectural drafting. Neither information about architectural design process nor human-centered design approach and related issues seems to be addressed among the main objectives in the curriculums of architectural drafting programs in Turkey. When it comes to disabled students in architectural drafting education, the issue is vaguer.

Embedded within the abovementioned complex framework and in addressing the aforementioned issues/concerns/goals the present study is employed as an integral part of a teaching/learning process conducted in a special educational setting. The research involves first year hearing-impaired students of Architectural Drafting Program of the School for the Handicapped, Anadolu University, between the fall and spring semester of 2017-2018. With a special emphasis on the issue of "raising awareness of hearing-impaired architectural drafting students about user oriented architectural design," the educational process provided both basic information about user

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oriented design approach and a hands-on experience concerning its practical application. The strategies of the DT approach were employed.

Conducted as a part of such an experience, the main purpose of the research is to understand and define the contribution of DT as a teaching strategy, particularly towards familiarizing hearing-impaired architectural drafting students' with "user oriented architectural design process" in relation to their occupation.[1] The research question was defined as "how the process of DT activity was performed?" The present study reports the process and its findings, hence not only providing a special instance of the model but also revealing its potential contribution to peripheral or even to non-design disciplines. Moreover, considering the information gap on these issues in both the design literature, and the literature concerning education of the handicapped, the research was also expected to contribute to these research frameworks.

THE EDUCATIONAL SETTING

The research was carried out with the participation of hearing-impaired architectural drafting students at the School for the Handicapped (Engelliler Entegre Yüksekokulu), Anadolu University. The School for the Handicapped (SFH) is an institution that provides university level education for hearing-impaired students in Turkey. Among students with disabilities, hearing-impaired students form a different group, which requires adaptation of education programs for their needs, due to their limitations of language use. The vocational education of SFH are supported with scientific researches for the improvement of the university level education of hearing-impaired students. Architectural Drafting is one of the associate degree programs of SFH, which aims to train hearing-impaired students as a technical staff for building industry. Preparing hearing-impaired students for their future workplaces and equipping them with required skills and knowledge are the main goals of the school. As part of these goals, language support is given, along with the field courses, for the improvement of communicational skills of the students in workplaces.

Since the architectural drafting occupation requires active and constant interaction with architects, civil engineers, contractors, learning effective use of professional language of building industry and architectural design is necessary for the students of architectural drafting. In the field courses, students learn most of the terms, concepts, and processes of the field of architecture and built environment. The focus of the courses is on building types, elements of building, structural elements, materials, furniture organization, drawing techniques, computer based

[1] Although there is no existing research addressing architectural design education of hearing-impaired students, a few notes from the previous experience of the researcher must suffice here. The aforementioned specialized-school once have had an "integrated" department of architecture, a four-year undergraduate program precisely reserved for hearing-impaired students working in corporation with the existing architectural department of Anadolu University. As observed from the classes and particularly from the design studios, architecture, a discipline that, to a great extent, relies on verbal communication/dialogue and being itself a language, depending much upon immaterial and abstract concepts, was a real challenge for a hearing impaired student. Suprisingly, at that time existing research on education of the hearing-impaired did not help, possibly because of the mostly ill-defined nature of architectural knowledge, and of course the design process itself. "Integration" carried the department so far, and actually it was thought to be particularly beneficial for he students to "feel" as a part of the society. But, all educators involved in this special case, including the present researcher, then suspected that such an undertaking required a setting and set of unique pedagogical considerations, perhaps even novel models, those exist neither within that great tradition of architectural education, nor within the vast mainstream hearing-impaired education doctrines. There was no chance to continue such explorations, since the program was frozen.

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drawing. Although graduates are expected to work mostly as part of the process of architectural design and be in close relationship with architects, familiarizing students with the concept of "architectural design" is not among the main objectives of the curriculum, or the topics of the courses. The notion of "architectural design," is just covered in one or two-week topic in one course.

From the responses of students, and graduates, it was observed that studying on definitions and examples were not enough to understand "architectural design," since it is actually a process based and an activity that is learned by doing. It was also observed that, after two-year intense education of architectural drafting program, learning the main issues, terms, concepts and processes of architecture, some of the senior students, even graduates used the terms "architectural design" and "technical drawing," and "architect" and "architectural drafter" interchangeably showing the lack of developing a keen understanding about "architectural design."

These problems indicate that there is a need for a strategy to improve students' understanding of "architectural design," at least for accurate conceptualization of "architectural drafting" as their own occupation. It is important for hearing-impaired architectural drafting students to get familiar with "doing user-oriented architectural design," "process of architectural design," and related terms and concepts in order to perform design related tasks, establish meaningful, effective communication with their colleagues in workplaces, and transfer their experiences as professionals especially in addressing the disability problems concerning the build environment.

Design learning is a compelling process by nature, since it requires certain level of knowledge, complexity of skills, and time for improvement, particularly for participants from non-design fields. Although providing a complete design education is not the purpose here, it is also necessary to support hearing-impaired students with additional measures in an application of simplified design process that aims to raise awareness. The researcher's eight years of experience with education of hearing-impaired architecture students on design also supports this.

THE RESEARCH SETTING AND THE METHOD

The qualitative research approach focuses on understanding of human behavior, provides flexible and holistic tools to search for the phenomena and it is based on systematic and reflective process (Lincoln & Guba, 1985; Bogdan & Biklen, 2007; Glesne, 2011). Since the main purpose of the research was to explain the design learning process of hearing-impaired students and working with hearing-impaired students needs systematic and

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reflective approach, qualitative research approach and its concomitant techniques and strategies were selected to focus on design learning processes of students.

Typically, there are three types of data gathering methods most commonly used in qualitative research; interview, observation and document analysis. In the present study, to increase the quality of the research by confirming the credibility of the data collected in the study and provide a broader perspective various data collection techniques were used together.[2] On this base, observation and document analysis were selected as the main data collection techniques of the research. Written documents involved student and instructor diaries, the reports of planning and evaluation meetings of trustworthiness committee, course plans, and messages of Facebook course group, e-mails, student presentations. Additionaly course products, which were developed for course assessment during the course and process photographs, were used to support main data gathering techniques. All data obtained, as observation notes and written documents, were analyzed descriptively during and after the process. Analysis of the research data was made simultaneously in a cyclical, systematic, and reflective way. As it was underlined by Lincoln and Guba (1985) trustworthiness in qualitative researches, as compared to validity and reliability criteria is of prime importance. The main criteria of trustworthiness are expressed as credibility, dependability, confirmability, and transferability. With this purpose, opinions and suggestions of the field expert were taken throughout the planning and evaluation meetings in the research.

The research was conducted at the Department of Architecture and City Planning, Architectural Drafting associate degree program, SFH, Anadolu University. The research data was collected from the twelve weeks of the Professional Language I-II courses of the program. For the research, one classroom was used. Considering hearing requirements of the students, the classroom, where the research was conducted, was equipped with appropriate sound insulation (Girgin, 2003). To support educational setting in the classroom, there were equipment like a smart board, eleven tables (four of them was used), which were also compatible with technical drawing studies, eleven chairs (five of them was used), a small additional mobile board, and wall panels to mount class works of the students (Figure 1).

[2] Observation is a widely used method in qualitative research in order to describe the behavior that occurs in any environment in detail. Observing human behavior in its natural environment is a prerequisite for a realistic examination of these behaviors. It is also underlined that document analysis, as one of the main data gathering techniques, can be used as a primary data collection technique, or it can be used as a supportive tool, when other data collection techniques are used in qualitative researches. Curriculum documents, student records, meeting reports, student works and exams, teacher files, class diaries can be used as main data sources in qualitative educational researches (Bogdan & Biklen, 2007; Şimşek & Yıldırım, 2011). When document analysis is used with other data collection methods such as observation and interview, it increases the validity of the research to serve the purpose of data triangulation (Şimşek & Yıldırım, 2011).

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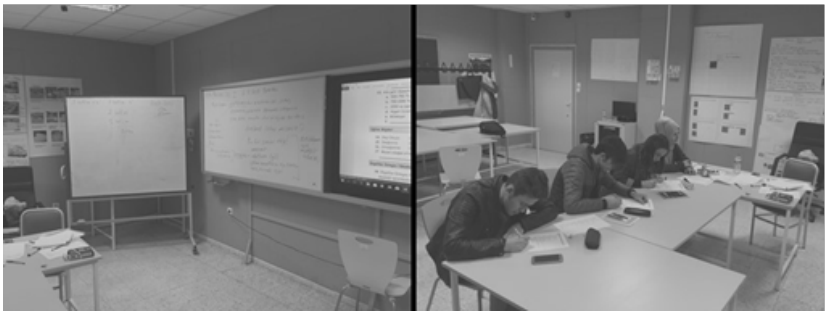

Figure 1. The classroom setting (Photograph by the author, 2017)

Students, an instructor (researcher), and a field expert were the main participants of the research. There were five student participants. They were first year students of Architectural Drafting program in the fall and spring terms of 2017-2018 school year. They had severe and profound level of hearing-impairment (Table 1). The students wore ear level hearing aids. The average age of the students was 19. All of the students were informed about the purpose, process, and dissemination of the research and all of them participated voluntarily (Ryen, 2011).

Table 1. General characteristics of participant students

	Student	**Age**	**Gender**	**Hearing Loss (dBHL)**	
				Right	**Left**
1	NA	20	FM	75	57
2	HA	20	M	97	103
3	Nİ	18	FM	97	100
4	SA	18	M	87	87
5	İS	18	M	110	110

The researcher and the consultant were academicians. The researcher as the instructor of the course had expertise of 23 years in higher education of hearing-impaired students covering Program of Architecture and Program of Architectural Drafting. In addition, she had a PhD degree in architecture and education of architectural design. She conducted architectural design studio courses in other architecture departments with normal hearing students for about 20 years. She conducted and participated academic researches on architectural design, user participation, and education of hearing-impaired, and qualitative action-research.

The consultant as a field expert of education of hearing-impaired students had 24 years of experience. Trustworthiness of data collection were carried out by the researcher and the consultant. As an academic member of the administration board of the SFH, the consultant both coordinated action-research projects and contributed them as a researcher. She had a Ph. D. degree in the education of hearing-impaired. Both researcher and the consultant had academic publications on education of hearing-impaired at university level.

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The research data was collected with the DT activity phase of the research, during the last nine weeks of fall semester and first three weeks of spring semester of the 2017-2018 educational year. Data collection and analysis were organized with the contribution of planning and evaluation meetings. The research was conducted with a weekly systematic process in relation to planning and evaluation meetings (Figure 2).

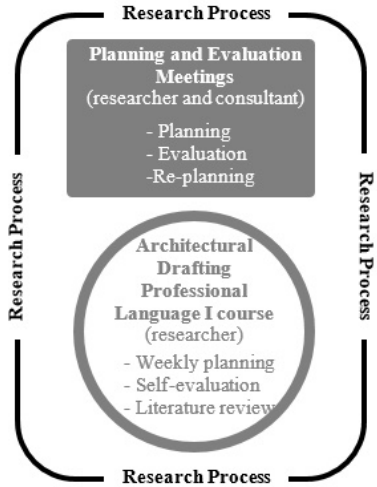
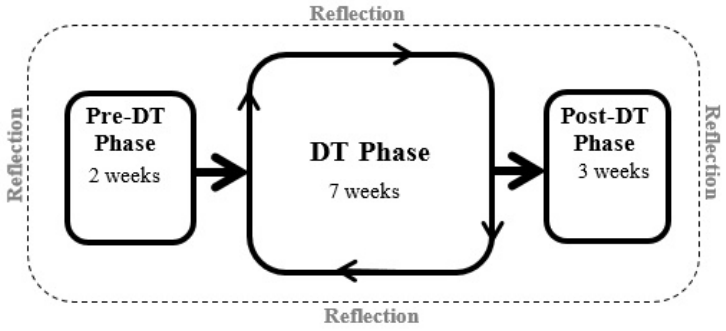


Figure 2. The research cycle

The planning and evaluation meetings were held nearly in every three weeks from the beginning of the process. There were five planning and evaluation meetings during the research process. Information was shared through office meetings, e-mails, and reports with the researcher and the consultant. Before and after each sub-phase of the research, the course plans and produced material were examined in the meetings.

THE STUDY, FINDINGS, AND EVALUATION

The findings of the study are presented in relation to the research question "how the process of DT activity was performed?" The DT activity process of hearing-impaired architectural drafting students consisted of three main phases; Pre-DT phase, DT phase, and Post-DT phase (Figure 3).



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Although the main DT activity was conducted in the concerned phase, pre and post phases were planned considering the learning needs of hearing-impaired university students, (Uzuner et al., 2011; Kaya et al., 2013; Uzuner and Derican, 2013; İstel, 2018). Pre-DT phase aimed to prepare the students to participate design process, providing them base information and a reason "why they need to familiarize with architectural design." On the other hand, Post-Dt phase aimed to provide students an opportunity to think on their previous design processes with a different assignment involving a different design problem. These phases of the process were explained in in the following part.

Pre-DT Phase

Pre-DT was a two-week phase and aimed to provide students main concepts of their field Architectural Drafting, which included clarification and consolidation of the concepts; architecture, architect, architectural design, architectural drafting, drafter, technical drawing (Figure 4). Although this phase was not directly related with the DT activity and design process of students, it provided students a base for the next DT phase. The main objectives of this preliminary phase were:

1. Providing students a knowledge base, a framework about their profession; architectural drafting, about their drawing related duties and responsibilities in workplaces, about its relation with architecture, architectural design.
2. Informing them specifically about design, architectural design, and examples of design to raise an interest about design process, which was the main issue of next phase.

Figure 4. Examples from the student presentations and class notes in pre-DT phase (Photograph by the author, 2017)

Design Thinking (DT) Phase

DT phase of the research was about eight-week phase. This was the main process of DT activity of architectural drafting students. The main goal of the DT phase was to enable students to execute a simple design process through their own learning by doing actions.

Before presentation of the findings of this phase, general overview of the adaptation of DT4E, as one of the DT approaches, is provided. DT4E is developed by IDEO group for the educators

specifically (IDEO, 2012). DT4E originally suggested five main steps of design; discovery, interpretation, ideation, experimentation, and evolution (Figure 5).

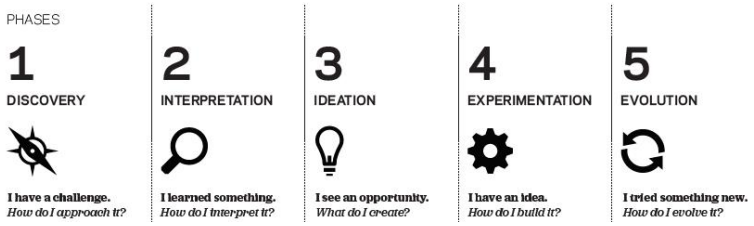

Figure 5. Main steps of DT4E (IDEO, 2012)

It is explained in the DT4E model of DT process that discovery step covers understanding the challenge, preparation of research, and gathering inspiration. Interpretation step includes telling stories, searching for meaning, and framing opportunities; ideation step includes generating ideas and refining them; experimentation step covers making prototypes and getting feedback activities; evolution step covers tracking learnings and moving forward (IDEO, 2012). Although these are the suggested steps of DT process in action, it is noted by the developers that this steps can be adapted by educators according to their aim, problem, and setting, without losing its core relations and meaning. Since present research aimed to provide architectural drafting students an acquaintance with the process of architectural design, there was a time limit for applying the process, and there was not a considerable framework for teaching design to hearing-impaired students, except a master thesis, which was conducted with graphic arts students in SFH (Uzuner and Derican, 2013). In his study, the discussion was not specifically on teaching design process to hearing-impaired Graphic Arts students. It was an action research process, which applied on design teaching-learning process and exemplified students' designing processes of portfolio, so portfolio design process itself may provide important clues of designing experiences of students and action research process, which has similarities with design process for the research.

The DT activity process of hearing-impaired Architectural Drafting must response also learning needs of hearing-impaired students and involve teaching-strategies for hearing-impaired students. It is underlined the importance of meaningful and active settings to apply learned skills and knowledge, importance of real goal and/or product oriented education, importance of how the process is taken place (Uzuner et al., 2011; Kaya et al., 2013). Kaya et al. (2013) stated that doing exercises in order to teach required skills is more successful if it is done after theoretical knowledge was given to hearing-impaired students as a successive activity. Kaya also underlined the importance of

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repetitions and enrichments for the improvement of required skills and knowledge. Assessment process is also critical for the education of hearing impaired. The techniques like question-answer sessions during the class, successive activity, and enrichment activity at the end of the class, control lists, which help students to evaluate their learning processes, application procedures, pre and posttests, and monitoring assessments during the class provide support for assessment of the learning-teaching process for both teachers and students (Kaya et al., 2013). The findings of Uzuner and Derican (2013) also support the validity of these techniques in graphic design teaching. In the DT process, design-learning process of hearing-impaired Architectural Drafting students was carried out with combining underlined techniques.

With these grounds, DT phase of hearing-impaired students was organized with four main activities, which corresponded to identified five steps of DT4E (IDEO, 2012), which were problem framing, idea generation, testing and evolution. Table 2 shows the duration of these steps.

In the present research, both discovery and interpretation steps of the DT4E model were combined in one step as problem framing, since performing discovery and interpretation steps together. This provided students data collection and reflection on collected information about what was found and what was required in sub-activities, which was more beneficial and meaningful considering learning needs of hearing-impaired students.

Table 2. The duration of the main steps of DT phase

The name of the step	Date	Duration	
Problem Framing	October 30, 2017 – November 13, 2017	3 weeks	
Idea Generation	November 20, 2017 – December 04, 2017	2 weeks	3 weeks
Testing	December 18, 2017	1 week	
Evolution	December 25, 2017	1 week	

Although the main steps of the DT phase showed a successive character, the steps were also iterative and reflective. Idea generation and testing steps of the DT phase corresponded ideation and experimentation steps of DT4E. Considering suggested teaching strategies for hearing-impaired and clarity of design process for students, who were unfamiliar with design process, it was also decided that integrating idea generation and testing steps together was more efficient and persistent. This is since the process involved regeneration and refinement activities successively, which required students testing the idea with the data coming from their research in each cycle (Planning

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and Evaluation Meeting, 2017). Evolution step was remained the same with DT4E, however, its reflective and implementation oriented activities were limited with thinking on "what was done and learned in the design process?" and sharing the process with others, since the time limit of the course. The steps of DT phase involved various sub-activities; Figure 6 shows main steps of DT phase and these sub-activities.

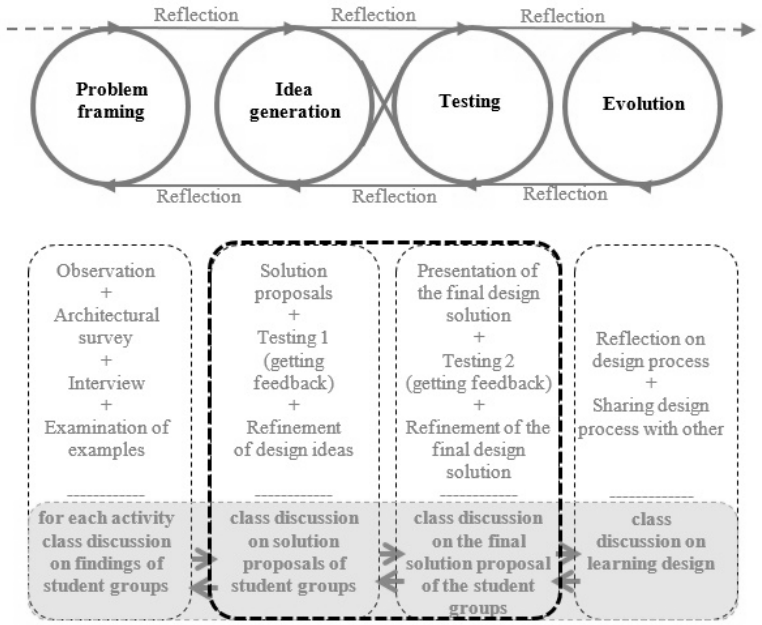

Figure 6. Main steps of design thinking (DT) phase and sub-activities

In addition to class hours (three hours a week), additional hours were used as a support for students in some weeks and Facebook course group was used for discussion, question-answer, and archive of the material produced in activities, and planning during the process. At the beginning of the DT phase, students were informed about the overall activities and the process. They were asked to make two separate groups. The design problem was selected from architectural design field. However, considering designing a space from the scratch was a highly complex problem for those who did not familiar with design, it was decided to be a space organization problem. At the end, the instructor suggested that two of the school spaces that could be redesigned by the students. They participated to the idea. Each group decided on their problem spaces; entrance hall was selected by the group 1 and canteen was selected by the group 2.

In the problem-framing step, students were expected to search their design problem with various research tools and define the situation, problems, needs, and user opinions in relation to design problem. With this goal, the main tasks of the students were:

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1. Observing the space; defining usage, furniture, users, relations, times of use
2. Architectural surveying; documenting the space and existing furniture with sketching, measuring
3. Interviewing; preparing questions for defined users and conducting the interview
4. Examining and observing example spaces
5. Preparing power point presentations for each task with written notes, photographs, and drawings

During all these tasks, students were asked to write their experiences including problems of the spaces and needs of the users, which they noticed while their observations. These tasks of problem framing step were conducted in three weeks; the purpose of the first week was to constitute a general picture about the selected spaces from the perspectives of the students. Observation and documentation of the spaces were the main tasks in this week. Before the assignment, students were informed about the aim of the step, observation technique, and architectural survey.

The purpose of the second and third weeks was to develop awareness of students about the users of their spaces and user opinions, diversify their experiences about the spaces with similar functions, and based on their previous week's information and perspective, improve their understanding about the problems and needs about their spaces, with the contribution of new research perspective. After the observation task, the students asked to choose exemplary spaces from the university campus with similar functions of their spaces. Through this, they diversified their experiences and knowledge about the usage, users, and furniture organization about canteen and entrance hall spaces in order to develop a design idea for their spaces in SFH (Figure 7). At the end of this three-week problem-framing step, to solve their design problem, the students gained a rich information base:

1. They familiarized with the user, who were different from themselves.
2. They familiarized with various research tools to understand their design problem.
3. They analyzed and discussed their findings in each team and in class.
4. They used architectural drafting techniques for their design task.

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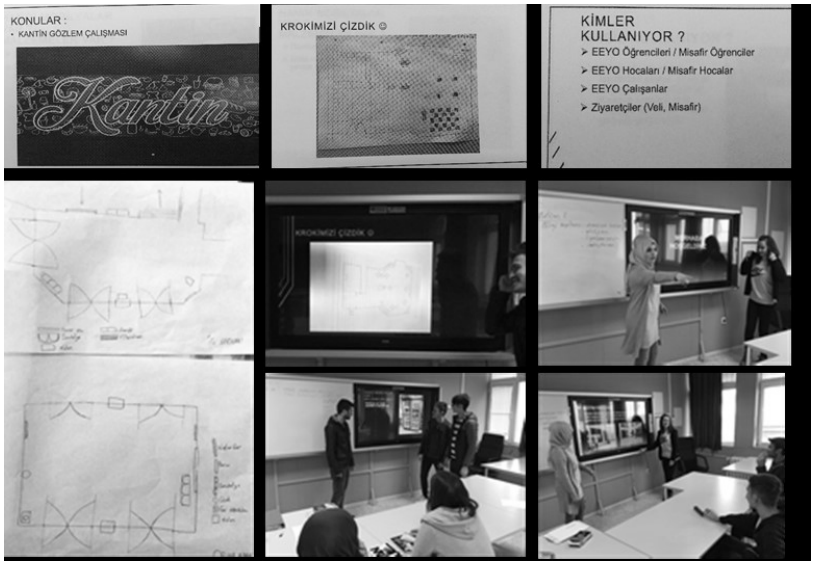

Figure 7. Student presentations and works of problem framing step of DT phase (Photograph by the author, 2017)

It was observed that, with this step they conceived the boundaries of their design problem and began to think on design solutions for their problems. Before the next step, students asked to write up-to-date list of problems, needs, opinions about their spaces and try developing very first design ideas for the next week. They stated that they did not know how a design proposal was prepared. They informed about sketching technique and thinking through draft drawings, testing their solutions by with their needs, opinions problems list. Idea generation and testing steps of DT phase were conducted as an integrated step. These steps took about three weeks. It had three cycles of idea generation and testing. For the first week, only one group provided their design proposal. Their proposal composed of plan and interior elevation sketches, selected furniture photographs, and written explanations for the proposal.

The first solution proposal of the group was discussed with other groups. The solution proposal testing was performed by answering the questions “did the solution meet defined needs? Which problems did it solve?” Based on the suggestions, the group was asked to revise its proposal. Next week, two groups had their proposals. The evaluation of them were made in the same way (Figure 8).

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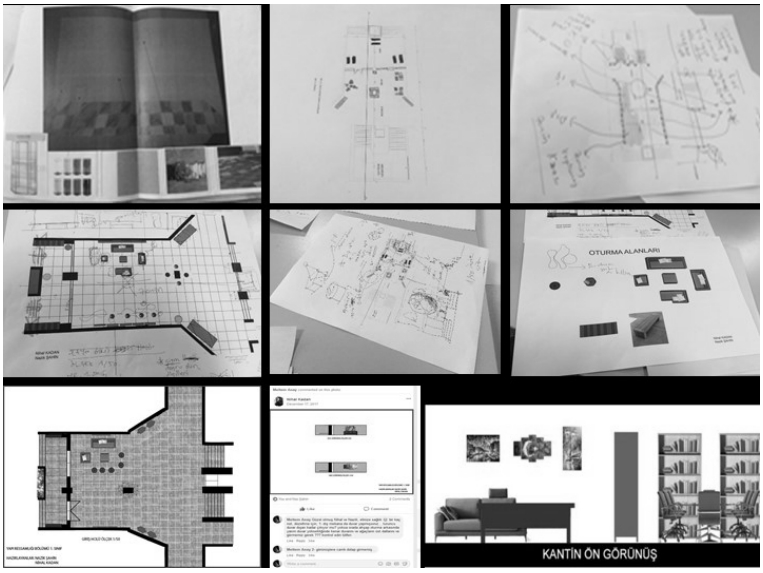

Figure 8. Student works from the idea generation and testing steps of the DT phase (Photograph by the author, 2017)

After the second cycle of proposal-testing, design solutions were refined and the groups began to prepare their presentations for the user evaluations of the canteen and entrance hall spaces. For this study, they first prepared few questions about their design proposals and they expected users to give their suggestions and opinions. This sharing part of the study was excited student. They mounted their design materials to the boards in canteen and entrance hall spaces. They prepared a suggestion box and question sheets for the users, waited with their presentation and explained their designs to the users (Figure 9).

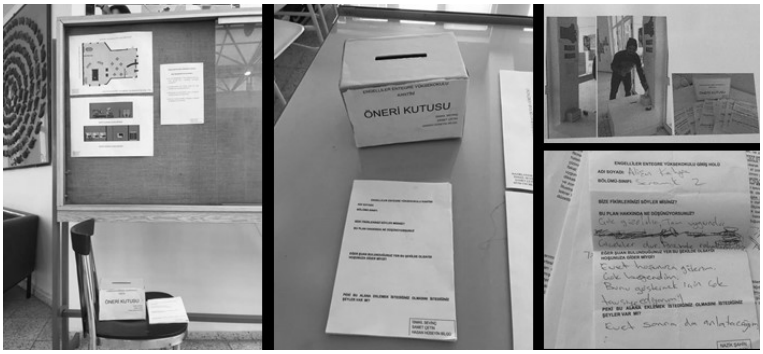

Figure 9. Student works from the testing (test2) step of the DT phase (Photograph by the author, 2017)

After they got feedback from active users of the canteen and entrance hall spaces, gathered information was evaluated together at the class. It was observed from the opinion sheets, most of the users responded to the design proposals with enthusiasm. Students said that the users, whom they explain their design study, underlined that there was a need to revise these spaces and the design efforts of the participant students were necessary. The students said that some of the student users just expressed their appreciation, not opinions about the design study. On the other hand, some of them discussed the design

decisions, provided opinions for the development of the design proposal. This was very constructive test cycle for the students, since they received various user opinions for their designs.

Evolution step of the study was used as final assessment for the DT process and the process took about one week. On previous experience, after the recall of the steps in the class, the students were asked to think on the overall design process, how they achieved it, and what they have learnt, and write their experiences. SFH had a school newspaper, which was run by the students themselves, in each semester end, the news from the students were gathered, the new design for the newspaper was created by the students. It was decided with the students that their final written process of DT delivered to semester's newspaper and the newspaper helped to disseminate their designing experience and proposals to the whole school (Figure 10).

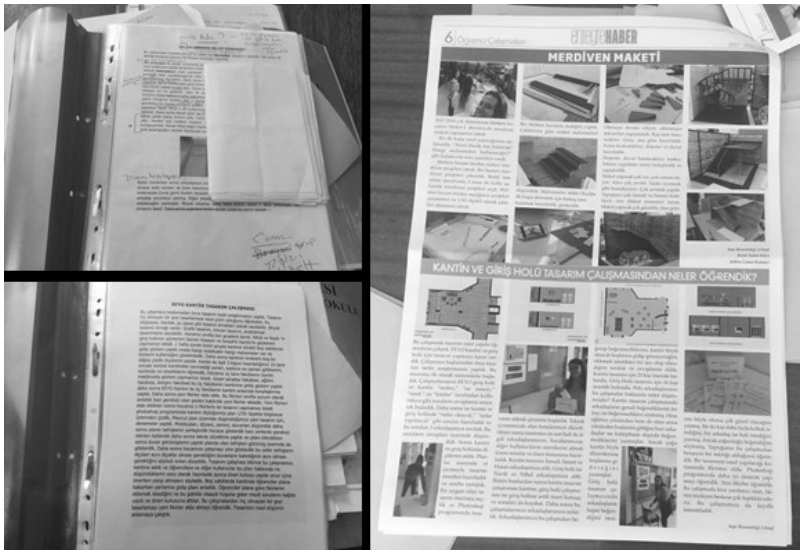

Figure 10. School newspaper article of the students from the evolution step of the DT activity (Photograph by the author, 2017-2018)

Post-DT Phase

Post-DT was a three-week phase. It aimed to reinforce the design understandings of the students with different problem context. For consolidation of students' previous experiences of design process, organization of a post-design experience phase was decided with the field expert in planning and evaluation meeting (Planning and Evaluation Meeting, January 10, 2018). This phase considered both as passing through the previous design process of students and as a new design problem solving activity for the students.

Poster preparation activity was one of the main goals of this semester. The purpose of poster presentation was to prepare and familiarize students for architectural project presentation task and reuse their information on Photoshop, gained in related

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course. The theme of the poster was given to the students as their design process, which was experienced in pervious semester. The design problem was defined as a poster design for year-end exhibition of the school. The same students were grouped together.

The Post-DT phase began with recalling the concerned design process, and categorizing the steps in order. It was a bit difficult for the students first, they remembered the tasks like; observation, interview, sketching, preparing design proposal, but not with their purposes and orders. The vagueness about designing experience was considered as normal for them, because of the semester break. Their writings for the school newspaper were used for recalling the issues. Based on that, they prepared a list of steps of their design process, and then they filled each list article in two separate groups. After this content development step, the process of designing the poster began, where the tools and end-product was different from the previous one (Figure 11).

Figure 11. Student works from the post-DT phase of the design thinking activity (Photograph by the author, 2018)

Throughout the whole process, with each activity in the phases, students were encouraged to reflect on "what they were doing" and they were encouraged to follow their learning processes and ensured that they did not miss the aim of the activity. For this, the students were asked to write their experiences and opinions to their diaries after each activity, in addition to class discussions. These diaries were examined by the researcher after each activity and feedback was given to the students. Diary writing task was used not only for helping students to reveal their experiences and opinions, but also for encouraging hearing-impaired students to develop their written communication (Figure 12). In addition, the progression process of student groups was visualized continuously with the dated photographs of the class material and shared with the students shortly after each activity on the Facebook group throughout the process. This reflection phase covered whole DT activity process. The purpose of planning the Post-DT phase was to encourage students to put whole their designing activity together and reflect on this

experience. The students shared their design process with a poster presentation to the whole school at the end of the year.

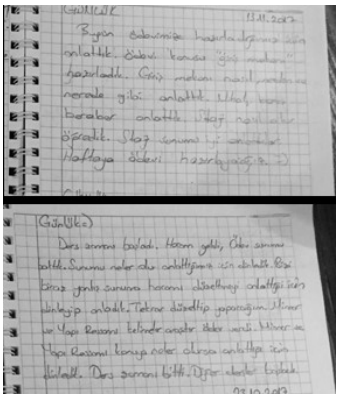

Figure 12. Examples of student diaries (Photograph by the author, 2017-2018)

DISCUSSION AND CONCLUSION

Towards the formation of more inclusive architectural environments, present research was aimed to contribute to the overlapping area between the need for training of peripheral occupations of design in user-oriented design and it addressed the need for the contribution of disabled design professionals to the profession with their experience on environmental barriers. With this aim, the study has focused on the application of DT as a teaching strategy to develop an awareness about human centered design process for hearing-impaired architectural drafting students. Hereby in the conclusion part, not only conclusive remarks and achieved goals, but also shortcomings, and possible contributions to the field, as well as a number of suggestions are provided.

Perhaps first thing to underline would be the limitations of the research: as any other research, the present research has had its limitations, one of them being its scope considering the case observed was a quite unique and refined one. From another perspective this situation could be found beneficial since it permitted the researcher a more hands-on control on the data and a more comprehensive analysis that is not only demanded by the case itself but also by the methodology. As it was stated the study was conducted as a part of a regular educational semester, and as a part of an existing curriculum. This points to further limitations such as projected time limit on observation and data collection, and since the main focus in a class setting should be the education itself, the research had to be embedded within the existing setting. The researcher strongly believes that expansion of the research both in timely manner (i.e. making it two semesters) and scopewise (i.e. including other level students) might add much to the initial findings presented here.

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In relation to hearing-impaired students' underlined need for getting familiarized with the process of architectural design and focusing on human-centered design approach, it was observed in the research that hearing-impaired architectural-drafting students gained an awareness about and develop an information base concerning the issues such as architectural design, (architectural) design process, and the essentials of the process. However, there were some deficiencies observed about their perception of design process as a whole. As for the "user oriented" emphasis of design process, it was revealed that although students developed a partial understanding for the place of "user" in design, user needs, designing in relation to the needs of user, their conception remained fragmented and limited with the design problem they solved.

Within the scope of the research, considering language limitations of the students, their lack of familiarity with the subject, and considering that it requires more time and additional learning to develop such an awareness, advanced development was not expected in students' conception of user inclusive design. However, it was thought that the students could add their experiences to their design processes, as hearing-impaired users, but they were unable to differentiate, express, and convey their experiences, although they distinguished some user groups and their specific needs in their processes.

It was observed that while the students carried out the design activity, they utilized "technical drawing" skills as part of design process, but differentiating it from design itself. Therefore, they clarified the relation of architectural drafting with architecture as a profession, and they were better positioning themselves and their professional field in relation to architecture and architects.

Therefore, it can be said that present application of DT strategy worked effectively to provide basic information about architectural design, design process, and related tasks and user needs as well, as part of design process for hearing-impaired architectural drafting students with a certain level of hearing loss and language ability.

In this case, where the students had moderate and high level of hearing loss, despite the measures such as; organization of pre and post phases, guidance of the field expert about the education of hearing-impaired, additional writing assignments on students' design processes, were taken before the process, the multi-faceted design process seemed to be challenging for the students. It was relatively hard for them to overcome and internalize new terms and tasks of the process and transfer information between phases. Additional language course support could be arranged, in order to reinforce new terms and concepts of the design process in other contexts.

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Since the hearing-impaired students were junior level, they lack prior experience concerning the university level education and architectural design education. Results that are more effective could be obtained if DT strategy were carried out with senior level hearing-impaired students, since they would have developed a background about design due to their formal education and they have been completed their compulsory internships in architectural offices and gained experience at professional level. Considering that, design learning needs recurring problem solving activities, single design problem solving process may not be enough to understand design process as a whole. The process can be arranged to include more and more manageable design problems. In addition, the fact that design related issues was not mentioned in other courses may be one of the factors that make it difficult to reinforce learning.

It can be more efficient to implement the DT process by supporting it with a theoretical background, providing essentials of user inclusive design. With this respect, a specific course addressing the issues such as transferring user experience, particularly their own experiences, as hearing-impaired users to design and practice, can be formulated for hearing-impaired students.

The research showed that teaching DT activity familiarized hearing-impaired architectural drafting students with various skills and provided crucial knowledge base, which supported their education and future work life (Figure 13).

While the students are acquainted with the basic skills of design activity; problem definition, solution generation, testing, and evaluation, at the same time, they gained problem-solving experience by following defined steps of design process and reflecting on these activities. It was observed that DT activity not only helped to familiarize students with design-based skills, but also involved and supported the strategies, which were emphasized by the literature for university level education of hearing-impaired students and basic concepts and techniques of architectural drafting education as well. This was particularly important owing to the literature on vocational education of hearing-impaired students strongly emphasized the importance of providing students educational settings, involving functional and product oriented tasks and their realization processes with real goals, meta-cognitive learning, for the improvement of language skills and effective learning occurred (Uzuner et al., 2011; Kaya et al., 2013).

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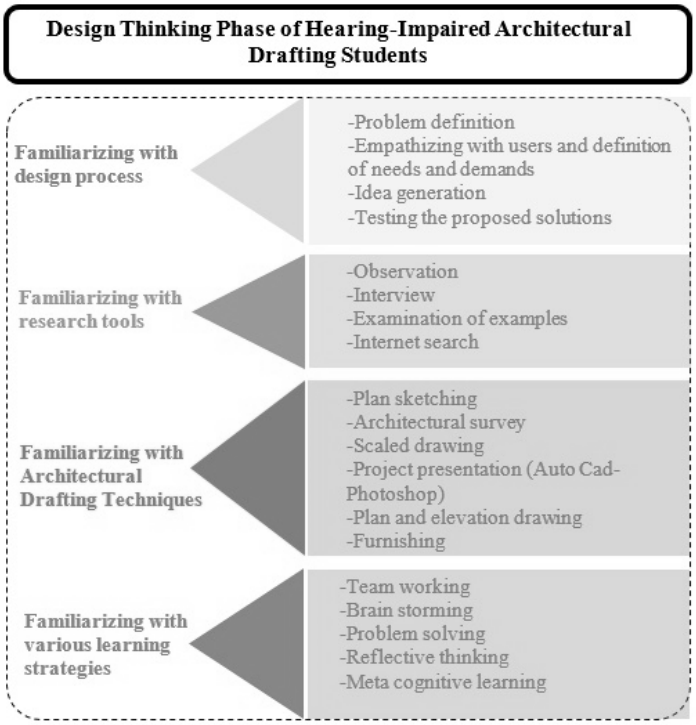

Figure 13. The DT phase and learning dimensions

It was observed from the application of DT activity that the selection of design problem in relation to spaces of the school was particularly beneficial. These spaces, which were part of daily experiences of students; provided means of communicating with other students about real problems and needs of them; getting evaluative comments about design proposals for them seemed to provide a meaningful, functional, and purposeful educational context for hearing-impaired students. The whole iterative, cyclical, and reflective process of the students' designing activity, augmented with class discussions and diary writings on what they doing, what they are learning, and with post-DT phase, allowed the students to assess their learning and not to miss the main purpose of the designing activity as meta-cognitive learning.

The main purpose of the Professional Language course was to facilitate the understanding of the main concepts of architectural drafting and to reinforce professional language use of students with the contribution of meaningful contexts. Considering this objective, the DT activity provided students a real and meaningful design context for the use of their profession's language and allowed new terms to discuss and repeat as part of this context. During the problem-framing step, they made plan sketches, architectural survey, scaled drawings, furniture organization, and developed an idea about the differences from each other and their places of use, which were the main topics of other courses and needed to pass through in Professional Language course. Through the DT phase, they used industrial-

standard computer programs, such as Photoshop, and AutoCAD, which they studied in other courses, for their design idea presentations.

Besides familiarizing with design related skills and required knowledge and exercising on field related techniques and concepts, the students gained experience with research techniques, while trying to define their design problem and users; they conducted basic observation and interview techniques and prepared reports of their applications. An unexpected contribution of the DT activity to the students was that observation, interview, getting user feedback tasks, which required establishing communication with others, seemed to facilitate and strengthen their relations with other program students of the school and make it easy to get used to the school as the first year students.

In general, the research illustrated that DT, as a carefully developed approach to be employed particularly for non-design occupations, could also be effectively used to teach design process for disabled design professionals. Consequently, it is thought that it could be applied to the formulation of courses such as; environmental design, design for all, inclusive design, as well as be utilized for students developing empathy with users, familiarizing with observation and interview techniques, and as a means of quick and systematic problem solving sessions.

This research was about the application of DT approach to hearing-impaired architectural drafting students, combined with the existing educational framework for hearing-impaired students provides. As such, it was a means of expanding the application of the initial DT model, and contributing to the existing studies concerning the education of the hearing-impaired students. It showed that DT, with the precise adoption has a potential to evolve as a teaching strategy, which effectively integrates separate educational objectives together as part of design problem solving for the education of hearing-impaired students. Therefore, it is expected that the research can be used as a model for different educational settings, in which hearing-impaired students will be educated and it can provide a viewpoint and guiding principles for educators.

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Resume

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Research Article

Conserving Modern Architectural Heritage: Review on First Numune Hospitals of Turkey

Mehmet Şener*
Emre Kishalı**

Abstract

Purpose

The new political approaches followed after the establishment of republic transformed the basic characteristics of many different dynamics in Turkey ranging from education and industry to art and architecture. The arrangements related to health services hold an important place among these fields and the great transformations seen in healthcare services necessitated the construction of hospital buildings with contemporary architectural qualities. In this framework, new hospital buildings known as "Numune" (Sample) Hospitals were established in Ankara, Diyarbakır, Erzurum and Sivas cities in 1924 to be good examples for further hospital buildings. In this context, the historical evolutions, architectural characteristics and current situations of these Numune hospitals are examined in this study together with an analysis of all the changes and interventions they were exposed to from past to present. This study aims to clarify the historical importance of Numune hospitals in question, address the changes they have undergone to date, criticize the interventions in the context of architectural history and conservation disciplines, and put forward various suggestions related to such disciplines. The search of the ways to provide the interrelationship of these buildings with the rapidly evolving current world by referring to the contemporary methods of

Keywords: *Health facility architecture, modern architectural heritage, numune hospitals, conservation*

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different disciplines, constitutes one other basic aim of this study. The applications of the public authority of health services; namely the -Ministry of Health- and the other efficient dynamics related with the conservation of these buildings are also critically evaluated with respect to their roles on the sustaining of the architectural and historial values of these buildings.

Design/Methodology/Approach

The problems in preserving the original characteristics and showing respect to the historical values of these buildings are discussed by using the instruments and concepts of architectural history and conservation disciplines. Besides, some strategies are proposed for the preservation of these buildings with an awareness of the current conditions of health services in Turkey, and the possibility of the conflict between today's conservation practices and health facility standards.

Findings

Taking into account contemporary approaches and the advanced conservation techniques being employed today, this study indicates that it is possible to make use of these structures by transforming their functions and maintaining their authentic values through proper applications. It is also expressed that a well-defined framework regarding that which structures are to be conserved according to which criteria could not be created, and that the decision-making mechanism focused solely on the conservation of the oldest structures.

Practical Implications

Some refunctioning and remediation strategies are presented for conserving the historical values of these Numune hospitals, while also improving their conditions as far as possible.

Social Implications

The concepts of heritage and value should be defined in a broader contextual framework and conservation principles should be revised according to these definitions.

Originality/Value

Considering these buildings serve as cultural bridges extending from the Ottoman era to the present and have important places in the historical development of healthcare facility architecture in Turkey, they hold symbolic values within the context of Turkish architectural history and heritage.

INTRODUCTION

With new architectural movements and the introduction of new constructions materials and technologies, the first years of the Republic witnessed radical changes in the field of architecture, as in all aspects of social life. Numerous public buildings were constructed by the government in pursuit of its goal to change the architectural tradition and knowledge inherited from the Ottoman era, leading to the production of a national and modern architecture that represented the ideals of young Republic. Additionally, policies that led to radical changes in social dynamics, such as those related to healthcare, education, public works, etc. were implemented, which, in turn, resulted in the

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provision of public services in the said areas, stronger institutionalization, the introduction of more modern technologies, and the adoption of different architectural approaches in the public buildings constructed in this period. As part of these efforts, comprehensive reforms were instituted in the field of healthcare, and contemporary structures that were able to respond to new applications started to be constructed simultaneously. The "Numune" (Sample) hospitals constructed in the early years of the Republic (1924), some of which were established under the orders of Atatürk, were the most important of the new healthcare structures, having been envisaged to represent the new healthcare system, and the Republic as a whole.

Since the foundation of the Republic, many of these numune state hospitals have been constructed in Turkey, the first of which were established in Ankara, Diyarbakır, Erzurum and Sivas in 1924 (fully equipped, and with a 150-bed capacity). Some of these structures that are still operational today, although they have been subjected to countless demolitions, interventions and transformations over time, were converted from the Memleket or Gureba (poor and desolate) hospitals constructed in the Ottoman era that were run by local administrations, and so today serve as cultural bridges extending from the Ottoman era to the present. Also serving as historical documentation of healthcare and the architectural characteristics of hospitals in the Ottoman era, these structures hold an important place in the historical development of Turkish healthcare facilities, serving as examples for the hospitals to be constructed in the years to come. Considering all these characteristics as a whole, these numune hospitals, as the first and most concrete indicators of the reforms instituted in the field of healthcare, hold symbolic value within the context of Turkish architectural history and national architectural heritage, and they can thus be considered as items of cultural heritage that are of historical importance, and so worthy of conservation.

Analyses to be conducted on the changes and transformations undergone by numune hospitals in various cities and under various circumstances, in addition to their value and importance, will facilitate multifaceted discussions in many academic disciplines, particularly in those of conservation and architectural history. The fact that numune hospitals, once Gureba hospitals, were altered through the addition of modern hospital equipment, increase in their numbers, some developments in their structures, and the demolishment of other numune hospitals constructed over time reveals the existence of a historical process that should be evaluated in a multidimensional manner. Accordingly, this study approaches

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these structures with respect to their historical importance and architectural characteristics, as well as the interventions that they have undergone over time, the problems experienced in this context, and suggestions for conservation and renovation works, as required by their value as heritage. As one of the main objectives of the study is to understand the impact of Republican policies on Anatolia, focus is particularly on the first group of numune hospitals that were established in Anatolia outside Istanbul, being those that opened in 1924, the interventions and annexations made to them over time, and their current status from the perspective of architectural history and conservation.

The study clarifies the historical importance and architectural characteristics of the structures in question, addresses the changes they have undergone to date in every aspect, criticizes the interventions in the context of architectural history and conservation disciplines, and puts forward various suggestions related to such disciplines. Taking into account the problems that may be encountered in ensuring that the structures in question can meet current healthcare standards, as well as the current level of development of healthcare architecture and their continued use in their unique functions, some refunctioning, remediation and conservation strategies are presented that are aimed at conserving their historical value and unique identities, while also improving their conditions as far as possible.

FIRST GROUP OF NUMUNE HOSPITALS: ANKARA, DİYARBAKIR, ERZURUM AND SİVAS

One of the most significant steps taken by the Republican government, which had inherited an insufficient healthcare infrastructure from the Ottoman Empire that included less than 2,000 hospital beds, around 1,000 doctors and three state hospitals with a total of 950 beds, was to open Numune Hospitals with a view to improving the system (Sayek, 1998). The goal in constructing numune hospitals was expressed for the first time in the "healthcare program developed by the Ministry of Health and Social Welfare for being a guide to and setting an example for local administrations (special provincial administrations and municipalities) due to the insufficiency of healthcare institutions and the lack of modern equipment in the country", specified under the name "Anatolian Numune Hospitals" in the budget of the Ministry of Health and Social Welfare adopted by the Grand National Assembly of Turkey on March 18, 1924, and it was stated that "these healthcare institutions would be financed from the government budget and be subordinated directly to the Ministry of Health" (Altay, 2015). As a consequence of the negotiations held in the Grand National Assembly of Turkey, "it was decided that four numune hospitals would be opened in

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Ankara, Sivas, Erzurum and Diyarbakır, and that these institutions would directly be administrated by the Ministry of Health and be financed from the government budget" (Altay, 2015)

As their name suggests, these hospitals were intended to set a good example for the many new hospitals to be constructed in the years to come in architectural and functional terms. Aside from the fully equipped numune hospitals opened in the abovementioned provinces, various healthcare institutions under the names "Nation, State, Homeland and Municipality hospitals" were entered into service in other provinces during the early Republican period, (Başar, 1979) and later some of these would go on to become numune hospitals.

Ankara Numune Hospital

The Ankara Numune Hospital was started out in life in the second half of the 1800s under the name Gureba Hospital, but became one of the first groups of numune hospitals to be established pursuant to the law enacted in 1924. The hospital started to offer services in three individual structures, with blocks added afterwards to the original structure that were designed in the national architectural style (hipped roof, arch windows, use of roof tiles, window jambs, stone covered sub-basement, etc.), as the most common style among the public structures constructed in the late Ottoman era, but failed to meet the needs (Figure 1). On the site of such structures, the "Refik Bey (Saydam) Pavilion" started to be constructed, to have a capacity of 50 beds, in 1927, and construction was completed in six years. The facility entered into service under the name the "Ismet Paşa Pavilion", with a capacity of 300 beds (Figure 2). The structure designed by Austrian architect Robert Oerley and constructed in 1933 is the only structure to have survived, bearing characteristics of Central European architecture with its "tile covered pitched roof and dormer windows", its entrance, taking the form of a hexagonal protrusion on the facade, and its monumental appearance (Cengizkan, 2011). However, the structure also bears traces of the national architectural style with its sub-basement covered with Ankara stones on its facade. The reinforced concrete skeleton of the main block of the Ankara Numune Hospital, construction of which started in 1932 and was completed in 1933 on the 10th anniversary of the Republic, was constructed by German company Riedlich und Berger, and its electricity and water installation, elevator and plaster/painting works were carried out by Vehbi Koç who had been awarded the contract together with the Burla Brothers (Dündar, 2006).

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Figure 1. (Left) First Numune Hospital transformed from Ankara Gureba 1881 *(SBÜ Ankara Numune Training and Research Hospital Archive)*; (Middle and Right) additional blocks after 1924 *(Arlet Natali Avazyan Archive)*.

Figure 2. Robert Oerley, The 300-bed Ismet Paşa Pavilion, which is still operational, 1933, Ankara *(SBÜ Ankara Numune Eğitim ve Araştırma Hastanesi)*.

It was also one of the largest and most costly structures in Ankara at the time, and today is located within the Ankara Numune Training and Research Hospital complex, where it has functioned as a healthcare facility until it was transferred to Bilkent City Hospital in May 2019. It has provided services under the name "Block B", along with other blocks that have been added within the historical process, and houses classrooms, administrative units and inpatient clinics (Figure 3). On a planimetric drawing of the structure, the symmetrical and function-oriented organization that was implemented within the framework of the Western design approach that was quite popular for public structures of the time can still be observed.

Figure 3. (Left) Robert Oerley, Ankara Numune Hospital site plan; (Right) Current view of Numune Hospital (Mehmet Şener Archive, 2018).

Diyarbakır Numune Hospital

The Diyarbakır Numune Hospital was established in 1924 by the Ministry of Health and Social Aid, following repairs and additions

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made to the single-story Gureba Hospital that opened with a capacity of 25 beds in 1884, and was the first numune hospital to be opened in the South-eastern Anatolia region. A 102-bed hospital was constructed with a total cost of 150,000 liras, and three pavilions were constructed with a total cost of 25,000 liras in the same year (Çağlayan, 2013). After the hospital burned down in 1936, it was reconstructed and reopened with a total capacity of 200 beds on March 21, 1939 (Çağlayan, 2013). The structure is still in operation today, housing such healthcare departments as a psychiatry clinic. The building carries the characteristics of the national architectural style of the time, with a hipped roof with eaves, a raised entrance with stairs, cut stone jambs emphasizing the column axes on the facade, its window typology and its symmetrical facade (Figure 4 and 5). The arch above the entrance door, designed in an Umayyad/Arabic architectural style, highlights the regional influences in the design of the structure. The Diyarbakır Numune Hospital comprised eight separate buildings in 1939, and although they were more or less constructed simultaneously, only one building could be conserved, with the remaining structures being demolished at various times.

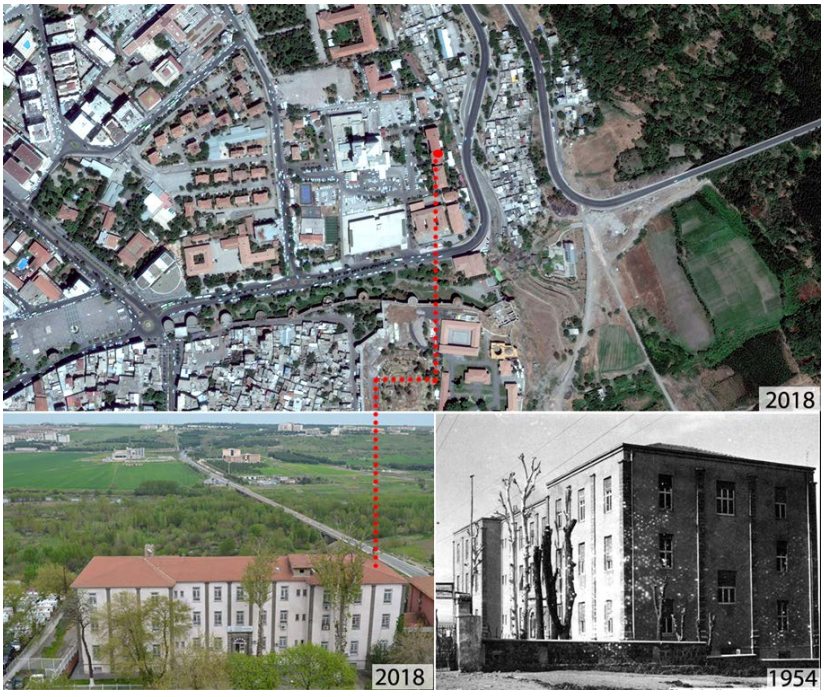

Figure 4. (Upper) current aerial view of Diyarbakır Numune Hospital in 2018, Diyarbakır; (Lower Left) the view of the hospital (Rubin Karakoyunlu Archive, 2018); (Lower Right) the view in 1939 (Arlet Natali Avazyan, 1939).

Figure 5. Diyarbakır Numune Hospital in 2018 (Rubin Karakoyunlu Archive: 2018).

Erzurum Numune Hospital

The Erzurum Numune Hospital was a continuation of the Gureba Hospital that had been put into service in 1904 during the reign of Sultan Abdulhamid II. The foundation of the Gureba Hospital was laid in 1902 using funds collected from the public under an initiative launched by Mayor Şerif Efendi (Küçükuğurlu, 2016). The hospital opened in the same year when Abdulhamid II acceded to the throne, and started providing services under the name Hamidiye Gureba Hospital. It had a floor area of 593 square meters, comprising a basement, ground and first floors and an attic. According to Küçükuğurlu (2016), the requests were made over time to construct an annex to the hospital with the aim of increasing its capacity to 50 beds, and to repair the original structure, although all such requests were declined by the central government in Istanbul. As a result, the structure became dilapidated and fell into such a state that in 1912 it was no longer deemed appropriate for the provision of healthcare services. Plans were made to hand the structure over to the military or to use it as an inspection building during World War I, but these never came to fruition. The structure survived thanks to the aid granted by special administrations and the state prior to the proclamation of the Republic, and continued to provide healthcare services as a continuation of the Gureba hospital after changing its name to Erzurum Numune Hospital in 1924 (Küçükuğurlu, 2016).

For the hospital that was opened in 1924 along with the first group of numune hospitals, no further structure was constructed that year, and only its name was changed after it was rendered subordinate to the Ministry of Health. Many healthcare facilities were constructed around it at various times. For example, the foundations of a U-shaped building were laid in 1953 in order to meet the newly emerging needs, and the subsequent building entered into service as a 400-bed hospital following the completion of construction on March 12, 1963 (Başar, 1979). Among these structures, only the first Gureba Hospital was able to be officially registered and survives today (Figure 6). After being used as the Şerif Efendi Polyclinic of the Numune Hospital for many years, the structure was refunctioned as an additional

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service building of the Erzurum Regional Training and Research Hospital (RTRH) in 2010, and was later named as the Şerif Efendi Family Health Center. The structure is built in the national architectural style that was popular in the late Ottoman era and the early Republican period. With its hipped roof and eaves, stone-covered sub-basement, window jambs, arched and stone-covered basement windows, and symmetrical facade design, the structure bears the characteristics of the style of the First National Architecture period.

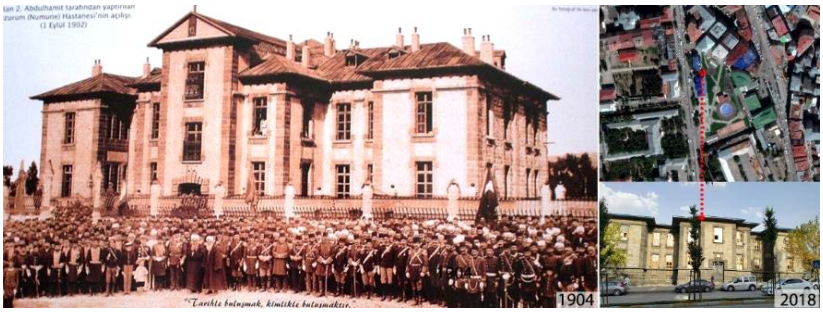

Figure 6. (Left) opening ceremony of the Gureba Hospital 1904 (Küçükuğurlu 2016); (Upper Right) aerial view of hospital; (Lower Right) a current view of Erzurum Numune Hospital (Dilek Okuyucu Archive, 2018).

Sivas Numune Hospital

The Sivas Numune Hospital was moved to various structures and provided services under various different names following its establishment in 1886, up until to the foundation of the Republic. Its final function before being reassigned as a numune hospital was as a building of the American College. As part of the first group of numune hospitals in the Republican period, it started out providing services as a 50-bed hospital in the building to which it moved in 1924 (Budaktaş, 2017).

The Sivas Numune Hospital started to operate under its new name after the 25-bed Memleket Hospital was reassigned to the Ministry of Health (Altay, 2015). It burned down in a fire in 1930, but reopened in a structure that was built in 1952 and that is still standing today, providing services in various structures. The construction of Sivas Numune Hospital started in the 1940s, and it entered into operation following the completion of construction in 1952. The structure's hipped roof and eaves, its neoclassical entrance colonnade, and the window design and arched jambs on its facade indicate that it was designed in the Second National Architecture style that was popular among the public structures of the time (Figure 7). The structure is still operational and provides services today. It was registered in 2016, while the hospital buildings that were constructed around it at various times have all been demolished.

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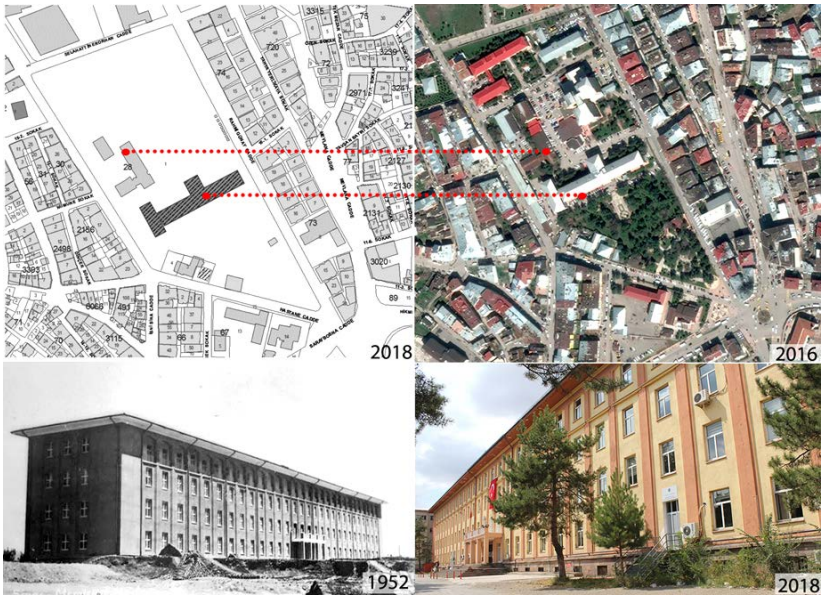

Figure 7. (Upper Left) Aerial view of Sivas Numune Hospital in 2018; (Upper Right) in 2016; (Lower Left) Sivas Numune Hospital (Directorate General of Cultural Assets and Museums, Natural and Cultural Assets Conservation Inventory, 1952); (Lower Right) Sivas Numune Hospital (Gülhayat Kılcı Ağraz Archive, 2018).

GENERAL ASSESSMENT FROM HISTORICAL AND ARCHITECTURAL PERSPECTIVE

In the first hospitals that opened under the name Gureba Hospitals in the late Ottoman period that were later transformed into "Numune Hospitals" in 1924, it is possible to observe an overall national architectural style (an Ottoman renaissance) based on the principle of "combining elements taken from classical Ottoman architecture with Europe's academic design principles and construction techniques" (Bozdoğan, 2012). The Ottoman architectural details that can be observed on the numune hospitals, as public structures that ensured the propagation of the said architectural styles across Anatolia, including symmetry, roofs with broad eaves, arched windows (some of which are pointed), etc. confirm this notion. These hospitals may be considered as examples of the public structures that "represented the ideals of the new Republic" for some time through such public buildings as government and municipality offices, schools and post offices in provinces like Konya, Izmir, Kütahya and Afyon by which the National Architectural Renaissance of 1920s that started from Ankara, spread across Anatolia (Bozdoğan, 2012).

On the other hand, the numune hospitals that were constructed in addition, or as an alternative, to such structures carry a number of modern architectural features that did not fit in with the said architectural language. These modern structures not only brought about a transformation of architectural language, but also significant innovations in the quality and technologies used in the provision of healthcare services. While the first numune hospitals, established through the transformation of Gureba hospitals, were a continuation of the healthcare approach and architecture of the Ottoman era, the structures constructed

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in place of, or around them, in the following years became the first examples of the implementation of modern architectural approaches in the field of healthcare in Turkish architectural history.

It is possible to attribute the adoption of the national architectural styles in a significant proportion of the hospital buildings to the early Republican period rather than the modern architectural styles that were dominant at the time, to the fact that the Gureba and Memleket hospitals that laid the groundwork for the numune hospitals had been constructed in the national architecture styles that were dominant in late Ottoman architecture, and to the influential role played by the German and Austrian architects who led to the emergence of a Second National Architecture movement in Turkey in the production of such structures.

NUMUNE HOSPITALS IN THE CONTEXT OF THEIR HISTORICAL AND CONSERVATION VALUES AND THE INTERVENTIONS MADE

Conservation Values

The hospitals in Erzurum, Diyarbakır and Ankara entered into service in the buildings of the former Gureba hospitals, while the Sivas Numune Hospital was established in the building of the American College, after providing services in several different buildings during the Ottoman era. Subsequently, various structures were constructed in place of, or around, some of these structures (Ankara and Sivas) in accordance with the new Republic's notion of creating a national identity. It is possible to differentiate between the various intervention approaches made to each numune hospital, such as reuse, reconstruction, and the addition of new structures to, or the enlargement of, the historical buildings. It is important to consider such alterations as a whole alongside the history of healthcare in the country that began to undergo a transformation in the 19th century, the architectural production that was seen in response to such services, and their users, stakeholders and spatial evolution. Additionally, the continuity of architectural value has another meaning in the hospital structures that are focused on human health and continuity of life.

The demographic, political and technological changes that occur within the historical process make interventions into such hospitals and their surroundings that hold historical and cultural value inevitable. In the early years of the Republic, new structures were constructed, while some numune hospitals were transformed from Gureba Hospitals or were created by way of a refunctioning of other structures. Some of these structures are still intact today, while others have been demolished following

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fire or other such reasons. The buildings that were added to the Erzurum and Sivas Numune Hospitals constructed in 1960s no longer exist, having been demolished to be replaced by urban parks. The growing need and trends in new hospitals, in parallel to the health policies and technological developments, resulted in the construction of further healthcare structures next to or around the existing healthcare facilities, such as registered numune hospitals, many of which still survive to date. The reuse of old hospital buildings lays the groundwork for new discussions; and all these discussions and the current state of the numune hospitals displays the necessity of integrated conservation approach and the continuity of values. The relevant health policies and architectural and urban productions such as numune hospitals that emerged as a result of these policies are also important in the sense that they encourage the analysis of hospital constructions from the Republican period, and suggest some necessary conservation applications.

The main reason for the focus on numune hospitals in this study is that these structures involve a multi-component body of values from the phenomena of urban development and cultural memory, to architectural history and conservation practices. Since they hosted "cultural processes of social activities that include remembering and memory-marking" apart from their functional qualities, they gain their "own significances" and "identity"; and inevitably turn into cultural heritages (Kamel-Ahmed, 2015). In this respect, although it is disputable whether they can be considered modern architectural works, they need to be approached from the perspective of a conservation relationship and an architectural history in which focus is on contemporary practices for an asset of architectural heritage that was considered modern at the time of construction. Numune hospitals, which possess almost all of the values associated with structures produced in the modern age is, according to Madran, carry heritage value, such as document value, identity value, architectural value, functional and economic value, and continuity value, and become appropriate tools for architectural history and conservation analyses from multidisciplinary perspectives together with the role of the complicated physical evolution they have undergone in the historical process (Madran, 2006). The fact that the numune hospitals addressed in the study are still being used for the provision of healthcare services, whether directly or indirectly, should be considered as something positive, in the sense that the authentic function of the structures has been retained.

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Problem Analysis: Interventions and Restoration Applications

When addressed together with the problems related to the conservation of registered structures in Turkey, one can see that these numune hospitals, which have maintained an important place in the provision of healthcare services and the architectural history of the Republican period, have been subjected to various inappropriate interventions as a result of rapid decisions that were made without taking into account their historical, cultural and memorial values. It is somewhat remarkable that some of these structures have never been conserved, that conservation measures were taken for some of them only after various inappropriate interventions, and that although some of them have been conserved, the necessary applications have been made with an inappropriate approach. As a conservation approach, priority has been given to values and approaches prioritizing economic size and use, while the memorial, monumental, historical and architectural values of the structures have been ignored. As a result, while the physical conservation of the registered structures has been ensured to a great extent, the body of complicated and multidimensional values acquired during the historical process of the structures has been ruined by bureaucratic, architectural and urban decisions taken without sufficient thought.

The fact that these numune hospitals are still providing healthcare services today, and are still in possession of historical conservation value, makes them necessary to be revised, renovated and reused in accordance with the current architecture and conservation principles related to healthcare structures. Given that the principles of conservation have not been complied to any great extent to date, and that the structures constructed next to the first numune hospitals in Sivas and Erzurum after the 1950s have been demolished and replaced with other structures (such as car parks, etc.), it is clear that destruction or transformation options are preferred rather than ensuring the maintenance of the authentic values of the structures.

An assessment of the Ankara Numune Hospital (Block B), which is located on a campus with a distributed plan consisting of various healthcare structures, and has been conserved as a registered structure (constructed in 1933) that still provides healthcare services, will provide valuable information on the subject. As is clearly apparent from the layout plan, the closely and randomly spacing of the registered structure and the other structures that were added to the complex at a later date in a disorderly plan is a wrong approach that is frequently observed in the construction of numune hospitals. The links connecting the

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structures to each other involve small tunnel bridges, which have an adverse effect on the functional operation of the healthcare structure in question. Furthermore, the cafeteria and ATM that were sited opposite the entrance to the registered structure and at a very close distance completely block the facade of the building and prevent it from being seen as a whole (Figure 8). All these factors result in the registered structure being lost to the chaos, and vagueness in the perception of its architectural characteristics from up close.

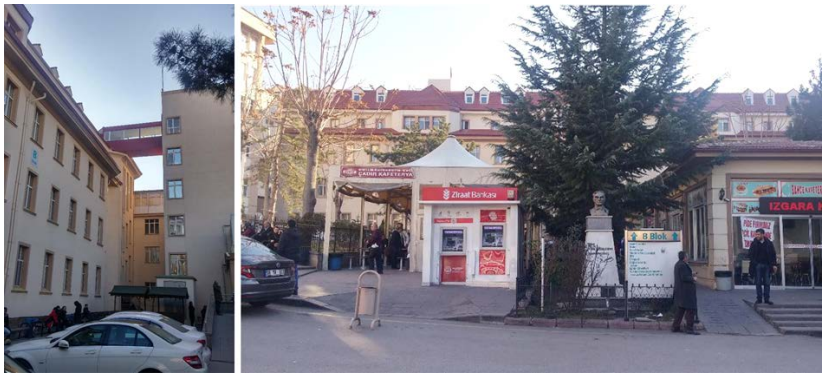

Figure 8. (Left) Ankara Numune Hospital, connecting bridge added later to Block B (Author Archive, 2018); (Right) the cafeteria and ATMs that disrupt the perception of the facade (Mehmet Şener Archive, 2018).

As is stated partially above, it should be underlined that locating other structures in very close proximity to the original hospital building of 1933 in a disorderly manner indicates that the value of the historical building was not adequately cared for. In contrast, the fact that the structures constructed on the campus were later designed with similar architectural characteristics ensured a common and consistent architectural language on the campus. The historical structure is seen as having undergone various interventions, and inappropriate construction materials have been used both on the envelope and within the structure, with two major renovations made over the last decade: one was the application of thermal insulation through the addition of plaster and paint, made approximately five years ago, and the other was the reconstruction of the roof, which had been lost completely during a fire that broke out in May 2016.

In a renovation made after the roof fire, a new inpatient ward was constructed in place of the attic and the wooden load-bearing system. Refunctioning the interior of the roof and covering the roof with tiles and metal cladding, if consistent with the original form, would be acceptable applications related to the function and architectural identity of the registered structure (Figure 9). On the other hand, it should be underlined that the cladding and engineering applications (electrical installation, ventilation, etc.) carried out to the facade damaged the authentic identity of the registered structure (Figures 10 and 11). The use of contemporary construction materials to the interior of the

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building at times to meet the new needs of the hospital resulted in an indoor environment that differed from its original form. It is apparent that the old (mosaic, marble, etc.) and new (PVC, aluminium profile, etc.) materials were used together, which is acceptable considering the functional requirements of the hospital.

Figure 9. (Left) Ankara Numune Hospital, renovated roof after the fire in 2016 (Source: Author Archive, 2018); (Right) the new clinic constructed in the attic (Mehmet Şener Archive, 2018).

Figure 10. Ankara Numune Hospital, the view of the mechanical installation to the hospital facade (Mehmet Şener Archive, 2018).

Figure 11. (Left) Ankara Numune Hospital before insulating (Source: Atalay et.al, 2011); (Right) the current view after the insulating (Mehmet Şener Archive, 2018).

Various positive and negative aspects can be observed when the other three numune hospitals are examined from this perspective. While the facade of the Diyarbakır Numune Hospital is suffering from visible plaster and paint damage, the hospital's physical integrity and authentic form have been maintained, to a large extent (Figure 5). Currently in use as a psychiatry clinic, its windows have been fitted with iron grills, which when coupled with the ventilation devices that have been applied to the facade, can be said to have damaged the authenticity of the registered structure.

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Figure 12. Erzurum Numune Hospital, Erzurum, 2018, the deteriorations observed on the facade of the Erzurum Numune Hospital, which was transformed from a Gureba Hospital and is currently serving as a Family Health Center (Dilek Okuyucu Archive, 2018).

The Erzurum Numune Hospital building was transformed from a Gureba Hospital in 1924, and is currently being used as the Directorate of Public Health (Block C) and the Şerif Efendi Family Health Center. The deteriorations to its facades resulting from moisture ingress and the materials used are remarkable (Figure 12). Comparing the photograph of the structure taken in 1904 to its current appearance, it is apparent that one floor over the entrance has totally been removed from the structure completely, and its roof finishings have been replaced (Figures 6, 12 and 13). Considering the registered status of the building, it is likely that the said intervention was made prior to the date of registration. The roofing material and pitch were probably changed due to physical requirements. The Sivas Numune Hospital building (Block A), which was completed in 1952 and is still providing services, was registered and preserved by the "Regional Committee of Structure Conservation" in 2016. Structures that had been added in later years were demolished in two stages in 2017, although "it had been stated in a report that they were very safe and solid" (The first stage of the

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demolition led to serious hazards) (Budaktaş, 2017; Ensonhaber, 2017). The additional structures that had been built in close vicinity to the registered structure and served as the "Directorate of Public Health, Provincial Directorate of Health and Yüceyurt Family Health Center" no longer exist, having been demolished to make way for a 7,000-person mosque project scheduled to be constructed on the site (Figure 14) (Budaktaş, 2017). In 2018, as noted in a Guardian article on February 27, 2012 with the new developments, the demolishing of the building came up on the grounds that the existing registered building does not have the required earthquake resistance (Cumhuriyet, 2018).

Figure 13. (Left) Erzurum Numune Hospital, the current view of east elevation of the hospital *(Dilek Okuyucu Archive, 2018);* (Right) the current view of west elevation of the hospital (Dilek Okuyucu Archive, 2018).

Figure 14. Sivas Numune Hospital, demolition of the structures around the registered structure (Ensonhaber, 2017).

NUMUNE HOSPITALS IN THE CONTEXT OF INTEGRATED CONSERVATION AND REUSE

The structures of Ankara, Diyarbakır and Sivas Numune Hospitals that have survived so far, and the structures of the Erzurum and Sivas Numune Hospitals that have recently been demolished should be addressed as part of efforts aimed at the conservation of the modern architectural heritage. The studies and activities of DOCOMOMO (Documentation and Conservation of Modern Movement) related to the documentation and conservation of cultural assets from between 1920 and 1975 and representing modernism are guiding in this respect (Ergut, 2013; Omay-Polat & Can, 2008). The numune hospitals addressed in the article are considered to be items of modern architectural heritage, in line with the concept defined in the Architectural Heritage Conservation Charter published by International Council of Monuments and Sites (ICOMOS) Turkey in 2013 as follows (ICOMOS-Türkiye, 2013).

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"Modern architectural heritage is any structure, group of structures or complex that has been constructed since the beginning of the 20th century and exemplifies both international and national orientations and/or innovative techniques and technologies."

An analysis of the numune hospitals in line with this definition reveals that they can be considered modern architectural heritage on the grounds that they represent the national and international orientation at an urban and structural scale, have a historical identity, and reflect the development of healthcare technologies and healthcare architecture of the Republic of Turkey. The major problem related to these structures is that a common and participative approach that takes into account the values they possess is lacking, and a number of impediments to the conservation of these structures in social, administrative and architectural terms are encountered. As a result of the determining role played by economic value in the conservation of modern architectural heritage, conservation committees and other stakeholders with a say in the issue have in the past made questionable decisions regarding conservation approaches and applications, and this has led to significant problems concerning the conservation of structures, as underlined in the previous section. In order to eliminate the problems in question, it is necessary to make the integrated conservation approaches applicable. The Amsterdam Charter makes various statements on the principles of integrated conservation (ICOMOS, 1975). For instance, the importance of conservation of architectural heritage in urban planning is emphasized, and it is stated that the pursuit of a conservation approach that takes into account economic, social, managerial and legal aspects is the primary purpose of conservation. Additionally, recommendations are made for the prevention of sudden and non-economic improvement processes to ensure the continuous maintenance of architectural heritage.

Moreover, the refunctioning approach and the things to be considered related to the conservation of the urban fabric are emphasized, together with the economic aspects of conservation, as follows:

... structures should be given functions that are in harmony with the requirements of modern life without neglecting their character, and thus their existence should be secured ..." (ICOMOS, 1975).

Another aspect of this issue is the important role that should be assumed by local administrations related to integrated conservation. The Ministries and local administrations that are responsible for ensuring the conservation of Republican period structures should clearly publicize the decisions they take

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concerning applications, and discuss and evaluate the reasons for such decisions with conservation experts.

Accordingly, the necessary conservation approaches should be reformulated based on recommendations regarding the use of numune hospital structures and their vicinity that are still standing through stratification from the perspective of resource saving and the adaptation for new functions in accordance with the requirements of modern life. Buildings constructed in close proximity to registered structures that were later found to be worthless and were consequently demolished; public areas that were designed around such structures, such as car parks and green areas; and approaches prioritizing economic concerns are all harsh interventions against spiritual values and urban memory that do not comply with the provisions of the Amsterdam Charter.

An analysis of how each of the numune hospital structures has been reused shows that each structure is in a different condition. The Erzurum Gureba Hospital building, which is currently home to the Şerif Efendi Family Health Center, is still functioning in line with its originally intended use. Interventions such as the replacement of the roof and the cladding to the facades of the numune hospital building in Ankara, which continues to function as a healthcare facility, have damaged the authenticity of the structure to some extent. The building of the first numune hospital in Diyarbakır, which has not survived, can be considered as a lost architectural asset, and discussions concerning the demolition of Sivas Numune Hospital building on the grounds that there would be a risk of collapse in the event of an earthquake, are another dramatic reality in the context of the abovementioned discussions.

The decisions taken regarding the Erzurum and Sivas Numune Hospitals at the urban scale contradict the participative conservation principles related to interventions. As these examples suggest, the conservation of relatively older numune hospital structures on the grounds that they are registered, the demolition of the structures around them for the construction of green spaces and car parks, and explanations made to the public stating that such interventions are necessary, indicate the implication of unilateral policies by the public authorities. The interventions and the rapid decisions made in such cases have eliminated the possibility of creating a memory that would allow an analysis of the architectural and technological development of cities in general, and healthcare structures in particular, and reveal the healthcare services provided to those cities. Such applications go against the principles of universal conservation, as another serious dimension of the problem of their

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implementation without sufficient planning or feasibility studies with regard to long-term economic gains.

EVALUATION AND CONCLUSION

The numune hospitals that were created through transformation of Gureba hospitals in 1924, as well as the construction of additional structures around them in the following periods, are important assets of cultural and architectural heritage that reflect the early years of the Republic and served as examples for the subsequently constructed hospitals. While it is evident that the architectural styles adopted under the guidance of the state in the early Republican period failed to spread to any great degree to the provinces of Anatolia, excluding Ankara, it should be underlined that the numune hospitals that were constructed in various provinces contributed to the dissemination of the architectural language demanded by Ankara for public buildings to various cities of the country, to some extent.

Today, it is known that there are various conservation and restoration methods for the protection of the comprehensive modern architectural heritage portfolio, and the numerous healthcare structures it contains. That said, considering the rapid transformations that the design standards, services and technologies witnessed in the health facilities, it is obvious that these hospitals, the newest of which was constructed in 1952, would not meet the current requirements of health facility architecture and be suitable for functional health service. There is little doubt that various technical and architectural revisions are required in the numune hospitals addressed in this study if the provision of quality healthcare services that can meet the current standards is to be achieved. Additionally, solutions such as the transformation of old hospitals into facilities that can support the current hospital program may also be implemented. Taking into account contemporary approaches and the advanced conservation and renovation techniques being employed today, it is possible to make use of these structures by transforming their functions and maintaining their authentic values through proper applications. If they are still part of a complex in which healthcare services are provided, they can be integrated into the existing functional structure.

One of the most important points revealed by this study is that a large majority of the first group of numune hospitals covered herein have survived to the present day, despite some improper interventions. In contrast, the structures that were added to or reconstructed under the same name were not treated with the same degree of sensitivity, and most have been demolished. This indicates that a well-defined framework regarding that which structures are to be conserved according to which criteria could

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not be created, and that the decision-making mechanism focused solely on the conservation of the oldest structures, or those constructed in the early years of the Republic. At this point, a theoretical framework and a consistent perspective concerning the conservation or demolition of numune hospitals should be presented. While one perspective of this subject focuses on the historical and cultural conservation value of these structures, another analyzes whether they have the necessary physical qualities to support the continued provision of modern healthcare services, as their primary function. First of all, it should be noted that the sustainability of these structures, which were registered as assets of cultural and architectural heritage dating back to the early years of the Republic should be ensured, provided that the authentic form of all components used at the time of their construction, is conserved. However, it is observed that although each of the structures clearly have conservation value, some were not conserved by the Ministry of Health or any other relevant authority, and consequently, have been subjected to negligent interventions. Since these interventions, made at various times in parallel with the development of healthcare technologies, were not in line with approaches that prioritized the identity of the registered structure, the original structures have been subjected to various levels of damage.

These structures that initially provided all of the services expected of a fully equipped hospital are today used for the provision of lower level healthcare services, with administrative and polyclinic services provided in the Sivas Numune Hospital; low profile polyclinic services provided with the function of a family health center in Erzurum; and administrative and inpatient ward services provided in Ankara. Considering the conditions and the requirements in the provision of healthcare services, it should be underlined that such functional transformations in which conservation principles and requirements are taken into account, are possible, and even necessary. In contrast, the Diyarbakır Numune Hospital is currently functioning as a psychiatric hospital, and differs from the other numune hospitals in terms of its use.

When the bulk of data obtained in the study is assessed as a whole in regards to the conservation policies to be followed for numune hospitals that have functional priority and still provide healthcare services, and equivalent public structures, it is the best to pursue an approach that "focuses primarily on the conservation of everything, that enables the formation of 'demolition approval committees' rather than conservation committees, and that allows the demolition of structures when required and survival of the others in their historical continuity...", as stated by Altan with respect to the conservation

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of modern architectural heritage (Turgut, 2017). While it is evident that the utmost care should be taken to ensure the conservation, reuse and refunctioning of these structures with modern architectural heritage status, the ways to take common decisions by making comprehensive discussions related with the demolition of such structures are opened if they are not durable and in a state in which they can functionally provide services, cause harm to the architectural and urban fabric around them both visually and functionally, and no conservation or refunctioning interventions could improve their status. That said, application practices that attribute heritage value only to the numune hospitals constructed in and before the early Republican period, and which focused on their conservation, but regard the numune hospitals constructed after 1950s that were the products of a modern architecture as demolishable, is in contradiction with this approach, and has led to the loss of urban memory from the times of their construction and the current projection of the historical richness. In order to prevent approaches that result in the destruction of historical bridges between the past and the present, it should be ensured that the concepts of heritage and value are defined in a broader contextual framework, and that conservation principles are shaped within the framework of such definitions.

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Research Article

Critical Aspects, Motivators and Barriers of Building-Integrated Vegetation

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Özge Süzer**

Abstract

Purpose

Green buildings which provide improved user health conditions and environmentally responsible applications have gained significant attention, due to the increasing environmental problems, particularly caused by the construction industry at the global scale. However, vegetation is still not sufficiently integrated into buildings, even though numerous benefits of plants have been proven by many studies in literature.

This research aims to find out the opinions of professionals and academicians in architecture-related fields regarding the critical aspects, as well as the motivators and barriers faced in BIV applications, namely; green roofs, green walls and interior gardens. Hence, it strives to help increase their application rates by underlining the significant issues to be considered.

Keywords: *Building-integrated vegetation, green roofs, green walls, interior gardens*

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Design/methodology/approach
As to fulfilling these objectives, a questionnaire survey was conducted on 120 participants with varying professions including architects, landscape designers and civil engineers, from four countries.
Findings
The results of this study pointed out that, healthcare buildings were given the first priority among the building types for applying BIV. Moreover, among the motivator factors, receiving a certificate was found as an important incentive, besides the environmental, social and economic benefits of BIV. Furthermore, although the highly rated barriers were found as 'the lack of proper regulations' and 'lack of demand by the user/client', the findings showed that the highest responsibility for the implementation of these applications was placed on the architect.
Research Limitations/Implications
Based on the five major groups of Köppen climate classification system, the case countries were selected as one from each of the four main types, and by neglecting only Polar, as it lacks settlements. By considering diverse levels of development and economic welfare, countries were selected as; Canada (Snow: Humid-Subarctic), Libya (Dry: Desert-arid), Malaysia (Tropical: Tropical-Rain forest) and Turkey (Mild temperate: Mediterranean).
Since the study covered four different countries, the survey was conducted by the use of Google Forms software program. This tool enabled the production and distribution of questionnaires, as well as the collection of data based on the responses of the participants. Furthermore, in order to provide consistency among the questionnaires applied in different countries, the survey was conducted in English language, although it was not the native language for a majority of the participants.
Moreover, based on studies claiming that participants are more inclined to select the option with the mid-value in a Likert scale, which implies a *neutral* position, in the questionnaire, these types of questions were constructed with the *forced choice method*, by keeping the scales with even number of options.
Practical Implications
It is expected that the results of this study would be beneficial to both the academicians and professionals involved in the green building industry, as well as to the governmental and/or green building authorities. It is expected that this study will help serve as a guide for the stakeholders to increase the application rates of BIV in the construction industry.
Social Implications
The results of this study were also evaluated based on the findings of four case countries and certain conclusions were derived as to their underlying socio-economic and geographical reasons.
Originality/value - Although studies on similar subjects have appeared in the literature, there are none which solely focuses on BIV applications by conducting a survey on the mentioned four case countries and compares its findings with the literature and presents an in-depth analysis on the issue.

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INTRODUCTION

Humankind has been fulfilling his many crucial needs from nature since his first emergence on earth. Plants are highly important as they eliminate carbon dioxide (CO2), carbon monoxide (CO), and some other toxic gases in the atmosphere via photosynthesis processes, which also help minimize negative effects on global warming and climate change. Recently, production and consumption of materials have dramatically increased due to the rise in urbanization rates, excessive use of energy, technological advancements, as well as industrial and economic developments. As a result, emissions of harmful gases have also increased, which has led to catastrophic consequences on the environment, and quality of life has deteriorated in urban areas because of the severely high levels of air pollution. Therefore, today, sustainable design of buildings, particularly in urban areas has become a fundamental issue to be considered. Building-integrated vegetation (BIV), which requires a multi-disciplinary and collaborative work of many professionals such as; architects, interior designers, landscape designers and engineers, offers a solution for lessening these environmental and social problems. In other words, application of green roofs, green walls and interior gardens, would help reduce air pollution and high temperatures, mitigate urban heat island effect and lead to energy savings in buildings and in urban areas.

By merging the living systems with the structural elements that currently dominate buildings, a fructuous type of architecture is created, which positively affects the quality of the exterior shell and the interior of the building, as well as its surrounding environment. The use of natural ventilation is undoubtedly one of the sound principles of sustainable building design. However, it should also be noted that using natural ventilation may cause outside air pollutants to enter buildings. As a consequence, exterior air pollution directly affects the indoor air quality of buildings. Moreover, when not properly maintained, mechanical ventilation systems can cause the spreading of air pollutants among the interior spaces of the buildings. Therefore, using BIV, namely applying green walls and gardens at interiors, offers a practical solution to improve indoor air quality as vegetation help filter the pollutants in air.

On the other hand, high exterior temperatures affect the indoor temperatures and increase the cooling loads of buildings, which result in higher energy consumptions. However, since green roofs and green walls act as extra layers of insulation, they help reduce the energy consumption in buildings. Moreover, green roof applications help reduce the heat island effect in urban areas (Dwivedi and Mohan, 2018), as Environmental Protecting Agency (EPA) stated that they "…provide shade and remove heat

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from the air through evapotranspiration, reducing temperatures of the roof surface and the surrounding air" (EPA, 2016) (p.1).

METHODOLOGY

Green buildings which provide improved user health conditions and environmentally responsible applications have gained significant attention, due to the increasing environmental problems, particularly caused by the construction industry at a global scale. However, vegetation is still not sufficiently integrated into buildings, even though numerous benefits of plants have been proven by many studies in literature. To be able to provide sustainable buildings which have lower energy consumptions than traditional buildings and help reduce the air pollution, BIV needs to be strongly promoted.

This research aims to find out the opinions of professionals, who are the decision makers in the construction industry, as well as academicians in the related field, regarding the critical issues, motivators and barriers of the mentioned green applications. By pointing out these aspects, their application frequencies are expected to be increased, and thus the environmental impacts of buildings on their surroundings and their users would be reduced in future developments.

As to the methodology of the study, a questionnaire survey was addressed to academicians and practitioners working in architecture-related fields with the aim of analyzing the critical issues, the opportunities and challenges of applying green roofs, green walls and interior gardens. The study was conducted on participants with diverse groups of professions including; Architects, Civil Engineers, Landscape Designers, Urban Designers, Planning Engineers, Agronomists and Investors. The participants represent different views from institutions related to the field of architecture from public and private sectors, which could affect the environmental, social and economic future construction developments in various locations.

This study comprises various countries with diverse geographical, climatic and regulatory conditions. According to the Köppen climate classification system, there are five major climate groups, which are; Tropical, Dry, Mild temperate, Snow and Polar (Chen and Chen, 2013). Based on these groups, the case countries were selected from four major climate types, by neglecting only Polar, as it lacks settlements. By considering diverse levels of development and economic welfare, one country from each major climate group was selected. These are; Canada (Snow: Humid-Subarctic), Libya (Dry: Desert-arid), Malaysia (Tropical: Tropical-Rain forest) and Turkey (Mild temperate: Mediterranean) (Chen and Chen, 2013). A total of 120 participants, with weightings of 60% practitioners and 40%

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academicians from institutions which are related to the construction industry and the field of architecture were included in this study. Leading companies and universities from the mentioned countries were selected to conduct the study, some of which are; Vitaroofs International Inc. (Canada), BH-Architects Office (Canada), Tatweer Research Company (Libya), Alemara Inc. (Libya), Teknologi MARA University (Malaysia), Lush Eco Sdn. Bhd. Company (Malaysia), Çankaya University (Turkey), Zorlu Holding (Turkey).

The questions in the questionnaire were grouped in four sections as to their types and contexts. These are; i.) Personal information of participants, ii.) Critical aspects of BIV, iii.) Motivators and barriers of BIV, and iv.) Future possibilities of BIV. The questions were constructed as clear multiple choice and ranking questions to determine the preference of participants related to the addressed issues, by avoiding any possible hesitations while answering.

On the other hand, in various studies in literature, it was found that participants are more inclined to select the option with the mid-value in a Likert scale, which implies a *neutral* position, or having *no opinion* (Lavrakas, 2008). Therefore, the questions with a Likert scale were constructed with the *forced choice method*, which is based on keeping the scales with even number of options that forces the participant to *actually* make a choice.

The survey was conducted in English language by the use of Google Forms software program. This tool enabled the production and distribution of questionnaires, as well as the collection of data based on the responses of the participants. As to analysing gathered data and extracting results by statistical reports, MS Office Excel and Statistical Package for the Social Sciences (SPSS) software programs were used. After that, a literature review on similar research topics was done for clarifying the obtained results and providing supporting findings for the study.

FINDINGS

Personal Information of Participants

Profession

All participants, either working as practitioners in the construction industry or in the academy as researchers or teaching staff, were chosen for their professions which were closely related with the issue of BIV. The group of professionals with the highest percentage was *Architects* with 30%, followed by *Landscape Designers* with 17%. *Civil Engineers* and *Urban Designers* followed them with each having 15%. *Planning Engineers, Investors*, and *Agronomists* followed these professions with lower percentages, as shown in Figure 1.

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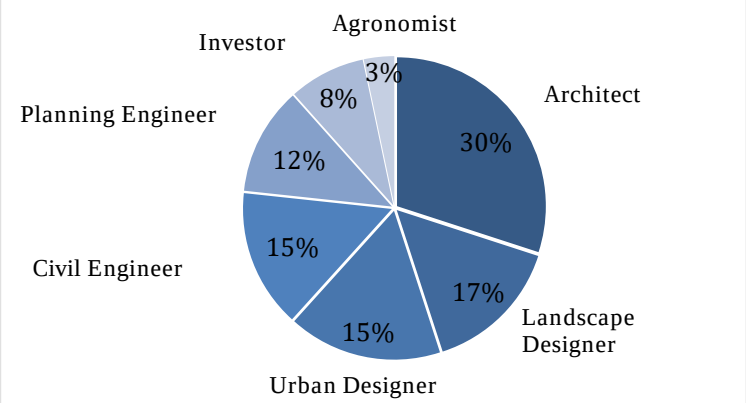

Figure 1. Professions of the participants

Work experience

These should be a The work experience of the participants varied as nearly half of them possessed an experience of 5 to 10 years, while 25% had less than 5, 18% had 11-15 and 10% had more than 15 years of experience (Figure 2). Regarding the number of construction projects contributed by the participants, the majority of them (40%) took part in 5-10 projects, while 30% joined less than 5, 23.3% joined around 10-20 and 6.7% contributed to 20 or more projects (Figure 3). Thus, it can be noted that all participants had significant work experience considering their time spent in the business and the number of projects they were involved in. Furthermore, a significant portion of the participants (77%) had taken roles in the design and construction stages of green roof, green wall and interior garden applications in buildings (Figure 4). Therefore, the participants were regarded as qualified professionals for the conducted survey, in determining the critical aspects, the motivators and the barriers of BIV.

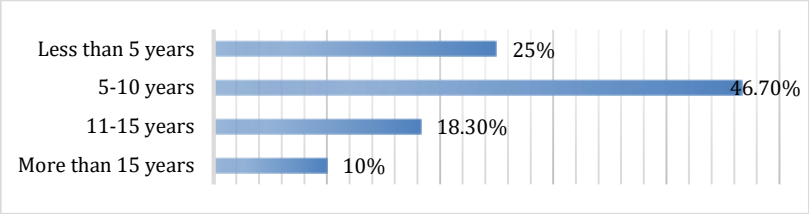

Figure 2. Number of years of work experience

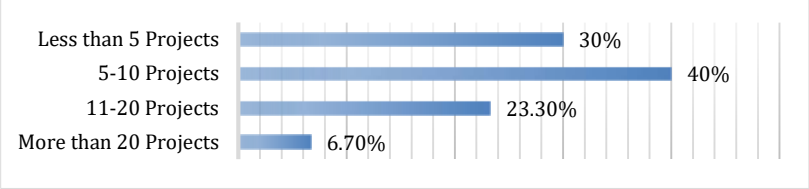

Figure 3. Number of projects contributed by the participants

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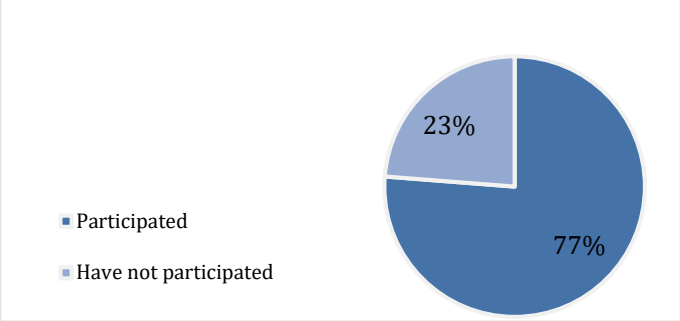

Figure 4. Participation in projects including Building-Integrated Vegetation

Critical Aspects of BIV

Different construction methods

A significant portion of the professionals support that there is greater opportunity in integrating vegetation into building elements if the structure is made of concrete. This finding can be linked with the fact that concrete structures are more resistant to humidity and loads (Franco *et al*, 2012; OCCDC, n.d.). 86% of the participants support that BIV is easily applicable in steel structures, while in timber frame structures it is seen as may not be possible (Figure 5). It should be noted that, considering the resistance of structural systems, differing BIV systems which vary in characteristics and methods of application provide various alternatives for designers. Moreover, the correct design of green roofs and green walls require detailed examinations and calculations by structural engineers to provide proper load bearing systems in buildings. This finding underlines the importance of a collaborative work on BIV applications (Brennek and Yuen, 2013; Clark, 2008; Hui, 2011; Shackell and Walter, 2012; Sharp *et al*, 2008; Wong and Baldwin, 2016).

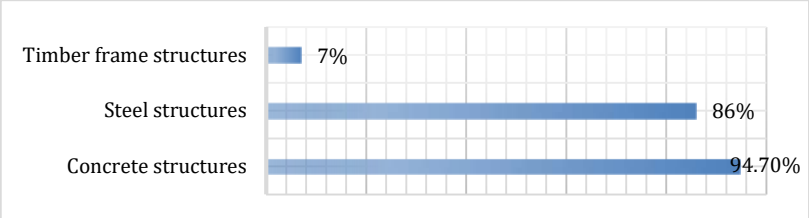

Figure 5. The ease of applying BIV for different construction methods

Significance order for types of buildings and professions

As to the order of significance for applying BIV in various buildings types, health care buildings were found to be having a priority considering the issue, by a majority of the participants. This finding can be linked with the positive effects of plants on the physical and mental health of patients and their visitors, proved by studies which encourage integrating vegetation in this building typology (Hartig and Cooper Marcus, 2006; Shackell and Walter, 2012). In the significance order, hospitality and commercial buildings were ranked second and third respectively. As the daily operational energy consumption and

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user densities are relatively higher in these types of buildings, they are considered as types that should benefit more from such sustainable applications (Bjerre, 2011; Tassicker *et al*, 2016). Moreover, residential building typology was ranked fourth in the above-mentioned order of significance. This result is found to be consistent with the findings of a study conducted by Stand and Peck (2017), about applications of green walls in different building types in USA. In the mentioned study, it was found that residential buildings find less chance to integrate vegetation due to the relatively high costs of these applications. However, the results on the level of importance of institutional buildings differ, since the participants of our study ranked them as having less importance, while the research of Stand and Peck found this type to be the most important (Stand and Peck, 2017). The significance order according to the respondents of our study, regarding the application of BIV in different types of buildings can be seen in Figure 6.

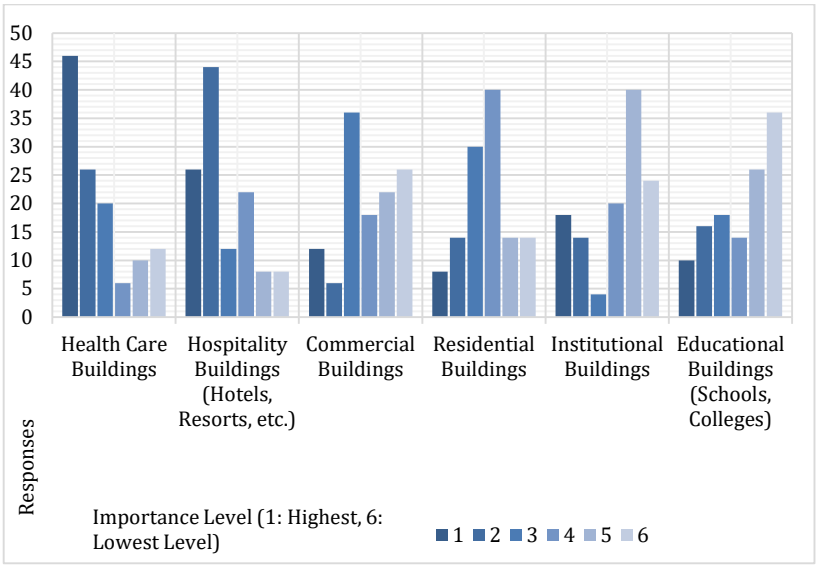

Figure 6. Significance order for the application of BIV in different types of buildings

Furthermore, based on their order of significance in management and implementation of these applications, professions which are related to BIV were ranked. The descending order of significance was found as, the architect, followed by environmental engineer, landscape designer, urban planner, civil engineer, project owner, financial expert and information technologist (Figure 7). Since the architect is responsible of organizing and directing how each branch of expertise works in a project, it is regarded as the most crucial profession considering this issue.

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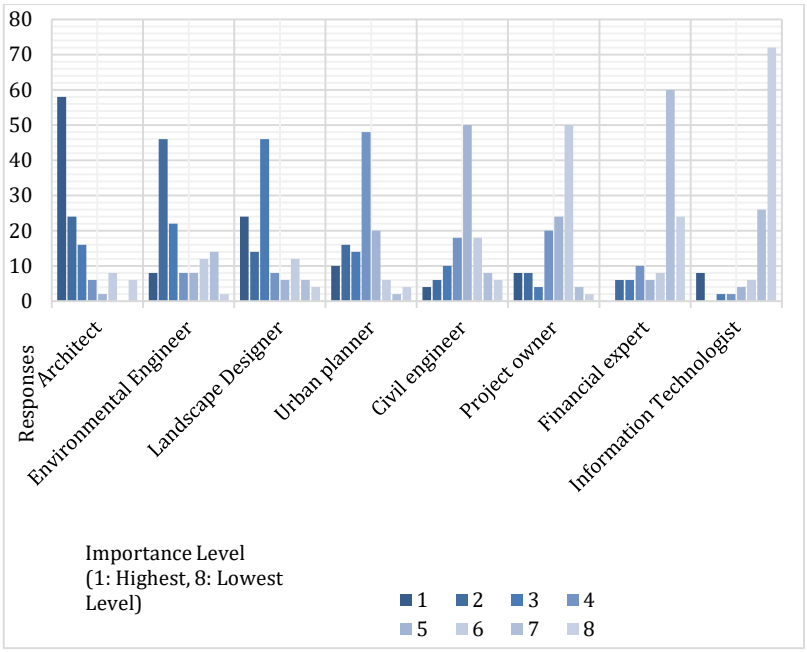

Figure 7. Significance order of professions in the management and implementation of BIV

Regarding the design of structures capable of withstanding large loads of green roofs, nearly two-thirds of the respondents supported that it was 'definitely possible', while 33.3% stated that it was 'possible to a certain extent' (Figure 8). Hence, provided that live and dead loads such as rain, wind and growth medium are studied and, the sizes and loads of plants are estimated based on their future growth (Hui, 2011; Lawlor, 2006; Miklos, 1998; Ottelé *et al*, 2011), the issue of large loads does not constitute a strict barrier for the application processes of BIV in new buildings.

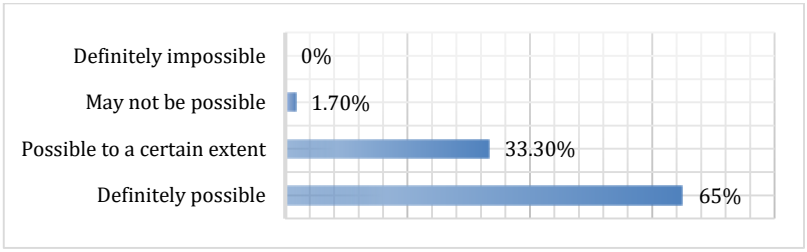

Figure 8. Possibility of designing structures withstanding large green roof loads

Applications in historical buildings

Another criterion that was assessed is related to the possibility of applying BIV in historical buildings. Majority of the participants supported that this issue was 'possible to a certain extent', depending on the structural conditions of the buildings and the types of BIV elements. 20% of the respondents stated that it was 'definitely possible', while a similar percentage considered it not possible (Figure 9). A report published by the United State General Services Administration in 2011, pointed out that some historical buildings with BIV had durable, high quality, well-engineered structures. Hence, these buildings

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offered solid opportunities in the implementation of BIV (USGSA, 2011). Moreover, National Gardens Service of U.S. Department of the Interior published guidelines for the rehabilitation of historical buildings. In this study, the criteria to be considered in the implementation of green roofs in historical buildings were given (Grimmer *et al,* 2011). Therefore, it can be stated that the responses of the participants showed parallel results with the literature regarding this issue.

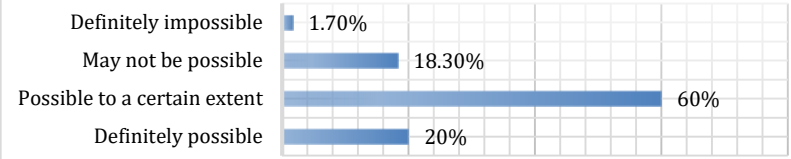

Figure 9. The possibility of implementing BIV in historical buildings

Contribution to energy efficiency

Moreover, more than two-thirds of the participants stated that BIV contribute to energy efficiency and reducing costs in buildings, which is coherent with the findings of the study of Charoenkit and Yiemwattana (2016) (Figure 10). It can be seen that these results are highly consistent with previously mentioned studies, and indicate a high level of awareness of the respondents regarding the benefits of BIV.

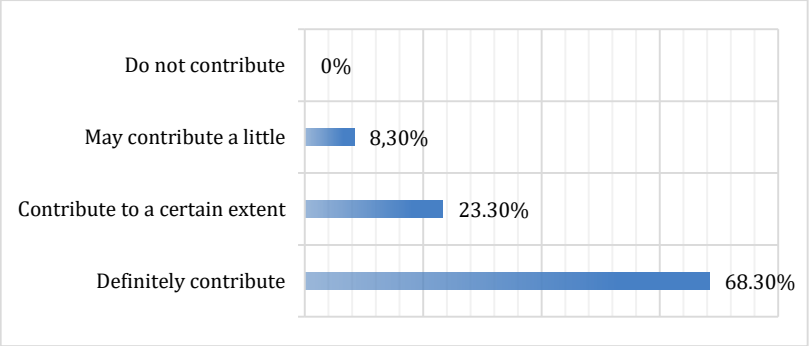

Figure 10. Contribution of BIV to energy efficiency and reducing costs

Motivators and Barriers of BIV

As a result of in-depth and extensive studies on the literature regarding the issue of BIV, the *motivator* and *barrier* factors were determined. After that, these factors were asked to be assessed by the participants of the study as to what degree they would affect the implementation of these applications (Figure 11).

Motivators of BIV

The following factors were determined as *motivators that affect the applications of BIV* by the participants of our study:

- Help reduce the effects of climate change (Zupancic *et al*, 2015; Stand and Peck, 2017).

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- The interest of owner/investor/institution (Gündoğan, 2012).
- Long term economic savings (Sutton, 2013).
- The awareness and interest of decision makers (i.e. environmental protection organizations, governmental authorities, etc.) (Liu *et al*, 2012; Gündoğan, 2012).

Motivators which *strongly affect the applications of BIV* are as follows:

- Improving indoor air quality. (Lee and Maheswaran, 2011; Pugh *et al*, 2012; Brennek and Yuen, 2013).
- Providing thermal and sound insulation for buildings (Wong and Baldwin, 2016; Charoenkit and Yiemwattana, 2016; Victorero *et al*, 2015).
- Providing the feeling of relief for building occupants (Shackell and Walter, 2012; Stand and Peck, 2017; Loh, 2008).
- Providing energy efficiency (Clark, 2008; Elston, 2000).
- Protection of the environment (Charoenkit and Yiemwattana, 2016; Wong and Baldwin, 2016).
- The awarded certificates for green buildings (Stand and Peck, 2017).
- The support of governments for sustainable projects (Clark, 2008; Bjerre, 2011; Larson, 2016).
- Increasing biodiversity (Loh, 2008; Engleback *et al*, 2003; Brenneisen, 2003; Clark, 2008).

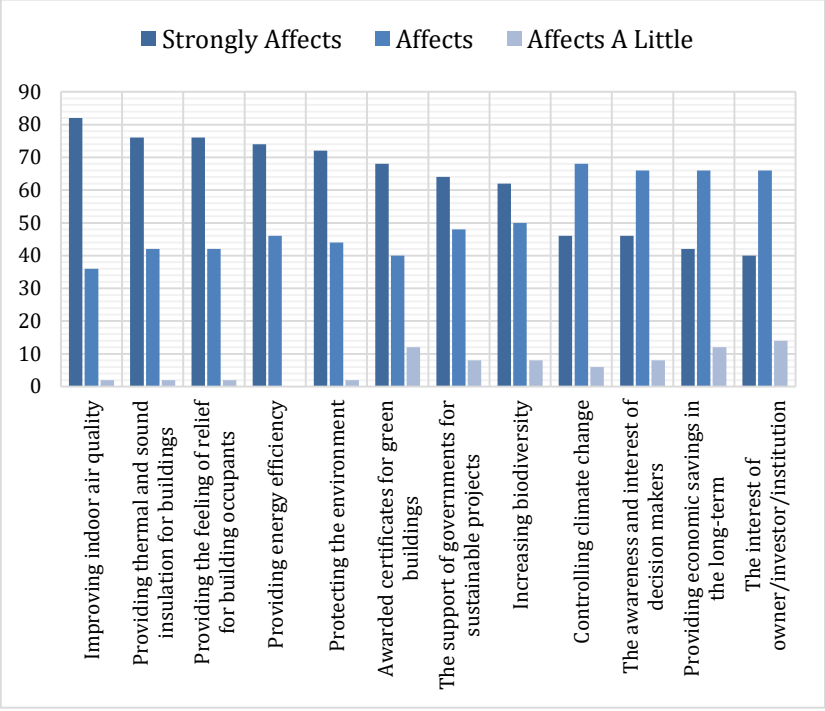

Figure 11. The effects of motivators of BIV applications

Barriers of BIV

According to the participants the *barriers that affect BIV applications* are:

- Lack of proper market (Gündoğan, 2012).
- Lack of specialized professionals (Gündoğan, 2012).
- Difficult climatic conditions (Hui, 2011).
- Frequent maintenance requirements (Sharp *et al*, 2008; Elgizawy, 2016).
- Lack of governmental tax incentives (Clark, 2008; Bjerre, 2011).

Moreover, as to the findings of our study, the following factors are determined as *barriers that strongly affect BIV applications*:

- Lack of awareness among stakeholders (Gündoğan, 2012).
- Lack of modern management skills (Gündoğan, 2012).
- Lack of knowledge (Bjerre, 2011).
- High initial cost (Bjerre, 2011; Tassicker *et al*, 2016).
- Lack of demand by the user/client (Tassicker *et al*, 2016).
- Lack of proper regulations (Gündoğan, 2012).

(Figure 12)

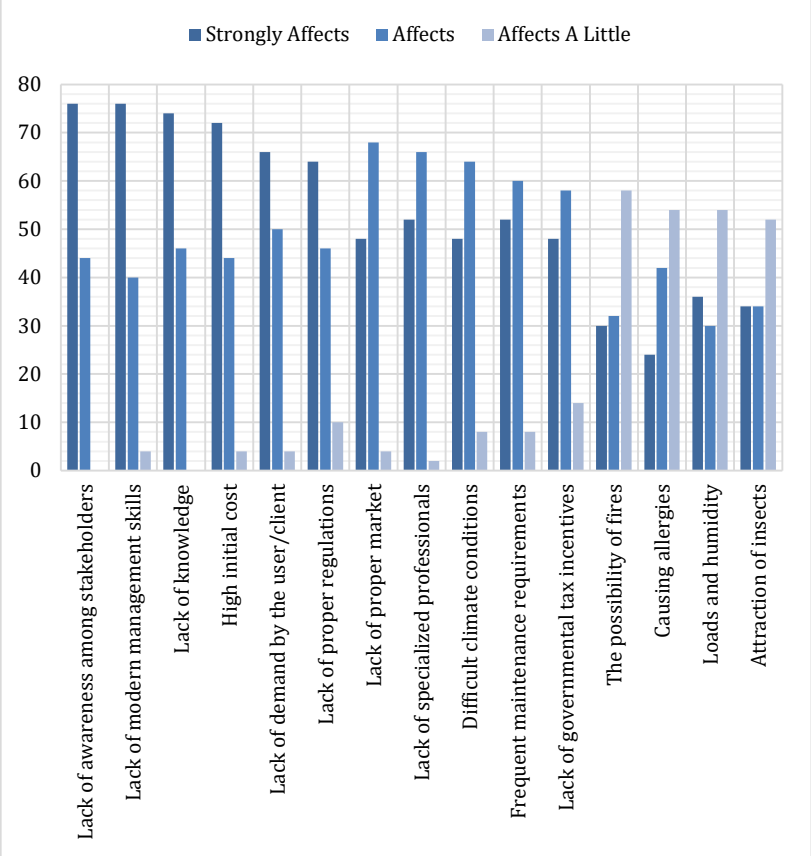

Figure 12. The effects of barriers of BIV applications

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A significant part of these results show consistency with the findings of other studies in literature, since 'lack of proper market and demand by the user', the 'lack of incentives from governmental and industrial bodies', 'high initial cost' and the 'lack of knowledge of their benefits' were found to be strongly affecting their applications (Bjerre, 2011; Tassicker *et al*, 2016). On the other hand, even though the possibility of starting fires was assessed as a barrier factor by some participants, studies in literature have shown that there are no fire risks associated with green roofs. As a matter of fact, some green roofs and green walls are built to provide fire resistance (FLL, 2002). Hui stated that "there is evidence suggesting that green roofs can help slowing the spread of fire to and from the building through the roof" (Hui, 2011) (p.4). Moreover, considering the effects of difficult climatic conditions on BIV applications, there are contradicting results between the findings of our questionnaire and the conducted literature review, as most of the participants supported that difficult climatic conditions can affect these applications. On the contrary, Sharp *et al.* (2008) states that green walls can be safely and successfully applied in a number of climate types (Sharp *et al*, 2008). Additionally, in the study of Sadeghian it is mentioned that "a green wall can be built outside (green facade, living wall) or inside a building cover, in a variety of countries and under various weather conditions" (Sadeghian, 2016, p.50). Also in their study, Timur and Karaca support this point of view by stating "green walls perform well in various climate environments. However, the selection of better species may adapt to the prevailing climatic condition" (Timur and Karaca, 2013, p.592). It should also be noted that, other studies have also underlined the importance of selecting the suitable plants capable of withstanding high temperatures and drought, such as local plants that can adapt themselves to difficult climatic conditions and keep growing for several years (Elliot, 2008; Li and Yeung, 2014; Perry, 2010).

Future Possibilities of BIV

Effects of professions on future developments

As to the effect of professions considering the promotion of BIV applications in future developments, respondents pointed out that the architect occupies the first place with respect to importance. Respectively; interior designer, developer, investor, building owner, building user and contractor follows this profession in the order of significance for this issue (Figure 13).

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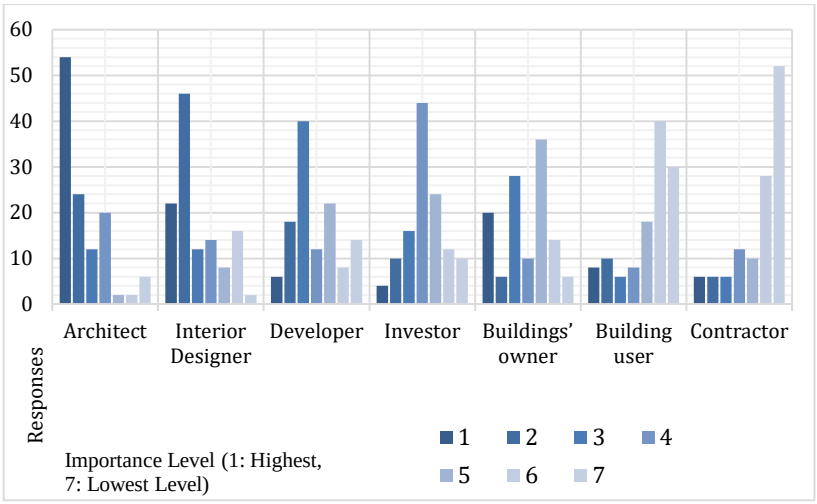

Figure 13. Effect of professions related to promoting BIV applications on future developments

The study of Wilkinson *et al.* (2015) which involved a smaller scale survey on green roof applications and targeted stakeholders in Sydney in 2012, found that in order to encourage their widespread applications, a great deal of pressure lies on architects and designers because of their capabilities of using BIV in their projects (Wilkinson *et al*, 2015). The findings of our study are parallel to the results of Wilkinson *et al.* (2015) and Anderson's studies, as it was found that the responsibility to convince the client towards the application of such projects relies heavily on the architect and interior designer (Anderson, 2004; Wilkinson *et al*, 2015). However, the study of Tassicker *et al*, conducted for Australia in 2016 stated that a major responsibility lies on the client (Tassicker *et al*, 2016).

On the other hand, it should also be noted that each and every mentioned profession is held responsible for providing certain strategies in their areas to solve the related environmental, social and economic problems of construction processes. Moreover, the collaborative work of diverse professions would promote the implementation of sustainable design approaches in building projects.

Motivator factors for future applications of BIV

The participants revealed that the most important motivator factor for the implementation of BIV in future applications is 'the dissemination of related studies', which implies the significance of the need to increase the level of knowledge and awareness on the issue. Moreover, the dissemination of related studies can help eliminate some barriers and increase the number of innovative applications regarding the mentioned issue. Therefore, the accumulation of such local, national and international studies constitutes an essential opportunity for researchers and practitioners to have a full comprehension of

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the issue of BIV. Furthermore, studies on its economic aspects would contribute to reducing its costs in the future.

The participants also pointed out that 'financial or moral support from effectual institutions' has an important role in promoting BIV applications. This support can be performed in the forms of loans, grants or discounts. These green incentives were implemented in several countries, such as Japan, USA and the U.K., and were well received by investors. Another motivational factor can be associated with green building rating tools, such as LEED and BREEAM, as these tools give certain points for BIV applications in the assessment of projects. BIV applications would help the assessed buildings get certified and receive higher rates.

Our study pointed out that 'increasing awareness on environmental problems' is also an important motivator. However, it should also be noted that, for the application of sustainable projects, the study of Wilkinson *et al.* (2015) found most environmental motivators to be less important than economic and social motivators. Finally, responses indicated that relatively less important motivators were; 'providing necessary materials in the local market', and 'having regulations and policies for the applications of such projects' (Figure 14).

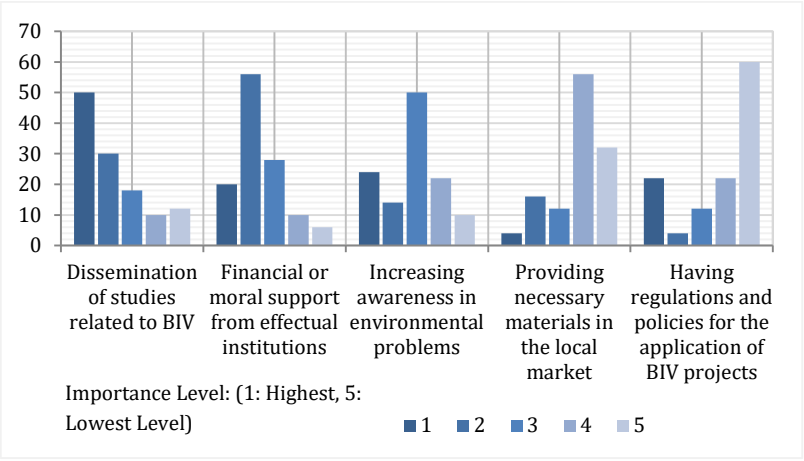

Figure 14. Significance of motivator factors for future BIV applications

Discussion and Further Studies

As stated above, the case countries for the questionnaire survey conducted in this study was selected to represent diverse climatic and regulatory conditions across the globe. Therefore, the results of the questionnaire were evaluated as a whole, by taking all answers of the participants as one sample group. However, to see if there was a significant difference or a rather more uniform distribution of rankings on the motivators and barriers of BIV among the four case countries, further research was conducted. Based on the responses, it was seen that among the four case countries, there was significant difference among

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certain factors regarding the motivators and barriers of BIV assessed in the present study. For instance, participants from Canada showed relatively higher rankings on certain motivator factors compared to other countries' distributions. These are:

- The interest of owner/investor/institution
- The awareness and interest of decision makers (i.e. environmental protection organizations, governmental authorities, etc.)
- The awarded certificates for green buildings
- The support of governments for sustainable projects

Moreover, Malaysia showed a significant difference in the factor; 'The interest of the owner/investor/institution', and Turkey displayed a significant difference in the factor; 'The awarded certificates for green buildings', among the ranking distributions of presented motivators.

On the other hand, as to the barriers it was seen that Libya showed a significant difference in the rankings of the following factors:

- Lack of proper market
- Lack of specialized professionals
- Difficult climatic conditions
- Lack of governmental tax incentives
- Lack of proper regulations

Moreover, while the highly ranked barriers which showed significant difference for Turkey were 'Lack of proper market' and 'High initial cost', the only significantly different barrier for Canada was found to be 'Difficult climatic conditions'.

Therefore, based on these findings it was derived that rather than the climatic differences, the regulatory differences played more significant role in the distribution of rankings as to the differences among the four case countries. It can be conveyed that these rather more highly ranked factors specific to the above-mentioned countries depend on their differences of development levels. Since Canada and Malaysia are more developed countries, the participants from these countries tend to have responses showing a higher state of awareness of the public and a more supporting governmental structure that provide suitable and promoting environments. However, as Libya is a developing country still having post-war struggles, the participants from this country highly rated barriers that show the difficult conditions faced to implement such applications in construction projects.

On the other hand, Turkey tends to display a more balanced state regarding motivator and barrier factors of BIV. According to the participants, green building certification is seen as an important motivator factor, while there also seems to be a lack of a

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productive environment as to its market for these applications. Turkey is still a developing country, however there is a significant amount of construction activities, both with and without the pursuit of green building certifications. Hence, the highly rated barriers for this country are believed to be associated with its financial drawbacks in the economy.

The barrier factor related to the difficult climatic conditions showed that, this factor was related to the relatively harsher climatic conditions of the two countries; Libya and Canada. It can be inferred that Turkey and Malaysia provide the ease of a more suitable environment for these applications, regarding their milder (Turkey) and more humid (Malaysia) climates.

Furthermore, in order to specifically determine the climatic and regulatory conditions that affect the motivator and barrier factors of BIV in the selected case countries, further studies can be conducted with the help of semi-structured interviews and/or open-ended questions. Following the present study, a separate research with the mentioned aim is considered to be conducted in the future.

CONCLUSION

It is evident that there is a vital need to propose and implement solutions to the problems of global excessive energy use and increasing levels of air pollution (Daly and Zannetti, 2007) Regarding these problems, BIV applications offer a remedy as they regulate air temperatures, act as insulators for the buildings and filter the pollutants in air. With this study, the opinions of decision makers and the influential figures involved in the implementation of BIV were gathered to determine the critical aspects, as well as the motivators and barriers of the application. Therefore, the participants of our study included a wide variety of professionals from various countries representing different climatic, geographic and regulatory conditions across the globe. Academicians of architecture-related fields and practitioners in the construction industry, have significant responsibility for promoting and implementing BIV applications, to increase awareness in these issues and fight the above-mentioned problems.

As to the findings of the study, healthcare buildings were given the first priority among the building types for applying BIV. Hospitality and commercial buildings followed this type owing to their high user capacities. Regarding the motivator factors for the application, besides the environmental, social and economic benefits of BIV, helping to receive green building certification was found to be an important incentive.

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Moreover, for overcoming particularly, the highly rated barriers of; the 'lack of proper regulations' and 'lack of demand by the user/client', the support and adoption of decision makers and authorities for the mentioned applications are needed. Governmental and non-governmental, as well as, profit and non-profit organizations should seek to increase the level of awareness in communities regarding energy consumptions and air pollution together with their negative effects on health.

Yet, responses have shown that the highest responsibility for the execution, management, and promotion of these applications is on the architect. Therefore, the importance of such issues should be strongly emphasized in educational programs on architecture. Furthermore, specialized professional teams composed of architects, interior designers, engineers and agronomists should be trained to be experts on BIV applications. Architects should persuade investors to integrate these applications in the designs of their buildings, despite their high initial costs, since they will redeem their costs by providing lower heating and cooling loads in the long term. In addition to these, the market for the construction industry should be developed to provide the required materials and the production of these materials should be at local scales.

To sum up, it is a well-known fact that projects with BIV outperform traditional buildings in terms of their economic, social, and environmental performances (Loh, 2008; Tassicker *et al*, 2016). It can be stated that this green design approach represents a sound and feasible solution for overcoming certain environmental, economic and health-related problems and helps the development of sustainable cities. To be able to achieve this, a collaboration of a wide range of disciplines and the incentives of governmental authorities are needed. Within this framework, it is expected that our study will help serve as a guide for the stakeholders to increase the application rates of BIV in the construction industry.

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Research Article
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A Narrative Analysis of Women's Use of Space in Tehran Modern Housing: 1960-1980

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Ahsen Özsoy**

Abstract

Purpose

Iran's modernization process began from late nineteenth and early twentieth century with political and economic reforms that were followed by socio-spatial reforms. The state's policy of modernization intensified in the 1960s to the late 1970s following the White Revolution and economic boom. Tehran was considered as the capital of modernization and a ground pattern for socio-spatial transformation in the country. The images of modern living spaces and modern society with a focus on women as agents of change and discontinuity were imported from the west. Modern socio-spatial ideas in confrontation with traditional and local ways of life transformed and adapted the status quo. The purpose of this study is to analyze the women's use of modern domestic spaces constructed between the years 1960-1980 in Tehran, considering political, economic and socio-cultural dynamics.

Design/Methodology/Approach

The factors that affected use of space and adjustments were categorized in accordance to user profile, dwelling unit and settlement. The data

Keywords: *Tehran modern dwelling, everyday life, modern domesticity, modern women, use of space*

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was collected through in-depth interviews with twenty women and analyzed through narrative content analysis.

Findings

The results showed that several links existed between socio-cultural norms, women's everyday life and use of space. Some of these connections represented demographic and economic sources, whereas others had physical, environmental and socio-political sources.

Research Limitations/Implications

Number of case studies were limited and making contact with the interviewees proved to be difficult due to security reasons of the settlements. Furthermore, in some instances it was challenging to have access to archives of buildings due to factors such as dissolution of companies in charge of planning in period of Iran Revolution (1978-9).

The significance of this study was to explore broader aspect of architectural design, housing development and evolution in Iran and leads to new perspectives in other fields such as socio-cultural studies.

Practical Implications

The investigation of practical aspect of modern housing through analyzing narratives of women dwellers provide useful analytical data for architects to consider factors such as household structure, privacy, everyday life and socio-cultural values in designing the domestic spaces.

Social Implications

A comprehensive study of the users in Tehran, based on the experience of women living there, unfolded a new level of findings. It showed that determinative factors on gender, domesticity and the use of space are deeply rooted within the context-specific social or cultural norms.

Originality/Value

The previous studies focused on political, social and economic aspects, whereas this study concentrated on gathering first-hand information from the occupants to provide data on the women's use of space in modern houses.

INTRODUCTION

Modern domesticity and woman's image in Iran emerged under the modern-national hegemony of the state which defined new ideal models for both. Euro-American concepts of domesticity concerning women were considered from the turn of the century and intensified during the last two decades of Pahlavi period (1960-1980). Mohammad Reza Shah's policies of "making Iran a modernization showcase" (Little, 2002: 221 cited in Karimi, 2009: 21) in the Middle East led to socio-spatial transformation in the country.

Although imported patterns of modernism are similar in non-western countries, Iran had a radical approach to it in 1960s and 1970s as a result of the state's top down modernity policies and economic boom (Madanipour, 1998; Abrahamian, 2008; Karimi, 2013). Modern domesticity was idealised, and the modern woman image emerged as a result of the state's modernization aspiration and social opportunities with a growing number of

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middle-class educated women with economic independence. The concepts of "modern home, life and woman" were promoted by Euro-American models.

Modern settlements constructed during 60s and 70s Tehran represent the social, economic and politic transformation in the country. Modernization became the government first plan and the White revolution (1963) of the Shah brought about social transformation that included women's freedom and immigration to the big cities. Furthermore, oil and industry dependent economic growth supported the state's plans. Tehran was selected as the capital of modernism and centre of the economic growth. Consequently, the construction of residential complexes and towers accelerated in this period with addressing new and educated middle class families.

In this framework, analyzing women's use of space provides further studies on the effects of the modernization, adoption and adaptation process and how political, economic and socio-cultural systems influence the process and how women use and modify the space during the time. Using narrative research methodology, the focus of this study was on the everyday life of women and the spatial connections. Particular attention was paid to the role of traditional, cultural factors and social change in individual relationships and alterations of domestic spaces.

THEORETICAL FRAMEWORK

Use, adaptation, modification of space are the practical sides of habitation. Spaces are used and modified in various patterns depending on the user's everyday life. There are different familial, economic, political, sociocultural, physical and environmental factors that influence the individual's use and modification of the space. There have been several studies on use of space in modern houses. Ghannam (2002) and Karimi (2013) showed how state and ordinary people, confronted with global notions of modernity, transform it to physical forms considering socio-cultural norms. Their study considered the struggle of power, family members and religious groups over use of space, while Foucault (1984), Lefebvre (1991) investigated similar issues in relation to political power and control mechanisms. The decision-making process by companies, families, "Popular" and "superior" taste about design, use of space and changes investigated by Bourdiou (1984), Kent (1990) and Cieraad (1999). Giddens (1984), Pader (1988) showed how changes in social relations affected the changes in spatial relations. Similarly, social and spatial relations were explored in studies of many scholars such as Edney (1976), Soja (1980), Hillier and Hanson (1984). From Wilk's (1990) point of view, houses symbolized the relationships among households and their

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community. Heynen and Baydar (2005) examined a research finding by Denby and Fry to ascertain how changes in space and living practices created new types of people. Michelson (1994), using a time-use research method on the basis of interviews and diaries, assessed the peoples' activities over a period of time, their interrelated behaviours and the system of activities related to them. He was seeking the relations between everyday life and spatial-temporal constraints in housing. Wills (2001) discussed the women's everyday life and modern family in her study. Hayat Khan (2014) explored the explicit and implicit reasons of transformation in urban housing. The core values of the Islamic culture in related to home and women considered by Al-Kodmany (1999) and Madanipour (1998).

However, mentioned studies mostly focused on a general inquiry on the use of space, gender and domesticity affected by political, social and economic conditions. This study took the investigation one step further and outlines several of those dynamics from different literature, comparing them with the ones gathered during the study in the context of Tehran's Modern settlements constructed during the 1960s and 1970s. The factors categorized in the user profile, dwelling unit and settlement domains give a more comprehensive picture of the use of space in Tehran modern houses. This study is about digging deep into the different effective factors of women's use of space in different levels.

METHODOLOGY

The research question focused on the women's use of space in Tehran modern houses constructed in the last two decades of Pahlavi period (1960-1980); their everyday life, modification and appropriation of space. How do women use and modify the space and how do socio-cultural, political and economic factors influence the use of space? As a qualitative approach, the narrative inquiry was considered in accordance with the study's socio-cultural contextual undertone and based on the users' experience of living in modern houses constructed in the defined time period. Women's experiences of the use of space, their personal and social interaction, the continuity with the past, present and future and place were considered in this method of research. Narrative inquiry was used as a method of study that concentrates on stories individuals tell about themselves (Clandinin & Connelly, 2000; Creswell, 2007). The women as active users of domestic spaces have a story to tell about their everyday life with the interplay of other socio-cultural, economic and political factors. The data collection process involved in-depth interviews, analysis and interpretation of stories,

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observation, memoirs, archival documents and photographs (Riessman, 2008; Marshall & Rossman 2011).

The women's interpretations that assigned to the modern home spaces with its practical aspects such as changes in use revealed many facts about modern houses, user interaction, the impact of socio-cultural, political and economic dynamics. The qualitative approach gives a voice to the users of space to convey the meaning of modern houses from the users' perspective. In fact, factors that contribute to the use of space by women in modern houses have been linked with issues that border on socio-cultural, political and economic factors.

The study sites were selected from the residential apartments constructed during the years 1960-1980 in Tehran. These settlements (Behjatabad, Saman, ASP, Eskan, Le Parc Des Princes, Zomorod) were constructed during the process of modernization of the capital and promoted new and modern lifestyles for the newly emerged modern middle-class (Table 1). These settlements are situated in district 6 (central), district 2 and district 3 (North and North West) of Tehran (Figure 1). The dwelling units were 83 m2 to 276 m2 and included one, two- and three-bedrooms apartments and duplexes (Table 2, 3). Twenty women aged 38-72 were selected through the snowball sampling method (Table 4). Participants were found by the reference of friends due to the difficulty of entry to the buildings and houses because of security and privacy issues.

The inclusion criteria for participants included: a) women who had lived there for more than 5 years for considering the use of space and modifications, b) the households which were homeowners as well for monitoring their authority for use and modification of space. The exclusion criteria were: a) tenants, b) recently moved households, c) suits. The participants were asked through an in-depth interview to tell the story related to the research question. The interviews took 60-120 minutes and were conducted in two different time periods, October 2016 and November 2017.

Table 1. Settlements' information

Settlement/ Dist.	Constr. Date	Number of Dwelling Units	Number of blocks / storeys	Total area(m2)
Behjatabad/6	1964-70	384 apts.	14 B. 14 S.	35000
Saman/6	1969-70	210 apts.+19 coms.	2 B. 22 S.	33000
ASP/6	1969-74	250 apts.+120 houses +140 coms.	3 B. 24 S.	112000
Eskan/3	1972-77	180 apt. +100 coms.	3 B. 23 S.	47000
Le Parc des princes/3	mid 1970s	330 apts.+30 coms.	A: 24 S. B1, B2, B3: 19 S. C: 15S.	68000
Zomorod/2	1975-76	749 apts.	Phase 2: 4B. Phase3: 4B. 5, 12, 18, 26 S.	50000

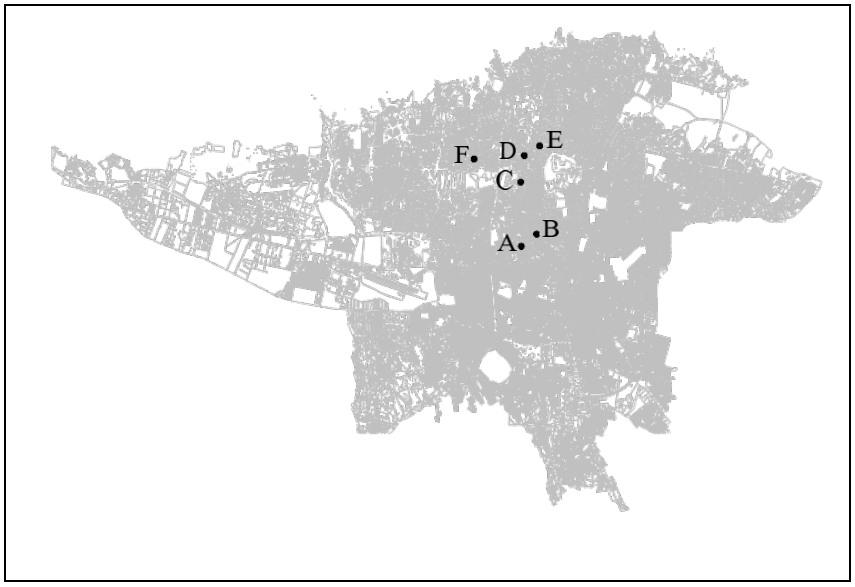

Figure 1. The Location of settlements; A: Saman, B: Behjatabad, C: ASP, D: Le Parc Des Princes, E: Eskan, F: Zomorod.

Table 2. Houses' information

Settlement	Name	Block	Floor	No.Beds	Dwelling Size m2
Zomorod	Z1	Apadana;wing B+	20	2	172
	Z2	Perpolis; wing B	17	3	209
	Z3	Saadi; wing B	14	3	209
	Z4	Bistoon; wing B	18	3	209
	Z5	Bistoon; wing B+	10	2	172
Le parc des princes	P1	C	14	Duplex, 2	132
	P2	A	12	2+1 service	224 (154+70)
	P3	B	10	3+1 service	217 (187+30)
Eskan	E1	A	16	3+1 service	205
	E2	A	12	2+1 service	185
	E3	C	8	3+1 service	205
Saman	S1	2	1	Duplex, 1	84
	S2	2	9	2+1 service	220
	S3	2	7	1	83
	S4	2	9	3+1 service	170
	S5	2	14	1	83
Behjatabad	B1	15	2	3	240
	B2	15	4	3	240
ASP	A1	C	4	3+1	276
	A2	C	12	3	205

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Table 3. Site plan and plan of case studies

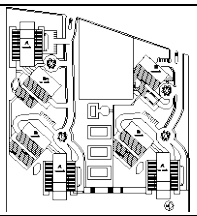
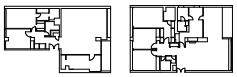
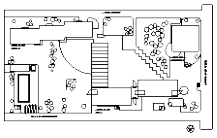
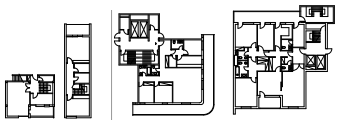
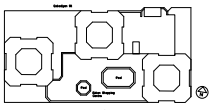
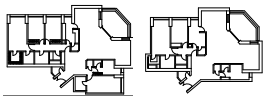
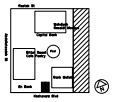
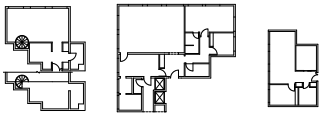
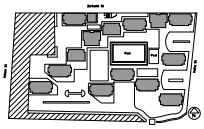
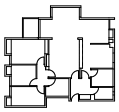
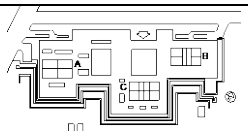
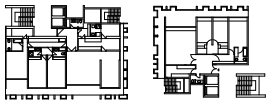
Settlement	Site plan	Plan
Zomorod		Z1, Z5 *Z2, Z3, Z4* 
Le parc des princes		P1 P2 P3 
Eskan		E1, E3 E2 
Saman		S1 S2, S4 S3, S5 
Behjatabad		B1, B2 
ASP		A1 A2 

Table 4. Demographic information of participants

Name	Age	Job status	Education	Marital status	Children	Years lived
Z1	65	Manufacturer	University	Married	2	30
Z2	60	Retired	University	Married	2	20
Z3	58	Housewife	H. school	Married	2	31
Z4	42	Housewife	H. school	Married	2	5
Z5	48	Housewife	H. school	Married	2	5
P1	65	Teacher	University	Married	-	22
P2	50	Architect	University	Married	1	15
P3	62	Retired	University	Married	2	30
E1	58	employee	University	Married	2	34
E2	46	Teacher	University	Married	1	20
E3	65	Retired	University	Married	2	32
S1	60	Retired	University	Widow	1	34
S2	60	Retired	University	Divorced	1	35
S3	38	Employee	University	Married	-	6
S4	48	Housewife	H. school	Married	2	20
S5	54	Housewife	University	Married	2	24
B1	38	Housewife	H. school	Married	2	7
B2	40	Housewife	H. school	Married	2	5
A1	72	Retired	University	Single	-	30
A2	72	Retailer	University	Married	-	30

The set of questions included in the interviews was used with the aim of understanding the major modern housing dynamics,

actors and factors in 60s and 70s Iran, to study women in their everyday life and use of space during the years, considering the socio-economic and political factors. The interview questionnaire was conducted with 20 women dwellers of the 6 settlements. The questionnaire was organized in three major parts; 1) demographic information, 2) the story of their house, 3) dwelling and site information. The first part's questions included age, education, employment status, marital status and changes in household structure. In the second part, the participants were asked to tell the story of their house and settlement, their everyday life, use of space and alterations. In the last part, questions were about general information of dwelling and site such as size, layout, placement in the building, location, neighbourhood and date of construction.

The data was analysed in narrative terms through the interpretation of what was said (Riessman, 2008). A qualitative software package (Atlas.ti 8.0) was utilized to assist with data organization, analysis and management. The process of interpretation commenced with the identification of codes within stories and writing comments on them (Table 5). Then searching back and forth for what was significant about the stories and what was common to more than one story led to identification of themes. Afterwards a second round of analysis was undertaken to compare and contrast important and distinctive features to establish sub-themes. Finally, all this information was compared with relevant literature in the use of space and women in modern houses and lifestyles, and socio-cultural studies in order to elucidate the final results, discussion, and conclusions.

Table 5. Codification and quotations

	Quotation	Codes
User	Reasons for the move to this house	▪ Being close to the family and relatives. ▪ Hotel like, security ▪ Living in a high apartment ▪ Previous bad neighbours ▪ Easy cleaning ▪ Good management ▪ High quality of materials, installations, acoustic, lighting, airflow ▪ Modern, open plan, proper size ▪ Dream house, Peaceful, Happy and energic, Love and joy ▪ Homeowners, low density ▪ Fame of the building and accommodation for famous and rich ▪ Central, close to work ▪ Space for Children

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Complains	Dwelling			Settlement	
	Daily activities	Social/cultural activities	Significant factors in use of home spaces	Changes and alterations of the space	Home and immediate surroundings	Communal spaces
▪ Large windows, Closed curtains most of the time ▪ Messy, busy and noisy place ▪ Lack of balcony, guest suite, bedroom downstairs, storage, green space, ▪ Visual/audio pollution	▪ Organizing business, home office ▪ Exercising, going to walk ▪ Shopping ▪ Visiting family and friends ▪ Walking dogs ▪ Going to the bazaar ▪ Doing chores ▪ Watching TV ▪ Studying	▪ Restaurant out night ▪ Travelling ▪ Ceremonies and parties, ▪ Gym ▪ Masnavi-Molavi mysticism courses ▪ Monthly gathering with friends ▪ Dinner invitations ▪ Religious ceremonies ▪ Cultural activities ▪ Cahrshanbe soori, Eyde- Norouz (Iranian New year ceremonies on 21th of March)	▪ Occupation of woman ▪ Daily and nightly activities ▪ Socializing patterns ▪ Individual activities ▪ Privacy ▪ Economy ▪ Formal/informal relationships ▪ Dirt/clean	▪ Segmentation of space, using partitions ▪ Opening the kitchen ▪ Adding Bar ▪ Interior design ▪ Decorative fireplace ▪ Renovation of bedrooms, service areas ▪ Use of Bedroom as second living room, TV room and work room, Gallery ▪ Change the bath to Traditional Hamam style ▪ Changing Servant room to Utility room or guests' room ▪ Interference in use and alteration semi-public spaces.	▪ Domesticity and publicity interaction and interference ▪ Furnished corridors, lobby ▪ Busy and unsafe	▪ Garden, hall, parks, supermarkets ▪ Space for walk dogs ▪ Bank branches ▪ Cafe shops ▪ Garden, yard ▪ Pool ▪ Restaurant ▪ Supermarkets ▪ Mosque ▪ Patisserie and Café ▪ Shopping centre

RESULTS AND DISCUSSION

The findings of the study and existing literature create a platform to investigate the use of space and modifications. The results show seven themes in according to user profile, dwelling and settlement levels (Table 6). There are two themes in the user profile level. The first is the demographic theme, characterized by the effect of sequential development of the different life cycle stages of the family on use of space. The second is the economic theme such as the women's contribution in the family's economy. The themes in the dwelling unit level were extracted from data collected with observations and in-depth interviews and narratives with women living in modern apartments and includes third and fourth themes; everyday life, time-space activities and socio-cultural norms.

Table 6. Theme matrix

	Themes	Sub-themes
User profile	Different life stages of the families affected the use of space	2
	Economy is a significant factor in space use and organization	1
Dwelling unit	Women use the space in accord to their everyday life	2
	Socio-cultural norms are determinative in use of space	4
Settlement	Communal Sites are women's extended domestic spaces	1
	Settlement characteristics affected the use of space	2
	Socio-political transformation affected the use of space.	1

The final major level is the settlement level and includes three themes: the first is the women's extended domestic spaces, that are context specific and provide more opportunities for women to use the space. The second is the settlement characteristics such as the need for security, cleaning, comfort, status, identity, good neighbours and central location. The last category is about socio-political themes such as change in the social and political relations and values affecting the use of space.

Theme 1: Different Life Stages of The Families Affected the Use of Space

Here two sub-themes emerged: (a) Household structure is important in use of space, (b) Increasing age demands new changes in space.

(a) Make and use of domestic space should be considered in families' different life stages; past, present and future. In the cases of change in familial context, marriage status, death or birth, leaving the home for work or education, rooms may be without use or subject to change or overload of competing

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demands. "we use the bedroom of my daughter after her marriage as second living room (Z2, two beds)" "my son's room is useless after his emigration abroad (S2, two beds)" "I can't use the bedroom after my husband's death (S1, one bed duplex).

The house is a stage for the manifestation of power relations between family members and genders in the struggle over space about how it should be used and presented. Family members as Kent declared, "negotiate, argue, fight or use deception in acquiring access or claim to space, in excluding others from it or in setting rules on its use" (Kent, 1990: 41). "I prefer to have an open kitchen, but my husband does not agree (P1, two beds duplex)" A study of the results of home alterations in Britain between 1986 and 1992 by Putnam (1999) revealed personalization was the most significant factor in the case of competing household members (Cieraad, 1999).

(b) Cases show that, the users' demands differ with their age. As a result, spaces lose their functionality or other spaces are laden with extra functionalities. "I can't use the upstairs because of my age and health problems such as backache" (S1, one bed Duplex) (Figure 2). She added the bedroom functionality to the living room. Or users have to alter the space to modify their needs or even think about changing their home: "I changed the bath to a traditional one which is easy use" (S1, one bed Duplex). "I am thinking to change my home to smaller one, I do not need so much space anymore" (S2, two beds).

This case shows the change in use of space during the time. Changes in household structure such as loss of a family member, increased age causing loss of bedroom functionality and living room in the ground floor overloaded with other functionalities such as sleeping.

Figure 2. Use of space in different life stages of a family (Davodipad, 2016).

Theme 2: Economy is a Significant Factor in Space Use and Organization

Here one sub-theme emerged; (a) Women's economic contribution to the family affected the use of space.

(a) The interviewees divided the domestic space to provide the space for their work; the living room in Nil's home (S3, one bed) was divided into two parts; sitting/dinning space and workspace. Furniture is very important in the organization of space in her home. The working space was separated with a decorative partition from rest of the living room.

The main part of Sh's work (Z1, two beds) including managing and selling of the products is done at home between the kitchen and dining space. A small part in the dining area is separated using a partition and is used as the storage space and fitting room for customers. The countertop of the kitchen is her work desk where she manages her interior work as a mother and wife and her exterior work as a manufacturer. Moreover, she uses the bedroom for the storage of clothes. Del (S2, two beds) divided the living room for creating a workshop in it. She uses the second bedroom for displaying her art works as well. Zi (P1, two beds duplex) uses the corner of her very formal living room to teach piano lessons privately (Figure 3).

These examples show how women partitioned living room to emerge workplace. Left; Sh (Z1, clothing manufacturer) used a folding paravane to emerge a space for trying cloths and storage. Centre: De (S2, painter) separated the atelier with a wall. Right; Nil (S3, massager) used a paravane to separate the space for her work.

Figure 3. Living spaces (Davodipad, 2017).

Theme 3: Women Use the Space in Accord to Their Everyday Life

Here two sub-themes emerged; (a) Users everyday life defines the use of space, (b) Kitchen is the women's place

(a) "The growth of the culture of modernity was inseparable from a re-evaluation of everyday life" (Wills, 2001:47). Women's everyday life, related behaviours and contexts revealed many facts about changes in their daily life including changes in standards, in family structures, economics, housing, traditions, women's safety, the quality of child raising, employment and gender equity. Michelson (1994) defined everyday life as a great system of interrelated behaviours and system of activities including employment-related activities, household and child-

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raising activities, recreational activities, and biological necessities over a period of time.

The everyday life of women changed with the introduction of modern life ideas, habits and objects and affected the combinations and patterns of activities they carry out as part of everyday life. Consequently, location, content and relative balance among daily activities and behaviours changed. Considering the daily life activities of participants in relation to space and time revealed that women use home and near neighbourhood over the day for their activities. Integrating the kinds of locations for child-care, jobs, shopping, social and recreational facilities into women daily life made these settlements desirable. This provided more opportunities for housewives, employed women, women with or without children.

(b)New types of kitchens introduced to new homes through the period in magazines and according to the Anglo-American taste of design (Karimi, 2009). The kitchen's standards, place in home, relationship with other spaces, lightning, habits of taking meals and women's needs were discussed in magazines. Consequently, kitchens placed in one of rooms around the central courtyard with one brick stove and one water well moved to the inside of houses with smaller sizes and new appliances and shaped new forms of identification. Modern kitchens equipped with electric and time-saving appliances and different programs (such as Act of July 1951, Truman Program) for educating women in relating to home organization were aimed at creating labour-saving homes and women without the need of maids (Karimi, 2013). Labour-saving devices accelerated the demands for servants and more household goods needed more cleaning and maintenance (Wills, 2001). Therefore, rationalization of homes in favour of improving women's individual and social life increased the need for servants and related spaces as it is seen in the layouts of many constructed homes of that period. However, increasing women's rights in public and private realms, emphasis on the reproduction, childrearing, motherhood and nationalist circles, extensive domestic courses pushed women into housework and homes more than before. Furthermore, socio-spatial transformation after revolution intensified the situation. Kitchen is "a workplace to manage and organize customer viewings, deals" (Z1, two beds), "meeting friends" (S2, two beds), "a closed space without need continuous cleaning" (S3, one bed) "a private space" (S5, 2 beds) (Figure 4). Servant's rooms changed their functionality to utility rooms (S2, two beds), women's workspaces (A1, three beds) or guest rooms (E2, two beds). Kitchens were preferred to be used as closed spaces for providing privacy and cleaning issues (Figure 5).

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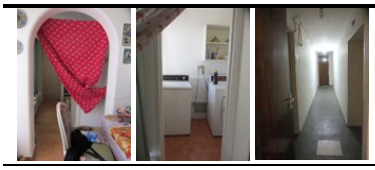


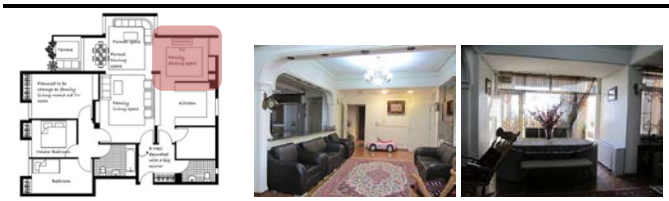
These pictures show the servant rooms and their separate entrance to the kitchen and shopping centre in the underground of the building. Over the years, servant's room changed to utility room and the servant's entrance was no longer used.

Figure 4. Servant room, Saman building (Davodipad, 2016).

Kitchen in these examples used as the back region and the private part of the home.

Figure 5. Kitchens (Davodipad, 2016).

Having meals in these households has two shapes; formal and informal. The dining table in the living room is used in formal invitations and a small table inside the kitchen or family sitting room or on ground around "sofreh" is used in informal familial meals (Figure 6).



In this case, formal and informal spaces for having meals by themselves and with guests were separated. The family used the space next to the kitchen for their taking meals on the ground, watching TV. The space decorated with sofas and dining table used for guests. The family decided to change the third bedroom to family living room "neshiman".

Figure 6. Back and front regions at homes (Davodipad, 2017).

Theme 4: Socio-Cultural Norms are Determinative in Use of Space

The cases show that there are four sub-themes; (a)Privacy is the most significant social value, (b)Presentable/intimate spaces are different, (c) Clean/dirty concepts are significant, (d)Traditions evolved, duplicated, changed but never diminished; they got new definitions and spaces.

(a) Visual privacy, male/female physical spheres as main characteristics of Middle Eastern cities with Islamic culture and religion underwent radical changes with the working woman outside home and shaping her social life (Al-Kodmany, 1999). Physical and psychological opportunities for privacy increase in modern societies rather than primitive ones. While privacy is limited by gender roles, taboos and family responsibility, and ancestor demands in primitive societies, it is more flexible in modern societies (Kent, 1990). The economic and political

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structure of the modern world resulted in individualization of household members and "privacy" changed to a main social value for bourgeois individual.

However, analysis of Iranian housing demonstrates that privacy of families in relation to social interaction and male-female segregation are more important than personal and interpersonal privacies (Madanipour, 1998). Participants defined different physical or behavioural barriers to control the intrusions. "Privacy is very important for me... the living room is the best place for guests" (Z1, two beds). Some participants alter their domestic space to gain more privacy; "Mo used wooden wall to separate private and public spaces" (Z4, three beds). Hierarchical access to the spaces, dividing the formal and informal parts through fixed or semi-fixed barriers are ways to provide privacy for the family. By entrance securities, ever-covered windows and unutilized balconies and adjusting other strategies of introversion, spatial hierarchies demonstrated new manifestations of privacy in modern housing (Figure 7).

These are examples of space segmentation for emerging privacy. Left; user separated the private part of the house with partitions. Right; dining, sitting and entrance spaces separated using walls.

Figure 7. Segmentation of space for privacy (Davodipad, 2016).

(b)Home is as "the archetypal "back region" in which everyone can relax and be himself or herself" (Giddens, 1984 cited in Munro & Madigan, 1999:115). Beside relaxing place, homes should be welcoming and presentable. Women often Create a tidy and respectable place and a social space for family (Munro & Madigan, 1999). Modern home in relation to gender is discussed as a reflection of its masculine architectural shell and as an extension of women's identities defined from the body outwards. The domestic interior is identified as the women's stage where they can represent their inner selves and act their lives; a site for self-expression. Home and its interior décor gain importance and change to an identity signifier and a way of keeping in time with social changes.

All families to be interviewed had separate parts of their home as presentable/intimate or front/back region. In spite of the elimination of guest room to prevent pretending and changing it to an all- in-one living room in modern homes people used to separate a place as guest space in their homes. Guest space represents the prestige of a home. The need for distinct room for guests in some cases causes the emergence of special corners in

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an open plan living room. Mo uses a decorative fir place (Z4, three beds), Sh has separate space for guests (Z1, two beds), del has a representable living room and uses the kitchen for casual friends' visits (S2, two beds). Mar has separate guest and family sitting rooms (B1, three beds). Zi separated the presentable and private living room (P1, two beds duplex), Za used bedroom as private living room (Z2, three beds) (Figure 8).

Figure 8. Intimate/presentable living rooms (Davodipad, 2017).

The households tended to have two separate spaces for living room; for guest and for their everyday use. In these examples, users used one of the bedrooms as the family living room and living room for guests. In the cases with smaller size, households divided the all-in-one living room to formal and informal spaces.

(c) "Health", "hygiene" and "personal cleaning" with their scientific meanings are significant in modern housing and related discourses. Cleaning has religious and cultural connotations in Iranian home culture. Cleanliness in religion is different from cleanliness in modern science and is on the base of "pure" (tahir) and "impure" (najis). According to Shiite belief, animals- dogs and pigs- are "inherently filthy" and settings affected by them considered impure or a "toilet was considered dirty and could not be inside house" (Karimi, 2009: 235). Water and related rules and rituals is the key substance to make everything pure that is not inherently filthy; these are included modern products, settings and activities. Therefore, the symbolic demonstration of the act of cleansing, rather than the actual cleanliness as measured by modern scientific standards, is what is vital in Islam.

In Iran, the purpose of cleaning preserves its cultural and religious connotations and is integrated to the new definitions of scientific dirt control. The term "nezafat", cleanliness, is connected to "iman", faith, and that implies to religious connotations and cleaning all the house twice yearly, the end of

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summer and end of winter, so-called "khane tekani" which has cultural importance. The cultural and religious importance of water in cleaning homes caused many families to use ceramic or washable materials for floorings in bathroom, kitchen, and toilet. As cleaning is the same as washing in the culture of Iran. Changing the floorings from parquet to ceramics (Z4, three beds), removing the wallpapers and carpets in bath and toilet and shared corridors (E1, three beds), replacement of bathtub to traditional baths with ceramic floorings (S1, one bed duplex, S2, two beds) are examples of the appropriation of the meaning of cleaning to interviewees home life (Figure 9).

These examples show the changes in bathrooms. Bath tubes replaced with traditional stone bench. The toilet and bath areas separated with a wall. Water as the most important substance considered in the cleaning of bathrooms.

Figure 9. Bathrooms (*Davodipad, 2016*).

(d)There emerged two approaches to the traditions during this period simultaneously with spreading western lifestyle and acculturation. The first group aimed to popularize and standardize the Islamic values and religion to the everyday life of contemporary Iranians and created a modern Shiite society and the second group granted a modern and secular quality to the home and created a modern Iranian society. Tradition was presented as alternative to modern life and traditional views specified as the marker of appropriateness of imported goods and household objects in comparison to local ones. They were codified as halal versus haram or pure and impure. Humble home life was promoted, and foreignness was concealed by this group. The other group turned the tradition into an honourable object but not necessarily a part of everyday life. They considered the distinction between material and spiritual.

The contradictions of the views of these two groups continued in contemporary houses in related to religious traditions. As cases revealed some groups welcomed new ideas and the secularisation of traditional and cultural habits, whereas for some others Islamic and religious traditions were continued in their home life culture. "I prefer to plant a tree instead of sacrifice an animal", "I go to "molavi" course instead of Quran sessions" (Z4, three beds). I had "abolfazl sofre" (a traditional and religious ceremony) in my house (B1, three beds). "…Me not but my neighbours if they have "nazri", write and hang it on wall

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(Z1, two beds). I don't believe in these things (P2, two beds). In the society of Iran being modern is in contradiction to being religious. The study results revealed that the contradictions in the two groups exist in other traditions such as marriage traditions and new year celebrations as well.

Theme 5: Communal Sites are Women's Extended Domestic Spaces

Here one sub-theme emerged; (a)The settlement communal spaces provide opportunity for more uses.

(a) Use of spaces encompass activities and interaction with residential areas. People's interaction with their residential environment through activities is part of their use of domestic space. And there is a process of adjusting and adapting between individual and their surroundings to gain appropriation at homes. The identity of modern homes was shaped during the appropriation process. The interviewees mentioned the facilities of the settlements in their daily life. They use communal spaces for their everyday activities. "I use the common spaces; the garden and yard for chatting with friends and riding a bicycle and exercises in the morning" (B1, three beds). Sh uses the communal space in their building for showing the clothes as part of her job (Z1, two beds). Other interviewees use the facilities such as a sport area for doing exercises and spaces for walking the dogs. Shopping centres, café, restaurants and bank branches provide spaces for preparing home necessities, working, socializing and doing everyday issues (Figure 10).

Communal areas included garden, playing area, exercising area, cafe shops and shopping centre.

Figure 10. Communal spaces (Davodipad, 2017).

Theme 6: Settlement Characteristics Affected the Use of Space

Here two sub-themes emerged; (a) Living in settlement is like living in a hotel, (b)The settlement is a sign of status and identity.

(a)Utopian ideas, well-being of occupants, quality and quantity of zones were the main characteristics of modern homes (Cieraad, 1999). Qualities usually referred to women's liberation, a better environment for children, good neighbourly relations, meaningful leisure time activities. To reduce and simplify housework in order to enable for women to join the social life and labour market was the dominant goal in most modern residentials. Accessibility to shopping centres, gym, children's

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play area, have a separate space for servants all indicate the goals of these settlement in providing a field for the contribution of the women in social life and work.

Interviewees believed that living in these settlements is like living in a hotel because of facilities such as security, cleaning and maintenance. Entrance to the buildings is very hard and is possible only with previous appointment according to the strict rules of security in these buildings. "living in this settlement is like living in a hotel, it is secure, I can leave my children and dogs at home and go to the journey" (Z4, three beds). "Easy cleaning and on-time service charge are important" (E1, three beds, P1, two beds duplex). The interviewees mentioned also other qualities of buildings such as; material, structure, accessibility and centrality.

(b)The modern home functions as a marker of the modern middle-class socio-cultural identity involving particular patterns of consumption and lifestyle, and consciously set apart from other classes. "Upward mobility" was the main characteristics of the modern middle-class homes for showing their class aspiration and identity. New modern identity is represented by their ability to afford modern convenience, education, modern taste and modern looking homes. People promote identity by articulating the boundary between the self and non-self and establish their uniqueness and distinctiveness from others and marking and personalization of spaces provides a mechanism to reflect and extend their personalities, attitudes, values and beliefs, what they are or ideally what they want to be (Edney, 1976).

Most participants define the specific and attractive characteristics of the buildings as "most famous actors, artists, producers live in the settlement" (Parc prince, Behjatabad), "the period prime minister, open-minded people, most of royal family and after the revolution officials live in the settlement" (Saman, ASP) "it was designed for the Shah guard and officials" (Zomorod), "people who are educated or have travelled to foreign countries live in this settlement" (Eskan). Therefore, these settlements have identities that are defined by previous and current residents and represent a different lifestyle.

Theme 7: Socio-political Transformation Affected the Use of Space.

With one sub-theme; (a) Use of space changed with changes in socio-political relations.

(a)Social dimensions are known as the predominant factor in defining spatial relations, organization and use of space. As Soja (1980) declared, "space is a product of social translation, transformation and experience" (Soja, 1980: 210). "Societies

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continually reproduce and re interpret social relations across space and time" (Pader, 1988: 253). Each society has its own specific modes of production and presentation and practice of space that can be revealed through the deciphering of its space.

Space in addition to be a means of production, presentation and practice, specific in each society, is also a means of control and domination. Spaces are shaped in relation to power relationships, practices, identities, and subjectivities. As Ghannam (2002) mentioned "space is central not only to communal life but also to any exercise of power" (Ghannam, 2002: 22). Power relations are embedded and manifested in the struggle over space by regulating the relationships and activities. Ideologies are the main outcomes of socio-spatial relations. They form, reform, interpret and reinterpret the society and spatiality. Each ideology has its own language, objects and placement of objects in space (Pader, 1988).

In this relation, change in gender relations and order in society affect the order of spatial relations inside homes and residential neighbourhoods. The raising of women's position and a greater interaction of women with the world outside the family led to a new organization of space and new relationships inside the home. Whereas, restricted gender relations and women activities in the society pushed women to the homes.

In the case studies, the communal spaces' functionality changed after the revolution. many communal spaces in residential complexes lost or changed their function. For example, the café and billiard salons changed to mosques or closed (Saman), pools were filled in (Zomorod) or used just by children and as a place for gathering with friends (Behjatabad, Parc des prince, ASP), balconies were closed (Parc des Prince). Political transformation in the country followed by socio-spatial transformation such as developing religious places and closing communal spaces such as pools, cinemas to restrict western-like leisure and socializing patterns (Figure 11).

Furthermore, household as a sociogram reproduce the rules and resources of social system in accordance with changing social and power relations (Hillier & Hanson, 1984). In the case of Iran, people produced secularised private spaces in a society with conservative socio-political relations. Women prefer domestic spaces for social activities such as invitations, celebration and gatherings with friends.

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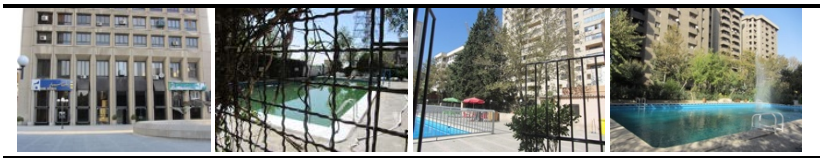

These pictures show how communal spaces' use changed after the revolution such as changing the café to mosque and open-air pools to friends meeting places.

Figure 11. Changes in communal spaces' use (Davodipad, 2017).

This study tried to systematically analyse the narratives of interviewee women by the use of the Atlas.ti 8.0 software package. Narratives were codified and categorised in themes and sub-themes in three major levels of user profile, dwelling unit and the settlement. Narratives in the user profile level confirmed the importance of household structure and economy in organization and use of space. Domestic Spaces of participating women reflect their age, profession and financial situation. In the dwelling unit level, the spaces mirrored the everyday life, time-space activities of women and socio-cultural norms such as privacy, traditions, cleanliness/dirtiness and intimate/ presentable concepts. In the settlement levels, participant women mentioned the communal spaces in the settlement as their extended home spaces that were used in their everyday life. Also, the narratives showed changes in the use of home and communal spaces of settlements in accordance with changes in social and power relations during the specified time.

CONCLUSIONS

The aim of the present study was to explore the use of space in relation to the modern women and modern homes constructed between the years 1960-1980 in Tehran, capital of Iran. In terms of the use of space, the results reflected the importance of socio-cultural, economic and politic circumstances. Ideas of modern society and modern domesticity were imposed from above and occupants adapted and appropriated the concepts. The results show the spatial shifting of activities in modern homes. Closing off the open plan by building walls between dining and sitting areas, separating the public and private spaces, the adaptability to fit in with their changing lifestyle were some alterations in the spaces. In fact, the incompatibility between the modern approach of the state and residents' living habits led to modifications inside homes. Uses of space changed in accordance with changes in political, social and familial contexts and changes in ideas and the values of people towards their dwellings through the course of their life cycles.

People create a local type of modernity resulting from rejection, adjustment and the transformation process. Rationalized and functional domestic spaces adapted to users private, social and professional life. There was an attempt to move the socializing

and identification models from homes to public places, but conservative public life show the opposite of it. Traditionalist and modernist contradictory approaches to the home and lifestyle continue as in many other issues. Whereas tradition and culture were secularised in one group life, the other group adapt their homes in accordance with religious traditions and values and use Quranic verses, religious symbols and signs at home and employ religious traditions at homes.

Society and state have predominant power over the public and private life of individuals. Changes in policies about model modern homes and model modern women in pre and post-revolutionary era affected the home spaces and women's public and private relationships.

This study aimed to in-depth analysis of the use of space in modern homes using narrative inquiry as a qualitative research method without generalization. Women dwellers of modern home expressed different narratives of their everyday life and spatio-temporal relations. The investigation of Iran's modern domesticity from the women users' point of view with considering their everyday use of space, the importance of socio-political context of the place, provided some useful analytical data for further studies in this field.

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Resume

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Research Article

ICONARP

Decoding the Unknown Historic Urban Grammar of Antakya Through Property Rights

Mert Nezih Rifaioğlu*
Neriman Şahin Güçhan**

Abstract

Purpose

This research proposes that the property rights in the title deeds records in an urban setting merit investigation to decode the unknown urban grammar of the order of historic Islamic-Ottoman urban forms which have consisted invisible links between the creation of urban form and its inhabitants.

Design/Methodology/Approach

This consideration of how an urban form is created and regulated according to property rights is a subject that has to date not been investigated like in this way by analyzing the archive materials and records in the title deeds and cadastral plans in a specific urban form. Accordingly, the hypothesis of this inquiry is focused on defining the relationships between property rights and urban form, which will help to reveal the hidden and intimate norms-regulations of the context. This will also help in the making of an objective analysis through information gathered from primary legal written and graphical sources –title deeds and cadastral plans– for a subjective issue. This research, therefore, suggest that the property rights and its urban grammar are

Keywords: *Property rights, urban morphology, urban conservation, interpretation, Antakya*

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not only one of the important factors in the formation of urban form, but important aspects in understanding the dialectic relations between formation and persistence of urban form and features.

Findings

The research findings can be group into two headings: literature review and case-study research. The literature review findings focusing on the analogy which is firstly used and defined in this research as a philosophical tool to explain the rules and rights related to property, and their role in managing the process of growth and shaping the urban form under the main tangible and intangible aspects. The case study research findings relying on Antakya historic urban form under the influence of property rights and presenting original analysis relied on original archive documents and site surveys. Accordingly, it concentrates on evaluations for decoding the unknown historic urban grammar of Antakya and presents original findings of the research.

Research Limitations/Implications

The research uses historical interpretive and case-study research methodologies in the limitations and implications of urban form and conservation studies.

Practical Implications

Increased knowledge on the influence of property rights and its order on formation of historic urban forms. The case-study part of this research demonstrated that the property rights an important aspect for considering how inhabitants created an urban form.

Social Implications

This research helps to understand the intimate values of urban forms by an objective and reliable analysis. It also helps to define social and/or moral values of historical urban form.

Originality/Value

This research firstly revealed the property rights that have major implications for understanding the formation and persistence of every single component of Antakya historic urban form. Therefore, it deserves greater consideration in urban studies such as urban morphology and conservation in order to make holistic assessments.

INTRODUCTION

Property rights within historical urban contexts, an important aspect when considering how inhabitants create an urban pattern from an urban context, being starting point of living, using, building, designing and forming the built environment. Property rights can refer not only to the physical forms, socio-cultural structures, administrative issues, political and economic conditions of the urban context, but also their way of defining an order between the context and its inhabitance, investigates the combination of tangible and intangible values and their continuity in an urban context, which has emerged as an important issue in historic urban form studies.

The main goal of urban form studies is to assess the values of a historic urban context in order to maintain or improve its character, and to guard it against harmful and destructive effects.

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It is structured on an extremely strong theoretical methodology, which consists of a careful and systematic documentation of the context, and an analysis and evaluation of data related to socio-cultural, economical, administrative, historical, and physical aspects at various scales, all of which led to guide an appropriate decision-making process.

Despite considering socio-cultural aspects and values, the current dominant methodology is unable to assess intangible values through the depiction of user experiences within the contexts. For this reason, urban form investigations should aim to go beyond the previously dominant investigations to identify the values of plural interpretations and meanings between the physical context and its inhabitants. John Pendlebury (2009, p.12), referring to the erosion of value assessments, focused on the importance of different value assessment methodologies so as to come up with plural interpretations and meanings between the object and its environment; "There has been an erosion of the previously dominant notion of value understood as intrinsic to the object or environment and able to be revealed by correct processes of investigation that could only be conducted by a limited body of experts. In a pluralist democratic society, it is argued; definitions of value cannot be singular but must allow for plural interpretations and meaning".

Yet, at an urban scale, investigating the combination of tangible and intangible values by understanding and identifying plural interpretations and meanings between the context and the users is a complex subject, and no widely accepted methodology has yet been developed (Rifaioğlu & Şahin Güçhan, 2013).

Accordingly, urban-scale conservation studies still face the question of what kind of investigations would help in understanding and identifying the values generated from human experiences within the physical context, or in other words, the spirit of place (Rifaioğlu, 2012).

In fact, there have been many theoretical and practical studies on this issue that may provide some answers for the field of urban studies. As a theoretical example, Karl Kropf (1993) defined the basic investigation principles in the built form derived from Johann Wolfgang von Goethe and applied by Gianfranco Caniggia and M.R.G. Conzen. According to Kropf (1993, 1996), the urban context should be investigated in terms of human choices, process of formation, arrangements of parts and an interpretation. Kropf (1993) defined the human choices as tangible attributes –stone, brick, timber, glass, tile, etc.– and how they are put to use by humans. He noted that (1993, p.10), "(The) built form is the material in an arrangement which is the result of human choice, the choice of using a particular material for a particular purpose and putting it in a particular place". From an

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urban conservation point of view, an assessment of human choices in the built form would allow a definition of the technical values of the context.

Another investigation aspect, the process of urban formation, is defined as the concrete phenomenon for understanding and appreciating the sequence of events and acts of buildings which have formed the context throughout history. In urban form studies, it would refer to the historical and socio-cultural values of the context. The arrangement of parts is another matter for investigation, being important for understanding the interrelation between individual parts, and between the individual parts and the whole. Such an investigation method would be appropriate for investigating the physical and morphological values of the context in urban conservation studies (Rifaioğlu, 2012).

Finally, Kropf (1993, p.11) discusses the issue of interpretation, which is proposed for investigating the vague aspects of the sense of built environment by understanding "the forms which contribute to a whole and make the means of identifying those forms identifiable and repeatable". This method refers directly to the tangible architectural features of the context and would allow the architectural and typological orders and/or values of the urban context to be determined.

Although interpretation is the key means of understanding the sense of built environment, Kropf leav[es] aside the ontological meanings of the object and aims to understand and identify the repeatable forms of the context in an assessment of the sense of built environment. The logic of his aim relies on addressing the problems faced in ontological investigations which may define subjective, expert's and/or observer's own viewpoints and values. (Rifaioğlu & Şahin Güçhan, 2013).

Essentially, urban form studies are almost wholly driven by the expert, and all of the values identified in the analysis are given by experts. Accordingly, their roles and values can be held up to criticism, since urban forms result from different value systems and shape different identities for different groups.

Yet in most national conservation systems it is the experts who observe the historic urban context, using objective tools so as to designate and conserve a very delicate and subjective subject, the spirit of built environment. It is important to find the intimate, hidden, unidentified, subjective values of the context through the use of objective tools and methods that have been created over time between the physical urban context and the experiences of different social groups, occupants and users.

Urban form studies normally seek to assess the character of the built environment through typological, morphological and architectural analysis. Nevertheless, although the identity of an

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area may persist through time, spirit of place can change as its inhabitancy or users change. This leads to the questions of how can experts understand the intimate values and define its continuity through observations and/or interpretations, since the residents change, the way and standards of living change, the physical structures, and the overall socio-cultural context change in time?

This is an important subject that is both theoretically and practically important and difficult subject to address in urban form studies; and still the right tools are yet to be found for understanding and conserving the very delicate subject and its comprehensible meanings from tangible features to intangible ones.

As Pendlebury stated (2009, p.13); "...conservation as a practice needs to evolve reflexively; it needs to embrace new understandings of the social role of heritage and its conservation, while retaining and sustaining many of its core principles. This is a difficult challenge".

On the other hand, related with interpretation, there are many urban form studies on mathematical interpretation of urban forms in order to present "the influence of various different cultures, geographical and climatic conditions in the historical process" (Topçu, 2019, p.212). Close relatedly to the case study of this research, Kubat and Topçu's urban form studies on mathematical interpretations were focused on "understanding the morphological transformation of Antakya in term of spatial integration" (Topçu & Kubat, 2012, p.8251:1) and "morphological analysis of urban textures…which have been shaped through the influence of different cultures in historical period" (Kubat & Topçu, 2009, p. 335).

This research, therefore, has aimed to investigate how property rights have affected the formation of historical urban contexts, and particularly in the historical urban core of Antakya. It clarifies the physiognomy/physis, the nature; and gnomon, the interpreter – of the historical urban core of Antakya, referring to the ontology of the physical environment and its builder. The physiognomy of a city derives from and/or is influenced by the property rights that brought order to the creation of the urban form and built consensus within the users of the urbanised environment. As Aristotle stressed, "order becomes custom," and has a crucial impact on the creation of logical and meaningful relations between the concrete phenomena – the built form – and the abstract symbolic and existential meaning – the human experience. Therefore, the research proposes that the property rights in an urban setting is merit investigation in an attempt to define the historic unknown urban grammar of Antakya which consists the invisible links and values that have emerged

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between the urban form and its inhabitants. This consideration of how an urban form is created and regulated according to property rights in the title deeds is a subject that has to date not been investigated in the Islamic-Ottoman urban form studies.

The city of Antakya has been selected for the case study due to its rich historical and multi-cultural urban core, which was first affected and formed under the influence of Islamic ownership norms, and then developed under the Ottoman land tenure system. Additionally, as archive documents such as Ottoman title deeds have been translated into Turkish alphabets, and the cadastral plans of the urban form have been prepared during the French Mandate Period, they can be viewed as sources of reliable information on ownership norms and property rights for every single property unit, which is a key asset when attempting to decode the physical urban structure and reveal the hidden salience of the city.

In revealing the historic unknown urban grammar of an Islamic-Ottoman city through property rights in the title deeds records of Antakya, this research is mainly divided into three parts. After introduction, the property rights are discussed and then the relation of property rights and the historic urban pattern of Antakya is presented. Finally, the effects of property rights for decoding the historic unknown urban grammar of Antakya is discussed.

PROPERTY RIGHTS

Property rights have been a common feature of different civilizations since medieval times. They were defined in Common Law as “upwards to infinity and downwards to the centre of the earth” (Umur, 1990; Lawson, 1958; Günay, 1999). This is a strict right of use (usus), collection of fruits (fructus), and use to the exhaustion (abusus) of the object of property (Günay, 1999, p.5).

However, codes and treatises were, throughout history, defined to regulate property rights in accordance with the shaping of urban form. The earliest example of these dates back to the Eastern Roman Empire, being Julian of Ascalon’s Treatise, written in 531-533 AD which is the oldest document discovered to date defining property rights and their effects on the shaping of cities (Hakim, 2001).

After the Julian treatise, there were various other treatises declared in different periods that affected the shaping of urban forms. When the treatises and the property rights are taken into consideration in the Islamic cities, it is clearly apparent that Islamic cities were shaped under property rights that were essentially based on the traditional Islamic rights and a Westernized modern law of property, while also retaining some

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of the characteristics of the traditional rights of property (Hakim, 2001).

The Pre-Modern Property Rights: Tradition and Religion

The general ownership mechanism in the pre-modern period of Islamic cities is based on three main aspects: the establishment of ownership through appropriation, which is the logical origin of any ownership in the Islamic property system; transfer of ownership through sale or donation by an individual or the government; and continuity of ownership through inheritance (Akbar, 1988).

Pre-modern property rights in the ownership mechanism are furthermore shaped by three main interrelated provisions: traditional Islamic principles, public interest and personal reasoning. In particular, it is the public interest rights that address the tangible and intangible benefits to the community, such as the property rights of the landless poor, slum dwellers and squatters; the use of public zones and services within and around the urban form; and beneficial rights for worship and the morals and customs of the public (Sait, 2010, p.32).

On the other hand, it is personal reasoning that addresses the benefits and liabilities of neighbors, inheritance, morals, customs, welfare, and so forth. These are related closely to society; the shape of the urban form; and geographical cultural differences, and accordingly, property rights that derive from personal reasoning can vary from one case to another.

The pre-modern Islamic property rights can be linked to a tall tree, which has influence both below and above the earth. It rises from out of the ground, which is the source of its existence; then it forms its body; and finally becomes a source of benefit for believers by providing fructus. The analogy of the tall tree is firstly used and defined in this research as a philosophical tool to explain the rules and rights related to property, and their role in managing the process of growth and shaping the urban form under the main tangible and intangible aspects in the following framework:

The root: The lands within the city and in its surroundings, as a fundamental aspect of the city

The body: The built environment, which derives from the root and is formed by the property rights

The branch: Liabilities and benefits of public streets and cul-de-sacs

The fructus: The rights of intervention and the prevention of damage to building materials and architectural elements

The users: The owners and tenants, and their benefits and liabilities

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The Root: Land

During the early-Islamic period, land ownership and use were a common undertaking for all schools of law. Since the towns were expanding and the cities were forming, the issue of ownership and use of lands was discussed extensively, and thus certain rights were established related to them.

Land rights were closely related to the productive use of land. Generally, an individual who worked unutilized lands would have priority over another in terms of access to the land and the benefit to be gained from it. However, unutilized land could not be owned by individuals. Land came in two forms, namely: protected lands (Harim) and dead lands (Mawat), which were established and defined with certain property rights by the Islamic school of laws in order to develop and control the urban form (Akbar, 1988).

Another important land type in Islamic urban forms was agricultural lands. The study of agricultural lands is important when they were located in the periphery of an urban area, since they would likely be transforming over time into urban areas. Agricultural land in general was dealt with in two major sections of the legal system: agricultural land owned by the state and benefited by individuals; and agricultural land is owned by individuals and benefited by others (Akbar, 1988).

The Body: Built Environment

The built environment of Islamic cities was derived from the responsibilities that were allocated and negotiations between individuals affected by the notion of property rights. At the level of neighborhood formation, Muslim schools of law established the qawa'id fiqhiyya – meaning "overarching legal principles that formed the framework within which the Muslim community that set out rules that people understood, respected and followed when making decisions that affected the design of their houses and the manner in which those decisions affected adjacent buildings" (Hakim, 2010, p.209). All schools of law agreed that the basic principles were the starting point of the establishment of secondary principles and rules to form and change the built environment. The qawa'ids came with a set of rules and rights related to formations and alterations to dwellings in the Islamic urban form. Considering the built environment at the single unit level, the origin of the principles was based upon the maxim of do not harm others, and others should not harm you, which become the leading rule in the organization and control of the built environment. This applied to every single formation and change to each single unit in the built environment, with the intention being not to harm to one's neighbors or other citizens, and vice-versa.

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The Branch: Streets

The street is an important element of the urban form that serves to shape and control the built environment. Factually, there were two types of street that existed in Islamic urban forms: streets and culs-de-sac, each with their own property rights. Streets are classified as open and continuous urban elements that are open to everybody and controlled by rules of public right-of-way. Culs-de-sac, on the other hand, are classified as no-exit streets that in some cases do not belong to the public, and as such could be considered as part of adjacent or bordering properties. Accordingly, they have different property rights than public streets and their use, sharing and control are specified under the culs-de-sac property rights in Islamic urban forms[1].

[1] This situation will be investigating in the case study phase of the research, as there is a lot of information in the archives. As such, the subject will be defined and detailed from the title deeds records of the case study.

The Fructus: Building Materials and Architectural Elements

Small and invaluable objects that exist within the urban form could be taken if neglected by the owner for a long time. An example of such objects would be building materials, which could be picked up, since the person who picks them up may derive benefit from them. This principle does not apply in such cases as when objects fall from a building without the owner's knowledge. However, the rights of interventions and the prevention of damage to architectural elements are an important matter, focusing on the rights of ownership and usage of the walls between neighbors and the architectural elements.

The Users: Owners and Tenants

The principles of the use of the urban form and rights and responsibilities between owners and tenants reflected the specific dialectic links within the experience of the urban form and can be studied at two scales: the single dwelling scale, and the neighborhood scale.

At the dwelling scale, the tenants were evidently responsible for what makes a property usable and functional. They are responsible for maintaining the walls, doors and other architectural elements; and also, for the functionality of the well and its safe use by the household. Tenants are also responsible for the privacy of the dwelling, and no interventions would be allowed that affected to the privacy of the dwelling. In such a case, the tenant would have to remove the unwanted interventions and retain the dwelling privacy, or face losing his tenancy.

Several rights and responsibilities were also established for property owners. The owner must rebuild a wall if it collapses, exchange a wooden beam if it breaks, fix doors and ensure a constant water supply, since such repairs keep the property usable (Akbar, 1988).

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ANTAKYA HISTORIC URBAN FORM UNDER THE INFLUENCE OF PROPERTY RIGHTS

This research into the relationship between the property rights and urban form focuses on a conceptually new and contextually rational, effective and orthodox control mechanism that contributed to the formation of the historical urban pattern of Antakya. These are understood and defined as property rights in this research and are identified as "benefits" and "liabilities" in the title deeds.

Ownership benefits and liabilities are the specific descriptions and obligations not only for the plot owners, but also the city's inhabitants. According to the title deeds, plot owners may have different benefits and/or liabilities relating to a specified plot, which take the form of detailed, strict and enforceable rights over the tangible and intangible features of the urban form. They play a key role in creating rational solutions for the physical, morphological, social and cultural aspects of the urban pattern. There are many interrelations through the urban form that produced from the property rights.

Therefore, this research has been designed under a holistic, accurate and factual methodology in order to better understand the links and interrelations between property rights and urban form. It has been structured in three main phases:

- documenting phase, comprising archive studies conducted in the research
- digitizing phase, covering the office work
- analysis and evaluation phase, comprising correlations and site surveys

The documenting phase of the research consisted of a collection of data from the title deeds records[2] of the Antakya historic urban pattern and gathering of the cadastral maps[3] which were prepared in French Mandate Period formed out of four circumscriptions namely the second, third, fourth and fifth circumscriptions of the city[4].

Parallel to the collection of data from the title deeds, the documenting phase continued with the conversion of the French cadastral Maps into the GIS medium. The aim of this stage is to have a geographical database which is correlated within the coordinate systems of Antakya, and to have a database for the data collected from title deeds.

In addition, another database is prepared according to the collected data from the title deeds. It is crucial in helping to transfer the 130,000 data points to the GIS medium. The research continued with an analysis and evaluation of the data on the title deeds and the historical cadastral maps. The

[2] Title deeds records were prepared in Ottoman Period of the city. They were translated in Turkish dated in 1929 while the cadastral plans were prepared in the French Mandate Period of the city.

[3] Cadastral Maps were gathered from Antakya Municipality. The maps covered the city's historic pattern in four circumscriptions (the second, third, fourth and fifth). The first circumscription covered what were new development areas in 1929, on the west side of Asi River; therefore, this was not considered to fall within the scope of this research. The second circumscription has three cadastral maps, one at 1:500 scale and the others at 1:1000. The third circumscription has again three cadastral maps, all at 1:500 scale. The fourth circumscription has five cadastral maps, one at 1:2000 scale and the others at 1:500 scale. The fifth circumscription has four maps all at 1:500 scale.

[4] The authors wish to use original French Cadastrate Map's terminology. Therefore, circumscription is used instead of circonscription which is used in French. The English equivalent would be 'survey'.

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circumscription plot pattern, area of plots, districts, the features of real estate properties, the way of acquiring real estate, ownership patterns, religious-ethnic identity patterns, and benefits and liabilities of plots were mapped and analysed.

The data gathered from the analysis and evaluations of the property rights in the title deeds records and cadastral maps was surveyed within the current historic urban core of Antakya during several site-surveys conducted by the first author. The aim of site-survey is to investigate the important features of the Islamic-Ottoman urban form through the existing urban fabric and seeking to understand the norms and rights of Islamic-Ottoman urban form still preserving their original relations in the current urban form[5].

Benefits and Liabilities Through the Antakya Historic Urban Form

There were different benefits and liabilities that affected to formation of Antakya historic urban context. They can be grouped as passage, use, construction and other benefits and liabilities.

Passage Benefits and Liabilities

Passage benefits and liabilities are grouped under two sub-headings: passage benefits and liabilities to which are referred a spatial reference; and referred non-spatial references. The spatial passage benefits, and liabilities allow an understanding of the way the inhabitants moved through and experienced the urban form. One of spatial passing benefits and liabilities investigated in this research is passage benefit from commonly owned culs-de-sac. Private culs-de-sac are commonly owned by the individuals within that building block, but passage benefit is given to a group of inhabitants as the right to pass through the private cul-de-sac (Figure 1). This benefit is given to those who need to pass through a private cul-de-sac, by which the benefit owner has the right to pass.

[5] Corresponded author is presented his original findings of the site-survey phase focusing on relations between property rights and the current urban form by using relational photos in the following sections of the manuscript.

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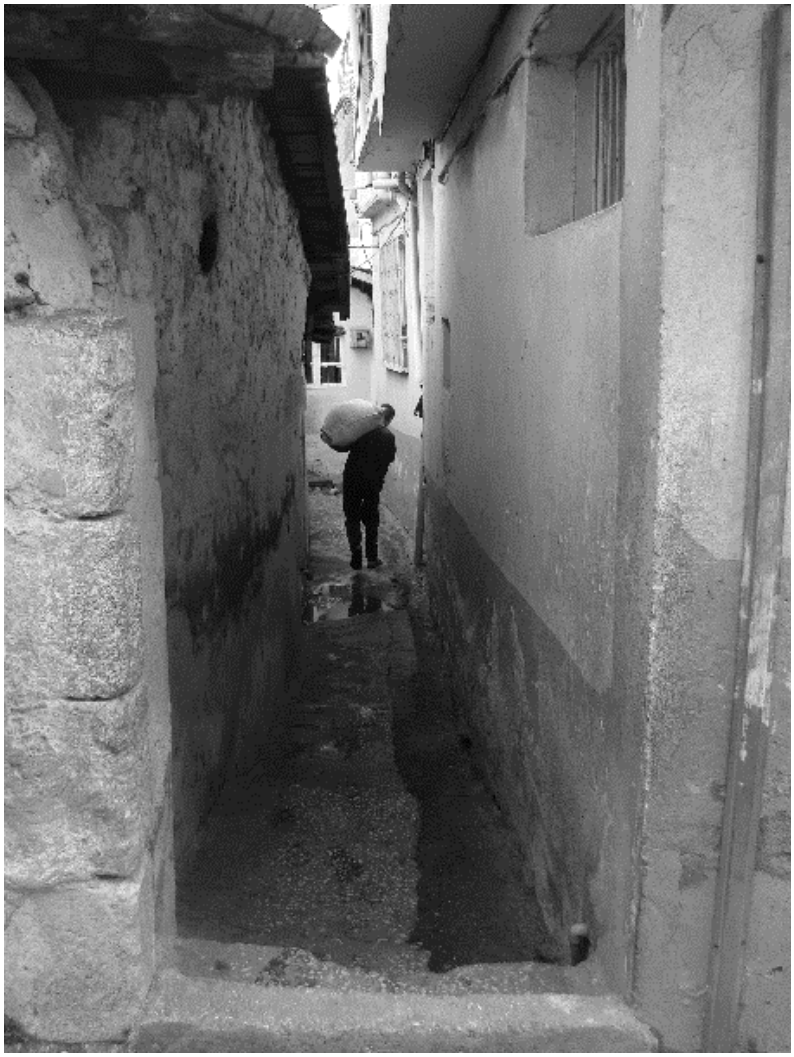

Figure 1. Inhabitant passing through private cul-de-sac (Rifaioğlu, 2009).

For this benefit, there is a liability defined in the title deeds. It is defined as the liability to give permission to specific property owners who need to pass through commonly owned private cul-de-sac. This liability is generally given for those with a direct access to their house from the private cul-de-sac but are not a co-owner of the cul-de-sac. In this case, the owners of the cul-de-sac are liable to give permission to them. The owners of private cul-de-sac cannot obstruct the passage of those with the right to pass through that cul-de-sac.

Another passage right is related to the case of two adjacent plots, defined as passage or entry right to a neighbours' plot. In this case, the owners of the adjacent plots are both beneficial owners and are liable for giving permission for passage. This property right can be applied in cases of non-adjacent plots. According to the property right, the benefit owner can enter somebody else's property not located adjacent to his/her property, passing through another's property. In this case, according to the property right, the property owner located between two plots is liable to give permission for movement, by which the benefit

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owner will be able to pass from one plot in order to access another specified plot.

While spatial passage property rights are detailed according to the purpose of movement, they are also clearly mentioned and defined in the title deeds. One such beneficial right is for passage through a plot to obtain water from a well located in another plot. According to this benefit, the beneficial owner can only pass through the plots to take water from another specified plot. Accordingly, the owner of the well is to share his well with the beneficial owner.

A liability defined so as to ensure the realization of the benefit, in this case for a specific purpose. The benefit owner may only pass through the liable plot to take the water from the other plot; and the liable owner is not obliged to give permission for passing through his/her property for other purposes.

The passage benefits for obtaining water is also defined in passage through a plot to obtain water from the water well. This time, the well is located on the adjacent plot, and the benefit owner cannot pass through any another plot in order to reach the well.

In this case, the owner of the well, being the liable owner, has to give permission to the benefit owners to obtain water from the well.

Besides those benefits and liabilities related to accessing a well to obtain water, there are other benefits and liabilities defined for accessing a toilet. According to the benefit, the benefit owner can pass through somebody else's plot in order to reach to the plot on which the specified toilet is located.

In this case, the owner of the toilet would be liable to give permission to the benefit owner for use of the toilet. Additionally, the other plot owners located on the passage route between the benefit owner's property to the toilet are obliged to give permission to the benefit owner to access the toilet.

The passage right for access to a toilet may also apply for adjacent plots. The benefit owner should be able to pass through an adjacent plot in order to access the toilet. In this case, the owner of the toilet is naturally a liable owner in giving permission to the benefit owner to pass through his/her plot to access the toilet.

In some cases, the passage benefit is defined for a specific place as a benefit right for passage through somebody else's property from the entrance part of the house or under the staircase. This right is given in very intricate plot formations, where the benefit owner can only access to his/her property by passing through an adjacent property. In this case, the adjacent property owner becomes liable for giving permission to the beneficial owner to access his/her property through a specified place.

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Such spatial passing benefits and liability rights were common property rights throughout the historical urban pattern of Antakya (Figure 2). However, locationally it is created zones through the urban form. Spatial passage benefits and liabilities were defined mostly for the residential area of the fabric; however, some properties in the historical commercial zone also required spatial passage benefits. For whatever the reason, passage from one plot to another was very common, especially on the west side of Kurtuluş Street towards the north-east of the fabric. On the western declivity of Mount Habib Neccar, spatial passage benefits for access to toilets and wells were quite common.

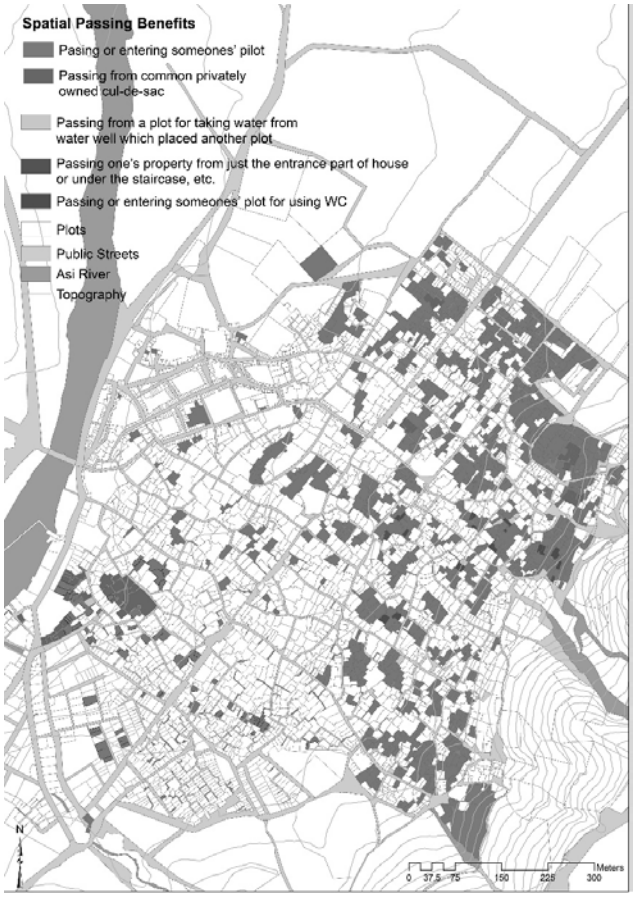

Figure 2. The distribution of parcels having spatial passage benefits throughout the historic urban pattern (Prepared by Rifaioğlu, M.N.).

Although the passage benefit for commonly owned culs-de-sac was defined for many private culs-de-sac, such situations where most common on the south-west and north-east side of the urban fabric, in the Christian and Alewite settlements, where the private culs-de-sac were very long. On the south-west of the urban fabric, characterized by long public culs-de-sac and differently arranged plots from the rest of the fabric, spatial passing benefits were extremely rare (Figure 2).

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Non-spatial passing benefits and liabilities are related to the flow of natural aspects throughout the urban form, rather than the movement of inhabitants. Different property rights are defined related to the drainage of water between properties, natural ventilation and the flow of rivers under the urban form.

One of the most common non-spatial property rights defined in the title deeds is the right to discharge and drain winter water and/or the water right. According to this property right, the benefit owner would be able to discharge winter water or normal water onto the neighboring plot, with the relevant plot specified in the title deeds. The benefit owner would be prohibited from discharging winter water onto any other plot.

Under these circumstances, the neighboring plot owner has a liability to accept the drained water onto his/her plot. Additionally, the neighboring plot owner can be able to have draining the water to the other neighboring plot. In this way, the first neighboring plot owner can be both a liable owner and a beneficial owner in the discharge of winter water.

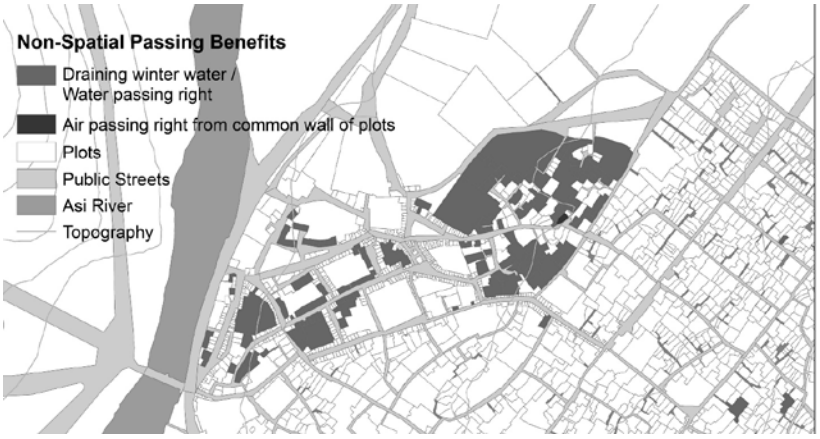

Figure 3. The parcels having winter water drainage right in the commercial zone of the historic urban pattern (Prepared by Rifaioğlu, M.N.).

Although there are a small number of individual cases seen in the historic urban form, this property right is more concentrated in the commercial zone and on the south-west side of urban form in the residential zone (Figure 3). In the commercial zone, the water discharge right is primarily given to the soap factories and is related with the topography. Soap factory owners have the right to discharge water towards the inclined topography, and the neighboring plot owners are liable to allow such water discharges over their properties (Figure 3). In the residential zone, again according to the topography, property owners have the right to discharge winter water onto other houses. In this case, the property owners have both beneficial and liability rights.

Another non-spatial passing right is related to the passage of air between neighboring plots and the plots located at a distance between them. Air passage rights are defined in the title deeds as

air passing right between the common wall of neighboring plots. In this case, the neighboring plot owners have the right to benefit from the air passing between their properties.

This property right is also defined as *air passing right from a specific location* within the urban fabric. In this case, the beneficial owner can take air from a specific place at a distance from his/her property. Under these circumstances, in the case of air flowing in a specified direction, the plots located on the route of the flow of air are liable for allowing air to pass.

A further property right exists related to an established water channel between two plots. Any plot where located between them is liable to give permission for the passing of a water channel through his/her property.

There is only one example of the discharge of water onto an adjacent plot. This property right occurred between two residential properties, one of which was a beneficial owner and the other liable owner of the property right.

Property rights are applied not only to the built environment and how it is used by the inhabitants, but also to natural elements, the earth and below ground as well. In Antakya's historic urban form, there are special passage rights defined for properties under which a river pass. The property right is defined in the liability section of the title deeds as *liability for giving permission for the passage of a river band under the plot*.

This liability is based on any intervention to the flow of a river passing under plots. The plot owners have responsibility for the ground below their plots, and the foundations of the buildings must be designed according to the liability (Figure 4).

This liability is seen in south-western part of historic urban form, which was developed in the Ottoman Period, and is related with the Akakir River that flowed from Mount Habib Neccar to Asi River. The owners of the row of plots that were developed over the river have a responsibility to ensure no un-wanted interventions are made to the river, and according to the liability, the river must be allowed to pass underneath them (Figure 4).

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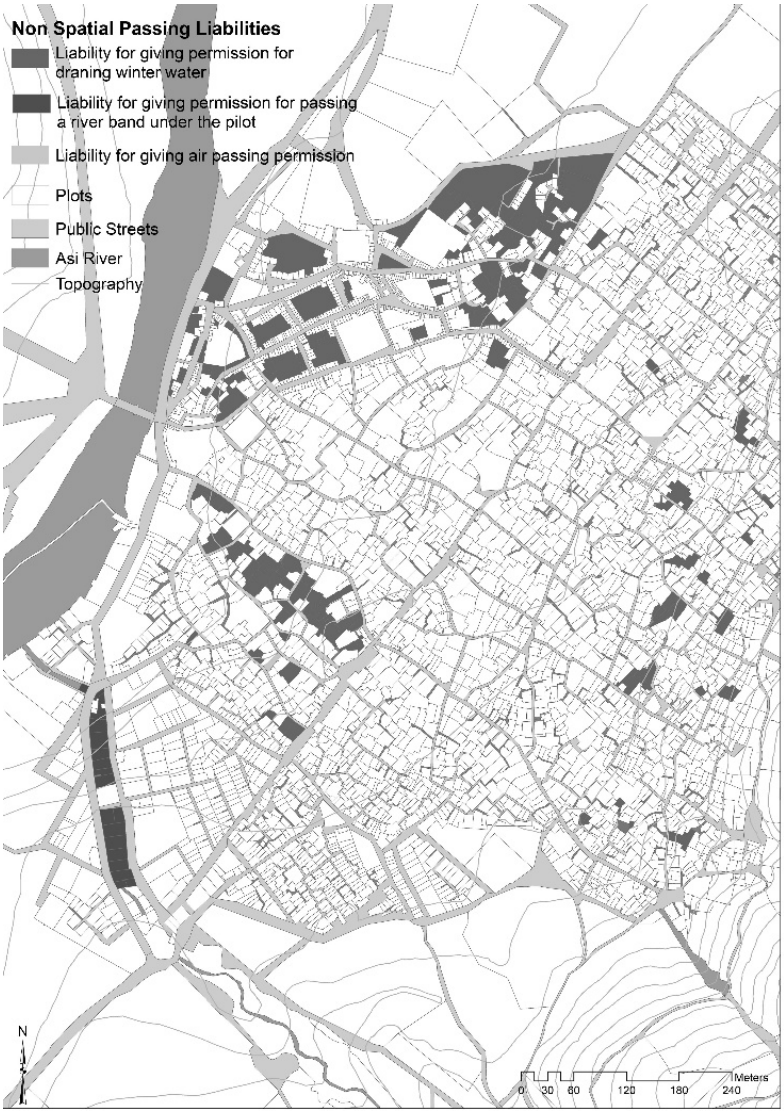

Figure 4. The distribution of parcels having non-spatial passing liabilities throughout the historic urban form (Prepared by Rifaioğlu, M.N.).

Use benefits and liabilities

Benefits and liabilities related to use are related to two situations: the use of a commonly owned well, toilet or wall; and use of somebody else's well, toilet or barn. For such cases, the ownership of architectural elements and their principles of use are defined in the title deeds. Commonly owned water wells, toilets and walls existed throughout the residential area of the urban fabric and were generally owned by adjacent properties. There are only two situations in which a commonly owned well and toilet existed between two separately located plot owners. Commonly owned toilets, wells and kitchens were common in private culs-de-sac (Figure 5). The ownership of the well, toilet or wall would be noted in the title deeds, and the use principle would be specified in the description of benefits and liabilities.

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Figure 5. A kitchen and toilet which are still preserving their original relations in a private cul-de-sac (Rifaioğlu, 2011).

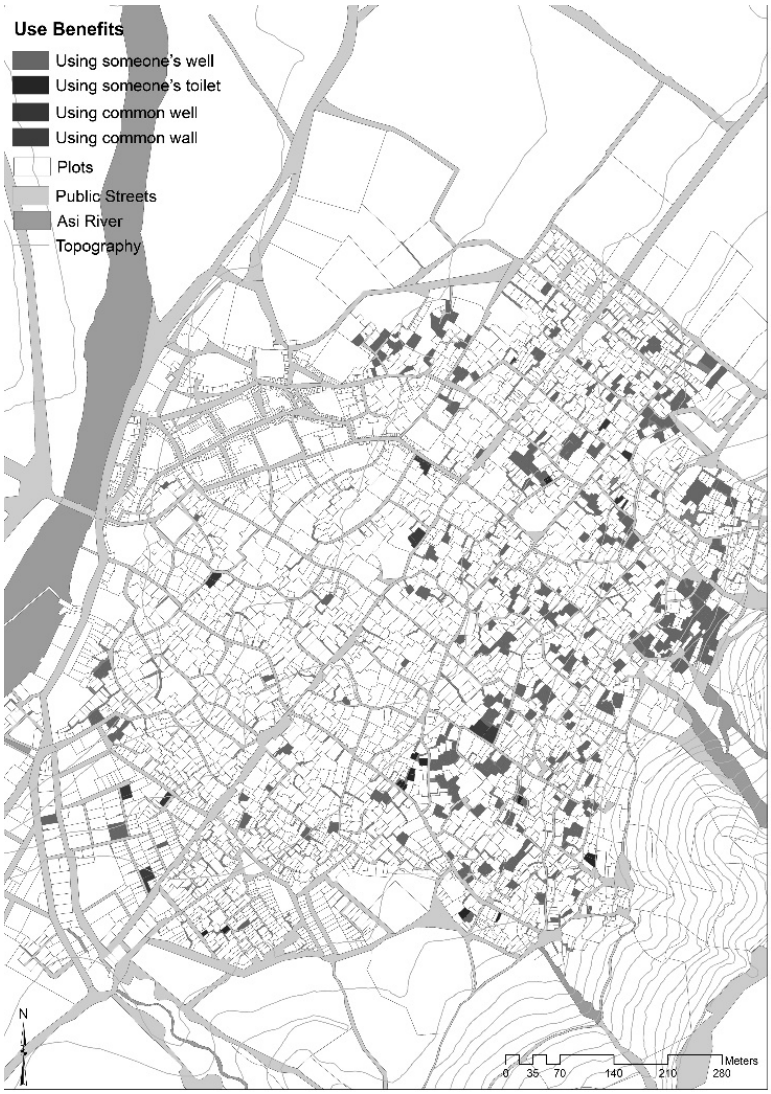

Figure 6. The parcels having use benefits in the historic urban form (Prepared by Rifaioğlu, M.N.).

Benefits are only defined for commonly owned wells, toilets and walls, when located on adjacent plots with all owners having the benefit of their use. An ownership right and use benefit is

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defined for common walls. The ownership of the wall is defined according to the exact locations and the lengths noted in the title deeds, and accordingly, the benefit. According to Islamic property rights, the owners of wells, toilets and walls have an obligation to maintain them. Use benefits and liabilities are also defined for somebody else's wells, toilets, barns and pits. In this case, the beneficial owner is not a common owner, having rights only related to their use under beneficial rights. Therefore, the owners are obliged to give permission for the use of their architectural elements by beneficial owners. Such situations in regarding the use of somebody else's well, toilet or barn can be seen in the residential zone of the historic urban form.

The use benefit for somebody else's pits is only defined for the tanneries in the northern part of the urban pattern, with the beneficial owners being artisans, who have the right to use the pits located on the plots of tanneries (Figure 6).

Construction benefits and liabilities

Construction benefits are generally related to building activities on empty plots or in development areas throughout the historical urban pattern. In the case of Antakya, however, they are found more frequently than would be normally expected, as they may allow specific intervention principles and/or solutions within the complex, introverted and organic historic urban form. Accordingly, they have a crucial role to play not only in controlling specific construction activities, but also in allowing additions or alterations to properties and preventing uncontrolled physical interventions.

One of the construction benefits investigated in this research is *projection benefits*, which generally occur in traditional dwellings when an owner wishes to make an addition to their property that projects over someone else's property. These are classified under two sub-groups in this research namely: "projection benefits over culs-de-sac" and "projection benefits over someone else's plot".

Essentially, there are two types of projection benefits defined for culs-de-sac; one being "the benefit for constructing a projected room over a cul-de-sac" (Figure 7) and the other being "the benefit for constructing a projecting facade over a cul-de-sac".

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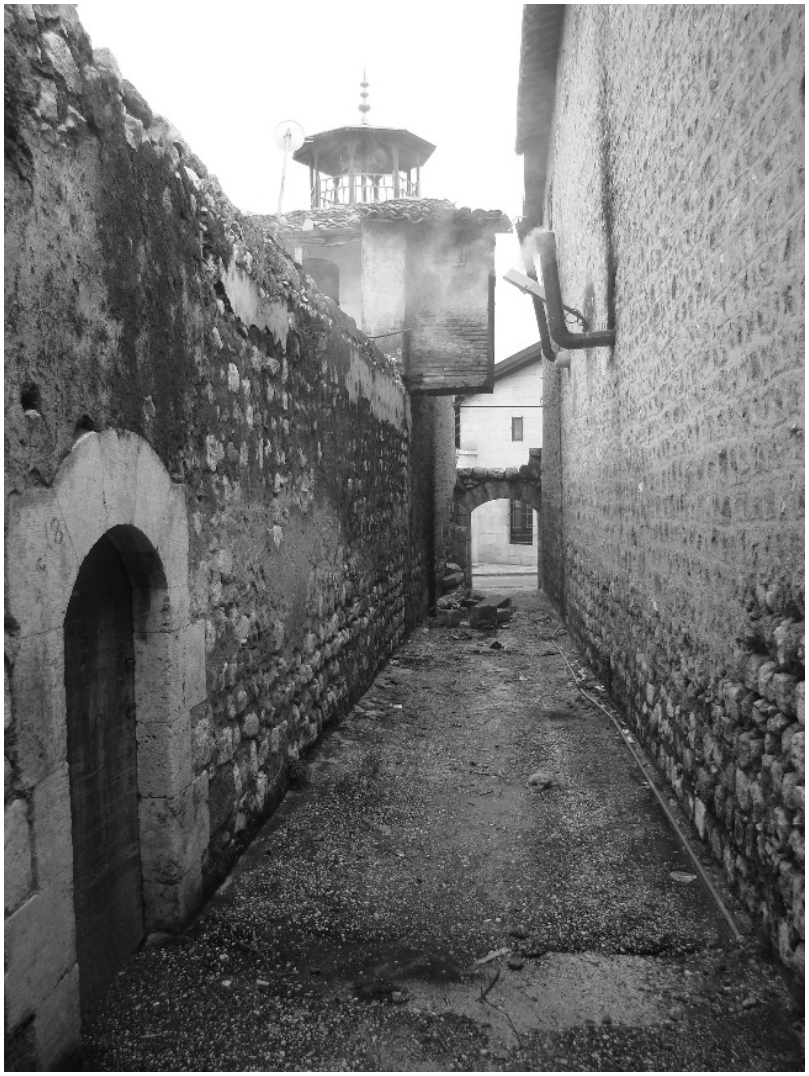

Figure 7. A projected room benefit over the private cul-de-sac (Rifaioğlu, 2009).

It is important to note that these type of ownership benefits are commonly used for privately owned and used culs-de-sac rather than semi-private ones, and that there are also liabilities to be applied in this benefit. For example, if a plot has a projection benefit over a cul-de-sac of multiple ownership, the owners of the cul-de-sac must allow and/or not obstruct the construction of the projection.

The other sub-group covers projection benefits over somebody else's plot. The owner of this benefit can construct a projection over an adjacent plot, and the neighboring plot owner is obliged to give permission for the construction activity. In some cases, this benefit is defined according to a particular place, location, etc. For example, it is clearly written in the title deeds that the projection can only built over the toilet or well of the neighbor's toilet or well, and accordingly the benefit owner would be prohibited from building a projection in any other place. Also, the neighbor has to give permission for the construction of a projection as a liable owner.

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In Antakya, projection benefits are concentrated on the east part of historic urban form, where there is more private culs-de-sac than in the rest of the fabric. Fundamentally, they still exist throughout the urban form as a characteristic feature of Antakya's historic urban form that developed over time, especially by influencing and enabling property rights.

Another construction benefit and liability group relate to building construction benefits. This group of benefits not only deals with building activities on the benefit owner's own plot, but also those related directly to building activities on somebody else's plot. These deal with benefits for constructing a building on somebody else's plot (Figure 8); benefits for the construction of a barn on somebody else's plot; and the construction of a building over somebody else's well. The plots belonging to others can be adjacent plots or any specified plot in the urban form. In this case, if other the plots of others are affected by the construction activity, they may also be liable for it (for example, allowing access).

Figure 8. Constructing building benefit on somebody else's plot (Rifaioğlu, 2009).

In addition to the building construction benefits, there are other construction benefits applying to small-scale physical interventions and/or alterations to the urban form. Strikingly, these benefits are not only related to interventions that occur between neighboring plots, but also have strong enforcements for alterations that occur both inside and outside the dwellings that are indirectly affected to the adjacent plots.

The resting timber wall benefit is used in the case of one owner wishing to build a timber structure against a common wall. According to the benefit, the plot owner can build a timber-framed wall against (i.e. supported by) a neighbor's wall. The

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owner of the neighboring plot is obliged to give permission for such a construction.
Constructing a cupboard against a common wall and opening a window through to the neighboring plot are other small-scale alteration benefits for dwellings. This benefit enables the construction of embedded cupboards against a common wall.

Other property rights
Other individual property rights that existed throughout the historic urban form include the benefit right for *overlooking somebody else's plot*. This benefit right, in some cases, is given for a specific place – for example the benefit of overlooking somebody else's courtyard from an upper-floor window, or a private cul-de-sac.
A benefit is also defined for *opening a new window that will overlook somebody else's plot*. In this case, the benefit owner can open a window, as specified in the title deed record, and therefore can look through the window onto somebody else's plot. Under these circumstances, the liable owner has to give permission for the creation of the opening. These property rights are classified in this research as visual interaction benefits and liabilities.
Another unique property right is defined as *giving property incomes to the poor, written specifically as "Antakya's poor inhabitants"*. This property right applies to some of the shops located in the commercial zone of the historic urban form. According to the property right, the benefit owners are the inhabitants, and the owners of specified shops are obliged to give a proportion of the income of the shop to Antakya's poor inhabitants. This property right is referred to as charitable benefits and liabilities in this research.
The final property right is related to the *burying of her relatives on somebody else's plot*. This benefit is clearly written who are to be buried in which specific plot, with their names and family information. The liable plot owner must give permission to the specified person to bury his/her relatives'. This property right is referred to as spiritual benefits and liabilities in this research.

THE UNKNOWN HISTORIC URBAN GRAMMAR
This phase of research concentrates on decoding the unknown grammar and identifying the invisible links and values that exist within the historic urban form through a combined evaluation of ownership, use and property rights. By using this method, the research aims to reveal the esoteric relations that exist between the physical context and the experiences of the inhabitants according to the title deeds records. It is worth mentioning here that these relations provide very important clues as to decode of

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unknown historic urban grammar of the order of urban form, and in defining the hidden values of Antakya.

The Correlation Between Ownership and Use

The correlation between ownership and use reveals a different kind of building type that cannot be defined through a survey of the current urban form, namely the residential-religious buildings.

If the owner of a dwelling was a religious foundation, and the title deeds clearly state that the dwelling was to be used for religious purposes, then the users would have a spiritual connection with the building. These are referred to as residential-religious buildings in this research.

Several different religious-residential buildings existed within the historic urban form, including those belonging to the foundations of minority groups like the Alewites and Christians; while other residential-religious buildings were owned by dervish foundations. The Alewites' residential-religious dwellings were concentrated in the southern part of the urban fabric, and today some of them are used for residential purposes, while others lie vacant.

Although Christian foundations owned monumental Churches spread throughout the historical urban pattern, there were only a small number of Christian foundations, such as the Caphuchins Priests Foundation, which owned dwellings for religious purposes in the form of house-churches. Additionally, dervish lodge foundations owned dwellings for religious use.

In addition, different sized residential buildings, many of them small (around 10–15 m^2) are defined in the title deeds as one-room dwellings owned by Alewite foundations and citizens. Their locations within the urban fabric give reliable clues to the social and spiritual interactions between the owners and users of the dwellings. The resolution of these two different aspects shows that the small one-room dwellings are located generally in the south and north of the historic urban form, where the Alewite citizens lived. These single-room dwellings are clustered around the religious and/or religious-residential buildings of the Alewites. A deeper investigation shows that one-room dwellings were used mostly by religious Alewites. Most of them still exist, and some of them are in normal occupation, while others are vacant or have been demolished during urban development activities (Figure 9).

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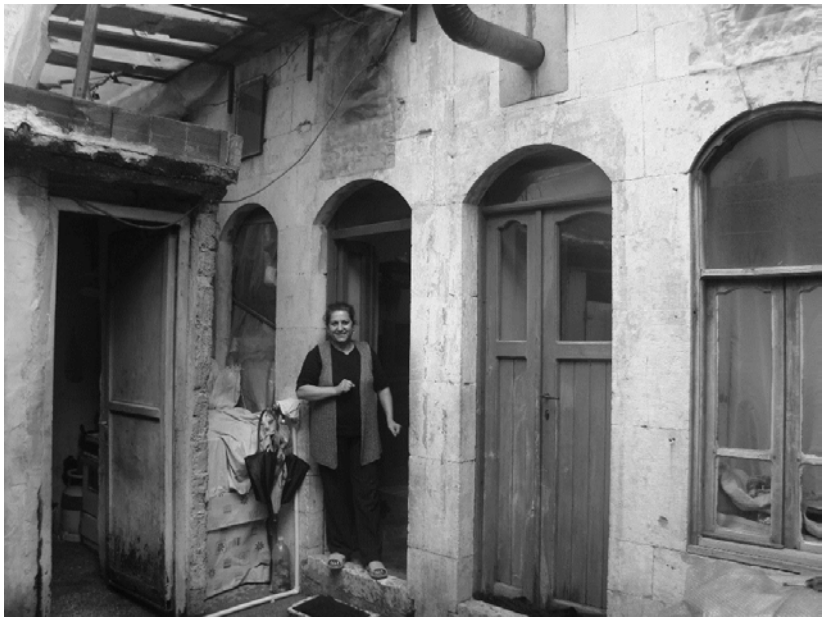

Figure 9. Two adjacent one-room dwellings located next to an Alewite visitation (Rifaioğlu, 2009).

Additionally, there are single-room dwellings that were owned by Sunni foundations, located close to the mosques and occupied by Imams. Today, they are no longer in use, and while most of them still exist, others have been demolished. The plots of some single-room dwelling were narrow and rectangular, and have suffered total collapse, and have since been replaced by public culs-de-sac. Most of the religious buildings owned by foundations are still used for religious purposes. Alewite visitations are commonly located in private culs-de-sac and retain their function today.

The correlation between ownership and use continues within the commercial nuclei, where shops and bakeries are located next one another. It can be seen that the commercial nuclei are located next to religious buildings and have a generic formation in the districts of all of the different ethnic-religious groups within the historic urban form. Most were owned by individuals and they are still in use.

The use of bakeries throughout the urban fabric has remained stable, however their ownership status has changed. For example, a bakery owned by the Armenian population of Antakya in 1929 is still in use and is owned by the Alewites today. Haysem, the current owner of the bakery said, “The bakery was abandoned by the Armenians, and since then it has been used in its original function by my family”.

The commercial zone of the historic urban form was used by all different ethnic-religious groups, with individual ownership being common in the area. However, differences existed in the way trade activities were conducted related to the ethnic-religious identity of the owners. The minority Jews commonly owned the fabric workshops; Christians owned the jewellery

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workshops; and the Alewites generally owned the bakeries and grocery shops. The large monumental commercial buildings, such as soap factories and khans, were most often owned by the majority group – the Sunni Muslims. There are sub-commercial zones, or *arastas*, within the commercial area of the urban pattern in which many souks were established for the trade of specific goods.

The Correlation Between Property Rights and Use

The evaluation of property rights and the use of the urban fabric by the inhabitants revealed different invisible links that have affected the shaping of the urban form of Antakya. According to the spatial passage benefits and the use of the services, there is a dense movement of inhabitants through the introverted urban form, concentrated on the western declivity of Mount Habib Neccar. The common reason for the movement of inhabitants is to obtain water from the well and to access the toilet. It is significant that the beneficial and liable owners are commonly from the same ethnic-religious groups.

Another aspect worthy of note is movements that are not limited to adjacent plots or to plots located next to one another. According to the property rights, there can be a movement from a different part of the urban form. For example, the beneficial owners of the passage right through the private cul-de-sac of the Alewite visitation can be from any part of the urban form. Accordingly, owners of the passage right can enter private culs-de-sac to access a place of worship.

The correlation between the service buildings and the non-spatial passage benefits indicates an orthodox solution for sustaining the public bath by orienting winter waters towards it. In the residential zone, there is only one area in which the winter water discharge benefits and liabilities are concentrated. When the area is co-related with the use of public baths, it can be seen that the direction of the drainage/passage of winter water is towards to the Cindi public bath.

There are two public baths located on the river, of which the Cindi Bath is the second. After the first public bath, there is a property right in place to increase the amount of water discharging towards the Cindi Bath (Figure 10). The combination of benefits and liabilities throughout the urban pattern offers a clear perspective of use and the forming of the physical fabric, and the way in which inhabitants experience that fabric.

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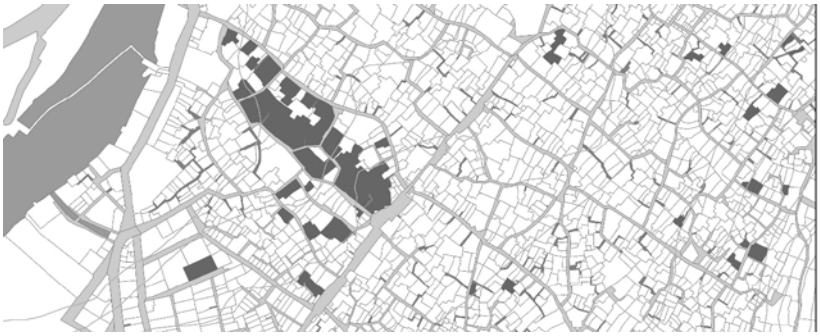

Figure 10. The winter water passage benefit, and the Public bath at the end of the beneficial owners (Prepared by Rifaioğlu, M.N.).

CONCLUSION

Antakya has been home to many different civilizations throughout its history, during which it has been subjected to a diversity of successes, significant upheavals and disasters. A few archaeological edifices still exist from ancient times, and the historic urban core of Antakya in the present day still contains characteristics that date from the Memluk era to Ottoman period. The intention of this research is to reveal the dialectic links between property rights and the formation of the historic urban core of Antakya. In the analysis, the ownership, use and property rights are evaluated and correlated with each other in order to reveal the esoteric relationships under the formation of the physical urban context. The invisible links and values that exist within the urban context are defined through an evaluation of property rights, which are investigated throughout the urban form through a site survey.

The study of the cadastral maps and title deeds allowed a unique perspective of the interrelations between the physical and social aspects of the urban core. It should be mentioned here that these aspects provide very important clues when attempting to uncover the “spirit of the settlement” as well as the “spirit of place” in a historical urban setting.

This research into the relationship between the ownership system and the urban form is based on a conceptually new and contextually rational, effective and orthodox control mechanism related to urban formation and the persistence of the historic urban core of Antakya. These mechanisms are defined as “property rights” in this research and are described as “benefits” and “liabilities” in the title deeds.

The ownership benefits and liabilities are the specific descriptions and obligations not only for the plot owners, but also for the inhabitants of the city. According to the title deeds, plot owners may be subject to different kinds of benefits and/or liabilities related to a specific plot in the form of detailed, strict and enforceable rights over both the tangible and intangible features of the urban form. They have a key role to play in the

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forming of rational solutions for the physical, morphological, social and cultural aspects of the urban core, such as:

- ownership rights relating to relationships between topography and the urban form
- the formation of the street layout and the built environment
- physical interventions throughout the urban core
- the movement of inhabitants within an introverted and complex urban form
- consideration of natural elements in the formation of the urban form
- the formation of services such as wells, toilets, etc. and their use
- spiritual and socio-cultural activities within the urban form, and so forth.

In the Antakya case, an analysis and evaluation of the influence of ownership, use and property rights would allow a clarification of the combination of tangible and intangible values that exist within the urban context and make it significant. Property rights are not only an important factor in the formation of urban form, but also for identifying and conserving the dialectic links between the inhabitants and the historic urban form, creating spirit of place. This investigation into three constant parameters creates a foundation of knowledge on the underlying, hidden aspects and beliefs at work in the formation of urban form and will be of great benefit in current holistic urban conservation studies. It is also an important input for the understanding and assessment of historical urban contexts and may help in the elimination of generalisations.

Fundamentally, this research clarifies that ownership has the means of affecting something that lies beyond the existence, beyond the apparent, beyond the known and beyond the man-made settlement boundaries that define elusive historical urban forms. The Antakya case reveals clearly that property rights have major implications when attempting to understand the formation and persistence of every single component of an urban form; and accordingly, these aspects deserve greater consideration in urban studies such as urban morphology, design and conservation when attempting to make holistic assessments.

Last but not least, ownership norms help one to understand and identify the esoteric features and their effects on the formation of the urban form, which is something that cannot be clarified through the survey methodologies of other urban disciplines. Accordingly, the persistence and effectiveness of property rights is also an important issue for sustainability and in the

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conservation of the character of the historic urban form of Antakya.

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Resume

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Research Article

A Comparative Study on Turkey's National Green Building Certification System Under Energy Policy Developments

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Dinçer Aydın***

Abstract

In today's living conditions, the quality of life depends on well-managed energy. Therefore, countries produce different energy policies to manage their energy resources. Determining appropriate, feasible, and controllable energy policies becomes important especially for buildings, as being one of the most significant energy consumers. Green building certification systems (GBCSs) are one of the most common applications for energy efficiency in the building sector.

Purpose

This paper is a comparative analysis of GBCSs in developed and developing countries, in an effort to establish the similarities and differences between Turkey's first national GBCS – B.E.S.T and other GBCSs, and to determine how the energy criteria in GBCSs contribute to each dimension of sustainability (i.e., environmental, economic, social).

Design/Methodology/Approach

The research methodology depends on the literature review and documentary review on energy-related regulations, legislation, and laws. A comparative analysis of GBCSs was conducted in the study. Not only the sub-criteria directly exist under the energy criterion, but also

Keywords: *B.E.S.T, CEDBIK, energy, Green Building Certification System (GBCS), sustainability dimension*

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indirect energy criteria, which are included in the sub-criteria of all other criteria within the GBCS, were numerically evaluated with the helped of developed matrix.

Findings

The results show that energy credits were given the highest weight by LEED (~33%) in international GBCSs and by GRIHA (~42%) in national GBCSs. In B.E.S.T, this is ~29%. It was determined that B.E.S.T was structurally similar to LEED, while it was similar to BREEAM in terms of weight and importance given to the energy criteria. According to the developing country GBCSs, the biggest similarity is seen with GBI. In terms of SD, it is found that GBCSs present similar characteristics to their regional development level. Where a GBCS serves for a developing region, the main concerns of energy criteria focus on the intersection of its environmental and economic aspects. Thus, B.E.S.T has been created in a similar structure and the highest share (%80) on environmental-economic aspects.

Research Limitations

In the study, the comparison was made between selected international GBCSs like BREEAM, LEED, and DGNB and national GBCSs like GM, GBI, and GRIHA.

Practical Implications

In practice, the results can help owners or developers to focus on which energy criteria contribute economic, social or environmental advantage for them.

Social Implications

This study also provides some recommendations for further application and academic studies of B.E.S.T.

Originality/Value

Increasing the recognition of Turkey's national GBCS in scientific researches and contributing to the development of it have made this study original and unique.

INTRODUCTION

In recent years, how to reduce energy use has become a topic of high interest, and many studies on the different scales are conducted (Gillingham et al., 2006; Calero et al., 2018; Naylor et al., 2018). With the awareness of energy, all countries, depending on their development levels (DLs), establish different energy policies by considering the environmental, economic and social effects of this issue (Rosenow and Galvin, 2013; Kim and Sun, 2017; Yu et al., 2017). The number of buildings rising parallel to world population growth causes an increase in energy demand. Although rapid urbanization occurs, cities take 2% space in the world. However, only this is enough to make cities one of the biggest energy consumers, which consumes 80% of energy and produces 80% of greenhouse gases (GHG) (Hoornweg et al., 2011). This is not a proper and sustainable approach to expand cities by maintaining the existing situation (Johansson and Goldemberg, 2002).

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In today's cities, only buildings are responsible for 40% of total energy, 70% of total electricity consumption and 30% of GHG emission in which residential buildings are about 38% (EIA, 2018; Hoornweg et al., 2011). Therefore, developing policies such as reducing energy consumption, controlling the consumption, using and extending alternative and renewable energy resources (RERs) in the building sector become inevitable. Because the critical aspect of achieving to live in cities with a sustainable way depends on energy sustainability (Rosen, 2009). This leads to aiming at sustainable construction in the building sector. Such that green buildings (GBs), which are a process of creating a healthy built environment under the principles of resource efficiency and ecological consideration, are the basic application of sustainable construction (Kibert, 2016).

Recently in sustainable construction, green building certification systems (GBCSs) are one of the most common and popular policies and/or tools for energy efficiency. In the literature, it is seen that after the emergence of GBCSs, studies examining GBCSs with different objectives are carried out intensely. In the last two decades, GBCSs are the second most studied topic after the GB project delivery and developments in the GB literature (Darko and Chan, 2016). While some studies focus on the overall analysis on criteria of GBCS (Lee, 2013; Illankoon et al., 2017; Shan and Hwang, 2018), others on only energy (Roderick et al., 2009), water (Waidyasekara et al., 2013), waste management (Wu et al., 2016) or health and comfort (Worden et al., 2020). With their integrated system, GBCSs aim to decrease the energy use of buildings and to make buildings healthier and more environmentally friendly for their occupants (Sev, 2011; Khoshbakht et al., 2018).

GBCSs are a kind of driver for the sustainability and/or success criterion of a building. Furthermore, sustainability recognizes a balance between the economic, social, and environmental dimensions (Brundtland, 1987). This is also known as "the triple bottom line" (Elkington, 2013) and called as sustainability dimension (SD) in this study. GBCSs include SDs at different levels depending on the weight and context of their criteria. It is seen that so limited studies focus on the SD of the evaluation criteria of GBSCs completely or separately (Awadh, 2017; Doan et al., 2017; Jensen and Birgisdottir, 2018). Therefore, a comparative analysis of GBCSs in terms of their SD becomes a significant issue. This helps to analyze how a GBCS aims to provide sustainability giving to high priority on its surrounding. This can be also considered as an indicator to show the DL of a nation. Because the weight given to the SD varies according to the DL of the countries. Thus, it is also expected a change in the SD of GBCSs.

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Starting with the first GBCS in 1990, this process continues today with the development of dozens of national and international GBCSs. After the success of international GBCSs, global awareness occurred to construct buildings more energy efficient. In time, some of the GBCSs became more popular in building evaluation systems. However, countries' national needs and building sector dynamics cause creating their own GBCS. One of these national GBCSs is B.E.S.T (Ecological and Sustainable Design in Buildings), which is Turkey's first official national GBCS and generated based on the international GBCSs by CEDBIK (Turkish Green Building Council).

In the literature, many studies have emphasized the need for a national GBCS for Turkey (Gültekin and Bulut, 2015; Erdede and Bektaş, 2018a). Following the first draft, although various studies on B.E.S.T, also known as CEDBIK, were carried out, these are mainly macro-scale comparisons of existing GBCSs or their selection processes (Geçimli and Yamaçlı, 2019; Sait and Harputlugil, 2019). Moreover, some studies are aimed at comprehensively examining one or more parameters of B.E.S.T that are topics on water efficiency in GB (Gültekin et al., 2018), site usage (Erdede and Bektaş, 2018b), daylight comfort performance (Durak and Ayyıldız, 2018), innovation in GBs (Mollaoglu et al., 2016), and its effect on urban transformation (Diker, 2019). However, it is seen that no detailed research has been conducted regarding the energy parameter yet. When considered the importance of energy for Turkey as a country dependent on foreign energy, energy is an important issue that should be examined.

The main objective of this study is to examine the international and national GBCSs in terms of energy criteria. In addition, this study is a comparative analysis of GBCSs in developed and developing countries, in an effort to establish the similarities and differences between B.E.S.T and other GBCSs, and to determine how the direct or indirect energy criteria in GBCSs contribute to each SD depending on DLs of countries. In this scope, the study was conducted as follow: (1) summarization of energy-related regulations until the emergence of GBCSs, (2) identification of the selected GBCSs and their key parameters, (3) comparison of the GBCSs, (4) discussion on the importance of energy criteria by evaluating the key credits awarded for energy efficiency and (5) determination the SDs of energy criteria.

To make a more cohesive comparison, this study has a restriction on the selection of the GBCSs. Due to generation of B.E.S.T depends on three widespread and well known international GBCSs, BREEAM (BRE Environmental Assessment Method), LEED (Leadership in Energy and Environmental Design) and DGNB (German Sustainable Building Council) were chosen as

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international GBSCs. Besides, Turkey is a developing country so that national GBCSs belonging to other developing countries like GM (Green Mark) from Singapore, GBI (Green Building Index) from Malaysia, and GRIHA (Green Rating for Integrated Habitat Assessment) from India were included in this comparative examination.

RESEARCH BACKGROUND

Nowadays, the management of energy with energy-saving policies is so critical. Therefore, to achieve sustainable development, countries are trying to re-evaluate their energy systems by planning their energy programs and strategies according to their energy efficiency aims and targets (Yüksel and Kaygusuz, 2011). In the 20th century, instead of local and vernacular architectural solutions of the 18th century, using products, equipment and energy-consuming systems developed by the influence of industrialization made buildings have a significant share of energy consumption. The buildings fit with active energy-consuming systems have become the environments threaten user health. However, after energy crises, energy efficiency decisions that were put forward after 1975 in the developed countries have resulted in a saving of 55% in energies consumed until 2005. Due to high importance on energy efficiency in the 1990s, total energy consumption in the world has not increased and has remained at a lower rate while industrialization and growth are occurring (Yaman et al., 2015). In the 21st century, buildings have been designed by removing systems increasing energy consumption. An approach was adopted in which energy reducing systems are used; physical environmental conditions are well analyzed; passive energy designs are applied (Goldemberg et al., 1987).

To regulate and decrease the energy consumption of buildings, some policies, which can be called as GB policies, are set. In literature, these can be summarized as requiring an energy performance building directive, using and also promoting RERs instead of non-RERs, encouraging to design GBs by regulating with laws, rules, taxes, creating a council or institution to arrange and to control the relevant standards, encouraging to get a GBCS (Pearce et al., 2007; Murphy, 2014; Tan et al., 2016; Huo and Yu, 2017). Figure 1, which is listing developments directly related to the energy consumption of the building sector, summarizes the important milestones of these policies with the help of a chronological chart established by using the data obtained from the literature.

According to Figure 1, despite the increased dependence of oil and natural gas after the 1950s, discoveries of hydrogen, solar, wind, and geothermal energies, have already occurred until that

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time. It is seen that these RERs were used for the first time in the 19th century. However, becoming widespread commercial usage of them took time. In the 20th century, it was possible to use RERs economically in buildings. Furthermore, in the 21st century RERs can have a wide and effective usage area in the building sector.

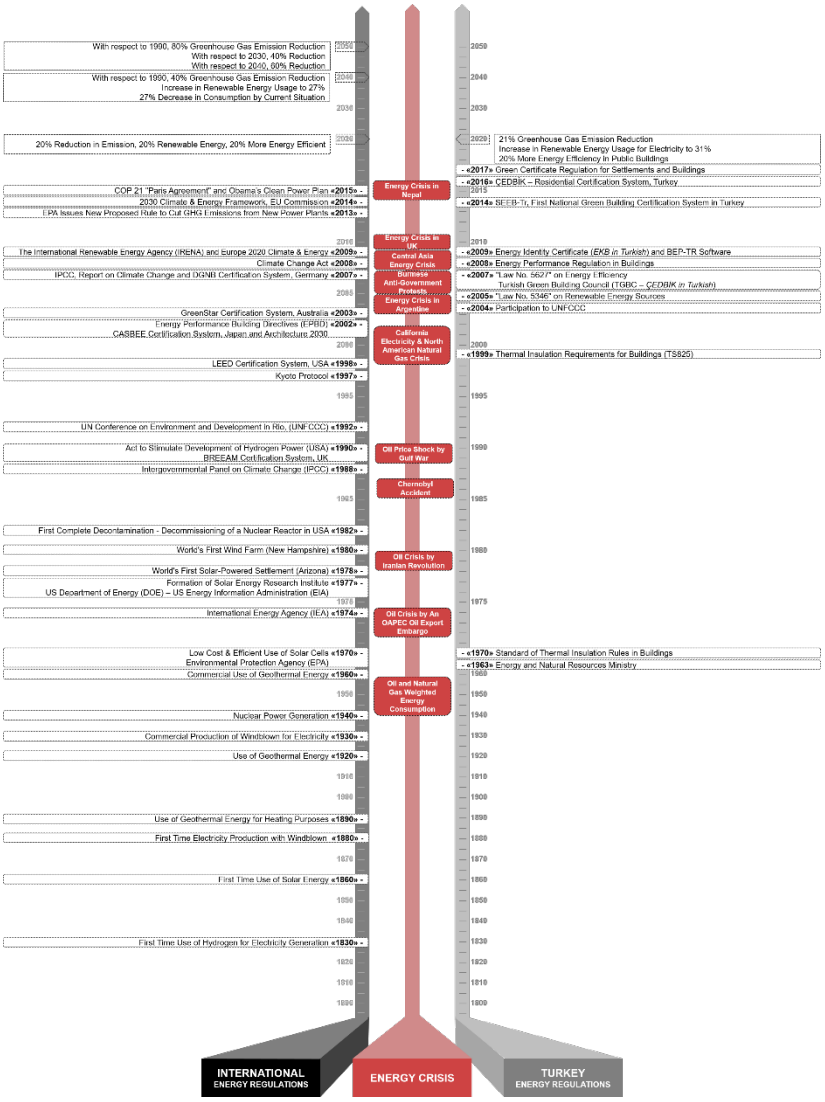

Figure 1. Comparison chart of directly energy-related regulations in building sector

The global energy crises of 1973 and 1979 necessitated the establishment of an energy governance institution to regulate, control, and follow-up energy issues in developed countries. Therefore, IEA (International Energy Agency) was instituted as a global regulator in 1974 (Figure 1). This was followed by the establishment of a Ministry of Energy in the same year in the UK and 1977 in the USA. Energy and Natural Resources Ministry was established in Turkey in 1963, before these countries and the global energy crisis. However, Turkey, whose industrialization process was much slower, did not have an effective mission/role in energy management in that period.

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The establishment of some international institutions or organizations also helps to regulate the energy efficiency of buildings such as IPCC (Intergovernmental Panel on Climate Change) in 1988, UNFCCC (United Nations Framework Convention on Climate Change) in 1992 and then the first COP (Conferences of the Parties) in 1995 (Figure 1). In 1997, the Kyoto Protocol, one of the largest participated agreements on a global basis for sustainability, has led countries to reshape their energy policies (Oberthür and Ott, 1999).

After Kyoto Protocol, the most important step taken by EU countries for the building sector is to generate and to apply the "Energy Performance Building Directive (EPBD)" in 2002 (Nikolaou et al., 2015). While EPBD allows decreasing the energy consumption of the 75% building stock in the EU, this also helps achieve energy efficiency targets of EU countries by reducing the EU's total energy consumption by 5-6% and lowering CO_2 emissions by about 5% (EC, 2018). In Turkey, one of the major legal regulations to reduce the energy consumption of the building sector is "Thermal Insulation Requirements for Buildings (TS825)". However, the fact that the TS825 is not mandatory restrains obtaining energy saving. Although it has become a compulsory regulation for all newly constructed buildings after revision in 2008, its contribution to efficiency is so limited.

It was decided by the EU to apply the "20/20/20 Climate & Energy Package" in 2009 to reach the energy targets projected in the Kyoto Protocol. Accordingly, EU countries have agreed to be 20% more energy-efficient, use 20% more RERs, produce 20% less GHG in 2020 than in 1990. Turkey's 2020 energy targets include a 21% reduction in GHG, a 31% increase in the use of RERs for electricity, and 20% more energy efficiency in public buildings. Both Turkey and other countries have been gradually increased their targets for 2040 and 2050.

GBCSs serve as an aid in achieving the energy targets of countries, prioritizing energy efficiency, and encouraging the use of RERs (Figure 1). GBCSs emerged in the 1990s for the first time have encouraged the creation of many national certification systems because of the understanding of their contribution to sustainability and energy efficiency (Li et al., 2017; Mattoni et al., 2018). This made GBCSs become an important tool to achieve the energy efficiency targets of many countries. After the emergence of BREEAM in 1990, many GBCSs were created as LEED in the USA in 1998, CASBEE in Japan in 2002, GreenStar in Australia in 2003, DGNB in Germany in 2007. These GBCSs primarily were generated to meet their own national needs of the building sector. However, their full content made some GBCSs turn into international certification systems or guided to establish

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countries' national certification. Especially, some countries needed to create their national GBCS to decrease energy consumption.

Turkey, which is one of the countries showing the most rapid increase in energy consumption in the world by importing 70% of its energy, is trying to develop a national GBCS. Until the 2010s, Turkey used only international GBCSs. However, to answer the Turkish construction industry and its culture, Turkey started to develop its national GBCS for the first time in 2008 with the help of Mimar Sinan Fine Art University. In 2013 SEEB-TR (Sustainable Energy Efficient Buildings) was generated as a national GBCS in Turkey. Then, the CEBDIK certification system was established in 2013. With CEDBIK, it is aimed to contribute to the economy of the country by providing the formation of healthy societies in a comfortable environment. This certificate will be legally enforced under the Green Certificate Regulation for Settlements and Buildings issued by the Ministry of Environment and Urbanization in 2017. With the last update in 2019, this GBCS is called "B.E.S.T".

According to literature, a LEED-certified building uses 25% less energy compared to a non-certified one with the same characteristics, and a reduction of 13% in energy consumption-related emissions and a 15% reduction in energy costs (DLA Piper, 2014; LEED, 2020). The efficiencies provided in energy are very important for countries like Turkey, due to importing a large part of its energy. Therefore, the use of B.E.S.T will also provide a valuable contribution to Turkey's energy targets. In a developing nation, GM developed by Singapore in 2008 has been able to reduce energy consumption by 9%-13% over in the seven years up to 2015 (BCA, 2017). This clearly shows that GBCSs have a significant impact on energy efficiency not only in developed regions but also in developing ones. Thus, this can prove that like a developing country, Singapore, a GBCS in Turkey, will help to increase its energy efficiency.

Brief Introduction to GBCSs

GBCSs, which are one of the energy-saving applications for buildings, were developed over the past three decades by countries depending on their energy policies (Awadh, 2017; Doan et al., 2017). With GBCSs, it is aimed at a reduction in energy consumption of buildings and their environmental impacts during construction, and sustainable management and operation (Kubba, 2010; Mattoni et al., 2018). However, GBCSs base on volunteerism. In general, GBCS is an assessment method analyses energy consumption, land use, indoor environmental quality, and its impact on human health.

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Many GBCSs have been developed based on the different characteristics, energy and environment targets, and requirements of each country (Kubba, 2010; Kubba, 2012). This causes some differences at the SD of GBCSs depending on the sustainability policy of nations. However, it is important that while developing policies like GBCSs, sustainability pillars must be considered (Sev, 2009).

The first GBCS developed in the world is BREEAM, which was generated by the UK in 1990 (BREEAM, 2020). BREEAM then was used as a guide for other countries' GBCSs. One of the GBCSs influenced by BREEAM is LEED, which was developed by the USA in 1998 and has become the most popular GBCS in the world (Scheuer et al., 2002; Reed et al., 2010). Figure 2 shows both international and national GBCSs. The fact that GBCSs, usually organized as national certification systems, can be adapted to the needs of other countries makes it possible to use them as a global certification (Mattoni et al., 2018). It seems that international certifications are generally used by countries that have a common social, cultural, and economic condition by revising the certification according to their national needs. Use of LEED in Mexico as LEED Mexico and in Brazil as LEED Brazil, and use of BREEAM in the Netherlands as BREEAM Netherlands and in Norway as BREEAM-NOR are examples of the adaptation of GBCSs (Figure 2).

The national GBCS in Turkey to contribute to its energy efficiency policies was generated later than the many countries. The first study taken in this context started with the formation of SEEB-TR in 2008, but SEEB-TR certified building does not exist in Turkey. Therefore, SEEB-TR can be considered as a kind of theoretical application of GBCS. CEDBIK as being a nongovernmental organization on sustainability formed a GBCS. The National Energy Efficiency Action Plan of Turkey prepared by the Ministry of Energy in 2016 and the law of Green Certificate Regulation for Settlements and Buildings in 2017 provided the legal basis for the creation of this certification. Thus, CEDBIK has developed the officially national GBCS – B.E.S.T – with the help of cooperation with the academia, public, and member companies by examining the widespread international GBCSs as BREEAM, LEED and DGNB. In this process, Turkey's national condition, culture, geography, and climate were taken into account by considering the international and EU standards (CEDBIK, 2020). However, the first evaluation system was prepared only for the new construction of residential buildings.

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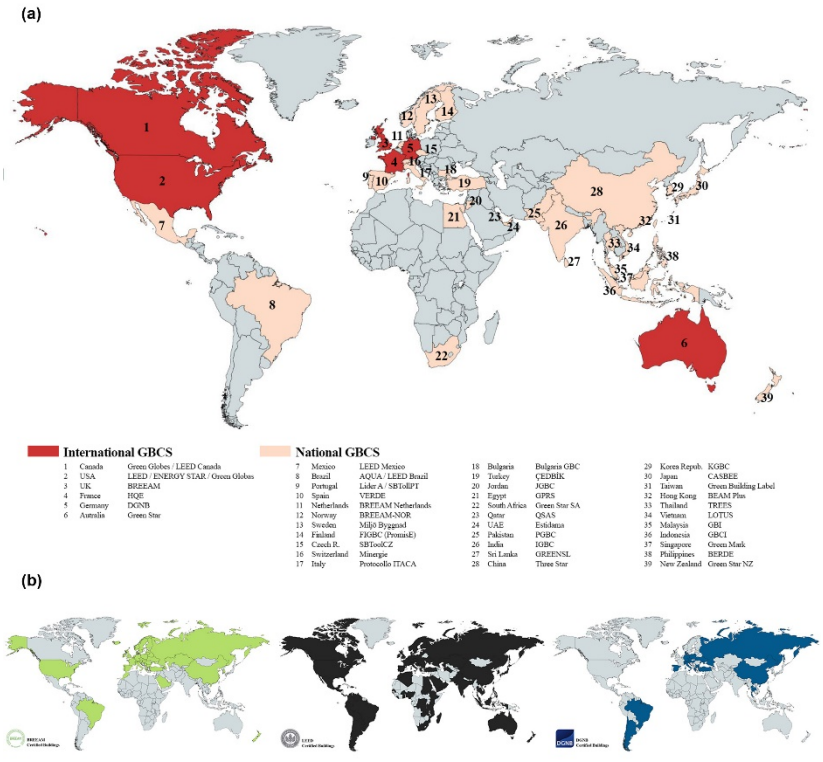

Figure 2. (a) Distribution of various GBCSs used around the world, (b) distribution of BREEAM, LEED and DGNB certified buildings in the world

Despite the delay in the emergence of a national GBCS in Turkey, there are totally of 430 certified projects including 388 LEED, 40 BREEAM, 1 DGNB, and 1 Green Globes (CEDBIK, 2020; DGNB, 2020; Green Globe, 2020). Turkey, with the total area of its LEED-certified projects, is located on sixth rank in the world (LEED, 2020). According to the distribution of BREEAM, LEED, and DGNB certified buildings worldwide in Figure 2, although BREEAM is the first GBCS, globally, the most common GBCS is LEED. It is also seen that BREEAM is generally preferred in developed countries, particularly in Europe, and DGNB is used in similar geography but the more limited area (Figure 2). However, a LEED-certified building is found in almost all countries except for some parts of Africa. This shows that LEED's global awareness is the largest, and its content is globally more appropriate or adaptable.

METHODOLOGY

This study comparatively discusses the energy credit weighting given by the selected GBCSs because energy is the most important parameter in GBCSs (Illankoon et al., 2017; Shan and Hwang, 2018). Each GBCS must meet with SDs, but it changes from one GBCS to another. Especially considering the energy criterion, it is seen that it shows different SD distribution. Therefore, the GBCSs are also analysed with respect to their energy criteria, addressing and prioritizing the sustainability pillars.

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In the study, the data compiled through literature review sourced from papers, proceedings, reports, and information available on the websites of GBCSs. In addition, a numerical analysis has been conducted as a method to calculate and to categorize each GBCS credits under SD. The examined GBCSs in the study are not random selections. This was conducted in two ways one for selection of the international GBCSs and the other for the national. International GBCS were selected from the GBCS used as a guide for the creation of B.E.S.T. These are BREEAM, LEED, and DGNB, which are also widespread GBCSs in the world. In the selection of the national GBCSs, the main concern is to belong to a developing country. Although there are many national GBCSs in the developing nations, another limitation is to have similar sustainable construction activities. According to the top 10 regions for LEED green building, India is the third country where Turkey is sixth (LEED, 2020). Singapore and Malaysia, as being developing countries, are in the top ten countries about economic indicators on sustainable construction (de A. Dias et al., 2017).

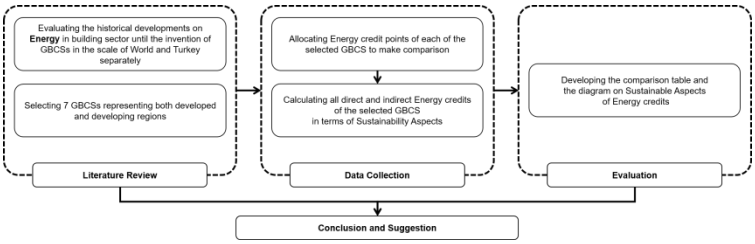

Figure 3. Research methodology

The research methodology is summarized in Figure 3. Firstly, a literature review was conducted in the study. The development of GBCSs was handled along with other developments in the building sector within the historical perspective. According to data, a comprehensive comparison chart was created (Table 1). By considering the research focus, energy credits of each of the selected GBCS were allocated. Then, a comparison matrix was developed, including all direct and indirect energy criteria of the GBCSs by making the calculation for each SD by taking the point value of the criterion into account in the same weight. These credits were converted to share values over 100 (Table 2).

The second step was to allocate credits of energy criteria to the relevant SD. For example, 'use of RERs' is one of the energy sub-criteria in LEED. This is attributed to 'environmental-economic' aspect with its proper credits. Likewise, all energy credits of each GBCS were attributed to the relevant SD. After attributing all credits to the relevant SD, the share of SD of all energy-related criteria was determined. According to data, a comparison diagram was developed to analyse the GBCSs (Figure 4).

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Finally, the study was concluded by evaluating both the overall SD of each GBCS in the literature and their SD specific to energy criteria. At this step, an evaluation has been made by taking into consideration the DL of the countries and the importance of energy for them.

COMPARATIVE ANALYSIS of GBCSs

According to Table 1, current versions of all GBCSs are updated soon. This means that they adapt themselves to changing conditions. This is important to make GBCSs a sustainable tool. Apart from GM, national GBCSs are used for only their regions. GBCSs gain international status when they adapt themselves to local conditions. However, BREEAM and LEED have a significant difference in terms of flexibility and the number of certified buildings. 572,661 buildings were certified by BREEAM, which is six times higher than those for LEED. BREEAM is used in 87 countries, while LEED is in 167 countries (BREEAM, 2020; LEED, 2020). The most fundamental reason for this difference is that the target mass of BREEAM is European countries. Although LEED has spread to more countries, BREEAM has enabled many more buildings to be certified in a limited geography. This is a result of higher European awareness of sustainability (Doan et al., 2017).

The use of international norms is also very effective to make certification a global certificate. BREEAM and DGNB benefit from EU standards and laws, and LEED from ASHRAE and ISO standards. Being regulated with ISO helps GM to use it in other countries. However, GRIHA and GBI are regulated depending on their national norms while B.E.S.T is based on the relevant legislation issued by the Ministry of Environment and Urbanization in Turkey due to being a national GBCS. This limits B.E.S.T to national use for now.

All GBCS have different evaluation criteria changing depending on the type of project - existing, new construction, and interior - as well as settlements. Only B.E.S.T is just to be used for new construction projects with residential function. GBCSs are important tools to certify the sustainability of buildings or settlements. GBCSs can help to obtain energy efficiency targets and policies of a city or a country (Beauregard et al., 2014). Besides sustainability, having a certificate also provides project/building recognition and reputation (Shan and Hwang, 2018).

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Table 1. Comparison of green building certification systems

	BREEAM	LEED	DGNB	B.E.S.T	GM	GBI	GRIHA
Origin of Certificate	UK	USA	Germany	Turkey	Singapore	Malaysia	India
Organization	BRE	USGBC	DGNB+BMVBS	ÇEDBİK	Ministry of National Development	PAM+ACEM	TERI
First and Last Version	1990 – 2018 (only for NC)	1998 – 2018	2007 – 2013	2013 – 2019	2005 – 2017	2008 – 2013	2007 – 2018
Adaptation to Local Conditions & Flexibility	Yes - 87 countries	Yes - 167 countries	Yes - 20 countries	In the Turkey only	Yes - 14 countries	In the Malaysia only	In the India only
Used Standards and Laws	BS, EN, ISO, CIBSE	ASHRAE, ISO, IESNA, ASTM, CIBSE	DIN, EnEv, EU Standards	Green Certificate Regulation For Settlements and Buildings	ISO, OHSAS	n/a	n/a
Type of Projects	Communities Infrastructure New Construction In-Use Refurbishment & Fit-Out	Building Design and Construction Interior Design and Construction Building Operations and Maintenance Neighbourhood Development	New Buildings New Districts Interior Fit-Out Existing Buildings	New Construction*	New Development Existing Buildings	New Construction Existing Buildings Township	Affordable Housing Existing Buildings Large Developments Cities
Main Parameters	Energy Health and Wellbeing Innovation Land Use Materials Management Pollution Transport Waste Water	Integrative Process Location - Transportation IEQ Water Efficiency Energy and Atmosphere Materials and Resources Sustainable Sites Innovation Regional Priority	Environmental Quality Economic Quality Sociocultural and Functional Quality Technical Quality Process Quality Site Quality	Integrated Green PM Site Use Water Use Energy Use Health & Comfort Material - Resource Use Life in the Residence O&M Innovation	Climatic Responsive Design Building Energy Performance Resource Stewardship Smart and Healthy Building Advanced Green Effort	Energy Efficiency IEQ Sustainable Site Planning & Management Materials & Resources Water Efficiency Innovation	Site Planning Energy & Occupant Comfort Water Savings Waste Management Sustainable Building Material Social Aspects Innovation
Distribution of Credits	27 10 12 21 12 11 10 12	33 12 6 14 13 14 11 7	22,5 22,5 22,5 22,5 10	24 12 13 7 12 9 7	25 25 35 35 20	23 13 8 16 12 12	25 7 16 17 7 10
Rating Approach	Pre-weight	Additive Credit	Weight	Credit	Credit	Credit	Credit
Rating Levels	Pass (≥30) Good (≥45) Very Good (≥55) Excellent (≥70) Outstanding (≥85)	Certified (40-49) Silver (50-59) Gold (60-79) Platinum (80+)	Certified/Bronze (35% -) Silver (50%-35%) Gold (65%-50%) Platinum (80%-65%)	Certified (45-60) Good (65-80) Very Good (80-90) Excellent (90-100)	Gold (50-59) Gold Plus (60-69) Platinum (70+)	Certified (50-65) Silver (66-75) Gold (76-85) Platinum (86-100)	One Star (50-60) Two Stars (61-70) Three Stars (71-80) Four Stars (81-90) Five Stars (91-100)
Pre-certification	Yes	Yes	Yes	Yes	n/a	n/a	Yes
Cost of Certification	£250 for registration Minimum £720 Maximum £3,700	$1.500 for registration Minimum $2,250 No maximum limit**	– Minimum 1.250€ Maximum 132,500€	Uncertain n/a	n/a for registration Minimum $800 No maximum limit**	500 RM for registration Minimum 5,000 RM No maximum limit**	n/a for registration Minimum Rs 3,14,000 No maximum limit**
Number of Certified Buildings	572,661	92,000	3,000	n/a	3,200	488	133
Availability of Information	Free Download (www.breeam.com)	Free Download (www.usgbc.org)	Free Download (www.dgnb.de/en)	Free Download (www.cedbik.org)	Free Download (www.bca.gov.sg)	Free Download (greenbuildingindex.org)	Free Download (www.grihaindia.org)

*For only residential buildings
**Cost can increase depending on building size and function.

Moreover, GBCSs cause additional cost to the construction budgets. This cost consists of three different items as registration to the GBCS, evaluation of the building, and certificate cost (Table 1). The registration fee and the certificate fee are the common costs for all. However, there are two different methods to calculate the evaluation fee, depending on the size of the project. In BREEAM and DGNB evaluation fee is calculated according to the determined project size limits. In others, this is made considering the unit price per square meter of each project. Therefore, no maximum certification value exists, and LEED has the highest cost. The negative impact of GBCSs on the project cost can be transformed into an economic advantage. A certified building has an average of 18% more reputation than the others,

which in turn leads to a 38% increase in its value and an 11% decrease in the operation cost (DLA Piper, 2014). Since B.E.S.T has not been used yet, its fees are not determined. However, it is considered to be cheaper than others as being a national GBCS. In Turkey, there are 813 projects have applied to LEED certification despite its high cost. With B.E.S.T, it can also be said that the number of certified buildings would increase (CEDBIK, 2020).

There are two different rating methods for the evaluation process. BREEAM and DGNB use a method of weighing their scores according to each building type, while others use a credit method based on the overall sum of scores. The differences in methods have a great effect on the final score (Suzer, 2015). B.E.S.T shows similarities with LEED about the rating method. Furthermore, the general structure of B.E.S.T is much more familiar with LEED. Because the building industry in Turkey is mainly used to LEED-certified projects. The result is certified in five different rating levels at BREEAM and GRIHA, but at the others in four. In the DGNB only, it is necessary to have a score of at least limit value for each category and total evaluation to get a certification.

Analysis on Energy Criteria

GBCSs include many environmental, economic and social parameters. Although some differences exist in the parameters, evaluation criteria generally concentrate five basic parameters as site (location and transport), resources (energy, water, material), indoor environment, socio-economic and management. The main reason makes differences between GBCSs is that each country is launching parameters for its market needs (Waidyasekara et al., 2013). As seen in Table 1, the most important criteria for all certifications except GM and GBI is 'energy'.

As the study was aimed to compare the energy criteria of GBCSs, energy related sub-criteria were also evaluated. It is important that some credits related to energy criteria are covered through different headings in some of the GBCSs. For example, in GM 'energy monitoring' credits are addressed under the 'Smart and Healthy Buildings' criteria. Therefore, to analyse the GBCSs cohesively, all criteria were evaluated, and the matrix in Table 2 was formed. Accordingly, many GBCSs allocated a range of 23-29 points for energy. The maximum credits allocated in the GRIHA, which is 42 points out of 104 (40.3%). Although, altogether fourteen requirements identified about energy, it is seen that some of them only addressed in each GBCS. GRIHA and B.E.S.T are only GBCSs addressed more than seven requirements relevant to energy.

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Table 2. Matrix for credits distribution on energy criteria at the selected GBCSs

		International GBCSs			National GBCSs			
	Energy requirements and credits distributions in GBCSs*	**BREEAM**	**LEED**	**DGNB****	**GM**	**GBI**	**GRIHA**	**B.E.S.T**
E_1	Reduce building energy use and increase energy efficiency	15	18	5	12	13	12	15
E_2	Use of renewable energy and green power		5		8	5	5	7
E_3	Energy evaluation, monitoring and commissioning	2	7	7	2	1		2
E_4	Energy efficient equipment/ technology/appliances	2					4	1
E_5	Energy efficient transport	3						2
E_6	External lightening	1				2		1
E_7	Optimize building design to reduce conventional energy demand				5		6	
E_8	Building envelope quality			2				
E_9	Renewable energy based hot water systems						3	
E_{10}	Sustainable maintenance or operations & building user manual					2	2	1
E_{11}	Low-energy material in interiors and embodied energy				2		4	
E_{12}	Utilization of fly ash in building structure						6	
E_{13}	Demand response		2					
E_{14}	Enhanced refrigerant management		1					
	Total Points Allocated For "Energy" Section	**27**	**33**	**14**	**29**	**23**	**42**	**29**
	Total Points Including Innovation and Bonus	**132**	**110**	**100**	**140**	**100**	**104**	**110**
	(%) From Total	**20.4**	**30.0**	**14.0**	**20.7**	**23.0**	**40.3**	**26.3**

Credits include the new constructed residential buildings evaluation criteria for each GBCS.
**Indirect credits for energy have been also formed by bringing together.*
***Evaluation system of DGNB is different from others due to weight scores calculations.*

Since it includes regulations for direct energy consumption, except for DGNB, 'reducing building energy use and increasing energy efficiency' has the highest share. The ratio of this criterion among the energy criteria changes between 28.5% and 56.5% where the highest share belongs to GBI while the lowest one is DGNB. While international GBCSs pay more attention to energy monitoring after efficient energy use, this trend is towards the use of RERs in developing countries. Because developing countries are aiming to reduce their dependence on energy and gain an economic advantage that will accelerate their development. However, it must be noted that the operation phase of a building is the longest period in its life-cycle. Therefore, energy monitoring is a significant criterion to manage energy consumption. Since developing countries generally focus on short-term gains rather than long-term benefits, the importance they place on this criterion is relatively low.

Energy-saving with passive systems depends on the design of the building envelope and the materials used on it, so DGNB, GM, and GRIHA are the GBCSs giving the credits for the building and

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envelope design. Accordingly, B.E.S.T has the highest similarity with BREEAM and GBI. While LEED is structurally a guide to B.E.S.T, BREEAM is taken as an example for the weight of the criteria. For the sub-criteria, which show some differences under the energy criteria, it can be interpreted that the impact of the habits of the users in the geography causes this.

Sustainability Dimensions of Energy Criteria

The most important idea behind GBCS includes providing sustainability. Each GBCS presents SD on a different scale. Figure 4 shows the share of the overall SD of BREEAM, LEED, and DGNB. Depending on the DL of countries, the importance given to the environmental, economic, and social aspects of sustainability has changed. Accordingly, the environmental aspect takes the highest share in BREEAM and LEED. They are almost free of economic concerns. However, DGNB gives the highest importance to its social aspect while it is presenting an almost equal balance between the three sustainability pillars. The reason behind this is DGNB was developed later than most of the other certifications and follows the European standards (Jensen and Birgisdottir, 2018).

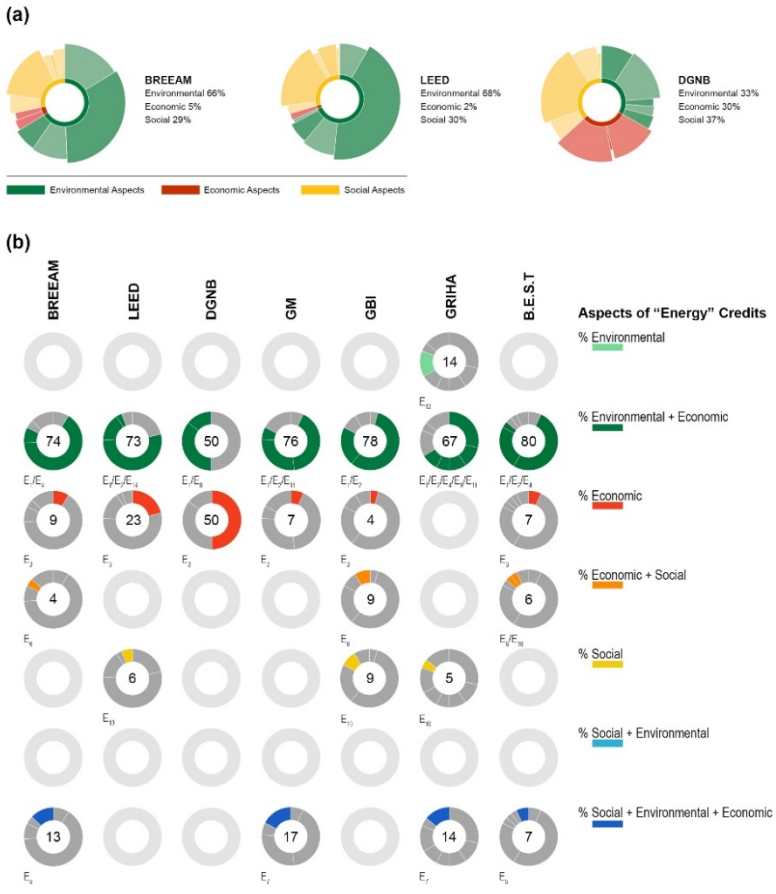

Figure 4. (a) Overall sustainability dimension of GBCSs: BREEAM, LEED and DGNB, (b) Comparison of the sustainability aspects of energy credits of the selected GBCSs

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In this study, the analysis categorizes direct and indirect energy criteria from the GBCSs within three SD – environmental, economic, and social aspects. In this framework, the energy credits in each GBCS listed in Table II are examined (Figure 4). In the analysis, the environmental aspect covers the impacts of energy on the natural environment. This aspect also leans toward optimization of resources through reuse and recycling, as well as lowering of environmental impact throughout the building life cycle. The economic aspect deals with the cost-saving opportunities of the designs, materials, and applications. The social aspect addresses the human well-being, social interaction, and commitment of users. However, the environmental and social aspects can potentially have an impact on the economic value of the building, and thus, the economic aspect could be argued to become a focus through the other aspects indirectly. For instance, evaluating the 'use of RERs' only environmentally without considering its economic aspect, is not accurate. Therefore, the intersection points of each SD of energy are also considered at forming this diagram (Figure 4).

According to Figure 4, out of DGNB, the intersection of environmental and economic aspects is most heavily weighted in the six GBCSs, followed by the economic aspect in LEED, DGNB and B.E.S.T. While the environmental and economic aspects are almost close to equally weighted, there is a noticeable lack of consideration towards its social and environmental sustainability. Merely one out of the seven selected certifications does not focus on only the economic aspect. DGNB has the highest economic value in terms of energy as well as its overall weighting.

The growth of developing countries is directly related to the economic empowerment of countries (Eggoh et al., 2011; Lemma et al., 2016). For these countries, energy is a key factor has a great economic impact on development. Moreover, the society in which GBCSs serve causes differentiation in the SD of GBCSs. Therefore, the importance of the economy in developing countries necessitates more emphasis on the economic value of the energy criteria in the GBCSs developed by them. The economic aspect with its environmental value has the biggest share in developing countries. However, the most important motivations for GBCS following the environmental aspect of sustainability in developed countries are addressed the social aspect, such as demonstrating social awareness (Figure 4). In developing countries such as India, it is stated that the cost and benefits of the practices, which are mostly directed towards the economic aspect, are given more importance (Potbhare et al., 2009). This argument is a result of the overall evaluation of GRIHA. However, it is found that GRIHA surprisingly does not put

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in the center the only economic aspects of energy. The lack of any energy evaluation, monitoring, and commissioning can be read as one of the reasons for this. For Turkey, B.E.S.T has the highest share on environmental and economic aspects of the energy criteria. Although Turkey is a developing country, the social aspect of energy has not been ignored. Furthermore, the SD of the energy of B.E.S.T shows almost the same characteristic as BREEAM. Accordingly, it can be said that BREEAM has been more effective in determining B.E.S.T's energy criteria than other international certificates.

CONCLUSION

This study comparatively discusses the similarities and differences between national and international GBCSs. The study is also limited to the examination of the energy criterion of GBCSs because the most important parameter in all GBCS is 'energy'. Therefore, the study presents how and in what approaches energy is addressed in GBCSs of developed and developing countries by examining the SD of direct and indirect energy criteria of GBCSs. The focus of the study has been formed by Turkey's officially first GBCS – B.E.S.T.

The comparison results can be summarized under two groups as energy criteria and SD of energy in GBCSs. The results show that the GBCSs are not homogeneous in terms of energy credits. Energy credits were given the highest weight by LEED (~33%) in international GBCSs and by GRIHA (~42%) in national GBCSs. In B.E.S.T, this weight is ~29%. Furthermore, apart from developed countries, the use of RERs is the second most significant energy criteria due to its direct effect on reducing the current energy needs of each building in Turkey as well as other developing countries. It is also determined that in B.E.S.T, short-term consumption-reducing practices are given more weight to see direct benefit such as in any other developing countries' GBCSs. However, energy is a multidirectional term, including the sustainability pillars. Environmental, economic, and social aspects of energy criteria change in the GBCSs depending on their DL. It is found that GBCSs present similar characteristics to their regional DL in terms of SD. Where a GBCS serves for a developing region, the main concerns of energy criteria focus on the intersection of its environmental and economic aspects. Thus, B.E.S.T has been created in a similar structure and the highest share (%80) on environmental-economic aspects.

To sum up, it is determined that B.E.S.T is structurally similar to LEED, while it is similar to BREEAM in terms of weight and importance given to the criteria. This is an acceptable result, as the Turkish construction industry is more accustomed to LEED practices. In addition, although B.E.S.T places more importance

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to the number of criteria, the biggest similarity in terms of national GBCS is with GBI. It can be said that the relations between these two countries and similar backgrounds are effective on this similarity.

B.E.S.T will positively contribute to the energy efficiency of Turkey soon. However, to achieve this, it is very important to increase the recognition of B.E.S.T. The most basic way to achieve this depends on adding the B.E.S.T to courses that address sustainability issues. In the construction sector, the fact that small and medium-sized construction companies do not see GB construction as a challenge depends on this process to be easily understandable and traceable. This depends on the development of the local GBCS in a national language. These and similar studies have an important role in ensuring the recognition of the certificate developed. The results will also help owners and developers to understand the dimensional contributions of the design, material, and application decisions they will organize for energy in GB constructions. For example, an owner or developer who aims to gain economic benefits can learn what criteria to focus on. Thus, the development of a national GBCS provides advantages to less cost, less time, and more promotion while contributing to an increase in the number of energy-efficient buildings in Turkey.

Moreover, future studies can address the challenges and positive aspects of the B.E.S.T-certified buildings on the construction and operation phase. Also, the numerical results obtained from the applications will make the B.E.S.T more widespread.

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A Spatial Translation on the Text of Raymond Queneau's "Exercises in Style"

Sırma Bilir*
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Abstract

Purpose

Founded in France in 1960, *Ouvroir de Litterature Potentielle (OuLiPo - Workshop of Potential Literature)*, is a literary game group that conducts experiments to improve creativity in the act of writing. The discoveries and inventions of the group in literature have also created an adaptable potential for non-literary fields. In this study, the work of Raymond Queneau *Exercises in Style*, one of the early works of OuLiPo, is translated into the medium of a different discipline. With this proposal, the study aims to make an external contribution to the creativity of disciplines which produce space.

Design/Methodology/Approach

The study uses an interdisciplinary approach to practice a translation process between the Oulipian literature and architecture. By exploring the possibilities of language with 99 variations of the same story, *Exercises in Style* establishes strong links with translation and

Keywords: *Translation, space, OuLiPo, Exercises in Style, Raymond Queneau*

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creativity; it has been reproduced in many different fields and translated into different languages. In light of this source text, and its reproductions in many different disciplines, 33 variations of a space are produced.

Findings

With this study, space is redefined as a translation object and the potential of the spatial medium is examined with an Oulipian approach. This translation process shows lots of equivalent aspects between linguistic and spatial expressions. Beyond adaptation of the Oulipian techniques used in the text, new creative methods also come to the fore. Therefore, this productive game represents a potential for the educational environment of space design.

Originality/Value

The reproduction produced in this study is the first spatial translation of *Exercises in Style*. While being a sign of respect as trying to keep the original text alive, this translation can open the ways for the text's other adaptations for several scales of space medium or even different disciplines that have not been studied in this context yet. Furthermore, 33 variations of this space can be varied infinitely and this game can be continued as an open work.

INTRODUCTION

The space object is fed from many different sources in the design process, just like any other design product. The direct relationship between space and the ways of living makes space design-related disciplines unlimitedly crossing with other disciplines. This is an observable process together in the actions of designing and translating that the new is produced. Within its generally accepted definition, the product of design refers to a newly created object attributed as original; the translation product owes its existence to another source which is clearly displayed. However, one of the other points that can be noted in these two different definitions is that the design process acts together with different resources just as the translation process. Therefore, the designer does not start producing the new from the zero point just like the translator. Another point to highlight in this comparison is that the translator does more than simply repeating the source.

Imitation refers to a desire for understanding and learning, as well as the pleasure people get from establishing similarities. Rıfat defines comprehending something by saying "having the power of potentially reproducing it" (Rıfat, 2008, p. 54). The translator imitates the work written in one language into another. However, this imitation requires not only the meaning but also the formal figural elements of the text, as well as the distinctive style of the author. In other words, this means rewriting the elements which cannot be imitated, that is, recreating them. In summary, the process is to reproduce the work by changing the linguistic context of its existing content.

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This reproduction is defined by many translation theorists as an artistic activity involving a strong interpretation.

In the translation action, another remarkable point is the dialogue between two languages that translate to each other, beyond conveying the meaning. Grossman (2010, p. 27) reminds that a language has the potential to evolve only if it makes a connection with other languages. Wittgenstein ([1985] 2013, p. 133) draws attention to the importance of this dialogue, which is forcing the capacity of languages, by saying: "The limits of my language are the limits of my world". On the other hand, Benjamin and Derrida discuss this dialogue based upon the dilemma of *"translatable"* and *"untranslatable"*.

Benjamin, in his text *The Task of the Translator*, points to a pure language while stating that languages are not alien to each other (Benjamin, [1923] 2002). According to him, the task of the translator is to give the pure language its freedom by rewriting the language, which is under the strong influence of another one. At this point, the translator breaks through the barriers of his own language for the sake of reaching the pure language; and every iteration of this act improves the language (Benjamin, [1923] 2002, p. 261). While defining well-written texts as translatable, he wants to reach unity without dominating the any of the languages and the dialogue they establish (Benjamin, [1923] 2002, p. 261).

Derrida, while expressing the idea of untranslatable, opposes to Benjamin's acceptance of the pure language. He emphasizes the impossibility of translation by specifying the transmission cannot be carried from one language to another in a pure and problem-free manner. Translation text can only be formed by disrupting the original language and shaking its roots. He argues that the meaning in the source language is impossible to fixate; he rejects the idea of originality in its essence, opposes the superiority of the original over translation (Derrida, 1985, p. 196). This argument of impossibility opens an inciting door for translation, unlike the negativity.[1] [2]

In light of these thoughts, the definition of the translation act breaks free from its usual patterns and turns into a multi-layered tool of thought. The translation becomes free from being a mere copy that coming after original, rather it becomes a plurality that moves with it. The following sentences of Octavio Paz also support this plurality:

"Every text is both unique and a translation of another text. No text is entirely original, because directly itself is a translation in essence. It is performed first by transferring the world, which is out of words, to the world of words, and then a translation in the world of words. In the universe of words, every indicator and, accordingly, every sentence is the translation of another indicator

[1] Although the Myth of the Tower of Babel is a story mentioned in religious sources, it is often referred by translation theorists in terms of its relationship with translation. According to this myth, which has been repeated since the ages, the Tower of Babel is built by a community of people who speak a common language and have power of solidarity. But since the rise of the tower to the sky is seen as a resistance, it is destroyed by God and humanity is sentenced to translation by the mixing of their common language until that day. The "pure language" that Benjamin pointed out through the translatability symbolizes the collective power that humanity can grasp of the truth. The untranslatability emphasized by Derrida, on the other hand, symbolizes the desire that enforces the translation to reach this power with incompleteness of the tower.

[2] While Benjamin draws attention to the aura and authenticity of the artwork in his text *"The Work of Art in the Age of Mechanical Reproduction"* many years later, he underlines that reproduction can take the original work far beyond its original position (Benjamin, [1982] 2018).

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and of another sentence. This proof can be reversed without losing its validity. Since every translation is different from each other, all texts are unique. According to this, each translation, to a certain extent, is regarded as an invention and creates a unique text" (Paz, (1971) 2012, p. 99).

The idea, referenced by the concept of translation, there is nothing that has not said or written before, is also expressed by the intertextuality theory put forward by Kristeva. With this concept she defined the permutation of texts, Kristeva argues that each new work is an endless re-reading of the previous (Kristeva, 1966). With a similar approach, Gerard Genette also proposes the Palimpsest theory he describes as hypertext. With this concept, which takes its name from reused parchment papers, he emphasizes the idea, that one text does not conceal the old text while overlapping, but on the contrary, it allows to show itself (Dillon, 2017, p. 17, 25, 27).

While suggesting linguistic studies as the basis of the research in non-textual areas in which human communication continues, Barthes claims that the concept of text cannot be limited with the field of literature, but all meaningful practices can produce a text (as cited in Aktulum, 2011, p. 13). This idea extends the translation activity beyond being a structure that is discussed only in textual/linguistic fields. Similar to this approach, besides intralingual and interlingual translations in the textual area, Jakobson suggests the concept of intersemiotic translation (Jakobson, [1959] 2012, p. 62).

The idea of intersemiotic translation makes it possible to translate between the two areas (disciplines) that are completely different from each other; and creates a legible frame where the translation approaches the design activity, although it makes us rethink about the limits of translatability/untranslatability. At this point, while the intersemiotic translation seems to be a very difficult process, it also approaches to the lean transformation activity like the act of thinking naturally develops.

Portzamparc expresses the adaptability of the intertextuality theory for the spatial environment by remarking that "one space always responds to another space" (Portzamparc & Sollers, 2014, p. 94). On the other hand, it is possible to extend this idea by saying, space always responds to another text or work of another discipline.

The translation activity between two different fields, including architecture, was first mentioned in the exhibition titled *Deconstructive Architecture*, curated by Mark Wigley and Philip Johnson in 1988 (Johnson & Wigley, 1988). With this step, a wide translation movement started, which includes many architects, from Derrida's deconstructive philosophy to the spatial production environment. In this translation act, as suggested in

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the essence of deconstruction "there is no hygienic starting point between architecture and deconstruction and they work together simultaneously" (Wigley, 1989, p. 9). While deconstruction architecture exists with the basis it gets from the deconstruction philosophy, the idea of deconstruction also finds itself an opportunity to survive by opening itself to another structure in architectural environment in which it is translated. On the other hand, Esra Akcan, studying Turkish-German relations through the urban and residential architecture, interprets the relationship which has established by architecture between different spaces as an act of translation (Akcan, 2012). Akcan addresses modern architecture through the cultural and political aspects of the translation and studies it with intertwined indicators between two sides. In a manner far from its hierarchical structure, which is frequently criticized, in this relationship, it is dominated by the mutual nurturing of both sides through translation and the emphasis on hybridization. Akcan's interpretation on the fidelity-infidelity relationship in the translation of architecture is an important reference about the structure of the design process:

"If there could ever be anything like an ultimate transformation during the act of translation in architecture, which there could not, it would be when absolutely no source could be detected in the work. If there could ever be anything like no transformation during the act of translation, which there could not, it would be the case when the identical conditions are attained in the places of departure and arrival" (Akcan, 2012, p. 8).

In light of these discussions, this study aims to make an external contribution to the content of the disciplines which produce space with the translation from literature, a completely unrelated field to space design. In this context, the texts of the OuLiPo Group, which establishes connections between the concepts of creativity and translation, provides an area that encourages translation for various disciplines for having a creative side. In this study, a spatial translation was produced from the text *Exercises in Style* written by Raymond Queneau, one of the early works of OuLiPo. In other words, this work has been reproduced in a spatial medium, in the light of its adaptations in different fields, which can be considered as intersemiotic translations.

In the production techniques of the OuLiPo group, while trying to develop creativity in the act of writing, translation action is approached from a different aspect. The group's perspective brings the reproductive and creative sides of translation to the forefront. On the other hand, in OuLiPo productions, there is the idea that creativity can be revealed by acting with constraints instead of unlimited freedom. In all these aspects, the attempt to

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reproduce *Exercises in Style*, which is an Oulipian work, with a spatial translation, is a process that brings space, translation, and creativity together. Therefore, the purpose of this study is an attempt to search for the potential of spatial production in OuLiPo's player attitude, by defining the space as a translation object and by pushing its limits.

OULIPO

OuLiPo is a game club founded by a group of friends[3] from different disciplines in 1960 in Paris, in the leadership of Raymond Queneau, a literary artist who is interested in mathematics, and François Le Lionnais, a mathematician who is interested in literature. The name OuLiPo, (Ou-Li-Po), consists of the abbreviations of "Ouvroir de Litterature Potentielle", Potential Literature Workshop.

When the word literature comes together with the word potential; a hidden and unknown future is pointed out that has not yet existed for literature. The word *ouvroir* means workshop (atelier) primarily, and at the same time, in French, means workplace in which women make handicrafts, such as sewing, embroidery and so on, for charity. It is meant an environment where the potential of literature is studied and cut out (Akdağ, 2010, p. 29). On the other hand, it has a sense that Oulipo's discoveries and inventions are open for anyone (Mathews & Brotchie, 1998, p. 202).

According to the Oulipians, creativity is revealed by being triggered by constraints, in contrast to what is thought in the classical sense. At the workshop which members established, try to find new values not yet discovered in literature, by introducing constraints to the content of the act of writing. Mathews (2005, p. 97) states that OuLiPo offers games for authors to play. He points out that, a game is defined "with the bother of following the compelling and perhaps impossible rules, people find themselves reacting beyond imagine by their capacity and in a trance of some sort" (Mathews, 2005, p. 98). He states that the things that revealed with this way, which are necessary to reach the goal, are noticed later. Paul Fournel supports this by pointing, when you are restricted, you can find a new path by another side (Özen, 2005, p. 78).

Oulipian constraints are the ones created by the authors, but outside from the text, also not related to its own content, in a sense the constraints that are foreign to the text. Raymond Queneau defines Oulipians as "rats who must build the labyrinth from which they propose to escape" (Motte, 1998, p. 22). The negative meaning evoked by the state of limitedness triggers creativity for the Oulipians and begins to be part of an arbitrary situation. According to Ekici, "the material of this creativity is not

[3] The first members of the group were the names like Jean Lescure, Jacques Bens, Noel Arnaud, Paul Braffort, Stanley Chapman, Marcel Duchamp, Ross Chambers. The members who joined the group later can be listed as Jacques Roubaud Marcel Benabou, Italo Calvino, Michelle Metail, Michelle Grangaud, Harry Mathews, Oskar Pastior, George Perec, Jacquet Jouet. The last members to join the group are Ian Monk, Anne Garetta and Oliver Salon (Consenstein, 2002).

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characters, stories, situations, emotions; but is words, letters, that is, the formal elements of writing" (Ekici, 2016, p. 49). The products created by the restrictions that must be complied with sometimes make the expression strange and alien; It enables the production of unique and hybrid texts in which absurdity and funny can be felt.

Techniques produced in the workshop environment, defined as a research laboratory of OuLiPo, are collective works applied as short exercises. These techniques are method recommendations for experiments in which the results are unknown. When a constraint is set, it opens another way to a new one. The interconnected structures of the techniques provide a fertile potential which is endless and constantly triggers each other.

Oulipians, as both technically and literary, associate the memory with their production, as part of their theoretical approach (Consenstein, 2002, p. 45). In this sense, for OuLiPo techniques, Queneau talks about a dual production method which looks both backward and forward (Viers, 2008, p. 34). Le Lionnais emphasizes the importance of memory and of survival for Oulipo and expresses the concepts of "anoulipism devoted to the exploration and synthoulipism devoted to the invention" (Motte, 1998, p. 2). One is analyzing the experiments from past structures; the other is to develop methods that have not yet tried before with an approach of synthesizing the facilities of these methods and turns them anew. Similarly, George Perec defines his production as experimental and quotational, a jigsaw kind of literature (Perec, 2003, p. 68-72).

While Oulipians develop their constraints from the idea of literature can be made in any way and can be fed from any field, they research a way for transfer the technology especially between mathematics and literature. The text named *Cent Mille Milliards de Poemes (One Hundred Thousand Billion Sonnets)* written by Raymond Queneau in 1961, triggered the establishment of OuLiPo as one of the pioneering works that gave the first idea of how the relationship between mathematics and literature can be established (Mathews & Brotchie, 1998, p. 14). Queneau writes a text consisting of 14 sonnets in total, each of which has 10 strings, and cuts each string of this work, which he interferes like an object, to form horizontal strips. Thus, each string of each sonnet can turn as pages that can be translated separately and can interact with each other (see: Figure 1,2). Eventually, a combinatorial work arises in which each reader can create his own poem (Motte, 1998, p. 4).

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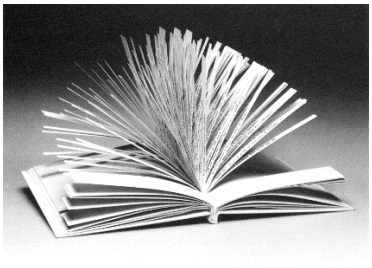

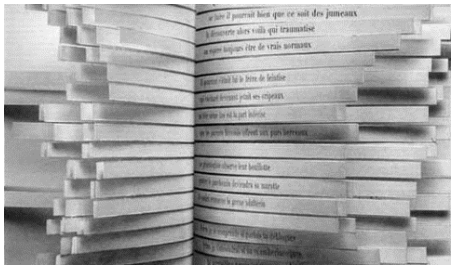

Figure 1. Image from the book *(Queneau / One Hundred Thousand Billion Sonnets, 1961).*

Figure 2. Image from the book *(Queneau / One Hundred Thousand Billion Sonnets, 1961).*

In addition to short experimental texts where techniques are tried, Oulipian novels are also produced. Perhaps the one which is the most known of these is George Perec's novel named *La Disparition (A Void)*, written in 1969. In this novel, Perec applies the Lipogram[4] technique and writes the text without using the letter "e" which is the most used in French. It is especially remarkable that critics did not realize that the text was written under this constraint at the time of its first publication.

As the constraint behind the writing action opens up to the reader like a riddle, a bilateral game occurs. This playful situation is transparent in some works and hidden in some and expects to be discovered by the reader. This returns the reader's passiveness to an active position and in a sense, provides encouragement for rewriting what is read. [5]

OUXPO

Le Lionnais introduces an Ou-X-Po model in OuLiPo's manifesto, by describing all kinds of creative activities, which are reproducible infinitely, with the expression "x" (Mathews & Brotchie, 1998, p. 320). The idea that a potential workshop may have a counterpart in any discipline that comes to mind, relates to creativity, makes it possible to turn OuLiPo by itself into other disciplines. In this way, OuLiPo keeps up to date while spreading to other areas, it also opens the way to intersemiotic adaptations of its techniques. Some of these workshops are very productive, some remained only by the proposal as an Oulipian game. [6]

All OuXPo workshops, just like OuLiPo, act as experimental laboratories that try to explore new techniques, far from the intention of producing a work of art. The first example of Oulipian techniques begins with OuPeinPo *(Workshop for Potential Paint)* (1980), especially with trials in a visual environment. OuLiPo's previous structures, techniques akin to taking old texts and transforming them with several interventions can also be witnessed in OuPeinPo. With mechanical interventions such as cutting to existing images, replacing the position of the parts, changing ratios, the meaning of the image is also transformed besides its shape (see: Figure 3). With these morphological games, new possibilities are tried to be discovered.

[4] Lipogram: It is a writing technique in which the use of a selected letter is restricted (Mathews & Brotchie, 1998).

[5] Barthes's text, *The Writer's Death*, supports this consideration between the author and the reader (Barthes, 1989).

[6] *OuLipoPo (Potential Detective Literature) (1973), OuPeinPo (Potential Painting Workshop) (1980), OuMuPo (Potential Music Workshop) (1980), OuBaPo (Potential Comic Book Workshop) (1992), OuCuiPo (Potential Cookery Workshop) (1990), OuHistPo (Potential History Workshop) (1993), OuMathPo (Potential Mathematics Workshop), OuPhoPo (Potential Photography Workshop) (1995), OuTraPo (Potential Tragicomedia Workshop) (1990), OuArchPo (Potential Architecture Workshop) (2001), OuPolPo, (Potential Politics Workshop) (2001), OuGraPo (Potential Graphic Design Workshop) (2001), OuGraPo (Potential Grammar Workshop) (2002), OuBrekPo (Potential Breakfast Workshop) (2015) (Elkin & Esposito, 2013)., OuLciPo (Potential Literary Criticism Workshop), OuCarPo (Potential Cartography Workshop), OuGeoPo (Potential Geography Workshop), OuOuPo (Potential Metaoulipo Workshop), OuTypPo (Potential Typography Workshop), OuLitramuPo (Potential Traditional Music Literature Workshop), OuJaPo (Potential Gardening Workshop), OuPoliPo (Potential Polish Literature Workshop), OuWiPo (Potential Wikipedia Workshop), OuMyPo (Potential MySpace Workshop.) (Becker, 2012).*

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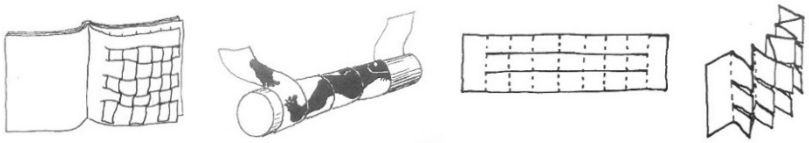

Figure 3. Studies on the manipulation of the paper surface. *(Mathews & Brotchie, / OuLiPo Compendium, 1998).*

The natural relationship between music and mathematics creates significant potential for another OuXPo initiative, OuMuPo (1980) *(Workshop for Potential Music)*. The fact that the notes, which are the composing tool of music, corresponding with the sound is in parallel with the letters also essentially correspond with the sound. Therefore, both language and music are structures that emerge through sound and made sense of those who perceive it. Concordantly, in Oulipo's translation to OuMuPo, some of the OuLiPo's constraints are tried on musical studies (Mathews & Brotchie, 1998, p. 329). One of these works is the solo piano work that Christopher Hobbs adapted the lipogram technique on notes instead of letters.

OuBaPo (1992*) (Workshop for Potential Comics)*, which associates comics with OuLiPo techniques, is one of the considerably productive workshops. It is also meaningful that this group was founded after OuPeinPo, since OuBaPo studies created a kind of narrative that combines textuality and visuality. The works of OuLiPo and OuPeinPo together become a resource for OuBaPo. Becker likens OuBaPo to "OuPeinPo's young and cool cousin" (Becker, 2012, p. 268). Many OuLiPo techniques have an easily adaptable potential for narrative strings in comic books (see: Figure 4,5). One of the significant examples is Gilles Ciment's work (see: Figure 6) that Herge redraw a 62-page *Tintin* adventure in 1997 using 6 non-speaking frames (Becker, 2012, p. 269). The re-framing technique becomes a translation for the comic book for converting to Haiku[7], which is one of the techniques that Oulipians use.

[7] The process of turning a poem into Haiku, a Japanese poem consisting of divided 17 syllables as to be 5-7-5. It was used as an abbreviation method by Oulipians (Mathews & Brotchie, 1998, p. 153).

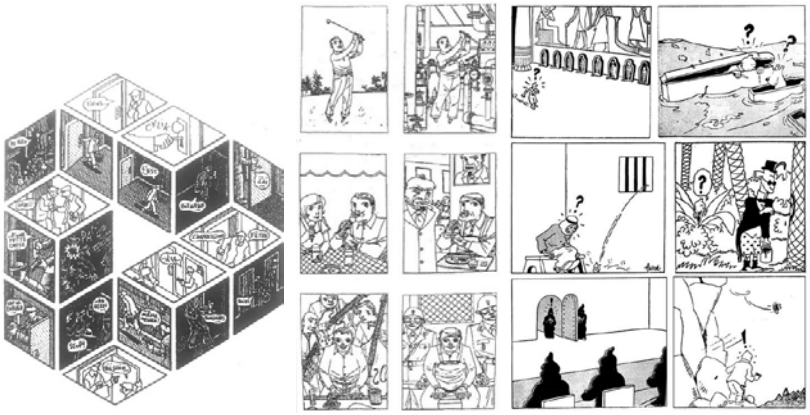

Figure 4. An example of a narrative type created in accordance with the multiple reading method. The novel allows to be read in 3 different ways (*Mathews & Brotchie, / OuLiPo Compendium / 1998).*

Figure 5. An example of a narrative type, in which a particular visual repeats, but the content changes (*Mathews & Brotchie, /OuLiPo Compendium, 1998).*

Figure 6. Gilles *Ciment's Cigares du pharaon* (*Mathews & Brotchie / OuLiPo Compendium, 1998).*

Considering Oulipo's counterpart in the architectural medium, it can be mentioned that the space, like literature, allows

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interdisciplinary transitions, as well as it establishes an intense relationship with mathematical structures. In addition to the fact that mathematics naturally affects architecture, it is necessary to mention the normality of the restrictive structure in the content of the space design process. Having introduced OuLiPo's relationship with architecture, Read has suggested that all architecture has as much potential as literature and stated that every project has its potential reading (Read, 1998, p. 192). According to him, in architecture, a constraint is continuous, but this limitation is what makes architecture meaningful (Read, 1998, p. 194). In addition, Read underlines that OuLiPo's tendency to use traditional structures is also valid for architecture (Read, 1998, p. 192). The structure of OuLiPo focuses on the craft of writing, for which the purpose is to search for potentials contrary to producing finished works, corresponds to exercises to increase imagination for architecture. In this context, Read produced a translation of *Queneleyev's Table*[8], (see: Figure 7) intended to architectural disciplines which expresses application logic of the techniques in OuLiPo (Read, 1998, p. 193).

Constraint by: / *Constraint of:*	Number	Dimension	Form	Nature
Material	Design with given amounts of given materials (e.g. design a shelter with a single 4x8 sheet of plywood) Join two materials	Tiling Patterns: Cut a pattern with no waste that will recombine in various ways Design with repetitive units of a single material	Standardized building components Erector Set Constructions Kit of Parts	Design with one material (eg. wood construction) Constructional Expressionism Handwork practice (Bauhaus Craft Studios)
Detail or Element	Using given elements in composition: Collage/Bricolage Design one detail within a given composition	Redundant elements Repeating Rhythms Overlay of rhythms	Classical Ornament: Codified ornamental palatte Substitution of materials in an element of fixed dimension. (Transformation of textile weaving into masonry patterns - Semper) (Origins of classical details in wood building technique)	Single intention in Detailing (eg. Modern details to make clean lines) Functionalist Design
Composition	Limit to one compositional device (Bauhaus 2-D and 3-D exercises) Adapting a spatial structure (eg. variations on the grid, FLLW)	Classical Proportions Design within dimensional limits (railroad sleeping compartment)	Classical Propriety: Formal rules for building according to social role. Building Typology: Rowhouse, Ranch House, bungalow	Demonstration houses: building as idea Design to address a specific phenomenon (Design a natural light fixture) (James Turrell)
Situation	Locate a given object in a given context. (Using mass produced elements in an old city) Place a brick on the ground (Gregotti)	Minimum intervention to change composition of city Design of Infrastructure. (Put a highway (of given dimensions) into a city	Design from outside in: Building as detail of city. (Gregotti) Urban Design Guidelines	Extension of project into city. Design to address an urban quality (e.g. juxtaposition of scales of movement: highways in the city)

Figure 7. Adaptation of the *Queneleyev's Table* produced with regarding restriction techniques in architectural disciplines (Read, 1998).

[8] *Queneleyev's Table* was produced by Raymond Queneau to explain the application of Oulipo techniques, with the relationship that formal items on the vertical axis have with semantic elements on the horizontal axis. The name of the table was made up by combining the names of Queneau, and Dimitriy Mendeleyev, who is the creator of the Periodic Table in Chemistry. This table has been reproduced by many other OuXPo members for their own disciplines (Mathews & Brotchie, 1998).

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Although it seems that Group OuArcPo *(Workshop for Potential Architecture)* was founded in 2001 (Elkin & Esposito, 2013), this group did not present any activity. Independently, Levent Şentürk founded the PoMi[9] workshop with its Turkish name in 2002. The activities of this group, which has been continuing since 2002, take place with a dynamic student group at the *Faculty of Architecture of Eskişehir Osmangazi University*. Among the experimental works performed, the adaptations of some Oulipian techniques for the spatial environment can be seen, and some principal Oulipian works are effective on the productions of the group (see: Figure 8). In this sense, it can be said that the craft factor, which can be observed in the definition of OuLiPo and the works it produces, is emphasized especially also in the architectural adaptations of PoMi.

[9] Pomi's *(Potential Architecture Workshop)* activities, continuing with many architecture students since 2002, have been published as a book in 2012 *(Şentürk / POMİ: Potansiyel Mimarlık İşliği: Bir Tasarım Stüdyosunun On Yılı (2002-2012), 2012).*

Figure 8. One of the structural experiments in PoMi, inspired by Oulipo techniques, where certain themes are expressed with a limited number of wooden bars *(Şentürk, 2016).*

EXERCISES IN STYLE

Exercises in Style (*Exercices de Style)* is a cult book written by Raymond Queneau in 1947 before OuLiPo was founded, which could be called OuLiPo's prototype. The text, unlike a classic narrative that begins and continues linearly, consists of 99 different repetitions of a same simple story.

The aim of Queneau to write this experimental text is to query the possibilities, limits, and potential of his language, French. He makes 99 separate translations in a sense with the claim that how different a story can be repeated, and each translation is a language exercise in which a different style is tired.

The rather ordinary and insignificant template story[10] in the text makes no sense when it is read apart. Entirety created by all variations together shows the purpose of the work. Each variation supplements each other. Queneau's use of such a story is a conscious decision. The neutrality of the story turns the whole of the text into a catalog in a way, creating an encyclopedic effect, even bringing it closer to a grammar book. Şentürk interprets *Exercises in Style* as "a kind of domestic flight route map or a *Burda* sewing pattern" (Şentürk, 2004, p. 393).

This experimental text then becomes an early source for the lab in which OuLiPo's experiments are executed. The insignificancy of the content gives the feeling that another template may be possible to remove and replace the story in the text and, in a sense, opens the way for its adaptations. Each variation has a

[10] In the story mentioned in the text; a tall and capped young man a young, long necked and capped man takes a bus in Paris. The young quarrels with one of the passengers as he disturbs him each time a new person gets on the bus, and then he sits in a vacant place. Two hours after than this event, the same young person is seen again in front of the Gare Saint-Lazare. He talks to a friend next to him about the button of his coat.

title. This indicates the theme, style, and hence the constraint under which it is written. Most titles in the text are the first examples of Oulipian techniques.

The number 99 can be seen as a symbol that makes association with mathematics and indicates exaggeration. On the other hand, this indicates even the variation can continue forever, the text may end only on a stoppable point. Queneau explains his decision by commenting "neither too little nor too much" (Queneau, [1958] 1998, p. 4). Also Umberto Eco, comments, "If the text consisted of only 10 exercises instead of 99, it would be less fun, or similarly if it consisted of 99,000 instead of 99, although maybe a little more tiring, it would have been even more fun " (Eco, 2013, p. 12).

The title of the entire *Exercises in Style* gives important clues about the text. Goto points out that the word "exercise" gives reference to three different areas, the concepts of school, music, and mind (as cited in Akdağ, 2011, p. 4).

Apart from the relationship between practice and repetition with translation, another concept that they refer to is education. Repetition is one of the ways to learn. In mathematics, grammar, music, plastic arts, sports; hence, in many disciplines and in every field that requires skill, repetition is applied with the desire to get experience and reach perfection. The relationship of *Exercises in Style* with music evokes the pleasure emerging with repetition. Recurring forms in music are an important starting point for this work.

THE TRANSLATIONS OF EXERCISES IN STYLE

It is known that, when writing *Exercises in Style*, Queneau got inspired by a concert in which Bach's *Fugue Art* played in the 1930s. The repeating as if going to eternity, forms of the music influenced Queneau and encouraged him to explore if he can create a similar work in the field of literature (Mathews & Brotchie, 1998). In this regard, both before and after, *Exercises in Style* can be read as a *palimpsest*, based on the relationship it established with productions in literary and other fields. It can be said that the work has embodied by being published, but in a sense, the writing process has never ended, and continued as an open work.

The translation of a text that is multiplying the layers of a classic text and moreover basing its writing on formal limitations, requires taking the challenges of OuLiPo games in the same way. This equates translation with rewriting. Le Tellier emphasizes that each OuLiPo translation is also an Oulipian practice by particularly rejecting the hierarchy between the original and the translation (Viers, 2008, p. 37). Mathews also points out that for translators of OuLiPo texts, the translation from one language to

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another is also a kind of writing constraint separately from the constraints of the original text (Symes, 1999, p. 99).

As an experiment that inquires the possibilities of the original language, *Exercises in Style* pushes the limits of French. Therefore, the relation of the text with the structure of French is in a tightness that is difficult to loosen up. This, in a sense, makes it almost impossible to translate the text into another language. Despite all the difficulties, the translation of the text was actualized in a total of thirty-seven different languages under the influence of a provocation. Every translation reveals the desire to test the limits and possibilities of the translated languages through this exercise, beyond the conveying of the story repeated in the text to another language.

The first inter-language translation of the text was made into English in 1958 by Barbara Wright. In the preface to the 1998 edition of his translation, Wright states her first opinion to the idea of translating the text, which is, "as untranslatable as the smell of garlic in the Paris metro." Over time, her opinion changes, and begins to think that "the language in which the work is written is unimportant, just as the story in it." (Queneau, [1958] 1998, p. 16). Later on, when translating the work, Wright did not want to take all the responsibility by herself, for the translation of an exercise that she had difficulty. She states that she consulted Queneau, but when Queneau says that he would not able to give her advice on this, she realized the meaninglessness of her expectation (Queneau, [1958] 1998, p. 16).

Umberto Eco, who translated the text into Italian in 1983, also emphasizes at first that it seems impossible to translate Queneau's exercises literally. According to him, "to transform completely these jargons, forms of speech and situations that contain a social context and time specific to France and Paris, is a so-called attempt. None of the intertextual and historical relations can be completely isolated from the soul of the French language, in which they are written" (Eco, 2013, p. 14). On the other hand, Eco states that, while translating *Exercises in Style* into their own language, both he and Wright were reproducing the text in another social, historical and intertextual context. Because, according to Eco, these are not the main issues revealed by the text (Eco, 2013, p. 14).

The first attempt to translate *Exercises in Style* into Turkish was realized by Ferit Edgü. As he stated in the preface of the book *Yazmak Eylemi (The Act of Writing)* published in 1980, that he started to translate *Exercises in Style* in order to make wording practices in his own language; however, he predicted that his effort would fail as the translation progresses (Edgü, 2015, p. 7). Edgü also predicted the possible losses for the translation of this

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text, which is based entirely on puzzles and word games. By stating that he preferred to try such research within the possibilities of Turkish, he left his initial translation halfway (Bozdemir, 2018). In this way, Edgü produced a different story than Queneau wrote and repeated it with 101 variations.

In 2003, Armağan Ekici produced the Turkish translation of the text under the name of *Biçem Alıştırmaları*. Beyond making *Exercises in Style* accessible in Turkish, this translation is also a pioneering text for trying Oulipian writing techniques in Turkish. By his experience from this translation process, Ekici states that "the obligation to comply with a certain formal limitation is a liberating power that removes all other limitations and breaking the deepest and strongest restrictions that the author put, in order to write with his own voice" (Ekici, 2016, p. 46).

In addition to the translations of the text into other languages, there are also many other translations with different adaptations where fidelity is reduced. Similarly, to Edgü's book, where he variated his own story, Gökdemir İhsan made 33 variations in different types in 2010 (İhsan, 2017). While the main content of the story remains constant in this text titled *Kurmaca Alıştırmaları (Exercises in Fiction)*, the types of fiction vary. In 2013, Bethany M. Brownholtz reproduced *Exercises in Style* in a temporal context (Brownholtz, 2013). In this translation, with 40 new variations in which the 21st-century narrative forms and techniques are used, the variations written in 1948 are adapted to the language of today with a kind of parody (see: Figure 9).

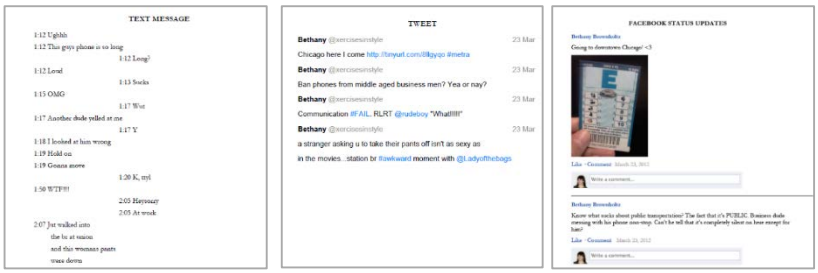

Figure 9. Variations titled *Text Message, Tweet* and *Facebook Status Updates* from the study *(Brownholtz, 2013).*

The first adaptation, in which the work is transferred to the outside of the textual medium, takes place with an audiobook published by French actor Yves Robert in 1954. With this work, how the text continues its impact when it is voiced, and the unique style variations of the audio performance have been tried (see: Figure 10). Based on this translation, similar adaptations were also made for the theater (see: Figure 11). OuLiPo's unique playful and absurd items are transferred to various plays named *Exercises in Style*. The effects of the constraints in the stage on the creativity of the actors and the play are experienced.

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Figure 10. Examples from the record covers of Yves Robert's *Exercices de Style* audiobook *(URL1).*

Figure 11. Example of poster of the theater plays *(URL2).*

Visual/formal areas are the most common in the adaptations of *Exercises in Style* to mediums outside the literary field. Book covers (see: Figure 12), which express summarized visual translations of texts, provide clues for intersemiotic translations produced in this context.

Figure 12. Examples of French, English and Turkish book covers *(Queneau / Exercices de Style, 1947), (Queneau / Exercises in Style, 1958), (Queneau / Exercises in Style, [1958] 1998), (Queneau / Biçem Alıştırmaları, [2003] 2010).*

Visual variations were added to the new editions of *Exercises in Style* over time. One of them is the illustrations made by the OuPeinPo member Jacques Carelman, added to the 1963 edition (see: Figure 13). Another series of visual variations is a special production edition prepared by designer Robert Massin and illustrator Jacques Carelman together. In print, 99 variations are reinterpreted, with typographic characters designed by Massin. 45 variations that follow were accompanied by Carelman's illustrations. The series with drawings, photographs, collages and 3D narratives led up the visual translations that were produced later (see: Figure 14).

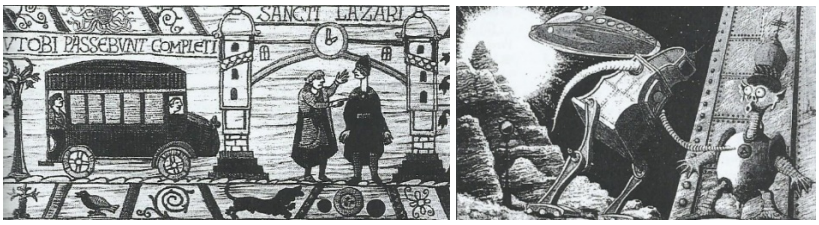

Figure 13. Jacques Carelman's illustrations from 1963 edition *(Mathews & Brotchie / Oulipo Compendium, 1998).*

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Figure 14. Examples of cover and pages from the book *(Queneau, Massin & Carelman / Exercises de Style, 1963).*

Architect and graphic designer Joost Swarte, one of the illustrators of *New Yorker* magazine, was involved in these visual translations with an illustration published in 2008 (see: Figure 15). Swarte, by drawing the story of Queneau in his language, replied with the 100th variation he added as a reader to 99 exercises (Moors Magazine, 2019).

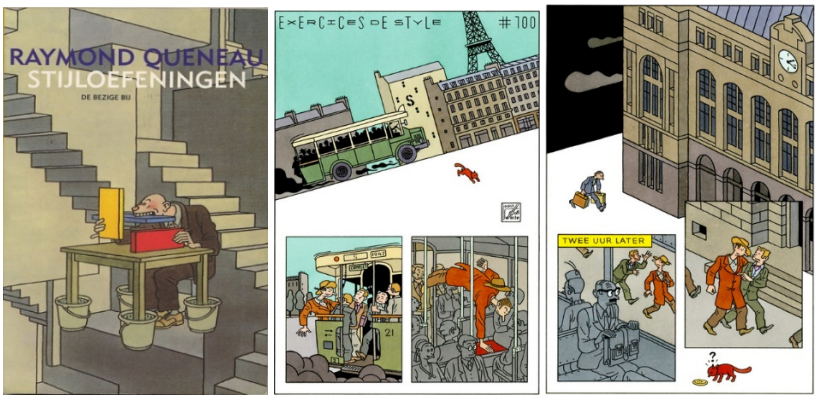

Figure 15. *Swarte / Raymond Queneau: Exercises de Stle # 100, 2008 (URL 3).*

Matt Madden, a member of OuBaPo, added a new one to the practices of *Exercises in Style* on the visual platform by changing the story. In the graphic novel *99 Ways To Tell a Story: Exercises in Style*, published in 2006, a simple one-page graphic story has been variated 99 times (Madden, 2006). Madden, with this work, investigates the ways of expressing with graphic novel medium and makes include in the game the stylistic features of this field, that differ in itself. In this sense, Madden also gives references to cult books and already known styles, using an Oulipian approach. Some of the variations consist of the titles of Queneau and some of the new constraints he produced for his medium (see: Figure 16).

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Figure 16. Variations titled *Template*, *Subjective* and *Long Shots (Madden / 99 Ways to Tell a Stoy: Exercises in Style, 2006).*

Similarly, Marcus Kraft published a 32-page newspaper in 2006. Also, this translation carried the story's expression into another medium where textual and visual expressions come together. Kraft interpreted Queneau's story like a piece of news in the newspaper and variated it with the opportunities of the newspaper (see: Figure 17). According to Kraft, the use of the newspaper is a remarkable medium in terms of showing how much news can be altered with different styles (Kraft, 2019).

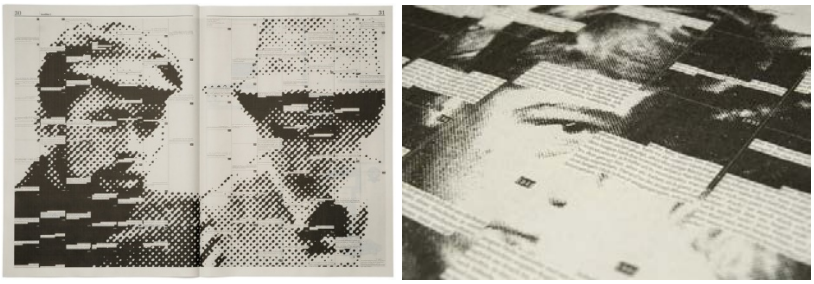

Figure 17. Examples of the newspaper sheets (*Kraft/ Stilubungen*, 2006) *(URL 4).*

Another series concerning the graphic expression of the text was made by Monica Bengoa in 2015. Bengoa visualized the text in French, sometimes directly using original book pages through interventions to them, and sometimes by reproducing them without changing their content (Bengoa, 2019). In this context, the series he separated into groups for 99 variations, include representations, in which she altered the form of papers where the variations are written, and used the photography technique (see: Figure 18). The productions that Bengoa uses especially sewing and embroidery, can be considered as a reference to the word *ouvroir* that the name OuLiPo includes.

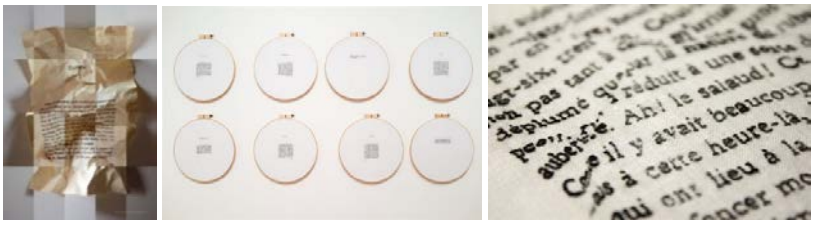

Figure 18. Variation representations created by the form given on the paper (*Monica Bengoa, Exercices de Style, 2015) (URL 5).*

In addition to the translations concerning the representation of *Exercises in Style*, examples in which the text is applied with new stories and new techniques increase over time. In 2014, Christina Videira Lopes, with her book *Exercises in Programming Style*, presented 33 programming methods defined by constraints (Lopes, 2014). In the text entitled *Exercises in criticism: The Theory and Practise of Literary Constraint* published in 2015, critic and poet Luis Bury suggests that the apolitical texts created by early Oulipian writers should be turned into a means of cultural criticism. Within this context, regarding the constraining-based literature, it offers again constraining-based criticism methods (Bury, 2015). Perhaps, the most current translation of *Exercises in Style* was applied in the field of mathematics by Philip Ording in 2019 (see: Figure 19). With his work, *99 Variations on a Proof*, Ording emphasizes the conceptual structure of mathematics and reveals research that questions the writing, reading, thus its form and stylistic features of mathematics (Ording, 2019). This study questions the relationship between mathematics and literature with an approach that can be performed from the reverse of OuLiPo.

Figure 19. Examples from cover and table of contents *(Ording / 99 Variations on a Proof, 2019).*

Translations of *Exercises in Style* include more than the examples presented here. This productive translation movement, which retains topicality, is similar to OuLiPo's enlarging network of OuXPo studies. Since its first publication, the work expands with its translations to languages other than French and all mediums other than the textual medium; constitutes a versatile dialogue. In other words, by creating an example of the Tower of Babel, it enables new experiments everywhere it reaches.

33 VARIATIONS FOR SPACE

In this study, 33 variations[11] are tried for the space object, similar to the text *Exercises in Style.* The source text of this study, which can be defined as a kind of intersemiotic or interdisciplinary translation, is not only the original French text written by Raymond Queneau in 1947, but also the English translation[12] made by Barbara Wright and especially the Turkish translation[13] made by Armağan Ekici. On the other hand, all the translations of the text in different disciplines, especially the

[11] In this study, 33 variations were made instead of 99, in order to create an easily perceptible number. 33 is one of the symbolic numbers used in many adaptations of the text.

[12] (Queneau, [1958] 1998).

[13] (Queneau, [2003] 2010).

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graphic novel variations of Matt Madden, have been included as equivalent sources for the emergence of this work.

In the study, a template story is created similar to the original text and all other translations of it. It was paid attention to the fact that the fiction of this story to be in an insignificant and simple perception, as in the textual and visual mediums of both Queneau and Madden. Therefore, to create an equivalent fiction, the content of the story in the text is associated with the functional content of the space.[14] The story in the text consists of two paragraphs and two particular actions are defined in two different contexts. Based on this, two different functions, namely working and resting, are defined in the template space produced. While making the variations of the space, although the organization and the form change for each iteration, the same attention has been given to the content that these functions are continued. The materials used for this fiction have also remained constant, but minor alterations and modifications are allowed in some exercises, depending on the constraint of the variation. The shell of the space is kept very neutral, and the moving elements in it are defined with the familiar and ready materials, based on the quotative approaches of OuLiPo. As in the original text, it is intended to produce variations that can be released even though the same content repeats every time. The first of the exercises, as in the original text, serves as a template for reference to others, with the ***Notation*** title (see: Figure 20).

[14] The final representations of the exercises were produced with different 2D and 3D CAD softwares that are frequently used in spatial production medium, as well as manual drawings.

Figure 20. Exercise 1- ***Notation***

While the variations were being produced, some titles were borrowed from Queneau (through their English and Turkish translations), and some from Madden. In his translation, the exercises in which Madden adapted the constraints to his visual medium, have been a guide, especially for this translation to produce its spatial constraints and its titles.

The titles of the exercises, as in the original text, include significant information on the variation, as well as the theme of the spatial representation. The titles of some exercises retain the same expression, as they were based on the exercises written in the original text, while others are defined with new proposed title, as they are produced purely for the spatial production.

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Exercise 2, titled ***Double Entry*** (see: Figure 21), derives its name directly from *Exercises in Style*; from the variation of second-person narrative, the fiction is interpreted through the user effect on space. Variations named ***One and a Half*** (see: Figure 21) and ***Too Many Tables*** (see: Figure 23) are also derived exercises from this title and exaggerated and humoristic. In the exercise named ***Classroom*** (see: Figure 24), a situation in which that the language of the space, its function and identity can be altered by changing the positions of the elements in the space is displayed.

Figure 21. Exercise 2- ***Double Entry***
Figure 1. Exercise 3- ***One and a Half***

Figure 23. Exercise 4- ***Too Many Tables***
Figure 2. Exercise 5- ***Classroom***

The exercise called ***Inventory*** (see: Figure 25) is an adaptation of one of the titles of Madden's translations. An inventory of structural elements and furnishings used in this space and its all variations has been revealed.

Figure 25. Exercise 6- ***Inventory***

While the ***Three Fourths*** (see: Figure 26) exercise replies to one of the expected functions in a semi-open area, in the exercise ***Independent*** (see: Figure 27), the two functions in the fiction are solved in two separate areas. These variations refer to the perceptual effect of structural interventions at the space.

Figure 26. Exercise 7- ***Three Fourths***
Figure 27. Exercise 8- ***Independent***

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In some of the exercises, it is aimed to point out different representation methods used for space design. While being created an example for the hand-drawn representations of the space with ***Hand Made*** (see: Figure 28) titled exercise, in the variation named ***Software (3Ds Max)*** (see: Figure 29), the representation of the computer program used in this process is made visible. The title of the variation named ***Hesitation (Sketch)*** (see: Figure 30) is taken from *Exercises in Style* and the hesitative thinking style is interpreted by associating with the sketching process of spatial production. In another exercise-related spatial representation, named ***Blueprint (Draft)*** (see: Figure 31), it is aimed to present one of the drawing types which gives information about the construction process of space.

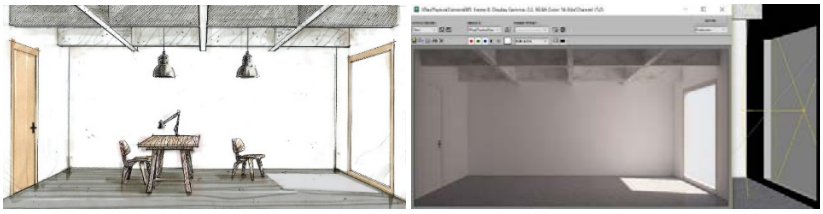

Figure 28. Exercise 9- ***Hand Made***
Figure 29. Exercise 10- ***Software (3Ds Max)***

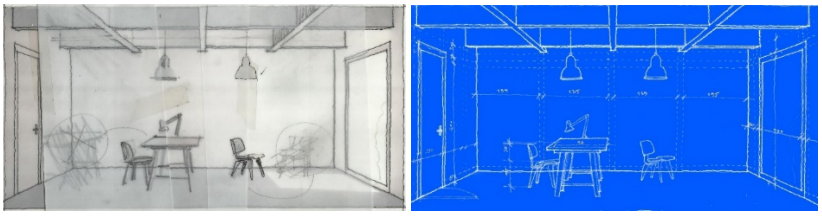

Figure 30. Exercise 11- ***Hesitation (Sketch)***
Figure 31. Exercise 12- ***Blueprint (Draft)***

In another group of exercises, has got inspired by *Lipogram* and other similar Oulipian techniques that restrict a selected element. In the variation named ***Single Wall*** (see: Figure 32), the functions are obliged to be solved on a single wall, whereas in the variation called ***Foldaway*** (see: Figure 33), a second constraint introduced as the single wall is additionally turned into a single surface. In the exercise called ***Single Mass*** (see: Figure 34), both functions are solved with gaps opened in a single mass independent of space. Similarly, the exercise named ***Single Surface*** (see: Figure 35) shows the variation in which functions are solved by a surface effect that continues instead of mass. In the exercise named ***Hanging*** (see: Figure 36), the use of the floor is restricted, and the necessary functions are solved with the elements hanging from the ceiling. In the exercise called ***Bottom*** (see: Figure 37), an opposite constraint method is tried and using the areas except the floor is constrained. With these exercises, it is aimed to discuss the alternative styles that can be varied with the design strategy of the space.

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Figure 32. Exercise 13- ***Single Wall***
Figure 33. Exercise 14- ***Foldaway***

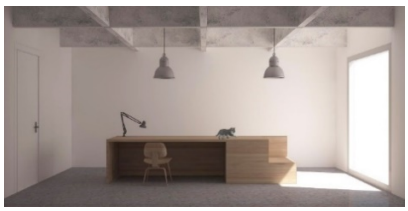
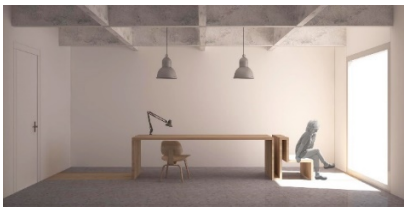

Figure 34. Exercise 15- ***Single Mass***
Figure 35. Exercise 16- ***Single Surface***

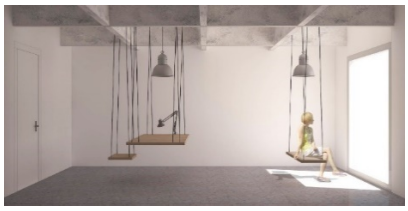


Figure 36. Exercise 17-***Hanging***
Figure 37. Exercise 18- ***Bottom***

In the variation named ***Transparent*** (see: Figure 38), the walls in the space are eliminated, and the effects of the context to the space and to its atmosphere are highlighted. In the next two exercises with similar approaches, different scales are revealed and the direct effects of the context are investigated. In the exercise named ***Zoom Out (x)*** (see: Figure 39), the space is presented as a single building independent of its surroundings, while in the exercise named ***Zoom Out (2x)*** (see: Figure 40), the space is located within a multistorey building. Both exercises, were inspired from the variations of Madden.

Figure 38. Exercise 19- ***Transparent***


Figure 39. Exercise 20- ***Zoom Out (x)***
Figure 40. Exercise 21- ***Zoom Out (2x)***

In the exercise named ***Window*** (see: Figure 41), an approach is fictionalized in which the existing spatial elements are manipulated by the window form. This exercise was inspired by the interfering techniques of OuLiPo and OuPeinPo. In the

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exercise titled ***Mezzanine*** (see: Figure 42), the function solutions are applied on only one surface and constrained with two different levels.

Figure 41. Exercise 22- ***Window***
Figure 42. Figure 42: Exercise 23- ***Mezzanine***

Ornate (see: Figure 43) is a title taken directly from *Exercises in Style*. This variation, in which Queneau made fun of exaggerated expressions of literature, is matched with similar approaches used in space representations. In addition, details referring to Raymond Queneau and *Exercises in Style* are used in the extra objects placed in the space. Similarly, in the exercise titled ***Young With a Long Neck and a Hat"*** (see: Figure 44), reference is made to the character in the original story with the visual figure used, it is also aimed to highlight human figures that make sense of spatial representations. In the exercise ***Cento (Hybrid)*** (see: Figure 45), the methods of representation using different techniques are brought together, inspired by the Oulipian *Cento*[15] technique. In the exercise called ***The Gare Saint-Lazare*** (see: Figure 46), it is aimed to refer to the spatial context mentioned in the story in *Exercises in Style*, and also to include similar assembly methods used in spatial representations to the story.

[15] Cento is an Oulipian poetry technique, also known as mosaic or patchwork, established with quotes from poems written in the past (Mathews & Brotchie, 1998, p. 120).

Figure 43. Exercise 24- ***Ornate***
Figure 44. Exercise 25- ***"Young with a long neck and a hat"***

Figure 45. Exercise 25- ***Cento (Hybrid)***
Figure 46. Exercise 27- ***"The Gare Saint-Lazare"***

In some exercises, it has been inspired by OuLiPo's techniques that interfere with the fixed fiction. In the variation titled ***Reverse Space*** (see: Figure 47), the solution of functions is provided by inverting the fixed spatial organization fiction of all the other exercises. In the variation named ***Reverse Material*** (see: Figure 48), material decisions fixed in other exercises are reversed. In another exercise that has been inspired by one of the

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variations of Madden, in addition to the material in the space, the color factor is included in the game and it is titled as ***Colour*** (see: Figure 49)***.***

Figure 47. Exercise 28- ***Reverse Space***
Figure 48. Exercise 48: Exercise 29- ***Reverse Material***

Figure 49. Exercise 30- ***Colour***

In the exercise named ***Grid*** (see: Figure 50), the aspects of Oulipian mathematical and formal methods, which are also valid in the design of the space, are tried to be emphasized. But in this variation, the grid which is a useful design tool is shown concretely in space with an opposite approach. It is aimed to create a playful sense that makes it impossible to use, with concrete grids used for carrying functional elements.

Figure 50. Exercise 31- ***Grid***

The exercise named ***Table Savoye*** (see: Figure 51) was inspired by some of OuLiPo's reducing techniques.[16] Le Corbusier's well-known building Villa Savoye has been readadapted by carrying its certain characteristic features according to the functional program used in the process. This reference is tried to be emphasized with the title of the exercise and the Corbusier figure in the representation.

[16] **See also**: *Haikutation, Io and the Wolf, End to end, Minimal Poetry, One-word poetry, One-letter poetry.* Ref: (Mathews & Brotchie, 1998).

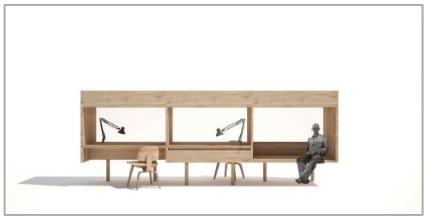

Figure 51. Exercise 32- ***Table Savoye***

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In the last exercise, an empty variation has been made that evokes the eternity as in *Exercises in Style* and many Oulipian works. With this variation called ***Tabula Rasa*** (see: Figure 52), it is aimed to emphasize the exhaustlessness of these translations and also to invite potential readers and translators to this game.

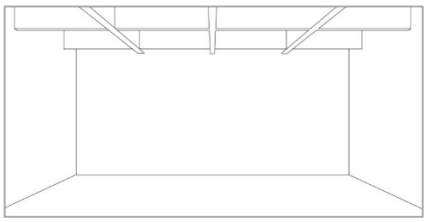

Figure 52. Exercise 33- ***Tabula Rasa***

CONCLUSION

In this study, it is desired to be included in the game started by the Oulipian text, *Exercises in Style*, through the representation methods of the disciplines which design space. In this process, the "space object" has also been redefined as a linguistic structure, interpreted in a translation medium as a writable/designable canvas, both with its objectivity and its various representations.

In these exercises, beyond the purpose of solving a communication problem, it is desired to push the limits of the target language through the translation process. In this context, it is also a conscious choice to establish a dialogue between a distant discipline and architecture, and translate an Oulipian source text, to question the possibilities of spatial expression.

In this translation, through which *Exercises in Style* is reproduced in another language, temporal context, and different discipline, the result also is naturally far from the fidelity sought in classical translation sense. Despite this variety, equivalent aspects have been found between linguistic and spatial expressions. The dynamic nature of the space object, which interacts with its designers, practitioners and potential users, has provided a linguistic medium suitable for a game in which a styling exercise is performed. On the other hand, since some of the variations made are produced in a different medium, it is required to adopt an appropriative method, while others, it is allowed to hybridize with preserving the strangeness of the original text. In these variations, the playful, absurd and strange sense seen in Oulipian texts is taken into consideration, and similar approaches especially are included.

In the variations in which the translation is close to the spatial medium, that space can impersonate different design approaches, are brought to the fore. In this context, in the space medium, besides the first variations that may come to mind, it was possible to present new design alternatives developed based

on the original text. Also, some Oulipian techniques that reference the past have been adapted to the spatial production environment through similarities. In addition, OuLiPo's inclusion of quotations as a collage was another attitude that could come to the fore in terms of its closeness to the representation of space production. On the other hand, different expression methods required at different stages in design processes made it possible to produce additional variations. Therefore, every variation subsequently evoked another variation and created a fertile process. In addition, how Oulipian restriction methods triggered another unimaginable idea while forbidding something, have been experienced through this translation process.

This query made through these exercises has enabled multi-layered readings, for the current and potential communicative possibilities of the spatial language, the transmission modes of spatial tendencies between times, the methods of expression of space medium, the restrictive factors in the design of the space, and the relationships that the spatial medium has established with other fields.

As a result of this experiment, a new translation was added next to many that keep the original text alive, as well as a sign of respect to *Exercises in Style*. However, this translation, of course, does not represent a completed product as in every translation. As in the attitudes of Oulipians and Ouxpians, the productions made in this study does not include any claim to be perfect result products, but it is aimed to point out the experience gained by the process. With the idea that the original text advocates, it is aimed to emphasize that these exercises can reach an infinite number and to obtain an open work that continues.

On the other hand, it is possible to produce many other alternative templates instead of the template space designed in this study. This fiction, made on the interior scale, may have other remarkable results at different scales. Instead of the sterile and imaginary fiction produced here, the variations to be made on a chosen tangible space may also be the subject of another exercise. Moreover, although the template space used here is represented on paper, given that space is a concrete place that is entered and experienced, the constraints and variations that may occur may be enriched and multiplied. This work created the first translation of the text in a spatial medium. However, this exercise aims to invite the potential trials of space-producing disciplines with OuLiPo constraints, just as *Exercises in Style* is a prototype of OuLiPo techniques.

Unlike searching for creativity with the expectation of spontaneous inspiration, Oulipian writers were able to discover endless potentials in situations where they came into existence by restricting their possibilities. Exercises in this area provide an

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experimental medium to improve creativity for space design in parallel with the purpose of OuLiPo. This translation experiment can be repeatedly edited for all kinds of educational activities, especially with its emphasis on exercise and repetition concepts, and creates an environment suitable for involving a large number of potential translators.

ACKNOWLEDGMENT

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URL5:http://monicabengoa.cl/en/obra/exercices-de-style-ejercicios-de-estilo-photography/

Resume

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Research Article

Privacy Cognition of Spaces by Agraph Tools in Temperate Humid Climatic Region of Iran

Parastoo Pourvahidi*

Abstract

Purpose
The aim of this research is to understand the spatial configuration between the spaces by using the space syntax method for close, semi-open and open spaces.

Design/ methodology/approcach
The method of this study is Agraph that is one of the tools of space syntax method. Agraph tool represent spatial relation between the spaces with graph and calculation included. During the research, all the space such as close, semi-open and open spaces analyzed with space syntax method.

Findings
The finding of this investigation demonstrated that although traditional houses have different topological issue, from different level of economy but the concern of organizing spaces under context and social hierarchy were same between all of them. Furthermore, inhabitants in different level of economy attempt to organize space by concerning privacy and public issue. Designing of traditional building in temperate humid climate is in a way to respond to the harsh climatic condition and to their cultural behavior.

Keywords: *AGRAPH tool, ıranian traditional building, space syntax, temperate-humid climate.*

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Research Limitations/Implications
Four different types of Iranian traditional buildings where are located in the temperate-humid climatic region of Iran analyzed for discovering the social relation of the spaces in Gilan province. These four different categories included of one bedroom to more than five bedroom buildings. Hence, this research just considered the analysis for the houses with less than five bedrooms.
Practical Implications
Applying Agraph tool for understanding privacy and public degree of spaces.
Social Implications
Applying Agraph tool on Iranian traduational architecture for estimating the degree of privacy in each spaces. Since in Iranian culture spaces organized based on the public and privacy factor.
Originality/Value
The original of this research is to finding the degrre of privacy in each building with different level of economy based on Agraph tool. However, the result was different from the previuse studies. The consequence of Agraph tool needs some modification for applying in architectural purposes.

INTRODUCTION

As Vursho illustrated that the place where inhabitant could sleep, eat, live named as the house but architect should understand the activity and accommodation of the inhabitant. From another point of view, arrangement of space represents a house that is demonstrated which type of spaces are grouped together for spatial activity or which one are separated for creating more privacy for the residents (Vursho & Yunnistyna, 2016).

Dawson (2003) demonstrated that throughout the structure of a house, public spaces are called for the spaces that are more accessible and private spaces are the one which have less accessibility. Hiller and Hansonin their method claimed that with the help of the justified graph, the plan layout, morphological characters can be revealed (Hanson, 1998). Therefore, the purpose of this research is to apply the Agraph tool for the dwelling where are located in temperate humid climatic region for understanding the relation of accessibility with the degree of public and privacy of the spaces by choosing different spaces as a starting point. Finding of this research demonstrated that drawing the graph could give various results for the degree of public and private of spaces. For instance, based on Agraph tools the outcome of calculation, is varied if graph drawn from the entrance as a starting point or another space such as close space (room) and open spaces.

CHARACTERISTIC OF TRADITIONAL BUILDING IN TEMPERATE-HUMID CLIMATE

Iran has five different climatic regions such as temperate humid (north part of Iran), hot-humid (south part of Iran) hot-dry and hot-dry with cold winter (central part of Iran) and cool climate

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(wester part of Iran) (Pourvahidi & Ozdeniz, 2013). According to this classification, this study evaluating the traditional houses where are located in north part of Iran (Gilan province). The name of the province where is located on north of Iran under the south part of Caspian Sea is Gilan. This area has a specific climate since it is positioned between Alborz Mountain and Caspian seas.

Life for the inhabitants in north part of Iran always signified the standards of simplicity and honesty of nature. In 2016 based on Rezaeirad investigation, there are two groups of architecture in this temperate humid climatic region of Iran. One type is the rural buildings which demonstrated the inhabitants need with minimum accommodations in nature and the other group is the modern building that constructed with the advance material such ceramic and composite (Rezaeirad, 1998).

According to Princ Diba research on several types of residential building, he claimed that traditional buildings in Iran have been made based on environmental issue. Since, in his evaluation he find out that architectural organization of spaces in these kinds of houses are divided into three categories such as closed spaces like rooms, semi-open spaces like Eyvan and open spaces like courtyard where are mostly located surrounding area of a house (Darab & Yaghini, 1998).

Yaran and Mehranfar (2013) in their research demonstrated that Gilan province has six architectural typologies. This kind of classification has the root into economic condition and living and social base of the inhabitants. Furthermore, they illustrated that there are some kind of building with maximum two stories. These kinds of houses, in relation to the number of floors that they have, consistent of one, two or three bedrooms and even some of the houses have five and six bedrooms (Yaran, 2013). In the related subject, Sajjadzadeh also mentioned that geography, life style and cultural issue have a direct effect to the relationship between building and the environment in Gilan province. For instance, by comparing Gilan's building with the buildings in the central part of Iran, the lack of boundaries between inside and outside is noticeable (Sajjadzadeh, 2016). Since the building in north (Gilan province) has no any boundary around the building for limiting the axes from outside. They have a short wall and most of the time they use trees for creating limitation. However in central part of Iran, long wall surround the building for creating privacy for the inhabitants. In addition to the relationship between the spaces reflect the activities of residents. This issue has a direct effect of environmental issue beside the cultural thoughts. Consequently, this research endeavor to understand the spatial organization which is

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subjective by environment and culture in Gilan's traditional buildings.

Furthermore, in this research four different kinds of traditional houses has been selected. These traditional houses are located in Gilan province where temperate-humid climate have. Selection of these cases studied is based on the number of rooms from one bedroom to five bedroom, and the reason was based on economic and typological issue.

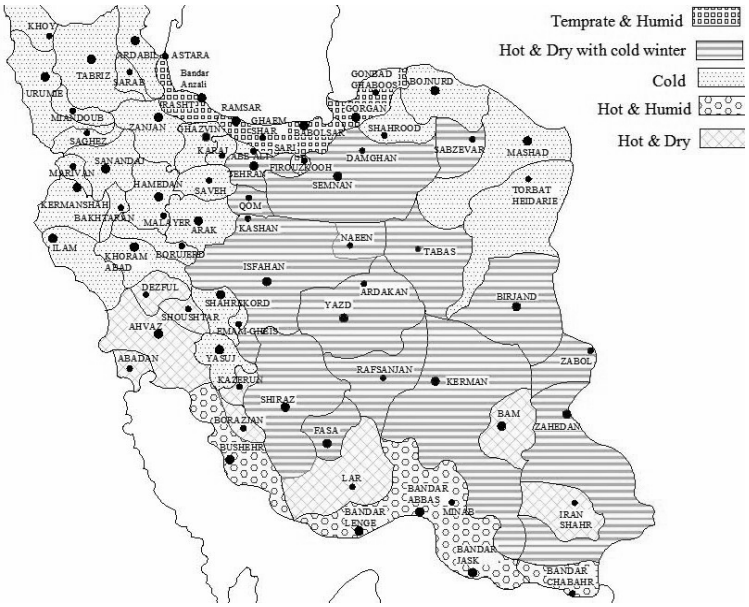

Figure 1. Iran has five different climatic regions (Pourvahidi & Ozdeniz, 2013).

Traditional building in temperate humid climatic region has a main semi-open space which is called Eyvan. Since of humid climatic condition the inhabitants prefer to spend their time in Eyvan during spring and summer where can wind blow through that space and create comfortable condition for the residents. Therefore, Eyvan has a main character for joining the spaces all together. Since mostly it is extended through the surface of a building. This extension of Eyvan in some of the traditional building is from one side, two sides, 3sides or all around the building. Subsequently, this paper divided the case study into four different categories according to the number of rooms and extended Eyvan (Table 1).

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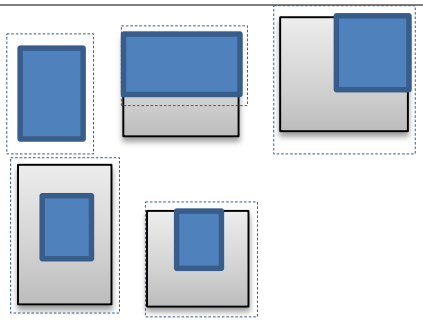
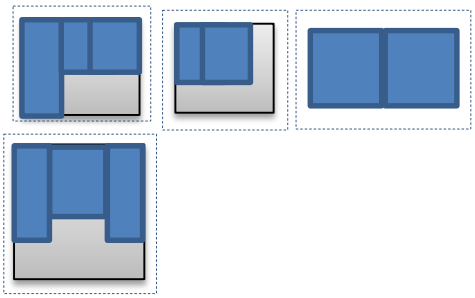
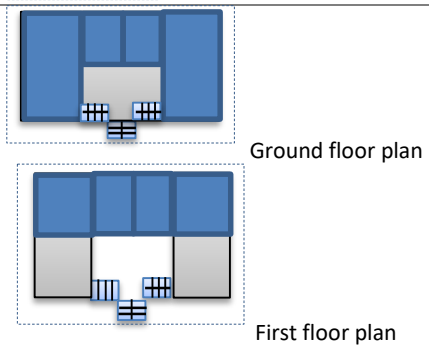
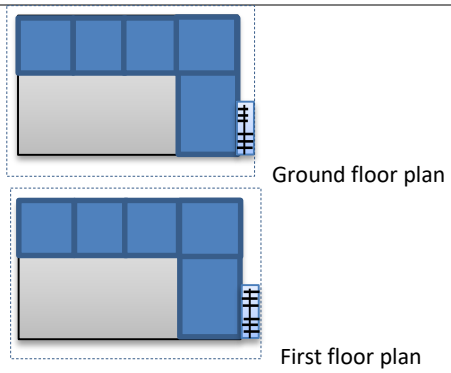
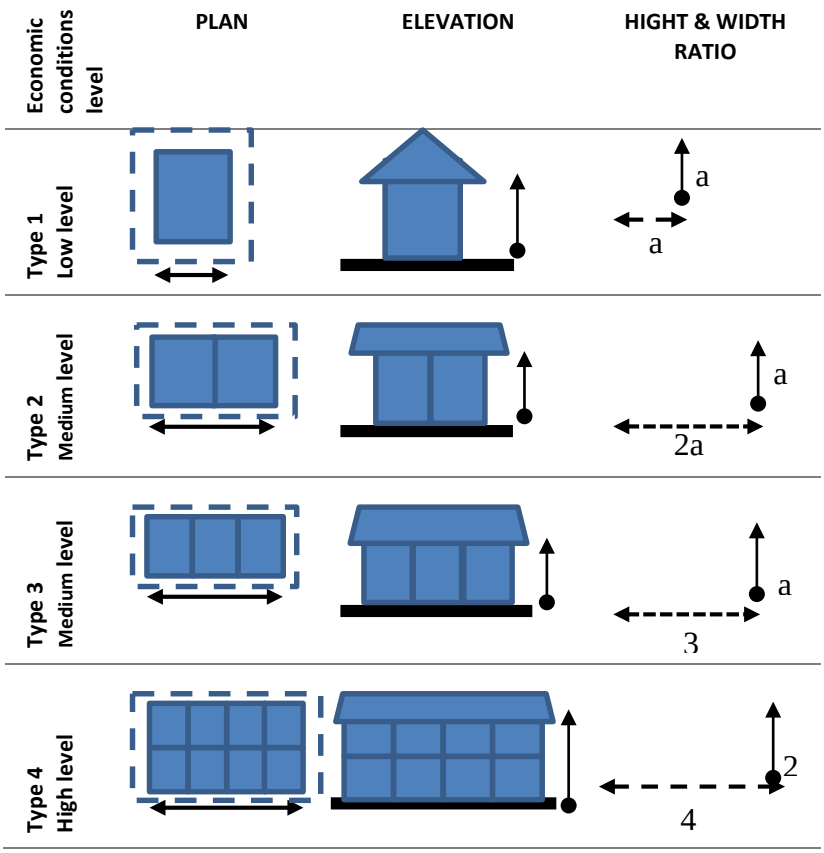
Table 1: Schematic topologies of traditional buildings plans where are located in the temperate-humid region of Iran

Type 1 (1 bedroom) Extended in surface	**without eyvan With eyvan in 1side With eyvan in 2 or 3 or 4 sides**	
Type 2 (2 or 3 bedrooms) Extended in surface	without eyvan With eyvan in 1side With eyvan in 2 or 3 or 4 sides	
Type 3 (3 or 4 bedrooms) Elevated in height	With eyvan in 1side With eyvan in 2 or 3 or 4 sides	
Type 4 (5 or more than 5 bedrooms) Extended in surface	without eyvan With eyvan in 1side With eyvan in 2 or 3 or 4 sides	

For better understanding the integration and segregation of the spaces in these kinds of traditional building, economy condition is the fact. Since the result of comparing one bed room building with five bedrooms is not accurate. Thus, this research classified them consistent with the level of economic in Table 2. The arrangement was based on the number of the rooms. Moreover, representing the proportion of width to height of these traditional building could be the answer of economic and climatic condition level of them as well. Since, the traditional

building which is elevated from the ground and extended from east to west and also has two to three floors has better economic and comfortable condition than others. For instance, first floor has better comfortable condition during winter time and also elevated building from ground cause less humidity. Furthermore extending building from east to west can create more windows toward south direction which has best lighting during winter and summer.

Table 2: Schematic classification of traditional buildings consistent with economic conditions.



By comprehending the fact that the climatic factor has effect on the formation of spaces in this climatic region. Afterwards, space syntax method which is one of the best method for revealing the accessibility relation between spaces assist the research to do the analyses with Agrap tool for detecting the social relation of the spaces for organizing the spaces in Gilan province.

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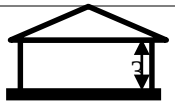
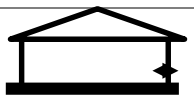
Table 3: Simulating the traditional building according to the climatic conditions

1	**Settlement Pattern**	**Diffused**	
2	Configuration of the Building	Extensive	 plan
3	Roof	Sloped	 front elevation
4	Balcony, Eyvan and Courtyard	Yes	 plan
6	Basement	No	 elevation
7	Elevation of Ground Floor Slab from Ground	Yes	 elevation
8	Extroverted and Introverted Buildings	Extroverted	 Plan
9	Height of the Ceiling	3m	 Elevation
10	Thickness of the Walls	Thin	 Elevation
11	Natural ventilation	High	 Elevation
12	Openings	High	 Elevation
13	Color of the faced	Free	
14	Material	Low thermal capacity	

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STUDY APPROACH AND METHODOLOGY

Some of the researchers such as cultural geographers and anthropologists like Amos Rapoport (Rapoport, 1968), Lawrence and Los (Lawrence, 1990) and Hiller and Hanson (Hiller, 1984), analyzed the built environment in the manner to notice the social, cultural and ideological features of traditional buildings and cities (Blanton, 1994; Martin, 2001; Trigger, 1989)

The analysis of the spatial organization of the built environment has been developed from the perspective of space syntax analysis which was conceived by Bill Hiller and Julienne Hanson (Hiller, 1984; Hillier, 1996; Hanson, 1998). (Space syntax analyses of the built environment theories and limitations of the space become probable to evaluate the social relationships characteristic in spaces as it is built through the built environment. Marcus (1993, p.13) mentioned that this perception is accepted that all space is formed and shaped by social relationships. This social relation constrains the character of spatial relations in the built environment hence it is fundamentally social (Hillier, 1984).

The significant theoretical idea of space syntax is that space has a social reason that is understandable. It could be assumed the two relationships that can define the logic of space syntax. These relations could be distinct between the inhabitants (private) and other people (public). This kind of impression is not distinctive to Hiller and Hanson's formulation of space syntax. For instance, Urry (1987) also illustrated that there is a significant disagreement between those who are local such as the people like us and those who are non-local such as the outsider. Therefore, this second opposition can be associated and reproduced in different kind of ways. The development of a strong set of analytical techniques and process in to methodologically association theory to the experimental record that is unique to space syntax. Thus, this study investigative on the space organization and social relation of them by using Space syntax method on the case studies included four different types of traditional Iranian building with different economic condition and different topological issue. The analysis followed by drawing justified access graph for each of the case studies by noticing the starting point.

Justified access graph is a kind of graph that represent the plan layout from the morphological characteristic of it. "The carrier" is a selected chosen space which from that space, depth value of all the spaces in one house could be calculated. Depth value of the space is numbered based on the location of the space on a graph. The numeric measurement established on spatial configuration of the graph could be achieved when the graph is formed. Furthermore, as Hanson mentioned the "busy" and "quite"

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characteristic of the spaced could be predictable by the integration and permeability (Hanson, 1998).

According to all these explanations about space syntax method, there are also different kind of software for analyzing spatial analysis such as DepthmapX, Omnivista, Qgis Space Syntax Toolkit (most used by urban planners), Confeego and Axman (most used by researchers) Agraph (to make axial-line analysis) (Manum, 2009). This research has chosen Agraph since it is the simple tool for understanding the spatial organization. Hence, this study used Agraph tool for the analysis of dwelling in Gilan Province. During the analysis, this research changes "the carrier" space (starting point) based on close, semi-open and open space for achieving the proper answer for public (busy) and privacy (quite) of the spaces.

DEFINITION OF AGRAPH TOOL

The parameters of total depth (TD), control value (CV), relative asymmetry (RA), mean depth (MD) and integrated value (RA) have been calculated with AGRAPH.

"Total depth: Total depth of a node n, TD(n) is the total of the shortest distances from node n to the other nodes in the systems, i.e.TD(n) is the total of line n (or column n) in the distance matrix.

CONTORL VALUE: the control values are found by letting each node give the total value of 1 equally distributed to its connected nodes. The control value of node n, CV (n) is the total value receive by node n during this operation.

Relative asymmetry: the relative asymmetry describes the integration of a node by a value between or equal to 0 and 1, where a low value describes high integration. RA is calculated by formula RA=2(MD-1)/ (k-2)4. The RA-value is defined to be 0 when a node is as integrated as possible. The most integrated position possible is the root of a pure "bush"-graph. As all distances from such a root are 1, the MD is 1. By this RA=0 when MD=1. The RA might therefore be of the form RA= a*(MD-1). Contrary, RA is defined to be 1 when a node is as segregated as possible. The most segregated positions possible are the end nodes in a pure linear sequence. For a linear sequence of k nodes the MD for the end nodes is half the number of nodes in the line, MD=k/2. By this: RA=1 when MD=k/2. This implies 1=a*(k/2-1) which gives a=2/(k-2). By this RA=2*(MD-1)/(k-2).

Mean Depth: mean depth for a node n is the average depth (or average shortest distance) from node n to all other nodes. If K is the total number of node in the system them MD (n) =TD (n)/ (k-1)

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Integration value: a parameter that contrary to RA describes integration by a high number when node is highly integrated is the integration value (i). The integration value is found by inverting the RA, i=1/RA5. This is the integration value of RA. Integration might be defined as the inverse of other asymmetry parameters than the RA. (Manum, Rusten, & Benze, GRAPH, Software for drawing and calculating space synatx Graphs).

Connecting spaces together have impact in what way integration is circulated throughout the structure. For instance, integration of spaces creates some areas in residential houses more accessible than others. The result of this organization consequences the interaction between residents and divides the spaces according to the activity that are located in it and not for the use of the public (Dawson, 2003). Hence, this research analyzed the traditional buildings with four different typological in Gilan provinces where has temperate-humid climate to understand the integration and segregation of the spaces.

AGRAPH TOOL ANALYSIS

Agraph tool is an application that can be used by computer easily. This method could be applicable for calculating space syntax. The plan of the building could be transferred to the drawing graph with Agraph application. Afterwards, Agraph calculated the parameter of space syntax from different kind of node(Manum, Rusten, & Benze, n.d.).In this program all the close, semi-open and open spaces revealed by bullet. The line between the bullets demonstrated the connection of the spaces. The number that is visible in the bullet demonstrated the starting point of drawing graph step by step through all the spaces. For instance if the courtyard has number zero in the bullet, it means that graph started from the courtyard and then move to other spaces. Furthermore, this research did the analysis by concerning the three different starting point. One of the table (Table 5) illustrated the starting point from the close spaces. In table 7, graph drawn from the semi-open spaces such as Eyvan. Afterwards, table 9 open demonstrated the spaces like courtyard is the beginning step of drawing graph. The reason of changing the starting point (the carrier) is that the first bullet and connectivity of that one with the other space could change the calculation in the number of TDn, MDn, RA, integration value and CV. According to Hanson's definition of space syntax, the spaces which have more connection have less privacy than the other spaces. Hence the number in calculation, which is given to each space can be changed depending on how graph could be drawn. In this paper all the connectivity spaces like stair case also considered in the calculation for better understating of the integration between the spaces. Table 4 verified the meaning of

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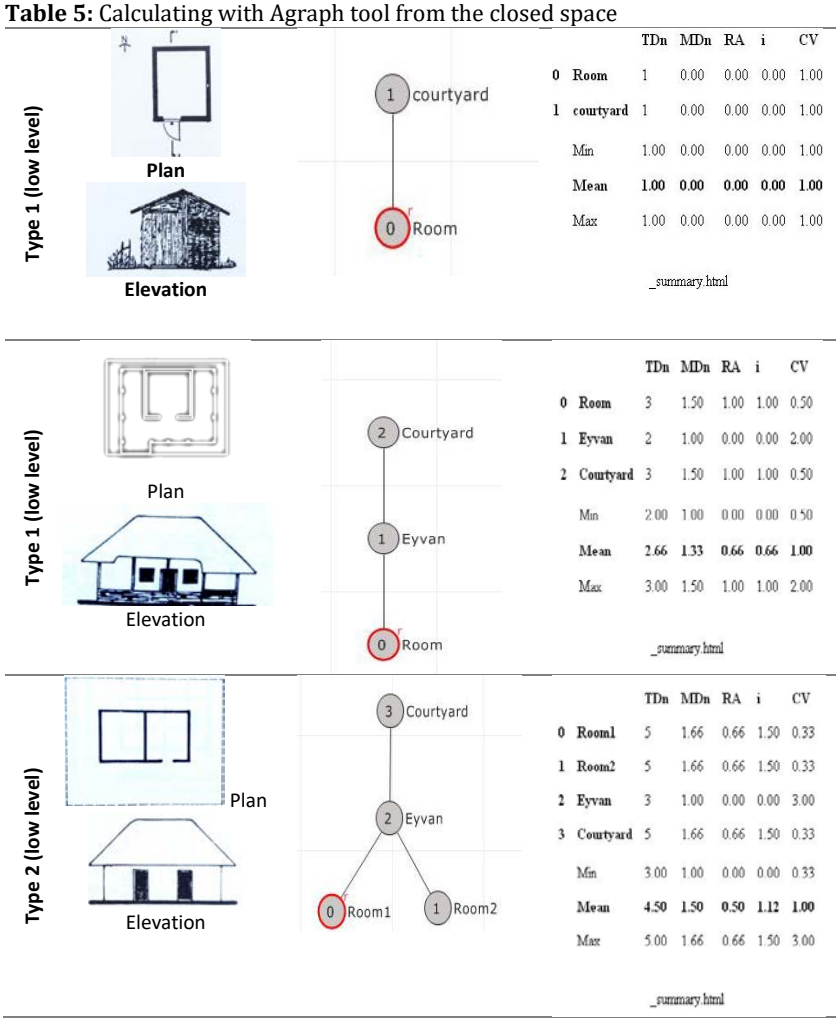
the numbers that have been observed in the calculation of Agraph method. For instance, the highest number of TD, MDn and RA signify more privacy of spaces and also less integration. However, the highest number of I and CV represent the less privacy.

Table4: Definition of number in calculation with Agraph tool

		Private space	Public space
Agraph tool		number	
TDn	Total depth	high	less
MDn	Mean Depth	high	less
RA	integration	high	less
i	i=1/RA	less	high
CV	Control value	less	high

By using Agraph tool in traditional buildings where are located in temperate-humid climate, the outcome demonstrated interesting variation depends on the starting point of the graph. For instance, in Table 5, closed spaces was the focal point of the Agraph analyses therefore, starting point was from one of the rooms.

Table 5: Calculating with Agraph tool from the closed space



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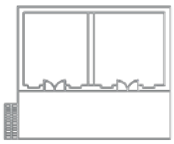
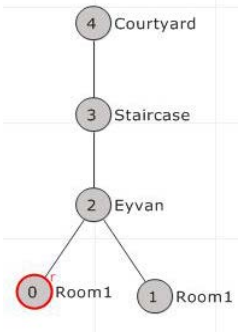
Type 2 (low level)



Plan

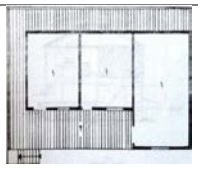
Elevation



		TDn	MDn	RA	i	CV
0	Room1	8	2.00	0.66	1.50	0.33
1	Room1	8	2.00	0.66	1.50	0.33
2	Eyvan	5	1.25	0.16	6.00	2.50
3	Staircase	6	1.50	0.33	3.00	1.33
4	Courtyard	9	2.25	0.83	1.20	0.50
	Min	5.00	1.25	0.16	1.20	0.33
	Mean	7.20	1.80	0.53	2.64	1.00
	Max	9.00	2.25	0.83	6.00	2.50

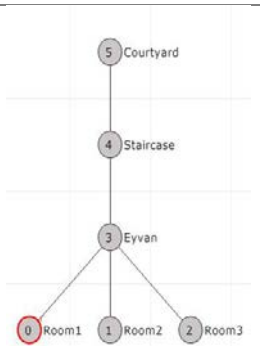
_summary.html

Type 3 (Medium level)



Plan

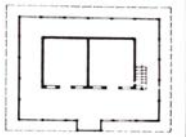
Elevation



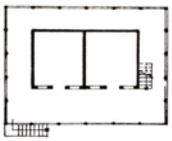
		TDn	MDn	RA	i	CV
0	Room1	10	2.00	0.50	2.00	0.25
1	Room2	10	2.00	0.50	2.00	0.25
2	Room3	10	2.00	0.50	2.00	0.25
3	Eyvan	6	1.20	0.10	10.00	3.50
4	Staircase	8	1.60	0.30	3.33	1.25
5	Courtyard	12	2.40	0.70	1.42	0.50
	Min	6.00	1.20	0.10	1.42	0.25
	Mean	9.33	1.86	0.43	3.46	1.00
	Max	12.00	2.40	0.70	10.00	3.50

_summary.html

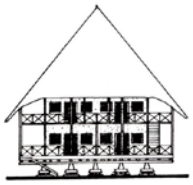
Type4 (High level)



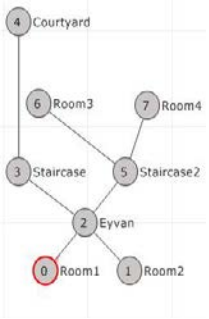
Ground floor plan



First floor plan



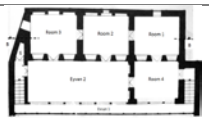
Elevation



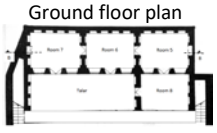
		TDn	MDn	RA	i	CV
0	Room1	16	2.28	0.42	2.33	0.25
1	Room2	16	2.28	0.42	2.33	0.25
2	Eyvan	10	1.42	0.14	7.00	2.83
3	Staircase	14	2.00	0.33	3.00	1.25
4	Courtyard	20	2.85	0.61	1.61	0.50
5	Staircase2	12	1.71	0.23	4.20	2.25
6	Room3	18	2.57	0.52	1.90	0.33
7	Room4	18	2.57	0.52	1.90	0.33
	Min	10.00	1.42	0.14	1.61	0.25
	Mean	15.50	2.21	0.40	3.03	1.00
	Max	20.00	2.85	0.61	7.00	2.83

_summary.html

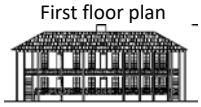
Type4 (High level)



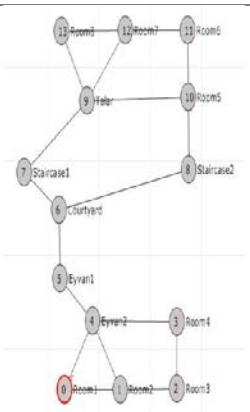
Ground floor plan



First floor plan



North elevation



		TDn	MDn	RA	i	CV
0	Room1	47	3.61	0.43	2.29	0.58
1	Room2	46	3.53	0.42	2.36	1.25
2	Room3	56	4.30	0.55	1.81	0.83
3	Room4	47	3.61	0.43	2.29	0.75
4	Eyvan2	37	2.84	0.30	3.25	1.83
5	Eyvan1	33	2.53	0.25	3.90	0.58
6	Courtyard	31	2.38	0.23	4.33	1.50
7	Staircase1	35	2.69	0.28	3.54	0.58
8	Staircase2	36	2.76	0.29	3.39	0.66
9	Talar	38	2.92	0.32	3.12	1.66
10	Room5	39	3.00	0.33	3.00	1.25
11	Room6	48	3.69	0.44	2.22	0.66
12	Room7	47	3.61	0.43	2.29	1.25
13	Room8	48	3.69	0.44	2.22	0.58
	Min	31.00	2.38	0.23	1.81	0.58
	Mean	42.00	3.23	0.37	2.86	1.00
	Max	56.00	4.30	0.55	4.33	1.83

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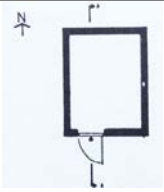
The result demonstrated that although the highest number of TDn, MDn and RA represent the more private space since they have less integration. However, the courtyard in all different kind of typology has the highest number. In the following the highest amount of integration and CV which represent the less privacy is belonging to room in the low economy houses. Also in the high economy condition, Eyvan has the highest integration value that represent more public spaces (Table 6).

Table 6: The result of Agraph tool from closed spaces

Economy level	Close spaces				
	The highest number represent:				
	TDn (private)	**MDn (private)**	**RA (private)**	**I (public)**	**CV (public)**
Type 1 low level	Room/ courtyard	-	-	-	-
Type 1 low level	Room/ courtyard	Room/ courtyard	Room/ courtyard	Room/ courtyard	Eyvan
Type 2 low level	Room/ courtyard	Room/ courtyard	Room/ courtyard	Room/ courtyard	Eyvan
Type 2 low level	courtyard	courtyard	courtyard	Eyvan	Eyvan
Type 3 medium level	courtyard	courtyard	courtyard	Eyvan	Eyvan
Type 4 high level	courtyard	courtyard	courtyard	Eyvan	Eyvan
Type 4 high level	Room3	Room3	Room3	courtyard	Room3/ Eyvan2

Table 7 exemplified the Agraph tool by changing the starting point from semi-open spaces such as Eyvan. In low economy condition of the building where has only one bedroom, the integration value of all the spaces is same. Furthermore, the degree of public and privacy of the room, entrance and Eyvan are represent the same result. In medium economic condition the number of TDn, MDn and RA signify that room has more privacy than the other spaces. Furthermore, entrance has highest degree of integration value. Consequently, Eyvan (semi-open space) is more public.

Table 7: Calculating with Agraph tool from semi-open space

Type 1 (low level)	 **Plan**	**There is NO semi-open space**	**There is NO semi-open space**
	 **Elevation**		

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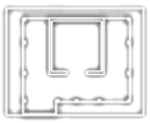
Type 1 (low level)

Plan



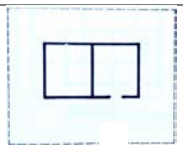
Elevation

		TDn	MDn	RA	i	CV
0	Eyvan	2	1.00	0.00	0.00	2.00
1	Room	3	1.50	1.00	1.00	0.50
2	Courtyard	3	1.50	1.00	1.00	0.50
	Min	2.00	1.00	0.00	0.00	0.50
	Mean	**2.66**	**1.33**	**0.66**	**0.66**	**1.00**
	Max	3.00	1.50	1.00	1.00	2.00

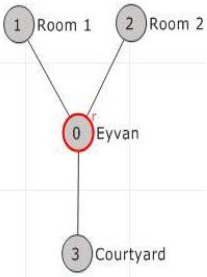
_summary.html

Type 2 (low level)

Plan



Elevation

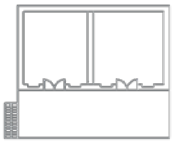


		TDn	MDn	RA	i	CV
0	Eyvan	3	1.00	0.00	0.00	3.00
1	Room 1	5	1.66	0.66	1.50	0.33
2	Room 2	5	1.66	0.66	1.50	0.33
3	Courtyard	5	1.66	0.66	1.50	0.33
	Min	3.00	1.00	0.00	0.00	0.33
	Mean	**4.50**	**1.50**	**0.50**	**1.12**	**1.00**
	Max	5.00	1.66	0.66	1.50	3.00

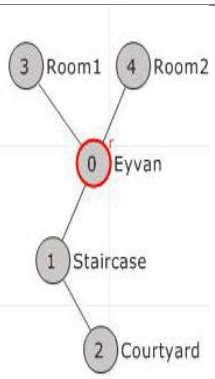
_summary.html

Type 2 (low level)

Plan



Elevation



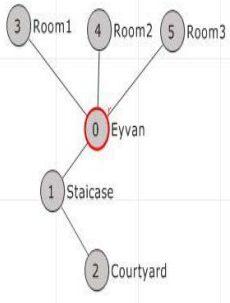
		TDn	MDn	RA	i	CV
0	Eyvan	5	1.25	0.16	6.00	2.50
1	Staircase	6	1.50	0.33	3.00	1.33
2	Courtyard	9	2.25	0.83	1.20	0.50
3	Room1	8	2.00	0.66	1.50	0.33
4	Room2	8	2.00	0.66	1.50	0.33
	Min	5.00	1.25	0.16	1.20	0.33
	Mean	**7.20**	**1.80**	**0.53**	**2.64**	**1.00**
	Max	9.00	2.25	0.83	6.00	2.50

_summary.html

Type 3 (Medium level)

Plan

Elevation



		TDn	MDn	RA	i	CV
0	Eyvan	6	1.20	0.10	10.00	3.50
1	Staicase	8	1.60	0.30	3.33	1.25
2	Courtyard	12	2.40	0.70	1.42	0.50
3	Room1	10	2.00	0.50	2.00	0.25
4	Room2	10	2.00	0.50	2.00	0.25
5	Room3	10	2.00	0.50	2.00	0.25
	Min	6.00	1.20	0.10	1.42	0.25
	Mean	**9.33**	**1.86**	**0.43**	**3.46**	**1.00**
	Max	12.00	2.40	0.70	10.00	3.50

_summary.html

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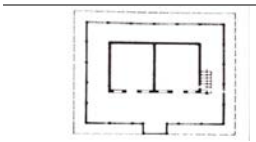
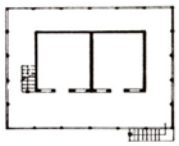
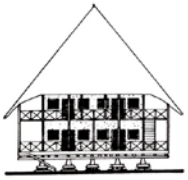


Ground floor plan

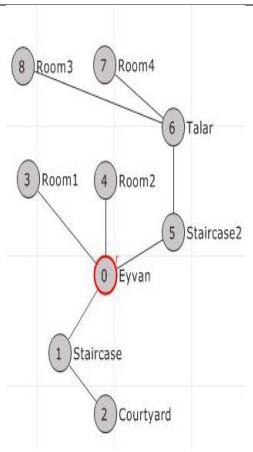


First floor plan



Elevation

Type4 (High level)



		TDn	MDn	RA	i	CV
0	Room1	16	2.28	0.42	2.33	0.25
1	Room2	16	2.28	0.42	2.33	0.25
2	Eyvan	10	1.42	0.14	7.00	2.83
3	Staircase	14	2.00	0.33	3.00	1.25
4	Courtyard	20	2.85	0.61	1.61	0.50
5	Staircase2	12	1.71	0.23	4.20	2.25
6	Room3	18	2.57	0.52	1.90	0.33
7	Room4	18	2.57	0.52	1.90	0.33
	Min	10.00	1.42	0.14	1.61	0.25
	Mean	15.50	2.21	0.40	3.03	1.00
	Max	20.00	2.85	0.61	7.00	2.83

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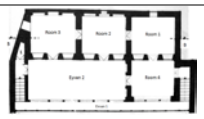
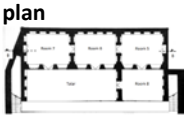


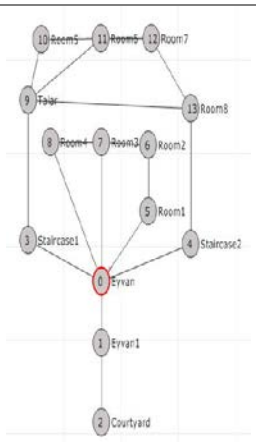
Ground floor plan



First floor plan

North elevation

Type4 (High level)



		TDn	MDn	RA	i	CV
0	Eyvan	23	1.76	0.12	7.80	2.83
1	Eyvan1	33	2.53	0.25	3.90	1.16
2	Courtyard	45	3.46	0.41	2.43	0.50
3	Staircase1	27	2.07	0.17	5.57	0.41
4	Staircase2	28	2.15	0.19	5.20	0.50
5	Room1	33	2.53	0.25	3.90	0.66
6	Room2	42	3.23	0.37	2.68	0.83
7	Room3	32	2.46	0.24	4.10	1.16
8	Room4	33	2.53	0.25	3.90	0.50
9	Talar	30	2.30	0.21	4.58	1.66
10	Room5	40	3.07	0.34	2.88	0.58
11	Room6	39	3.00	0.33	3.00	1.25
12	Room7	40	3.07	0.34	2.88	0.66
13	Room8	31	2.38	0.23	4.33	1.25
	Min	23.00	1.76	0.12	2.43	0.41
	Mean	34.00	2.61	0.26	4.08	1.00
	Max	45.00	3.46	0.41	7.80	2.83

In Table 8 the result of high level of economy which has more than three bedrooms are totally different. Calculation verified that entrance has more privacy by having higher value of TDn , MDn and RA although entrance cannot be private space by comparing to the rooms. Moreover, the integration value and CV of these houses represent that Eyvan has the highest public value which, the result is meaningful and accurate.

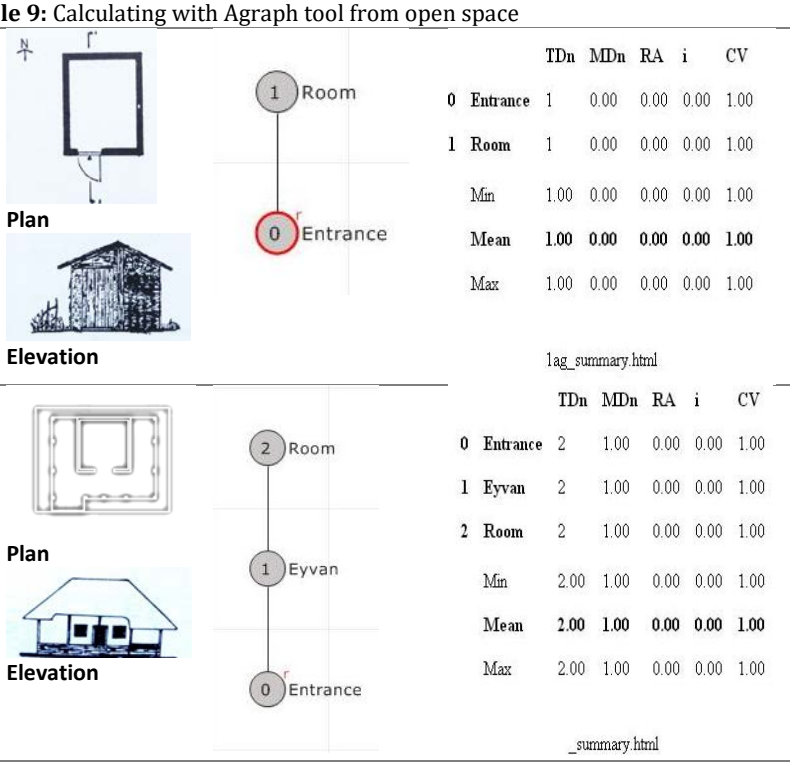
The last analysis is the one that started the calculation from the entrance (open space). Investigating the building for evaluating the degree of privacy and public could be more reasonable if the starting point began from the entrance area. In Table 9 same as the previous analysis the result of TDn and CV are same in low economy condition. It means that the degree of public and privacy is same in both room and entrance. This outcome is wrong and it cannot be acceptable. In addition, room in the medium level of economy has more privacy, and entrance has

less privacy by comparing to each other. Conversely, room in this analysis signifies the highest integration since it has more degree of integration value and CV that is not acceptable by comparing to the entrance and courtyard area.

Table 8: The result of Agraph tool from semi-open spaces

Economy level	Semi-open space				
	The highest number				
	TDn (private)	MDn (private)	RA (private)	I (public)	CV (public)
Type 1 low level	-	-	-	-	-
Type 1 low level	Room/ courtyard	Room/ courtyard	Room/ courtyard	Room/ courtyard	Eyvan
Type 2 low level	Room/ courtyard	Room/ courtyard	Room/ courtyard	Room/ courtyard	Eyvan
Type 2 low level	courtyard	courtyard	courtyard	Eyvan	Eyvan
Type 3 medium level	courtyard	courtyard	courtyard	Eyvan	Eyvan
Type 4 high level	courtyard	courtyard	courtyard	Eyvan	Eyvan
Type 4 high level	courtyard	courtyard	courtyard	Eyvan	Eyvan

Table 9: Calculating with Agraph tool from open space



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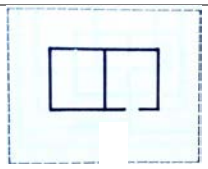
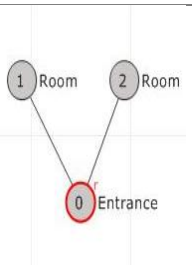
Type 2 (low level)

Plan



Elevation



		TDn	MDn	RA	i	CV
0	Entrance	2	1.00	0.00	0.00	2.00
1	Room	3	1.50	1.00	1.00	0.50
2	Room	3	1.50	1.00	1.00	0.50
	Min	2.00	1.00	0.00	0.00	0.50
	Mean	**2.66**	**1.33**	**0.66**	**0.66**	**1.00**
	Max	3.00	1.50	1.00	1.00	2.00

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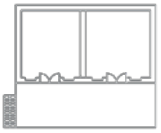
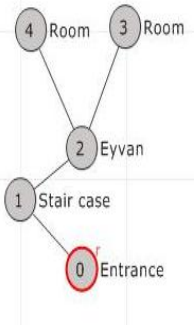
Type 2 (low level)

Plan



Elevation



		TDn	MDn	RA	i	CV
0	Entrance	9	2.25	0.83	1.20	0.50
1	Stair case	6	1.50	0.33	3.00	1.33
2	Eyvan	5	1.25	0.16	6.00	2.50
3	Room	8	2.00	0.66	1.50	0.33
4	Room	8	2.00	0.66	1.50	0.33
	Min	5.00	1.25	0.16	1.20	0.33
	Mean	**7.20**	**1.80**	**0.53**	**2.64**	**1.00**
	Max	9.00	2.25	0.83	6.00	2.50

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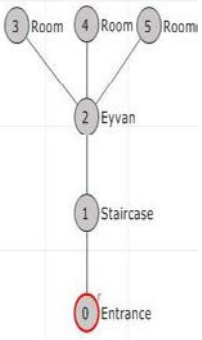
Type 3 (Medium level)

Plan

Elevation



		TDn	MDn	RA	i	CV
0	Entrance	12	2.40	0.70	1.42	0.50
1	Staircase	8	1.60	0.30	3.33	1.25
2	Eyvan	6	1.20	0.10	10.00	3.50
3	Room	10	2.00	0.50	2.00	0.25
4	Room	10	2.00	0.50	2.00	0.25
5	Room	10	2.00	0.50	2.00	0.25
	Min	6.00	1.20	0.10	1.42	0.25
	Mean	**9.33**	**1.86**	**0.43**	**3.46**	**1.00**
	Max	12.00	2.40	0.70	10.00	3.50

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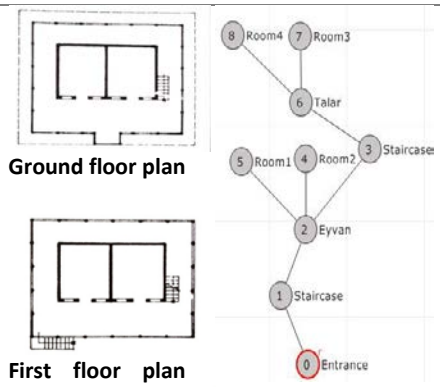

		TDn	MDn	RA	i	CV
0	Entrance	26	3.25	0.64	1.55	0.50
1	Staircase	19	2.37	0.39	2.54	1.25
2	Eyvan	14	1.75	0.21	4.66	3.00
3	Staircase	15	1.87	0.25	4.00	0.58
4	Room2	21	2.62	0.46	2.15	0.25
5	Room1	21	2.62	0.46	2.15	0.25
6	Talar	18	2.25	0.35	2.80	2.50
7	Room3	25	3.12	0.60	1.64	0.33
8	Room4	25	3.12	0.60	1.64	0.33
	Min	14.00	1.75	0.21	1.55	0.25
	Mean	20.44	2.55	0.44	2.57	1.00
	Max	26.00	3.25	0.64	4.66	3.00

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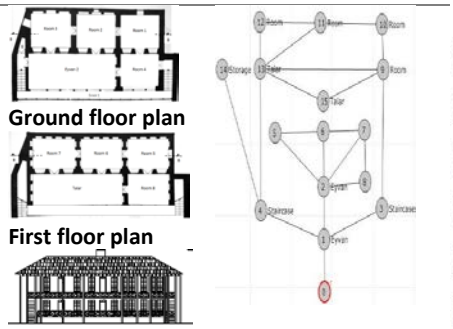

		TDn	MDn	RA	i	CV
0	0	44	2.93	0.27	3.62	0.25
1	Eyvan	30	2.00	0.14	7.00	2.03
2	Eyvan	36	2.40	0.20	5.00	1.91
3	Staircase	35	2.33	0.19	5.25	0.50
4	Staircase	32	2.13	0.16	6.17	1.45
5	5	49	3.26	0.32	3.08	0.53
6	6	48	3.20	0.31	3.18	1.03
7	7	48	3.20	0.31	3.18	1.03
8	8	49	3.26	0.32	3.08	0.53
9	Room	37	2.46	0.20	4.77	1.70
10	Room	48	3.20	0.31	3.18	0.58
11	Room	46	3.06	0.29	3.38	1.20
12	Room	47	3.13	0.30	3.28	0.53
13	Talar	35	2.33	0.19	5.25	1.91
14	Storage	46	3.06	0.29	3.38	0.33
15	Talar	46	3.06	0.29	3.38	0.45
	Min	30.00	2.00	0.14	3.08	0.25
	Mean	42.25	2.81	0.25	4.13	1.00
	Max	49.00	3.26	0.32	7.00	2.03

_summary.html

Furthermore, the result in high economy level is varied because of differentiation in number of bedrooms. For instance, in traditional building which has three rooms the result is same. But in the four bedrooms the result is different. In three bedrooms building, entrance area has revealed as the private space and Eyvan as the public space concerning with the number of TDn, MDn, RA, integration value and CV. This result is not conventional since entrance is the first space that everyone should pass through it for entering to the house. So the entrance (open space) cannot be considered as a private space and it is more public. But the result of Eyvan (semi-open space) which is more public spaces in these kind of buildings is logical. For the reason that the resident in this humid climate spend most of the evening time in Eyvan. For the reason that Eyvan is cool and it has comfortable condition during the spring and the summer time for the inhabitants in this climate (Table10).

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Table 10: The result of Agraph tool from open spaces

Economy level	Space syntax for simulating the privacy in traditional building				
	The highest number				
	TDn (private)	MDn (private)	RA (private)	I (public)	CV (public)
Type 1 low level	Room/ entrance	-	-	-	Room/entrance
Type 1 low level	Room/ Eyvan / entrance	-	-	-	Room/ Eyvan / entrance
Type 2 low level	Room	Room	Room	Room	entrance
Type 2 low level	entrance	entrance	entrance	Eyvan	Eyvan
Type 3 medium level	entrance	entrance	entrance	Eyvan	Eyvan
Type 4 high level	entrance	entrance	entrance	Eyvan	Eyvan
Type 4 high level	Room5/ room8	Room5/ room8	Room5/ room8	Eyvan1	Eyvan1

Disscussion

The graphs and calculation analysis that the starting point is from the entrance (open space), represent the outcome in a way that if the building has only one or two bedrooms, all the spaces such as room, Eyvan and even entrance have same degree of integration. Thus there is same privacy in all of the spaces. In addition, spaces in traditional building with two bedrooms where are classified in low level of economy have different kind of segregation. For instance, rooms have degree of more privacy and Eyvan is more public. Although in some of the case in the same level of economy, entrance displays more privacy which the outcome is conflict. Furthermore, in medium and high level of economy, accruing to the result of AGRAPH, entrance has specific role that demonstrated less integration and so more privacy. Consequently, calculation of TDn, MDn,RA is not response with the routine life of the inhabitant in this temperate-humid climate. For the reason that entrance could never be the space with more privacy comparing with rooms. In other calculation with semi-open and close space as a starting point, the outcome is the same. Meanwhile, in all the level of economy, the courtyard has more privacy than other spaces. Although in some analysis room got the same number like courtyard where signify more privacy but these spaces are not comparable with each other.

CV in all the analysis and calculation of traditional building in different level of economy illustrate the same result. Eyvan in Agraph analysis has more integration therefore, has less privacy. Successively, Eyvan is comfortable space for the inhabitants in this humid climate, since wind could flow through it, so the outcome is accurate.

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CONCLUSION

Space syntax analysis is one of the best methods for the architect to comprehend the integration and segregation of the spaces. Also by considering the segregation and integration, the degree of privacy and public of the space could be reasonable. Agraph tool by drawing graph and doing calculation could easily represent all these issue. This research did the analysis with Agraph tool on traditional buildings where are located in temperate-humid climate of Iran. In this climate semi-open and open space since of humidity condition has an important role for the gathering of the inhabitant and also connecting the spaces such as rooms all together. Though, the result of Agraph analysis has conflict with the method of life that the inhabitant have in this climate. One of the problems is related to the drawing of the justified graph. For instance, starting drawing the graph from rooms could give different calculation than starting from entrance or any other spaces. In architecture the basic method for reading the building is from the entrance point. Therefore, the proper result could be the justified graph that is started from entrance point (open space). However, this paper did the analysis from semi-open and closed space as well to have comprehensive result. The outcome of the analysis confirmed that although Agraph tool is the easiest way for understanding the degree of segregation and integration of the spaces but it cannot be accurate from the option of TDn, MDn and RA evaluation. As regards, the Cv and I evaluation in the analysis of traditional building represent the accurate result. The future studies of this research could be finding the solution for covering this gap in Agraph tool for better figuring out the social relation of the spaces based on space syntax method.

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Resume

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Research Article

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ICONARP

An Investigation of Sustainable Transportation Model in Campus Areas with Space Syntax Method

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Murat Yücekaya**

Abstract

Purpose

Campus areas should be designed as centers where social activities can be fulfilled to meet students' needs, and which can serve the society by promoting sustainability. Nowadays, transportation systems (bike path, public transport, etc.) that support sustainability are not very common in campus areas. This situation leads to many environmental, economic and social problems. Therefore, it is extremely important to develop sustainable transport plans to uncover the current state of the transport system and to meet future transport needs. In the study, it was aimed to compare the spatial characteristics of Kilis 7 Aralik University's current situation and its design in line with sustainable transportation principles.

Design/Methodology/Approach

This study was carried out in the central campus of Kilis 7 Aralik University. In the study, the existing transportation infrastructure of

Keywords: *Green campus, Kilis 7 Aralık University (KIYU), space syntax, sustainability*

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the campus has been evaluated, a sustainable transportation model has been formed in accordance with the concept of "green campus," and changes in spatial characteristics of the campus with the environmental, physical and social contributions of this model have been explained. Spatial composition method was used to analyze the spatial properties.

Findings

In the sustainable design model, while the local integration value decreased, global integration, intelligibility, accessibility, and synergy values were found to increase.

Research Limitations/Implications

In the study, the sustainable transportation model was carried out in a narrow area, such as the campus area. It is thought that the results obtained will be the basis for the studies to be carried out in larger areas.

Practical Implications

Campus accessibility, intelligibility and global integration values have increased with the sustainable transportation model. This situation is expected to increase the livability of campus areas.

Social Implications

It is thought that the mental health and academic achievements of the campus users will be positively affected in the campuses designed with the planning approach based on the sustainable transportation model.

Originality/Value

The article is considered important in terms of examining sustainable transportation in campus areas compared to spatial analysis.

INTRODUCTION

Many countries around the world are trying to take precautions to solve global and local problems such as rapid urbanization, climate change, social inequality, poverty, biodiversity loss, overpopulation and lack of resources. The first step towards resolving these problems is Our Common Future Report (Brundtland Report), which was published in 1987 by the World Commission on Environment and Development (WECD). The most important feature of this report is that it introduced the concept of sustainability. In general, sustainability is defined as the ability of future generations to meet their current needs without compromising the competence to meet their current needs (B. Patel & P. Patel, 2012; Rodwell, 2003). Its main objective is to reduce the available resource consumption and expand the resource production limit (Amr et al., 2016).

Sustainability is about how a community at various levels of the society predicts and maintains its social, economic and ecological well-being (Mohamad et al., 2018). It is no doubt that universities are among the key examples of these communities. Universities are not only considered small communities because they offer dense populations and complex services, but they also play a vital role for a sustainable future in the education system

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(Gu et al., 2018). Efforts to manage environmental problems of university campuses and to promote social change are called campus sustainability (Washington-Ottombre et al., 2018). The sustainability of the campus expresses the ways in which campus communities create a sustainable vision for the future and plays an important role in researching potential pathways by discussing the vision and values they represent (Miller et al., 2011). Sustainable university is also known as green university, green campus and eco-campus (Günerhan, 2016).

University campuses are separated from the cities and other regions that make up the city in terms of their missions, objectives and managerial formation. Campus areas should be designed with a concern to create an environment that supports learning. The physical characteristics of campus areas should improve students' life quality and help them manage the challenges of academic life (Dyson & Renk, 2006). A well-designed green campus can reduce students' mental fatigue levels by encouraging them to socialize in their spare time and increase their perceptions in the social context. Previous studies have shown the relationship between students' attitude and environmental factors (Berger & Braxton, 1998; Lounsbury & DeNeui, 1996; Roberts & Styron, 2010).

In the last 50 years, various studies have been conducted on sustainability of campus areas, communities have been formed and declarations have been signed. The first of these was to draw attention to environmental protection education in 1972 at the Human Environment Conference in Stockholm. In 1990, the University Leaders for a Sustainable Future (ULSF) association signed the Talloires Declaration, which identifies the ten steps to be followed for sustainability, and which was signed by more than 500 colleges and university leaders in more than 40 countries worldwide (Tan et al., 2014; ULSF 2019.). This declaration was one of the most important foundations for sustainable universities. In 1993, the Kyoto Declaration compelled universities to promote sustainability by reviewing its activities, which would place higher education institutions to the foundation of sustainable development practices (IAU, 1993). In 2011, a guide to the design of sustainable university campuses was prepared headed by Greening Universities Initiative which was founded by the Global Universities Partnership for Environment and Sustainability (GUPES), United Nations Environment Program (UNEP) and the Environmental Education and Training Unit (EETU) (Oktaya & Küçükyağcı, 2015) .

Sustainability is a major element of transportation considering its resource consumption, environmental, economic, and social impacts. Latest developments in automobile industry has rapidly contributed to societal improvements. Yet, it has also caused

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many problems that has negative social, economic and environmental effects like dense traffic, noise, pollution, loss of natural resources, incorrect land utilization, and damage to property and life due to accidents (Schiller et al., 2010).

The contribution of sustainable transportation model to the solution of social, environmental and economic problems has been discussed in many study conducted until today (Azapagic & Perdan, 2000; Demiroğlu et al., 2018; Litman & Burwell, 2006; Lukman et al., 2009; Mohamad et al., 2018; Oktaya, 2015; Olszak, 2012; B. Patel & P. Patel, 2012; Schiller et al., 2010; Wey & Huang, 2018). However, it has been observed that the studies on the social dimension of sustainable transportation model in urban context are fewer in the literature. Thus, this study focused on the social changes of the sustainable transportation model in campus areas rather than its economic and environmental contributions. Space Syntax method was used to determine the changes in the social dimension, in other words, to identify and quantify the changes in its spatial characteristics (Accessibility, Intelligibility and Synergy). Space syntax is a method developed by Bill Hillier and his team in the 1970s to identify and analyze spatial organizations from residential scale to urban scale. The aim of this method is to demonstrate the extent to which the spaces are used and the relationship between social variables and architectural forms with an objective and precise definition (Hillier et al., 1983). One of the most important features of the method is that it can visually demonstrate how the new designed spatial models work, compare the old and the new ones, predict the future problems to a degree in small or large scale planning and design studies, and allow making planning and design in line with these problems (Kubat, 2015). The method differs from other methods in that it reveals the possible effects of the designs through mathematical values. This methodology is expected to contribute greatly to the understanding of the physical structure of the design created in this study.

This study was carried out in Kilis 7 Aralık University Central Campus (KIYU).In the study, the existing transportation infrastructure of the campus has been evaluated and a sustainable transportation model has been formed in accordance with the concept of "green campus" and this model's all possible contributions to the environment from social aspects and the changes in its spatial characteristics have been identified.

METHODOLOGY

Research Case

The main material of the study is the KIYU central campus. Kilis city is in 36 ° 45 'and 37 ° 45' north latitudes and 37 ° 00 'and 36

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° 45' east longitude. Kilis is neighbor to Antakya in the west and Gaziantep in the north. Turkey-Syria border is in the southern part of the city. The campus is in city center in north-west direction. The university campus has 5 faculties, 2 vocational schools, President's Building, Central Laboratory, Mosque, Library-Congress Center, Technical Departments and various social, cultural and sports areas (Figure 1).

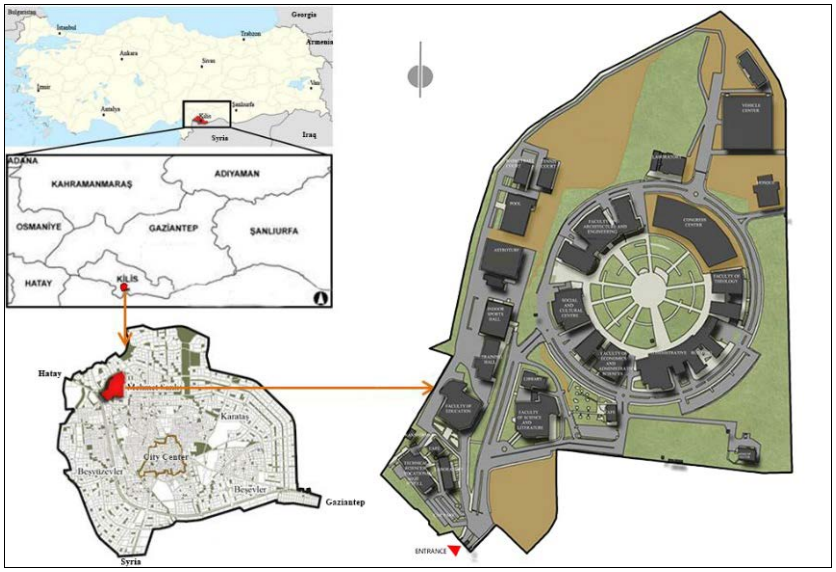

Figure 1. Geographical location and current state of the campus

Space Syntax

The space syntax sequence is a set of techniques that analyze the relationship between spatial structures and the societies that make it up according to some theories from residential scale to urban scale(R. C. Dalton & N. S. Dalton, 2007). Space syntax is a graphical model based on dynamic and static measurements (Hillier et al., 1987). The spatial system is represented with the shortest and longest lines that define all gaps in the urban area in the graphs. The map created by these lines is called the axial map (Jeong et al., 2015). After axial maps are converted to graphs and topological (non-metric) analyses, a model based on the linear link called "integration" was created (Hillier, 1999). Integration maps describe how both vehicle and pedestrian movements work within the urban system, and they are important to understand how often public spaces are used (Hillier, 2007). Hillier, 1998, 1999; Hillier & Iida, 2005; Li et al., 2016; Özbil et al., 2013; Özer & Sema, 2014 have demonstrated the relationship between movement and integration values in their work. Integration is a static global measurement (Klarqvist, 1993) and shows accessibility spatially, not in metric terms. It also defines the average depth of a space in the system compared to all other spaces. Total depth (TD) is calculated by summing the depths via

each of the shortest paths between one segment and all others in a street network; $TD_x = \sum_{i \in s, i \neq x} D(x, i)$ (Jeong et al., 2015).

The Integration is as follows: $I_x = \frac{NC^2}{TD_x}$ where Ix denotes the integration value of space x, and NC indicates the node count (i.e., the number of nodes within a radius to be analyzed) in a street network regarded as a graph consisting of a set of nodes and a set of edges (Jeong et al., 2015). The integration value has two different measurements. The first is the Global integration value (Rn), which takes into account all the other nodes within the system; the second is the Local integration value, which defines the connection density of a node with the three-step (R3) depth nodes in the system (Dettlaff, 2014; Gann, 2003; Hillier, 2007).

One of the basic analyses of the space syntax method is integration analysis. However, other analyses such as connectivity and choice can also be conducted. While integration and connectivity are static measurements, choice is a dynamic measurement (Al_Sayed et al., 2012). Connectivity is the numerical expression of spaces that can be directly connected to another space (Klarqvist, 1993). Choice refers to the probability of the selection of lines that can be passed in order to go to another line in the system (axial line) (Hillier, 2005). Correlation is established between these measurements obtained by using the spatial syntax, and then, characteristic features of the space such as Intelligibility, Accessibility and Synergy can be fully explained.

The intelligibility of a space refers to the relationship between its integration and connectivity values. If the integration values is high in the lines that are connected locally, the correlation between them will be strong and the system will be understandable. Conversely, if the integration values of well-connected lines is low, the correlation will be weak and the whole will not be understood from the parts. Integration and choice value are two important parameters in accessibility. The correlation between these two values gives us how accessible the space is. To clarify, the correlation between these two variables indicates the degree of a space's movement potential and its moving potential.

Hillier at all. (1987) describe the concepts of intelligibility and accessibility as follows;

"Intelligibility is quantified as a second order measure and it is defined as the degree of correlation between connectivity and global integration values of the axial lines in spatial configuration analysis. It indexes the degree to which the number of immediate connections a line has - which can therefore be seen from that line - are a reliable guide to the importance of that line in the

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system as a whole. If locally well-connected lines are also integrating lines, then the correlation will be strong, and the system will have "intelligibility". The whole can be read from the parts. Conversely, if well connected lines are not also integrating lines, then the correlation will be poor, and the whole will not be readable from the parts. Equally suggestive is the degree of correlation between the "global state" measure (integration) and "global dynamic" measure (choice). The correlation between these two variables will indicate the degree to which the accessibility of a space as a destination from all others (how many steps it is away from all other spaces in the layout) is a reliable guide to its likely popularity as a space to be passed through on shortest routes from all points to all other points in the layout. More simply, it indexes the degree of agreement between a space's potential for to-movement and through-movement" (Bill Hillier et al., 1987). Synergy, which is similar to intelligibility in many respects, is the correlation coefficient between local (R3) and global (Rn) integration (Dalton, 2010; Hillier, 2001; Sayed, et al., 2014). There are many study that have analyzed intelligibility, accessibility and synergy by using the space syntax method (Asami et al., 2001; Hillier, 2001; Park, 2009; Dalton, 2010; Legeby, 2013; Sayed, et al., 2014; Ugalde et al., 2009; Zhang et al., 2013; Topçu, 2019).

Analytical Framework

The study focused on the comparison of spatial analysis based on the current plan of the KIYU central campus and the spatial analysis as a result of the new planning based on the sustainable transportation model. The study was carried out in three stages: current situation analysis, design and analysis based on sustainable transportation planning, and comparison of the spatial features resulting from these two designs.

The first part of the study, necessary changes and drawings were made on the existing map of KIYU central campus and current Axial map was created. Then, this axial map was analyzed with the help of DephtmapX software, integration, connectivity and choice maps were created in global and local (R3) scale. The intelligibility, accessibility and synergy analyses were conducted based on these maps. As a result of these analyses, the current spatial situation of KIYU central campus was revealed.

In the second part of the study is based on the sustainable transportation model of the central campus. In this part of the study, the existing usage and transportation infrastructure has been identified based on the current plan of KIYU central campus obtained from directorate of construction and technical works. In the last section, a sustainable transportation model of the campus area has been formed based on the literature. Public

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parking spaces are created in this model and the use of private vehicles is restricted within the campus area. In this transportation model, Standards for the Design and Construction of Bicycle Roads, Bicycle Stations and Bicycle Parking Places on Intercity Roads have been used (Official Gazette, 2015) (Figure 2). An axial map of the new model was created based on this planning. This axial map was analyzed in DephtmapX software, and integration, connectivity and choice maps were created in global and local scale. The intelligibility, accessibility and synergy analyses of the new model were conducted using these maps.

By comparing the results obtained with the space syntax method, which allows comparison of the current situation and the situations in which the recommendations are developed, this study seeks answers on how intelligibility, accessibility and synergy values are affected based on sustainable transport system model. The flow chart of the method is shown in Figure 2.

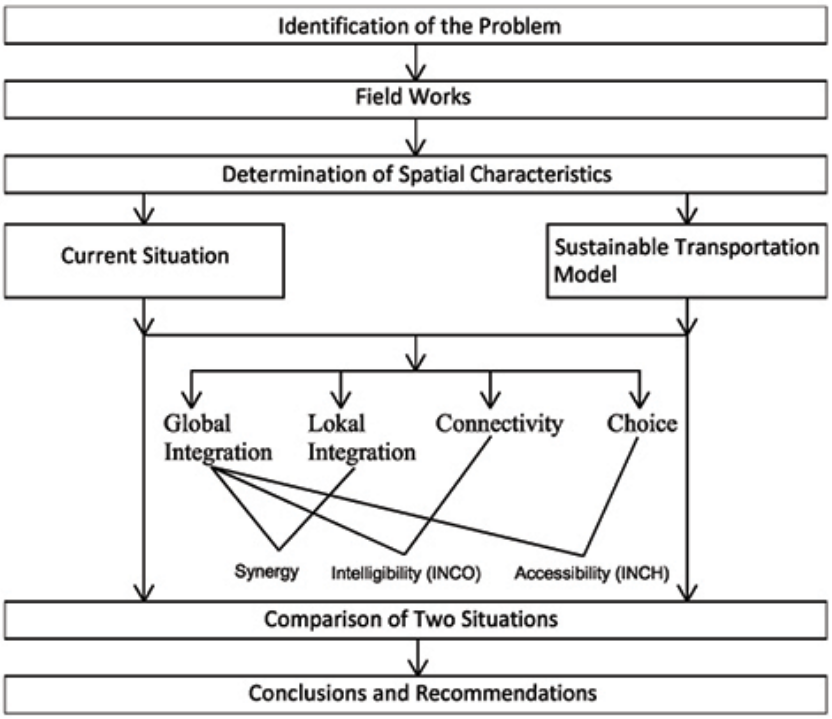

Figure 2. Method scheme

RESULTS AND DISCUSSIONS

Sustainable Transportation Model

Situated within approximately 256,000 m^2 of land, the campus' current situation is given in Figure 1 and Table 1. %31.70 of the campus is covered with green areas, followed by %18,82 vehicle ways, %17,42 building area, %17,37 soil area and %11,81 pedestrian path. 200 administrative staff, 290 academic staff and 6900 students, 7390 people in total currently use the campus area (KIYU Personnel Department, 2018; KIYU Registrar's Office, 2018). 2 gates are actively used to enter and leave the campus.

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Approximately 1000 vehicles enter and exit the campus per day according to 2018 data.

The main transportation axes planned based on the section in the campus is given in Figure 4 and sustainable transportation model of the campus created based on relevant literature is given in Figure 3.

In the model, it is recommended not to use the main transport axes and vehicle roads which are planned to be used to enter the building except emergency situations. Two different locations are recommended in campus entrances, including bicycle maintenance / rental services and battery-powered vehicles for disabled users. In addition, the parking spaces between the buildings were removed and these areas were planned as green areas in the model (Figure 3). By building car parks near the campus gate, the vehicle traffic to the camp was limited to approximately 1000 cars per day (Figure 4). It is recommended that no motor vehicles should not enter the campus except in emergencies.

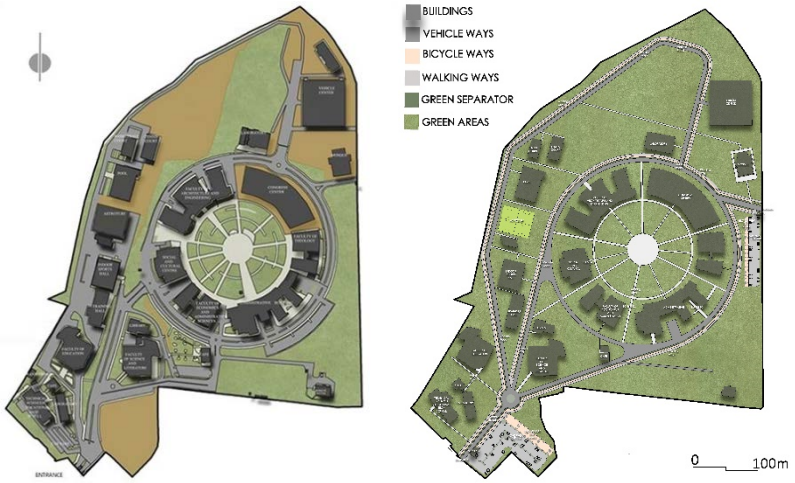

Figure 3. Campus Master Plan. Left Current Stuation, Right Sustainable Transportation Model

Figure 4. Recommended road section for the sustainable transport model (Demiroğlu et al., 2018).

By making the following changes in the existing campus master plan, a sustainable based campus master plan was created.

- All of the car parks between and around the building have been removed and converted to green areas.
- A wide central square is created after the main entrance and distribution to all roads is provided from this area.

- The idle space at campus entrance has been converted to a car park, and the areas in the north are still under development and planned as green areas.
- All of the nonfunctional hard floors on the campus have been turned into green areas.
- Pedestrian paths have been planned in such a way that they can form gathering-dispersion spaces, provide the main circulation and provide access to faculty buildings.
- In the sustainable transportation model, only service roads or emergency roads have been designed with double lanes instead of current double lane roads.

Table 1. Current land area usage rates and rates after suggestions inside the campus

	Current (m^2)	Rate (%)	Proposed (m^2)	Rate (%)	Inc. and decr. rates (%)
Green space	81.08	31.70	142.2	55.60	75.38
Soil Area	44.42	17.37	31.65	12.37	-28.75
Vehicle path	48.14	18.82	17.36	6.79	-63.94
Car Park	7.36	2.88	7.99	3.12	8.56
Pedestrian path	30.21	11.81	7.11 (5.4 km)	2.78	-76.46
Bicycle path	0	0.00	4.9 (2.3 km)	1.92	1.92
Building Area	44.56	17.42	44.56	17.42	0
Total	**255.77**	**100.00**	**255.77**	**100.00**	

The vehicle roads have been reduced from 48.140 m2 to 17.360 m2 in the campus area with this plan. Green areas increased to 142,202 m2 from 81,088 m2. The aim here is to reduce greenhouse gas emissions and support biodiversity. In addition, a 2.3 km cycling route and 5.4 km walking path has been designed in the plan. The highest increase occurred in green area, the highest decrease was in pedestrian and vehicle roads. Thus, sustainable campus design, which constitutes the main hypothesis of the study, was attempted to be realized.

The activity areas designed for university students on campuses are important to spend their free time effectively. These areas increase the social development of students by decreasing their social oppositional behaviors and contribute positively to reduction of drug addiction and crime rates (Kuo & Sullivan, 2001; UN-HABİTAT, 2008). Therefore, it is aimed that these areas contribute positively to campus users in term of issues like social cohesion, integration and physical health. Hipp, Gulwadi, Alves, & Sequeira, (2016) highlighted the physical and psychological positive effects of green areas on students in their study.

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Comparison of Sustainable Transportation Model and the Current Situation in terms of Spatial Features

While preparing the campus transportation plan, current complex transportation planning has been simplified as far as possible. This is the reason for approximately %40 decrease in the number of axial lines. The campus access is provided via three main axes starting from the entrance in the proposed campus transportation network map. Central axis that provides access to the circular center area and lines that are connected to this line are the axes with the highest integrated value in the area. There was an approximately %12 increase in Average Global integration value with this proposed transportation plan (Figure 5, Table 2).

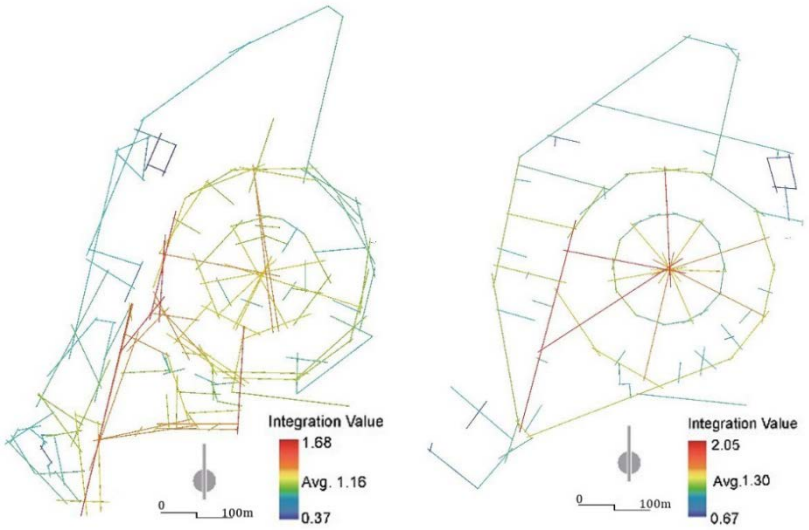

Figure 5. Global integration map. Left existing state, right proposal plans

The integration values of the current transport network in the R3 radius were higher. This situation is normal because the current transportation axes are large in number. However, the radial axes expanding outwards from the main center in the proposed transport map have high integration value. There was a %18 increase in the proposed map compared to current map considering the synergy graphs obtained from the correlation of Rn integration and R3 integration values (Figure 6-7, Table 2).

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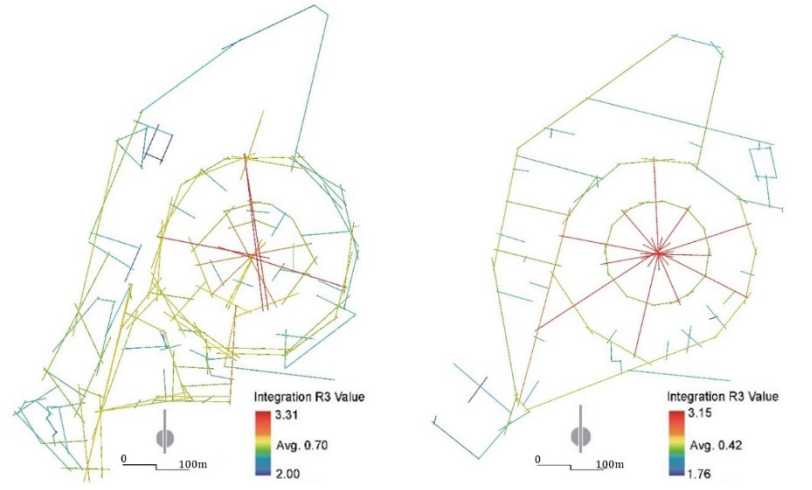

Figure 6. Local integration map (R3). Left existing state, right proposal plans

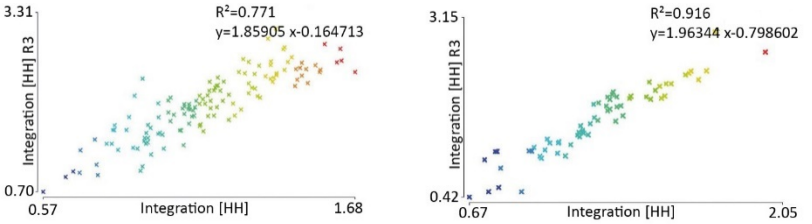

Figure 7. Existing state and proposal plans synergy graphs

The average connectivity values are approximately %25 higher in the current situation (Figure8). However, there are approximately %21 increase in the proposed plans in the intelligibility charts (Figure 9). This situation can be interpreted as current situation's having a high level of connectedness and choice alternatives, but that intelligibility and accessibility can be increased by more simple, functional and purpose-oriented designs.

In the same way, while average choice values in the choice maps (Figure 10) are less than half of the proposed plan compared to current situation, the accessibility as the definition of correlation graphs of the choice and integration values showed an approximately %62 increase (Figure 11, Table 2).

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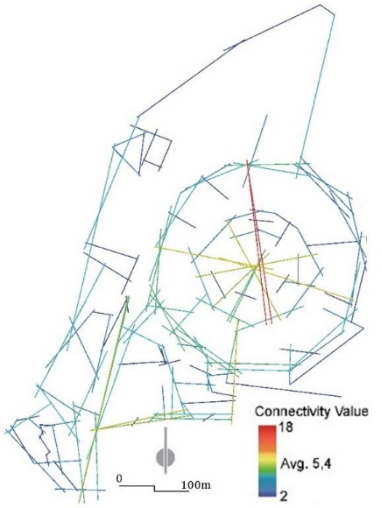


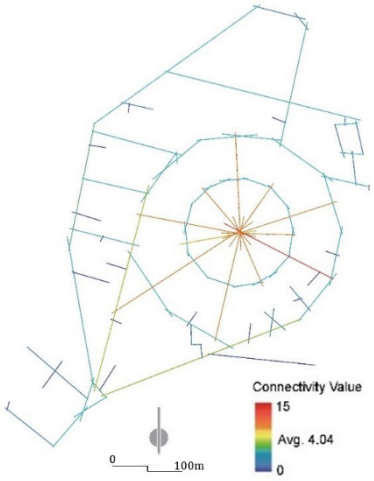
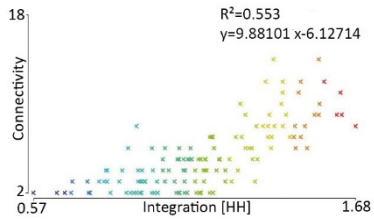


Figure 8. Existing state and proposal plans connectivity maps



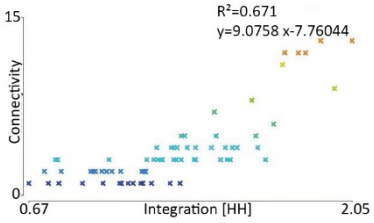
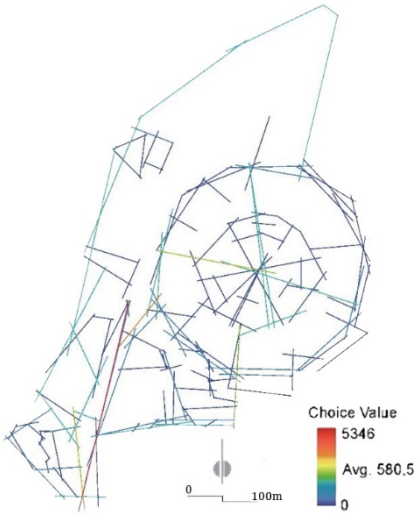


Figure 9. Existing state and proposal plans intelligibility graphs



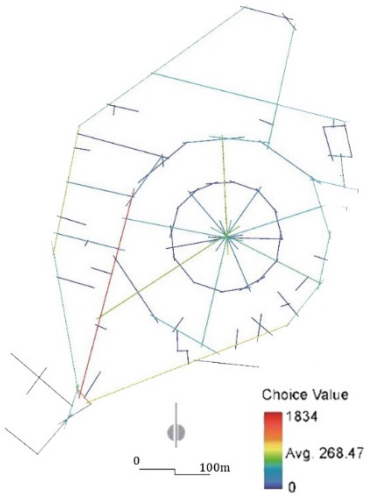
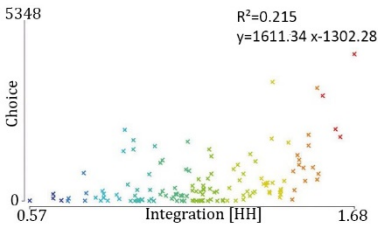


Figure 10. Existing state and proposal plans choice maps



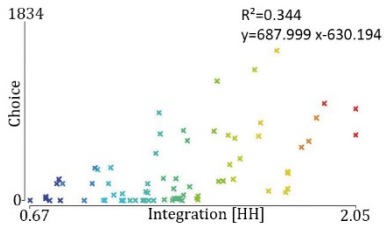


Figure 11. Existing state and proposal plans accessibility graphs

The changes in spatial characteristics as a result of proposed sustainable transportation model are given in Table 2.

Table 2. Comparison of the current spatial characteristics of the campus area and the spatial characteristics after the proposal

	Current	Propose	Inc.-Dec. Rate (%)
Axial line	141	85	-39.72
Global Integration (Rn)	1.16	1.30	12.07
Local Integration (R3)	0.70	0.42	-40.00
Intelligibility (INCO)	0.55	0.67	21.81
Accessibility (INCH)	0.21	0.34	61.90
Synergy	0.77	0.91	18.18

INCO: Correlation of Between Integration and Connectivity
INCH: Correlation of Between Integration and Choice

As a result of the analyses, it is seen that there is an increase in global integration, intelligibility, accessibility and synergy features of the campus area but a decrease in the local integration value. The cause of these reductions might be the decrease in the connectivity values and the number of axial lines. As Hillier, Penn, Hanson, Grajewski, & Xu, (1993) stated, "higher levels of integration necessitate more network connections. A more integrated space is shallower on average, whereas a less integrated space is on average deeper." This definition is in line with the results of this study.

The study differs from previous sustainable transportation model studies in the literature with its focus on spatial characteristics. As stated at the beginning, while the studies based on sustainable transportation model generally deal with its contributions to social, economic and environmental problems, this study is important in that it examines the contribution of sustainable transportation model to spatial characteristics. Balsas, 2003; Demiroğlu et al., 2018 have demonstrated the contribution of sustainable transportation model to campus areas in their studies. As a result of this study, it has been observed that the campus design based on sustainable transportation model contributes positively to spatial characteristics such as intelligibility, accessibility and synergy as well as its economic, social and environmental benefits. However, this study does not claim that all designs based on sustainable transportation model will always contribute to spatial characteristics. To make such a claim, more studies should be done, and the subject should be addressed in a broader sense.

CONCLUSION

This study carried out in KIYU campus aims to identify the changes caused by sustainable transportation model on intelligibility, accessibility and synergy levels. Based on this model, a new planning model is proposed that restricts private vehicle usage and supports cycling and walking activities. With this model, adverse effects of economic, social and environmental problems resulting from using motor vehicles as

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specified by Schiller et. al., (2010) will be reduced and thus, sustainability goals stated at Litman (2011) will be achieved.

The study presupposes that campus planning is important for campus users. The space syntax method was used to provide more specific suggestions to the question of how to design campus areas. It is argued that designs to be made using the space syntax method and sustainable transportation model can improve the spatial characteristics of campus areas.

As a result of the findings obtained from this study, it is claimed that a campus area, which has a good spatial character, that is which is formed with perceived and accessible spaces, will contribute positively to students' academic success and mental health. Therefore, the physical campus should be designed and managed as an environment that will reduce student's mental fatigue and improve life quality and academic performance. For this reason, the university management should make a sustainable campus area as a basis for research and teaching and should strive to preserve natural resources and support sustainable use in a way that ensures the environmental health and safety of the university community.

Sustainable planning can be examined under many subheadings. This study evaluates the effects of transportation-oriented sustainable design at university campus scale. Further studies might be carried out by using detailed sustainable design principles from other various fields. It is considered that the study might open new paths for more detailed studies to be carried out in the future.

Campus planning is a complex and multidisciplinary process that requires more and more actors to communicate with each other. Higher data requirements, different methods, accepted assumptions and limitations should be carefully considered by planners in the planning processes. Indicators evaluating the spatial characteristics of campus areas such as accessibility and intelligibility represent quite useful agents for developers and might provide campus managers with sound policies to create more livable and healthier campus environments.

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Resume

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Research Article
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The Infographic Model of Design Thinking Process

Pelin Koçkan Özyıldız*
Pelin Yıldız**

Abstract

Purpose

Creativity as an outcome of our thoughts and actions is a controversial concept that has been discussed by many disciplines in different ways. In the light of cognitive research on creativity, this study aims to deal with the components of the idea generation process specific to interior design education. Based on the study conducted in the interior design studio, this paper introduces the infographic model of design thinking. the main purpose of the model is to summarize how design students initiate the design process, create their own design ideas, and also how they lead design thinking for a spatial solution.

Design/Methodology/Approach

The cross-disciplinary research paper within the context of the psychological studies on creative cognition consists of a detailed analysis of the design process in the design studio. A case study was conducted in the second-year undergraduate interior design studio at Hacettepe University in order to observe the students' experiences during one semester. In the wake of this qualitative research, the data obtained from 15 design students selected have been analyzed gradually and a design thinking model has been generated with the findings.

Keywords: *Creativity, creativity models, design thinking process, design education, interior design studio.*

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Findings
In addition to the interpretation of the creativity models from the literature, initial analyses showed that design thinking can be explained in three main stages as preparation, conceptualization, and spatialization that underlie the internal and external process of design thinking in the design studio. With subsequent analyses, these stages have been divided into different strategical layers according to students' experiences. As a result, the infographic model of the design thinking process is structured based on the evaluations of these components and the design approaches identified.
Research Limitations/Implications
The data acquired from the case study undertaken by the author were compared so as to identify the similarities and diversities of these processes. More research on different stages of the design process can shed more light on design thinking. In addition to this, qualitative data are based on a small group of students to get detailed information about the process. The proposed model can be adapted for different studies in the context of the design studio with more participants.
Practical/Social Implications
The proposed model in the research is intended to be used as a content map that shows the alternative ways of thinking in design ideation, and also an analysis method of the design process for future studies. In other words, the paper shows the two-way implications of the design thinking model on design education. One of which is a guide for practical use for design students and the other is an analytical tool for studio instructors or researchers.
Originality/Value
This study brings to focus on conceptualization and spatialization for creative idea generation in design studio education. On the basis of drawn from creativity models, the paper introduces a new process model that provides an original interpretation of existing models in design. The proposed model differs from previous cognitive studies, as it expands the ideation process with both internal and external operations.

INTRODUCTION

Creativity refers to the transformation of the existing things into new things through a unique, original manner. In addition to its perception as innate talent or gift, creativity exists in everyone at different levels, when considered as an act of generating ideas in a new way. Many theoretical studies have measured this talent and attempted to improve creative potential by examining the mental mechanisms of creative thinking. Especially with cognitive research, the nature of creative thinking and the components of the idea generation processes have been defined as multifaceted. These cognitive studies about creative idea generation, the basis of design, have gained significance and supported design education in different aspects.

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In this study, which inquires idea generation in design, creative processes have been identified through the stages of association, interpretation, and transformation. Accordingly, it is aimed to analyze the components of these stages and to discover different tendencies in the design studio.

To that end, in this research, cognitive approaches explaining the concept of creativity have been discussed and previously produced creativity models have been presented. Following, the effects of these studies on design practice and design pedagogy have been analyzed, and cognitive models, developed for design education, have been scrutinized. Finally, along with all the data obtained from the case study conducted in the design studio, the multilayered thinking structure of the designer has been represented by the infographic model of the design thinking process.

CREATIVITY

Creative production, which lies behind scientific, artistic and technological developments, exists at the intersection of many disciplines. Due to this reason, there are many explanations based on different paradigms related to creativity. Chronologically, the concept of creativity could not be described scientifically before the 1960s, whereas studies on creativity increased in number in the 1960s when the structure of the human mind began to be construed. These studies demonstrated that creativity is an act of mental production essentially, and therefore, it was acknowledged that it exists in every mind to some extent (Lowenfeld, 1947; Rouquette, 1992; Smith *et al.*, 1995).

The objective measurement of creative potential became possible through creativity tests. In order to improve creative performance, it became necessary to explain the structure of the human mind and to identify the factors which affect it. Therefore, many qualitative studies have been conducted on the factors affecting creativity, in addition to studies based on quantitative measurements (Getzels and Jakson, 1962; Guilford, 1968; Torrance, 1972). Among these, cognitive studies based on thinking, information processing, and problem-solving skills, set light to the mental processes that lie behind creativity (Finke *et al.*, 1992; Cross, 2001; Runco, 2007; Ward, 2007). Based on these explanations, especially cognitive approaches, that deal with the mental processes of creativity, have gained importance for this study.

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CREATIVE COGNITION

Cognition refers to mental operations such as perception, conceptualization, knowing, learning, and problem-solving. Cognitive approaches attempt to explain creativity through the mental representations of these processes. There are two main concepts for creativity within the scope of cognitive studies. The first one is *cognitive processes* that describe the mental mechanisms and the second one is *cognitive styles* that represent the individual approaches or preferences during these processes (Fakhra, 2012).

Martinsen, Kaufmann, and Furnham (2011; 214) define the concept of style as the "preferred manner or way of doing things" and interpret the cognitive style as "individual differences in the ways people organize and process information". According to this, even though cognitive processes are the same for everyone, it can be said that different approaches and behavior patterns in the process vary due to cognitive styles. It was observed that cognitive styles such as thinking visually or verbally, analytical or holistic organization of information indicate an opposite bipolar tendency. In contrast, more tendencies were discovered in some research (Martinsen *et al.*, 2011; 215). Even though cognitive styles are perceived as a measurement for creativity, studies on education, in particular, showed that both tendencies may be advantageous at different stages of creative thinking (Cross, 2001; Demirbaş, 2001; Fakhra, 2012). In this regard, styles have not been enough on their own to explain the structure of creative thinking, and therefore the knowledge of cognitive processes has become a necessity.

The cognitive processes of creativity are generally associated with problem-solving (Guilford, 1968; Newell and Simon, 1972; Schön, 1985) or problem finding activities (Cross, 2001, Benami, 2002; Runco, 2007). Runco (2007; 16) expands the scope of problem finding in a cognitive sense as "problem construction, problem identification, problem definition, problem discovery, problem perception, and problem generation". According to this, it can be said that what matters for creativity is not only the solution but also the *formulation of the problem*.

The meaning of the term "problem" varies depending on the creative production field. For instance, Runco associates the problem in an artistic production with the artist's conceptual or formal search. He defines the "problem finding" as "problem expression" and states that the "problem is not extrinsic, but more a matter of finding a way to capture a feeling or need" (Runco, 2007; 17). It can be said that this explanation also applies to design disciplines at the intersection of science and art. A design problem generally includes more than the

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requirements and is most of the time defined through the designer's insights.

Another issue as important as a *problem* in cognitive researches is *knowledge* because configuration or formulation of the problem is directly associated with the relevant information about it. In creative thinking, various information related to the problem comes together and forms ideas. By changing these pieces of information, a new problem and accordingly a new knowledge can be generated. In other words, the problem and knowledge fields are in a dynamic relationship through bidirectional communication (Kahvecioğlu, 2001).

In any act of production, stored memories and knowledge in mind regarding concepts, objects, and events, associates with newly acquired information and generates new syntheses through several networks (Ward, 2007). Generating an idea out of the existing information stands for an association that takes place in mind beyond control. This has been explained through *Mednick's associative theory*. This theory holds that information and experiences generate ideas by coming together in mind through free associations (Mednick 1962; Andreasen, 2011). There is such a link behind the novelty and originality value of creative production. However, Runco (2012; 602) drew attention to the importance of establishing this connection with the right relationships and identified two important requirements for a creative idea: "originality" and "effectiveness".

In the generation of creative ideas, analogy and metaphor are among the frequently employed methods for new syntheses (Runco, 2007). Analogy stands for semantic or formal references between two similar things, whereas metaphor represents the figurative use of similarities in differences. In both of these methods, the main point is the transition of similarities or affinities. However, the similarity between these things runs the risk of extreme adhesion to the origin or getting out of the scope. Therefore, interpretation and transformation of the origin are the most important operations in analogy and metaphor. Thus, creativity ceases to be an uncontrolled action and turns into a conscious process of discovery.

As can be seen, the description of the problem, acquisition of relevant information, generation of new ideas, and elimination of them are discussed for a creative thinking process. In cognitive studies, these processes and their links with each other are expressed by relationship charts which have been named as creativity models. Charts can also be diversified in every model according to the emphasized content of them such as cognitive processes or styles. Therefore, a model, which explains the relationships that the researcher has focused on, should not be considered as a rule, but as a content summary.

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Cognitive Models of Creativity

The former models related to creativity have been named stage models, which attempt at explaining the mental processes with successive operations. As the creative process depends on generating plenty of ideas at first and then evaluating them, different models represent the stages with similar explanations. In his renowned model, Wallas (1926;10) describes the stages of creativity as "preparation, incubation, illumination and verification". The preparation stage stands for cognitive processes taking place during problem defining and information gathering. The incubation stage signifies the connecting of ideas unconsciously while retreating from the problem. In the illumination stage, associated ideas emerge suddenly, whereas in the verification stage appropriate solutions are determined. Many subsequent studies have tried to explain these stages which were described as unconscious before in more detail through problem defining, information processing, and decision-making, (Weisberg, 1986; Runco, 2007; Fakhra, 2012).

In the widely adopted Geneplore model, Finke, Ward, and Smith (1992; 191) suggest two main stages, "generation" and "exploration", which lead to the creative idea (Figure 1). According to the model, the process, starts with the generation of "pre-inventive structures" through "knowledge retrieval, idea association, mental synthesis, mental transformation, analogical transfer, categorical reduction, etc.", and is developed through "interpretation, hypothesis testing, attribute finding, functional inference, contextual shifting, searching for limitation, etc." (Finke *et al.*, 1992; 192).

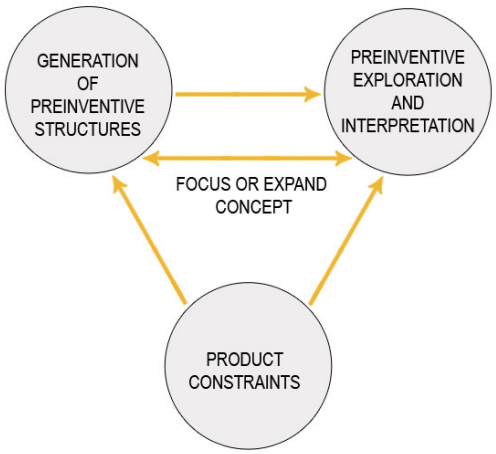

Figure 1. The basic structure of Geneplore Model (adapted from Finke, Ward, and Smith, 1992; 193).

Mumford (2017; 318), on the other hand, examines the stages of creative thinking through the processes of "problem definition, information gathering, concept/case selection, conceptual combination, idea generation, idea evaluation, implementation

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planning, adaptive execution" (Figure 2). The stage of "conceptual combination", in which different information and concepts combine to generate a new conceptual idea, has particular importance for obtaining original results.

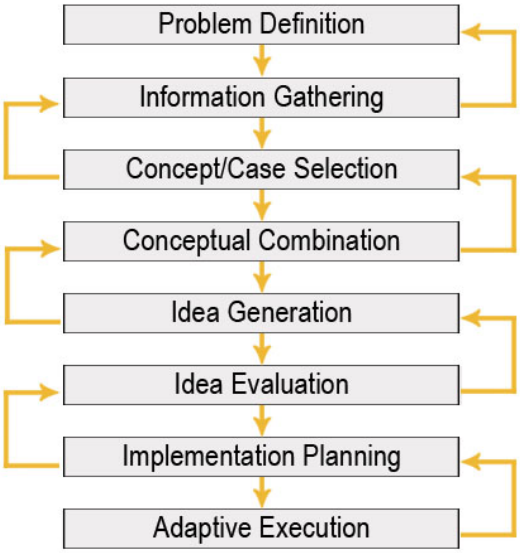

Figure 2. Creative process model (adapted from Mumford, 2017; 318).

In addition to process models, componential models underline the different paradigms of creativity. For instance, in the 4P model of Rhode (1961), person, product, and press were taken into consideration besides the process. Runco and Chand (1995) proposed the two-tier model of creativity. In the first layer of the model, they explain "problem finding, idea generation, and evaluation" processes, whereas they address "motivation" involving internal and external factors affecting the process, and "knowledge" in the second layer (Figure 3).

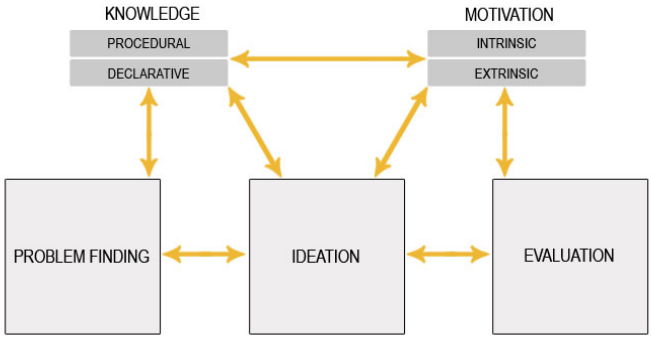

Figure 3. Two-tier model of creative thinking (adapted from Runco and Chand, 1995; 245).

As can be seen, some of the models focus on the process, whereas some others explain creativity through cognitive styles, strategies, or factors, etc., in a multi-dimensional manner. The

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basic cognitive mechanisms of creativity such as information-processing or problem-finding explained through the models above, have been contributed to this research in order to define creative thinking within the scope of interior design.

DESIGN COGNITION

Design, expanding between art and science, is one of the outstanding disciplines influenced by creativity research in cognitive psychology. Cognitive approaches have discussed processes of creativity, such as problem-solving, generation of the design knowledge, and decision-making, in addition to the frame of mind behind them. The frame of the designer's mind and thinking processes are known as design cognition.

What differentiates design from a creative act is how the problem is formulated, how the design objectives are generated and what kind of strategies are preferred in this process. Due to the fact that the design problem is ill-defined, objectives are restructured in the course of the process. Re-defining the problem with a new target is particularly important for the designer, as it provides an opportunity to be unique. Because it is opened to external influence, there is a strong connection between creativity and the generation process. It is a dynamic process, with the potential to retrieve, open to new information or other factors at any time. In this regard, the design process should be regarded as an ongoing process of idea generation, not solely as a problem-solving operation.

Cognitive Studies and Models in Design Education

As is known, the ability of *designerly thinking* could be developed due to experiential knowledge gained in the studio, which lies at the center of design education. This type of knowledge includes the explicit knowledge of design called "declarative" and the methodological knowledge of design called "procedural" (Uluoğlu, 1988; 21). The primary objective of design education is, therefore, the acquisition of these abilities about thinking and also expressing.

In this context, cognitive studies have been very important in design education. Many cognitive models were borrowed from psychology to be used in design education, and these shed light on different aspects of education. The relationship between cognitive styles and learning (Demirbaş and Demirkan, 2003; Kwan and Yunyan, 2005; Robert, 2006; Salama and Wilkinson, 2007), the meaning of designerly thinking (Lawson, 2005; Ochsner, 2000), problem-solving approaches (Cross, 2001), information, representation, and decision-making processes (Akın, 1978; Goldschmidt, 2005) are some of the outstanding exemplary studies in design education.

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Lawson in his book, *How Designers Think*, analyzes the designerly thinking from different aspects and presents some cognitive models (2005). In this study, he refers to the stage models as the "route maps of the design process" but also emphasizes that these consecutive maps cannot completely explain the complex structure of design thinking. Based on this, he interpreted the design process (Figure 4) as "negotiation between problem and solution through the three activities of *analysis*, *synthesis,* and *evaluation*" (Lawson, 2005; 48).

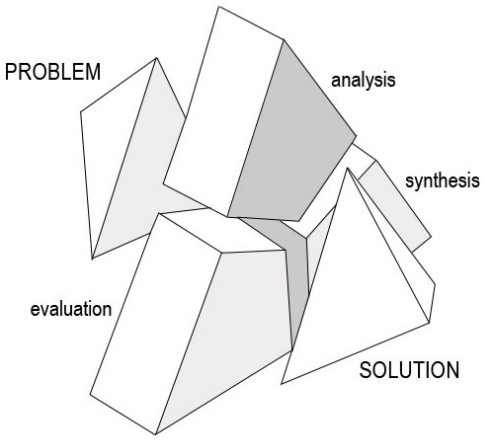

Figure 4: Lawson's map of the design process (adapted from Lawson,2005; 48).

In another study, Roberts (2006) associates cognitive styles with design processes and identifies important stages in which students' cognitive styles are efficient. Ochsner (2000), who draws attention to the similarity between the process in the design studio and the psychoanalytical processes, approaches the design education from a pedagogical perspective and focuses on the individual processes of creativity in the studio.

In addition to design knowledge and design thinking, the representation of the design process is another important aspect in design education. In some cognitive studies, visual representations are evaluated as a separate stage of the process (Akın, 1978; French, 1985). Instead of this, Goldschmidt (1994) and Oxman (1997, 2004) describe sketches or any visual representations in visual thinking, as important tools supportive of cognitive processes.

Regarding these studies, in some of the current studies, the stages of the design process are detailed, while in others, new synthesis has been introduced. For example, Türkyılmaz and Polatoğlu (2012; 103) determined the selection of information and its transformation, as two important creative stages in the "early design phase".

Fakhra (2012), on the other hand, aims at developing the conceptual model of creativity and proposed the Meta-Creativity Componential Model, which contains the synthesis of previous

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Four-staged model (Wallas,1926), Investment theory (Sternberg and Lubart, 1992), Geneplore Model (Finke et l.,1992), and Five characteristics of the design process (Ziesel, 2006).

models[1]. He puts the "conceptual processing space" at the center, considers other components as influential factors and conditions which have an effect on the process and inspirational idea stimuli (Figure 5).

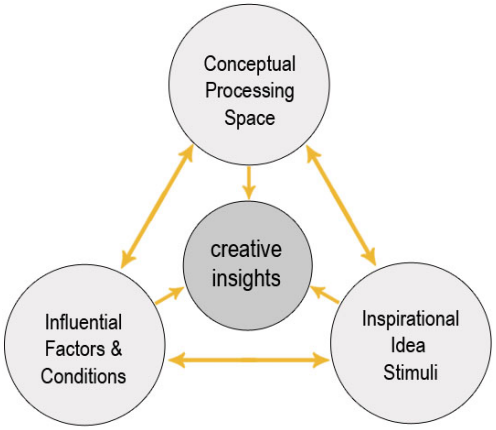

Figure 5: Meta-Creativity Componential Model (adapted from Fakhra, 2012; 75).

Based on the explanations above, generating a design thinking model is the purpose of this study conducted in the studio. In this study, the creative process was harmonized with the *generation of design thinking* and the process was structured based on the processes followed in the studio.

All the externalized information serves as valuable expressions that provide insight into the designer's thinking process. Therefore, in this study, sketches, drawing, and other visual representations are accepted as the designer's most significant tools to generate and to express ideas. The components of the design thinking process and various approaches in the process were determined through these representations generated in this study.

THE STUDY

Design thinking stands for the cognitive, practical and strategical processes through which the design concepts are developed. Based on this, a model has been built around the *design process* and *design approaches* followed in the 2nd-year interior design studio. A design project was investigated as a case study within the scope of a doctor of fine arts research. The stages of the creative process have been determined through the contribution of the creative models from the literature. The components of these stages and different design approaches have been structured through a qualitative analysis of the data collected in the design studio. Based on the findings, the content of the study has been expanded and the design thinking model for the design studio has been developed with this research.

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METHODOLOGY

The study was conducted in the design studio with 60 students, which continued during one semester. Their experiences during the design process were evaluated through qualitative analysis. The design topic was given as a "hostel." The structural system of the building and the site on which it is located are determined as design constraints. As can be seen in the weekly chart (Figure 6), the design process began with research and then continued with conceptual design, the development of design ideas, and technical drawings.

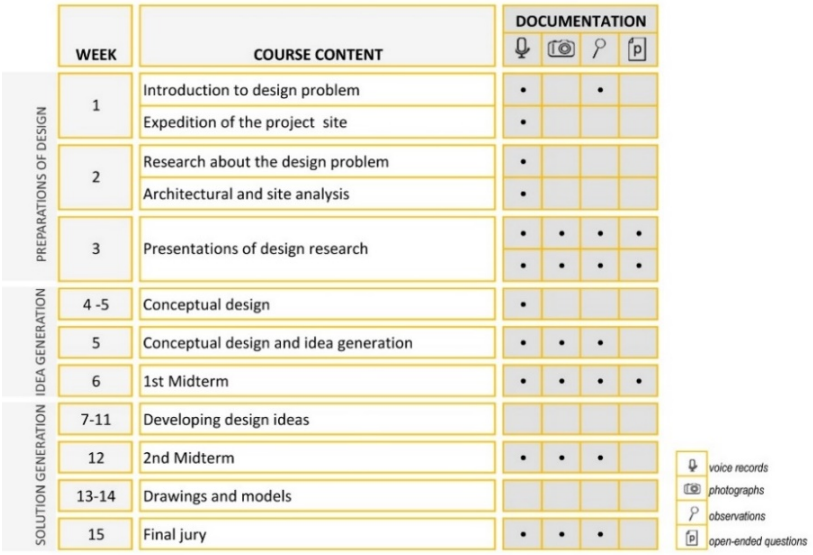

Figure 6. Course Outline and Documentation Methods.

To facilitate the retrospective evaluation, visual representations, recordings, observations throughout the process and open-ended questions posed to the students were used as documentation methods. After the problem was given, students had to explore the design problem field from different aspects during the first three weeks. That was an important research process to be generating or defining a unique problem for them. After this preparation process, they presented initial design concepts about their design problem. For this reason, the first six weeks of the course in which original design ideas were generated explicitly, were critical for this study.A total of 2250 photographs of the design project outputs (sketches, drawings, and models) were taken, and 39 hours of presentations were recorded during the studio critiques. 19 hours of these records, including presentations of design research, conceptual design, idea generation phase, and midterms, have been completely decoded. Visual presentations of designers directly representing the design process have been selected and combined with records. After these raw data have been grouped according to the students, datasheets that document the development of the

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participants have been prepared by the researcher. Details of these datasheets having student codes, images selected from the presentations, and information summarized from the data acquired are presented in Figure 7. The 3-piece datasheet, comprises conceptualization, form generation, and spatialization phases in order to have a holistic view of the process.

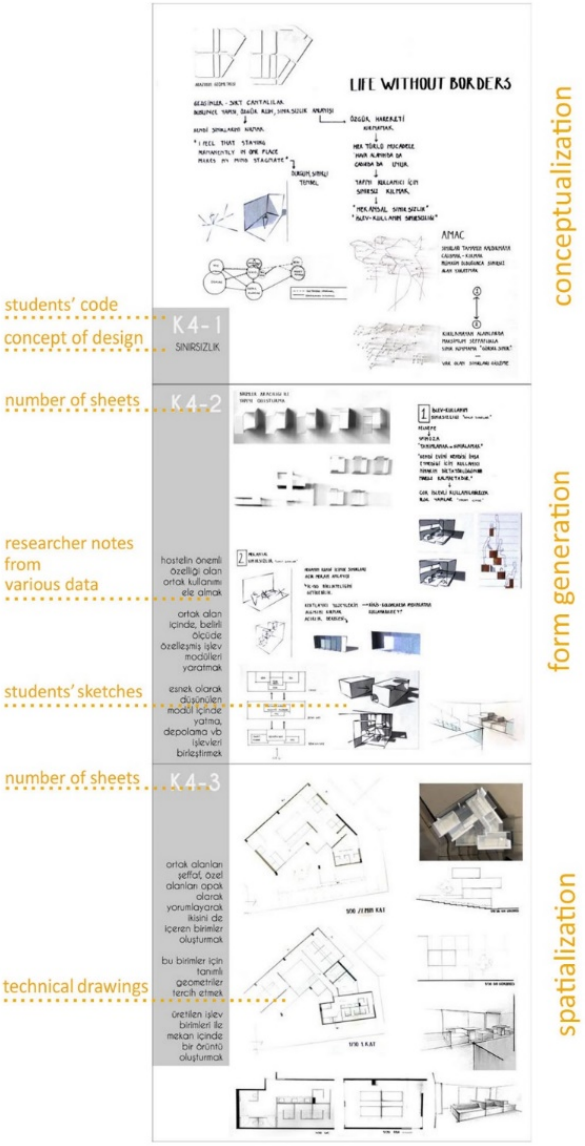

Figure 7. Explanation of data sheets

DATA ANALYSIS

Evaluation of the data acquired in the case study was realized in three stages:

- In the first stage, design thinking process models related to the scope of the study were selected from the literature, and the main stages of the *design thinking process* were determined by overlapping the design process followed in the studio.

-In the second stage, 15 students out of 60, who fully participated in the course during the first three weeks, were chosen and data were deepened through their studio outputs. In this way, the

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sub-components of the process and different approaches were identified from the data acquired.

- In the third stage, the design project outputs of the remaining 45 students was checked for other approaches, and differences were added to the content.

In the evaluation of the data, the design process was analyzed by decomposing it into stages from the general to the specific. Although the design students seem to have followed a similar process, significant differences were identified in detail, therefore, the findings were expanded by deepening the data.

The success rates were avoided on purpose in the evaluation. The objective was more to see the diversity of ways in generating design ideas on the same topic. For this reason, each approach was considered as a sample for a separate classification. Every difference detected in design thinking was taken into account in determining potential ways for the designer. The aim of the model produced was to show all these possibilities simultaneously.

Description of the Design Thinking Process

In order to determine the design thinking process, stage models dealing with the creative process through cognitive operations such as problem-solving, information processing, decision-making and so on, were considered in the research. The stages of the models were codified depending on the processes in Figure 8 to see the relationships between them. The figure shows that the creativity process starts with the preparation stage, then, ideas come together consciously or unconsciously for an ideal solution and the solution is evaluated before application.

In this study, which focuses on the generation of design thinking in the studio, evaluation and application were excluded and other stages were adapted to the course outline. In this regard, the design thinking about a specific topic was divided into two main processes. These processes were named as the *pre-design phase* during which intellectual preparation related to the topic was made, and the *ideation phase* during which ideas were generated and became concrete.

In the pre-design phase during which the contact with the design problem increases, the aim is to reveal the information about the problem. There is an initiating step in the transition to the ideation phase, in which concepts, images or ideas are encountered. Essential information from different sources come together at this step and spread out into new alternative solutions from there. This preliminary thinking phase has been emphasized in the study, as it reveals the main idea of the design. The design solution generating stage was defined through the association of mental and formal interpretation processes which

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depend on visual thinking and visual representation as part of the necessity of studio education.

1970	1985	1992	1995	2001	2003	
WALLAS	FRENCH	FINKE et al.	RUNCO CHAND	CROSS	MUMFORD	
preparation	analysis of the problem		problem finding	problem formulation	problem finding information gathering information organization	PREPARATION
incubation	conceptual design	analogic transfer association retrieval synthesis	idea generation	solution generation	conceptual combinations idea generation	IDEA GENERATION
illumination	embodiment of schemes	contextual shifting functional inference hypothesis testing				SOLUTION GENERATION
verification			evaluation		idea evaluation	EVALUATION
	detailing				planning the application	APPLICATION

Figure 8. Analysis of creativity models.

For this reason, this cognition-based research expands the creativity process, in a way that includes internal and external processes together as outlined in Figure 9. In this respect, the study differs from others.

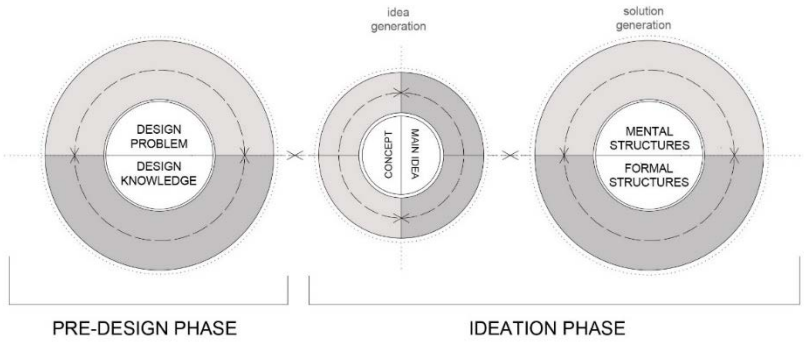

Figure 9. Outline of the design thinking process

Determination of Components and Approaches

In order to see the components of the two phases stated above, in-depth analyses were made on the design project outputs of the selected 15 students. Since the traceability of these phases is varied, evaluations were made by using different methods. The

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components of the pre-design phase were determined through the content analyses of the open-ended questions (Table 1), whereas the components of the ideation phase were determined through the students' presentations, voice recordings made during critique sessions, and observations of the researcher made in studio during the design process.

Table 1. Example of content analysis in pre-design phase

CODES	ANSWERS OF PARTICIPANTS	PRIMARY CATEGORIES	SECONDARY CATEGORIES
K1.	Social area, Friendly accommodation, Sharing rooms.	Type of Space	Objective Aspects
K2.	Affordable, Cultural interaction, Common kitchen.		
K3.	Public spaces, Sharing rooms, Environmental factors,	Functional Program	
K4.	Common areas, Cultural coexistence, Comfort.	Architectural Factors	
K5.	Affordable, Socialization, Culture change.		
K6.	Comfortable, Free, Low budget.	Structural System	
K7.	Limited spaces, Common areas, Low budget.	Environmental Factors	
K8.	Privacy necessity, Sharing living spaces, Motivating sociality,		
K9.	Intercultural diversity, Sincerity, Low budget.	Field conditions	
K10.	Traveling users, Meeting new people, User diversity.	Typology of Architecture	Subjective Aspects
K11.	Sociability, Free and limitless, Sharing living.		
K12.	User diversity, Daylighting, Neighborhood,	Daylighting	
K13.	Low costs, Common areas, An intimate atmosphere.	User Profile	
K14.	Common spaced, Cheap accommodation, Accessibility.	Other qualities	
K15.	Socialization, Cheap accommodation, Touristic location.		

All the data from 15 students were evaluated simultaneously in order to determine the variety of approaches in thinking

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processes. Then, the missing parameters were added to the components upon checking classwide. The components and approaches in the design process were compiled by the analysis charts as in the example in Figure 10 and then summarized with graphics that form the proposed model in the following sections.

Figure 10. Examples of analysis charts

Pre-Design Phase of The Design Thinking Process

Designing means to generate an ideal solution in the face of a problem. In the design studio, an intensive research process begins to collect data on ill-defined design problems by students. The essential information integrity, which starts and leads the design, is generated from these data. Based on this, the pre-design phase has been identified with two components, *design problem* and *design knowledge*, and detailed evaluations of these components have been made as follows:

- A problem in the field of design does not always indicate a troublesome situation, except for its widespread use, but rather refers to the design subject or content. By identifying the limitations and necessities related to the problem, it is expected that the designer's connotations, experiences, tendencies, and similar conscious or unconscious intuitions will interact with the problem. Analyses have shown that designers put forward some other limitations out of the given problem, utilizing their past experiences or information acquired. For instance, qualities of the "hostel" such as being "comfortable", "free", or "dynamic" have become the *limitations* the designers have propounded although they do not exist in the problem definition. In other words, the designer has re-defined the design problem through his/her objectives and wishes. In this light, some of the students only dealt with the defined problem, whereas some came up with a new one. This situation has been associated with the cognitive style of the designer, which is problem or solution-oriented. Also, the design problem as the first layer of the pre-design phase was detailed with the *designer-dependent problems* and *designer-independent problems*.

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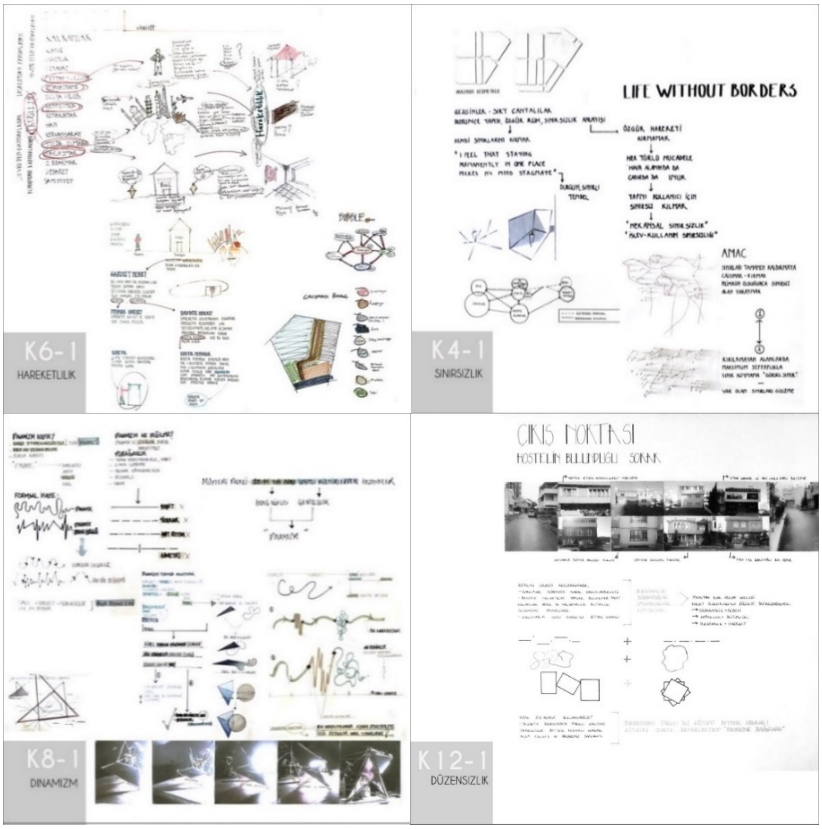

Figure 11. The use of *concept maps* (K6-1), *charts* (K4-1), *symbolic graphics* (K8-1), *photographs* (K12-1) in verbal and visual representations.

- Students' presentations showed that representation of information varied as *verbal* or *visual,* based on cognitive styles. Some participants used verbal expressions, whereas the others externalized information using concept maps, diagrams, symbolic graphics, or just photographs (Figure 11). Regarding the emphasized information, the verbal or visual dominance of these expressions varied. In addition to this, as observed in the study with code K8, the external representations in this phase contributed to the of the ideas in the further stages.
- What distinguishes knowledge from information is that it is interpreted and transformed individually for a specific purpose. External information, combined with the implicit knowledge of designers, builds a new intentional knowledge for design. For this reason, *design knowledge* refers to processed information about the design issues. In this study, the information that can be accessed from external sources is called the *objective aspect of design knowledge*, while the acquired or experienced information is called the *subjective aspect of design knowledge*.
- According to the analysis of projects, the sub-components of objective aspects were identified as *the type of space*, *design program*, *user profile*, *architectural limitations*, *environmental factors, etc.* Although, there have been a few, who defined the problem based on environmental factors only, information

about the type of space and user profile has gained more importance for the students.

- In this research-based stage, according to students, objective aspects were more important than subjective aspects, because of the desire to be aware of all details about the design problem. However, as sub-components of subjective aspects of the design knowledge, *connotations, past experiences*, *impressions*, *designer's preferences or tendencies*, etc. affected the problem formulation. It was observed that this knowledge depends on life experiences rather than on educational or professional experiences because the participants were second-year students.
- Students' presentations showed that representation of information varied as *verbal* or *visual,* based on cognitive styles. Some participants used verbal expressions, whereas the others externalized information using concept maps, diagrams, symbolic graphics, or just photographs (Figure 11). Regarding the emphasized information, the verbal or visual dominance of these expressions varied. In addition to this, as observed in the study with code K8, the external representations in this phase contributed to the of the ideas in the further stages.

Consequently, along with all these evaluations carried out for the pre-design phase, the components of the *problem* and *knowledge* layers were specified as *problem definition, problem approach, information source,* and *information representation* which are presented in Figure 12.

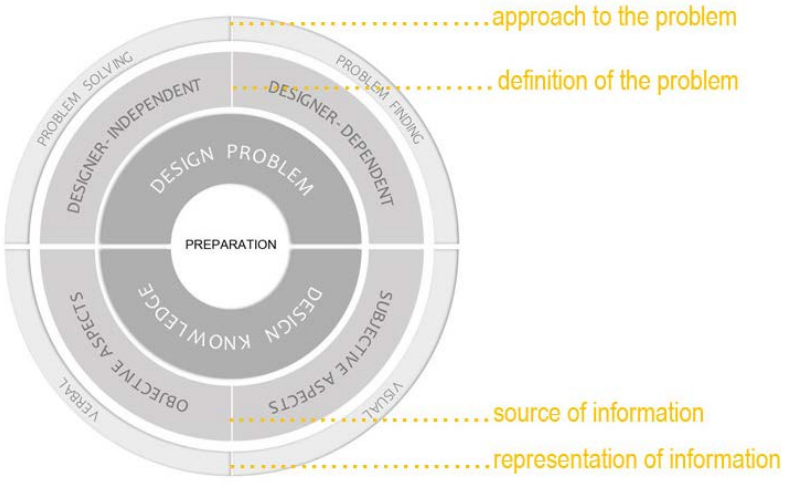

Figure 12. *Problem* and *Knowledge* Layers of Pre-Design Phase

Ideation Phase of The Design Thinking Process

After an intensive contact with the problem defined within the previous phase, the designer aims to find an original idea. For this reason, the transition step referred to as *conceptual design* in the studio becomes evident at the beginning of the ideation

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phase. During this stage, the designer considers *what the design will represent*, *what it will look like*, or *how it will be used*.

Following the inquiries about the *semantic*, *formal*, and *functional qualities* of space, it is desired to produce a *perceptional*, *emotional*, or *experiential* effect. To find an original idea, the designer needs some *triggers*, like concepts or images, regarding the aforementioned effects. Verbal or visual representations related to each trigger already have existing expressions in the mind. Therefore, visualization starts through imagination well before any externalization.

The characteristic features of the triggering concepts or images have an effect on the expressions of ideas within the visual thinking process. However, further interpretation of the main qualities is necessary for a unique solution. By means of successive abstraction and concretization, the initial ideas could be developed into conceptual and formal structures, and then spatial solutions.

Based on these explanations, the ideation phase of the design thinking is defined as two stages in which ideas and solutions are generated. In addition to this, the sub-components of the stages are explained according to the following determinations:

- The enlightenment in the pre-design phase establishes an important ground for the design ideation. The initial ideas have become an indicator of the fact that concepts or images, which have a close or distant relationship with the design topic, have interacted with each other consciously or unconsciously. The sources of triggering concepts specified by students have been verbal or visual evocations, past experiences, impressions, and preferences concerning the topic. Concepts that regard the *user profile* (e.g. freedom, dynamism, etc.) and the *distinctive features of space* (e.g. socialization, privacy, etc.) have become the primary initiator terms for guiding the design ideas.
- Concepts regarding objective and subjective aspects of design knowledge have been categorized as *quality-specifying*, *object/space-defining*, and *action-notifying* (Table 2). For example, "infinity" for K4 was one of the most important features of the space to be revealed in the end. On the other hand, using "street", K2 designed a hostel similar to another area, while K14 wanted to lead users' behavior with a multi-functional path.

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Table 2. Description and interpretation of concepts

QUALITY -SPECIFYING CONCEPTS	DESIGN IDEA	SPATIAL SOLUTION
K1. Freedom	Freeing the space	Separating the building from the ground and floors from each other.
K4. Infinity	Removing the spatial definitions and functional limitations	Reducing the spatial elements and merging the functions.
K6. Mobility	Maintaining mobility in the building	Mobilizing the spatial surfaces in all directions.
K12. Disorder	Disrupting the row-housing order.	Differentiating from the architectural typology by rotating the building.
K8. Dynamism	Arousing curiosity with a dynamic structure.	Using a rising, striking and dynamic structure in the building.
ACTION-NOTIFYING CONCEPTS	**DESIGN IDEA**	**SPATIAL SOLUTION**
K3. Creating a private space	Generating specialized modules in common areas	Forming modules for individual needs.
K13. Socialization	Bringing together and separating users and functions	Separating the private and public spaces with a multi-function wall.
K14. Gathering the users	Encountering users on a promenade	A functional path to be encountered within the building.
OBJECT / SPACE - DEFINING CONCEPTS	**DESIGN IDEA**	**SPATIAL SOLUTION**
K2. Street	Creating an interior street	Dividing the building into separate internal and external areas through a circulation.
K5. Puzzle	Different pieces coming together and forming the whole	Developing a construction method with partition walls.
K7. Backpack	Having a sufficient amount of the need	Realizing multiple functions with few items.
K9. Origami	Reaching the whole with similar parts	Forming the space by using folded surfaces.
K10. Stop motion	The contrast between dynamic and static elements	Changing the orientation of repeating similar items.
K11. Caravan	Multiple functions in a narrow space	Using compact solutions as in a caravan.
K15. Inn	Similar solutions as in a traditional example	Locating the accommodation units around an inner court.

- It has been observed that the concepts have been dealt with in two ways. Some students have used them as a tool (e.g. caravan, street, module), while, others have used them for a purpose (e.g. freedom, infinity, dynamism). For example, using

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sleeping units for private solutions in K11, the concept of "modules" has become a tool for design solutions. In contrast, the concept of "freedom" has shown the design purpose of K1, rather than a design solution.

- It has also been determined that the design idea is associated with at least one of the *semantic*, *formal* and *functional* parameters of the space. Each study came to an end with a spatial form, but the relationship with the semantic and functional parameters varied. In the study with code K4 for instance, the concept of “infinity” was interpreted as “the spatial and functional infinity”, so it was associated with all those parameters. On the other hand, K13 aimed to isolate private spaces through a volumetric path, and only the functional parameter has been taken into consideration.
- It has been observed that there are several relationships between concepts and images depending on semantic, formal, or functional transitions. The formal transition has been referred to as an analogical exposition, the semantic transition as a metaphorical exposition, and the functional transition as a usage exposition. In the case of concepts such as freedom, infinity, and mobility, the typical feature of concepts has been transferred to space semantically, which is a metaphorical exposition. For example, the concept of "freedom" has been defined through “the situation without any restrictive connection” in K1, and the building as an unbound person or thing was raised by separating from the ground (Figure 13). In different circumstances, an analogical exposition has been used through concepts that describe a concrete object/space such as “caravan, street, or inn”. In such concepts, there was a formal or functional similarity between the source object and the final space. In the example in Figure 13, the inner plan of the inn has transferred in the pension with an atrium. In other studies, triggering ideas that imply an act such as comparison, socialization, or isolating the private space, has provided a new usage.

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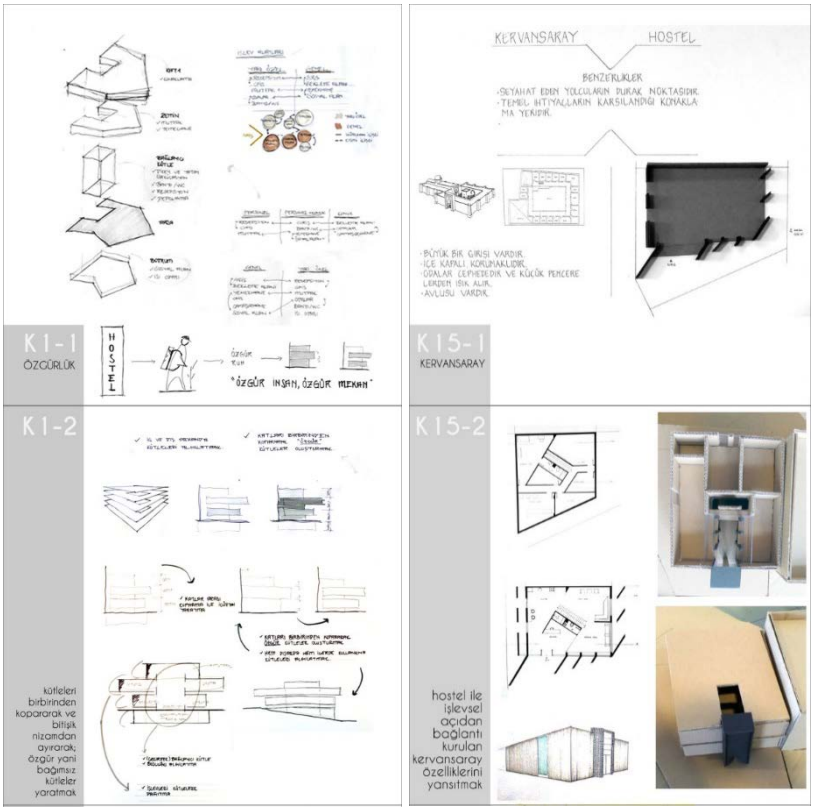

Figure 13. Examples of semantic transitions (K1), and formal transitions (K15).

- After the conceptual stage, it became necessary to define characteristic features of concepts and images in order to reflect them to the spatial aspects. In the example of K6 "mobility" was represented visually by moving the spatial surfaces like walls, grounds, or ceilings toward different directions in an immobile space. In the other project with code K11, a compact solution similar to the caravan was put forward in order to implement multiple functions in the limited space. In other words, the functional solutions gained more importance than the formal aspects of space.

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- It was observed within the studies carried out that some students processed concrete concepts like street, origami, puzzle, etc. whereas the others preferred abstract concepts like infinity, mobility, dynamism, etc. in the idea generation stage. Formal features of the concrete conception enabled the use of it as a source. However, students who preferred abstract concepts had to look for other formal sources. Depending on this, two types of form-giving approaches, *space-dependent,* and *space-independent* have been detected. The observations showed that space-dependent solutions relied on an existing architectural space or environment, whereas space-independent solutions relied on other existing images or archetypes, which were generated by the designer. For example, conceptual sketches and draft models were made for embodying "dynamism". These abstract trials have been gradually embodied and turned into the space through functional parameters in K8. However, in the other project in which the concept of "socialization" was used, the formal aspects of the existing architectural space were utilized because there was not any associational form of the concept (Figure 14). Besides, in the study with code K2, the existing building was divided into two separate blocks through a walkway similar to a "street".

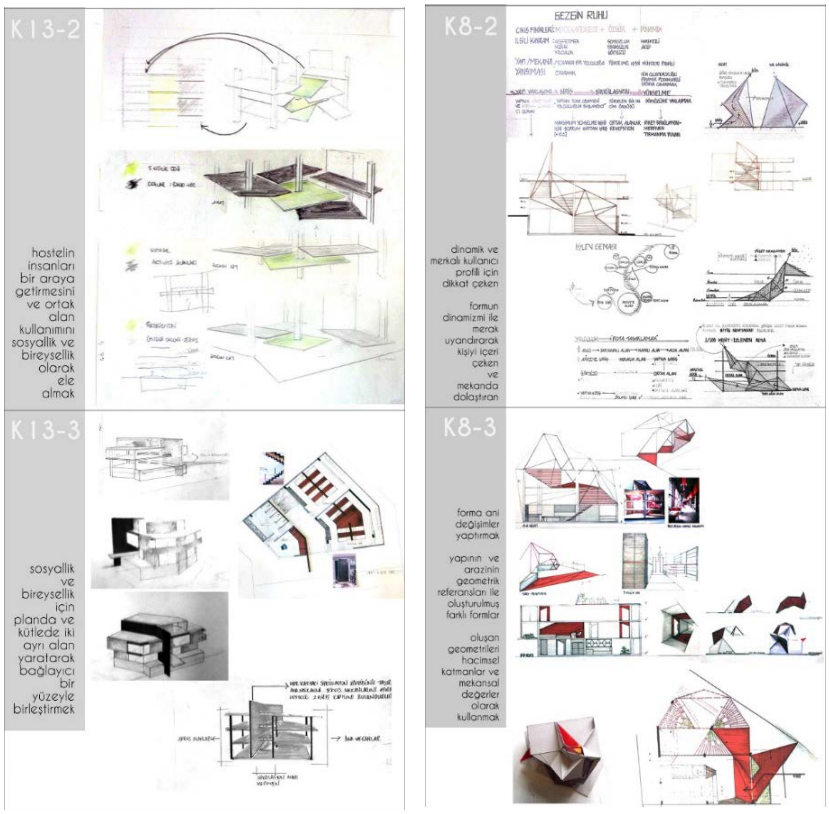

Figure 14. Examples of modification (K13) and adaptation (K8).

- In space-dependent designs, the geometric properties of existing architectural space were mostly preserved as in the

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K13. However, in space-independent designs, different formation technics have been detected. Regarding this, using visual aspects of an image was defined as a *transformation*, using geometric aspects of the existing building was defined as a *modification,* and using another archetype was defined as an *adaptation* (Figure 14).

Based on the determinations above, the ideation phase has been defined within two stages, as *conceptualization* (*idea generation)* and *spatialization (solution generation)*. The sub-components of the stages and the ideation approaches are shown in Figure 15.

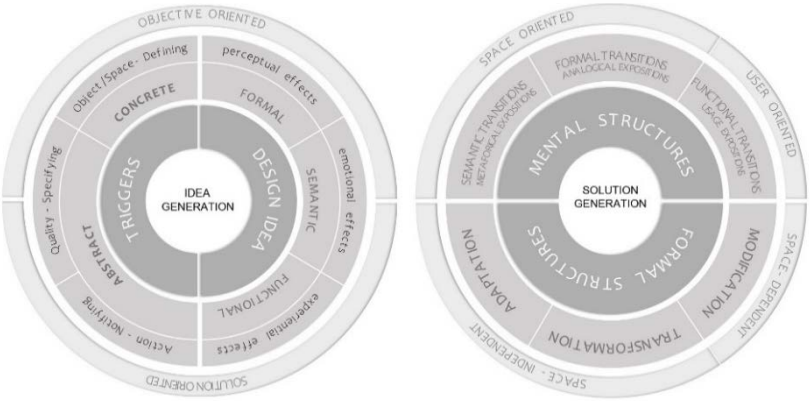

Figure 15. Layers and components of Ideation Phase

Based on these evaluations, two of the diagrams, formed in the pre-design phase and the ideation phase, have been associated with each other and expressed by a model of design thinking. The details of the model and recommendations for future studies are stated in the conclusion section.

CONCLUSIONS AND RECOMMENDATIONS

Based on the study, the pre-design phase and the ideation phase have been determined as two main stages of the design thinking process. The components of the pre-design phase were defined as *design problem* and *design knowledge*. On the other hand, the ideation phase has been divided into two sub-processes that include the generation of ideas and solutions.

In the conceptualization stage, the layers of triggering concepts or images and the main idea have been analyzed. In the following spatialization stage, the layers of mental and formal structures have been discussed. Individual differences specified through the qualitative analysis of the students' works have constituted the subcomponents of each layer. Ultimately, with this content of data, a model has been proposed (Figure 16).

According to the model, the definition of the design problem varies depending on how the designer handles it. The designer's approach to the problem shows the relationship between the two main styles, problem-solving and problem-finding. On the other hand, design knowledge as one of the most important

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factors of design ideation also varies according to the problem definition. The designer processes his/her past experiences, educational or professional acquisitions, and his/her subjective tendencies with essential information about design the problem. In other words, the design knowledge and the design problem interactively initiate the design process. Therefore, the pre-design phase of the model is considered the first step for originality in the design process.

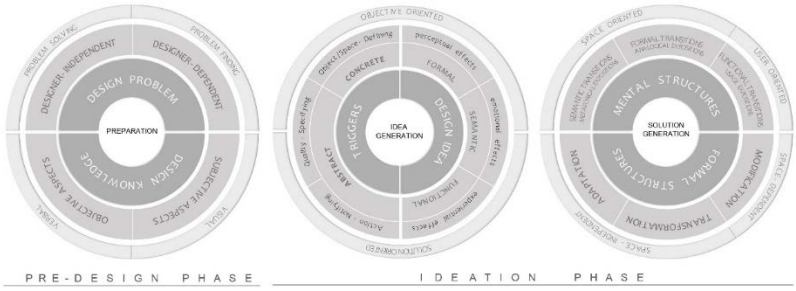

Figure 16. Infographic Model of Design Thinking Process

At the beginning of the ideation phase, the designer searches a good reason or a design purpose through the information acquired. This is the most important step of the model, especially for educational practice. Because the internal process of design thinking starts to externalize during this conceptualization stage. For the externalization of these implicit operations, the designer often needs some initiators, such as images or concepts related to the design problem. The triggering concepts or images relate to at least one of the semantic, formal or functional parameters of the design. These concepts, which can be concrete or abstract, begin to emerge both mentally and physically through imagination and representation. Therefore, the unique purpose of the designer and the semantic, formal or functional ways to achieve it are determined at this conceptualization stage.

Form-giving to an idea is another important stage that varies according to the type of design discipline. In design disciplines related to the living space like interior design, some architectural or environmental limitations affect the design. These limitations should be considered, but there are also some opportunities to interpret them uniquely with the help of concepts in the previous stage. In addition to modifying the architectural form, generating an archetype or transforming the visual qualities of the design concept can be used for the spatialization method.

As a result, the model summarizes all the methods observed in this study to show different options for users. Additionally, this model has also been designed to be used as an analysis tool for other studies. Because of this, each stage has been represented with a circle and each circle has been divided into layers and

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sub-components in the graphic expression of the model. In this way, an information chart has been generated, that each student can be coded in different colors and her/his design process can be pinned on the model. In the example of Figure 17, 5 students have been integrated into the model according to their similarity in conceptual design and the divergent processes have been evaluated.

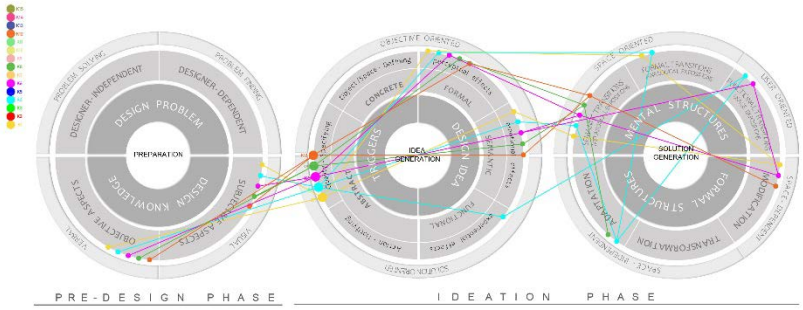

Figure 17. Using the Infographic Model of Design Thinking Process as an analysis map.

For example, K4 differs among these students as s/he used all the possibilities of semantic, formal and functional parameters during the ideation phase. Besides this, there isn't any quality-specifying concept, which used the transformation in the spatialization stage. Regarding this, the model allows further analyses of any stage or the whole process, and it can be expanded with different contains.

The primary purpose of the model is to give information about the process, components, and different approaches, whereas the secondary aim is to provide a template for monitoring the data analysis. It has the potential to demonstrate both information content and data analysis simultaneously. For this reason, the model is referred to as the *infographic model of design thinking*,

The model does not suggest a specific design method but documents the previously employed methods in the studio. With this regard, it should be considered as a content map that represents potential ways of thinking. These ways crossed or separated according to designers' approaches at significant junction points have been recognized as essential moments in design, especially in terms of diversity and originality.

In conclusion, this study intends to observe the creativity process rather than measuring creativity in design studios. With the proposed model, it is aimed to offer a two-way contribution to design education. The first one is to discover the important moments, which have the potential to guide the design process, thereby leading the design students to an alternative way of thinking. The second contribution of the model is to introduce both an ideational and a graphical template for further analyses or evaluations to be carried out in design studios.

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Resume

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Research Article

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A Scientific Approach to Flat-For-Land Basis Model in an Urban Transformation Project: Beyoğlu Okmeydanı

Ufuk Altunbaş*

Abstract

Purpose

Contribution to our country's urban transformation application literature was aimed via the transformation and mathematical distribution model which was developed considering the unique properties of Okmeydanı Urban Transformation Area, which was officially declared as "risk area" by the Cabinet.

Design/Methodology/Approach

After the Introduction, information about the emergence, definition, purpose, and differences in the historical application of the concept of urban transformation were given. The changes of urban transformation practices and their reflections on the cities since 1950s in Turkey were analyzed on the basis of urban transformation experiences and practices in the developed countries. Financial methods used in transformation projects were discussed in detail by taking the current urban transformation law and policies into consideration. On the third section, physical, social, and economic data regarding the City of Istanbul, Country of Beyoğlu, Okmeydanı Urban Transformation area, which is the main topic of this study were presented in detail. The

Keywords: *urban transformation, urban regeneration, flat for land basis model, Beyoğlu, Okmeydanı*

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urban transformation and distribution model which was developed based on the technical data, community requests, and official data was described in detail with its formulas. In the conclusion section, the reflections of the model on both the area itself and on the city were evaluated.

Findings

In accordance with the analysis conducted based on the current settlement, the size of the population, and the zoning plan of the urban transformation area; it is inevitable for the rights holders to agree to a downsizing of their estates and to take action collectively. This situation makes it harder to realize the urban transformations' legal obligation of approval by at least 2/3rds of the rights holders. Furthermore, meeting of the investor's and all the rights holders' project rights on the project area will inevitably result in new urbanization problems in the future.

Research Limitations/Implications

Due to the not being able to collect enough social and economic data on Okmeydanı Urban Transformation Area, the developed transformation model was based mostly on technical and physical data. Therefore, the social evaluation, which is one of the requirements of a successful urban transformation could not be conducted.

Practical Implications

The determined urban transformation model for Okmeydanı Urban Transformation Project was developed in a transparent and egalitarian approach using the official data, supported by scientific methods, and preparing the legal background for all decisions.

Social Implications

Although the social data of the area was not one of the parameters used in the developed transformation and distribution model, the implementation of the transformation model is consistent with the social benefit expected from transformation projects since it is based on the principle of keeping the resident rights holders in their neighborhood after the completion of the project.

Originality/Value

Okmeydanı is an area that is not suitable for implementation of previous transformation models due to its ownership structure, its licensed and unlicensed constructions since 1950s, its historic past and protection status, location, population size and density, and inevitability of unified action from its residents because of the zoning plans. Therefore, a unique model that befits the unique properties of the area was developed.

INTRODUCTION

Although the concept of city has a major criterion such as the coexistence of a certain number of people, it is actually as old as the history of human beings in terms of geographic locations of different sizes, where there is communication between people. From the first settlements to the present day, all cities have been in a continuous change and transformation. This is in fact a natural consequence of urban life and conditions (Harvey, 1987). At the same time, these changes contained both chances and risks for the future of the cities. As a matter of fact, while many cities that do not keep up with the social, cultural, political, physical and economic changes in the globalized world face either degrowth or disappearance, cities that turn competition

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into opportunities have turned into big metropolises in every sense. While this transformation process took place gradually due to needs and challenges of the period in some cases, on other cases it took place with the projects realized by the human hand.

Urban transformation practices, which aim to improve the physical structure in the rapidly transforming cities, prevent social and economic problems, increase economic and cultural opportunities, and develop social life for weaker groups – especially children and young adults (Auerbach, 2013), have first emerged in the United States, then spread to the United Kingdom and Europe respectively (Carmon, 1999). While the urban transformation implementations had positive aims such redesigning the unplanned growth of the citites and includingthe slums and the poor living areas in the urban planning initially, later on it turned into a negative process with aims such as removal of the poor class from their living areas and introducing new functions with high economic value to these regions. This situation brings to mind the most criticized notion of ''gentrification'' in urban transformation literature, and urban transformation practices in all around the globe have become subjects of criticism in terms of location selection, method, purpose and results. The fact that fundemental changes caused by big urban transformation projects in the physical region change both the region and its surroundings both economically and socially is accepted by everyone. This is the biggest indicator of the fact that the practice is not only a construction activity, but also a total social engineering project that shapes the economic, social and cultural lives of the inhabitants of the city.

All positive and negative practices of the urban transformation that took place in the developed countries where it first appeared are also forms the recipies for the correct implementation from now on. In fact, these policies forms a basisin particular for developing cities, and they need to identify their own transformation policies by paying attention to the local characteristics and potentials of the city. In this context, unfortunately, the concept of urban transformation in our country is perceived only as a change of the physical structure. Illegal buildings and squatters get demolished in the classical zoning concept and high-rise buildings get constructed in accordance with development plans. Strategies that take into account the social, economic and environmental aspects of the issue are not developed. As a natural consequence of this generally accepted and preferred approach, urban transformation in our country is perceived as a rental income source by the society. In order to remove this perception and to avoid development of bigger problems due to these urban transformation processes that we witness even more often,

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development of urban transformation models that are unique to our country is inevitable for all stakeholders. Therefore providing an alternative model for urban transformation applications in similar areas was aimed in this paper. Although the model developed in this paper mostly contains mathematical parameters for the physical structure, it also puts emphasis on the social structure with its aim to keep the residents in their own locations. For Beyoğlu – Okmeydanı region, which was legally declared as an urban transformation zone in 2016, mostly theoratical and project based works have been completed, and the negotiations still go on. Demolition and construction work has been started only on a very small section of the areas with completed negotiations.

CONCEPT OF URBAN TRANSFORMATION AND PERCEPTION IN TURKEY

The Emergence Of Urban Transformation And Its Historic Evolution

The concept of urban transformation can be defined differently in terms of its purpose, method, point of view and results, since it involves more than just the physical transformation of a space. In its broadest definition, it includes all the economic, social and physical interventions for the city (Couch *et al.*, 2003). Thomas (2003) define the urban transformation as the whole of actions that try to improve the physical, social and economic conditions of a region and try to find a permanent solution to the problems. According to Moseley (2006), urban transformation has a different meaning for everyone, it can be define as a series of processes for betterment of land, ownership and infrastructure in order to gain social, economic and environmental benefits. Couch (1990) already refers to urban transformation as an effort of the state or local people to improve the quality of life in the city.

Donnison (1993) describes the urban transformation as the path and methods of all the units of the city in order to find solutions to the problems in the city's collapse areas. With a similar definition, Roberts (2000) define urban transformation as a consensus that reveals the processes of urban deterioration and the intended results after the transformation. What is meant by a consensus is that all stakeholders agree on a targeted outcome in order to restore economic viability, establish social cohesion, and improve the quality of life in areas where economic, social and environmental problems exist.

It is possible to classify the purpose of urban transformation in different ways based on all the definitions that complement each other. Verhage (2005) classifies it in three groups as socio-

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economic, socio-cultural and physical-economic objectives. For socio-economic objectives, the aim is to obtain building typologies where individuals from various socio-economic groups can live together and to increase the activities that will boost the economic viability in the region. For socio-cultural objectives, it is essential to strengthen the social cohesion and increase the social activities and the struggle against crime rate. For physical-economic objectives, increasing the economic value by enhancing the infrastructure facilities, transportation network, public space quality and social space quality of the region and making the region attractive for the private sector come into prominence. Getting into a bit more detail than Verhage, Roberts(2000) divide the objectiveof urban transformation into 5 groups. The first one is to investigate the causes of social degradation and to take preventive measures to intercept the formation of depression areas caused by deterioration. The second is the focus on the re-planning of the urban areas according to the physical, social, economic and environmental needs that arise in the rapidly growing, changing and deteriorating texture of the city. The third objective is to introduce new development approaches to improve urban quality of life. Fourth, the development of strategies to restore vitality in places where economic viability is lost. The last one is to introduce the most effective use of urban areas and strategies to avoid unnecessary urban spread.

For all these objectives, different transformation methods have been preferred in line with the needs of the region, the conditions of the period, and the country's transformation policy. Urban renewal, revitalization, rehabilitation, redevelopment, urban clearence, regeneration, preservation, and gentrification can be counted as the foremost of these methods (Zeng *et al.* 2014). However, these methods actually do not have very different meanings. There are even experts who think that methods are intertwined or that one is the subheading of the other. For example, according to Clay(1979) gentrification is one of the two basic types of revitilization method. Pınar(2016) believes that gentrification is not a method of urban renewal but is essentially the result of urban renewal. Rui(2003) defines restoration, rehabilitation and redevelopment methods as sub-titles of urban renewal method in his renewal matrix.

Economic, political and social factors are the most decisive elements in determining the name of these methods which are not far from each other and/or which one is preferred. In particular, the perspective of the ruling party on the issue reveals the programs and approaches to be used and shapes city policy of the country (Beswick and Tsenkova, 2002). Throughout history, urban transformation practices have been implemented

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through these factors first in the US, and then in the UK and other European countries. As a matter of fact, the interventions of Haussman in the center of Paris in the middle of the 19th century and the construction of new buildings in London after the big fire can be accepted as urban transformation practices and they were made within the framework of the political decisions of the period (Couch and Fraser, 2003).

It can be said that urban transformation practices have become a part of the urban policy as a method after World War II. Roberts (2000) divided the evolution of these policies into five periods in terms of the period after the war. Although these policies differed from country to country in historical terms, in general the dominant understanding in the 1950s was reconstruction, revitalization in the 1960s, renewal in the 1970s, redevelopment in the 1980s, and regeneration in the 1990s. Since the 2000s, the urban renaissance has entered the agenda of urban policies as a new concept originating from the UK (Lees, 2007).

After World War II, most European cities had to face re-construction. This situation has been observed not only in urban centers but also in residential and industrial areas (Couch et al, 2013). This process is realized in 2 stages. In the first stage, it is aimed to demolish the designated area as the area of transformation, and in the second stage, it is aimed to construct new buildings. Essentially, demolition is a widely used method in the United States and England since the 1850s (Diacon, 1991). However, the reconstruction policy was started to be discussed in the 1960s due to the cost of new building construction and slum's cleaning. Experts such as Ian Nairn and Jane Jacobs joined the discussions with their criticism that the process should be conducted more humanely(Couch *et al.*, 2013). Another criticism of the method is that the regions that most frequently face the practice of destruction are poor and ethnic regions where minorities live. In addition, similar discriminations in the allocation of housing in the new buildings caused the method to be accused of racism. In order to prevent these criticisms, legal regulations had to be made (Pacione, 2001). After all criticism and negative results, the policy of "reconstruction" has begun to be abandoned since the 1960s. The first country to give up this policy in Europe was Britain in 1957 with the Law on Housing Act (Couch *et al.*, 2003)(Couch *et al.*, 2011). From the 1960s onwards, the prevailing urban policy is the "revitilization" method. The emphasis is also on the economic and social aspects of settlements, not just as a physical site. Kenedy and Leonard (2001) defined the physical dimension of the new transformation policy as building and street texture quality, economic dimension as job and service opportunities, and social dimension as reducing crime and increasing job opportunities. In

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this sense, it is possible to show the historical sites as the best examples for "revitilization" method. The restoration practices in historical places ensure that the historical heritage is preserved and transferred to the generations in a physical sense, but it is insufficient to ensure the continuity of the site economically and socially. On the other hand, Oc, Heath and Tiesdell(2010) believe that the revitalization policy will provide a great contribution to the revival and sustainability of the region by introduction of new economic functions in the restoration areas and integration of identifying feautres such as the street texture in the new designs.

As a matter of fact, the subject was considered together with its social dimension with the concept of secteur Sauvegardein France (1962) and the concept of “conservation areas” (1967)in England, which are developed European countriesthatare aware of the importance of revitalization policy in historical places. The role of urban transformation in the 1970s has changed somewhat since then. The economic recession resulted in unemployment, the increase of vacant lands and the increase of migration from the city. Transformation practices have started to be used as a tool to get out of the economic bottleneck (Couch et al, 2013). The first emergence of the new urban policy called "Renewal" was in England in 1969. England was followed by the Netherlands and France in 1970 and by Germany in 1971. Although there were different approaches in each country, generally they all cooperated with the private sector(Couch and Fraser, 2003). In the 1980s, the redevelopment policy came to the fore. However, there has been no major change in general policies. Only more attention has been paid to the economic dimension of the work. Demolition and displacement applications were preferred to make better quality, economic and functional buildings by using technological facilities (Visscher *et al.* 2006). However, the problems experienced in the evacuation processes of the residential areas planned as a transformation region have created great obstacles in the implementation of the applications. In addition, the social and political adversities caused by these projects have made the application of "redevelopment" difficult. Because of such negativities, the 'redevelopment' policy was implemented mostly outside the city and in commercial areas. Newly produced buildings weremostly commercial buildings such as large business centers, fair areas or hotels and have contributed to the economic development of their surroundings (Koebel, 1996). The dominant policy in the 1990s was "regeneration". It is a more comprehensive, longer-term and practical policy than previous policies. Private sector, transformation-oriented agencies and voluntary funds are in cooperation with the public

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in the process. It is a process that involves experts from different disciplines and includes political, economic, social and managerial elements(Teixeira, 2010). In the 2000s, the 'regeneration' policy from England was replaced by the 'urban renaissance' policy. Although they are similar to each other in a multi-faceted way, sustainable and liveable cities are targeted in areas such as social improvement, health, crime, education, environment, energy and freedom, where more actors are together and social participation is achieved (Lees, 2007). There wasa global competition among cities through large projects (Couch et al, 2011).

Urban Transformation in Turkey and the Financial Models Used

Although the method, time and name of the policies implemented vary from country to country, it has been shaped from the perspective of finding solutions to the problems that arose in the previous practices within a certain system in developed countries. Unfortunately, it is not possible to talk about a similar system in our country. Torus and the Aydin Yönet(2016) analyze the above historically grouped and defined urban policies in three different periods for Turkey. The first one is between 1950-1980. In this period, according to statistics, the number of squatter houses in cities reached from 25,000 (1948) to 1,5 million (1983). The legalization of the squatter houses, which the state is forced to accept out of the political concerns, has started the transformation in the squatter neighborhoods. Over time, the legalized squatter houseshave been demolished and multi-storey buildings have been built (Akkar Ercan, 2013). Regeneration and rehabilitation come to the forefront in these squatterareas as a transformation policy. Thus, it is aimed to gain the squatterareas for the city in line with a certain plan. The second period is between 1980-2000. In this period, renewal, rehabilitation and preservation practices come to the fore with neo-liberal policies and the effect of globalization. Transformation practices are seen as a market tool and used by all partnersto provide economic benefits. In the previous period, the construction process, which was carried out through local contractors, gradually fell into the hands of big contractors. In the same period, some public companies, especially Public Housing Administration(TOKİ), have been involved in the construction process. In addition, in 1980s and 1990s the Law for Metropolitan Municipalities No. 3030, Zoning Law No. 3194, Mass Housing Law No. 2985 and Law No. 2981 have accelerated the process by increasing the effectiveness of local governments on urban regeneration (Akkar Ercan, 2013). The third period is the period from the 2000s to the present. In this period,

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dominant policies are renewal and reconstruction. The most important issue affecting the process is the natural disasters. The shock which was created in the society upon the Marmara Earthquake of 1999 has triggered the process of urban transformation in Turkey. In particular, the demolition and renovation of the apartments has accelerated. However, after the Van earthquake in 2011, it was realized that the transformation issue could not be overcome with building renovation. The idea of approaching the subject as spatial rather than the building was supported by the central government and in 2012 the Law of Transformation of Areas Under Disaster Risk No. 6306 was enacted. Thus, the issue of urban transformation has become a country policy.In the same period, Law of Usage of Timeworn Historical and Cultural Real Property with Restoration and Protection No. 5366 (2005) facilitated the transformation process in historical places. The aim was to speed up the process in all the legislative amendments made especially in the laws numbered 5366 and 6306. In both the central government and the authority received from the center, the local government increased its cooperation with the private sector. Thus, while the public is benefiting from the financial power of the private sector, the private sector also reduces the risk thanks to the public assurance. Considering the financial dimension of the transformation projects, this cooperation has become the most important strategy of urban transformation projects for our country.

Financing is one of the most important issues in terms of urban transformation practices in developing countries like our country. Transformation especially in large areas is long-lasting due to the fact that the area of influence is not limited only to the selected area, but it concerns all segments of society socially, culturally and economically and takes important decisions about the future of the city. It is inevitable for the organization to be financiallystrong in order to prevent the practices to be interrupted within this period. This situation is solved by the participation of non-profit organizations in the multi-sectoral partnerships established in the developed countries based on upper-scale strategies, in order to increase the reliability in public, private and civil organizations as well as in expenditures (Atkinson, 2004; Hague, 2004). However, similar mechanisms have not yet been established in developing countries like ours.

In our country, the number of urban transformation applications that are seen as a so called magic wand solution in order to find solutions to the problems of urbanization are increasing day by day. However, the financing of such projects by the state becomes more difficult. Revenues determined in accordance with Law No. 6306 for use in transformationpractices only consist

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of50% of the contributions and administrative fines collected under the Environmental Law, 90% of the sales revenue of the lands that are taken out of the forest known as 2B lands in the community, and the %50 of profits of Iller Bank(ILBANK) from certain activities. Apart from these, TOKI or public companies that do not have large profit targets are put into service. Despite all the public resources, it is not possible to make the transformation only by the state. It is inevitable to cooperate with the private sector.

The financial methods that can be used in the cooperation phase are divided into two groups as Internal and External Resource Solutions in the City Planning Council Urban Transformation Commission report (2017) organized by the Ministry of Environment and Urbanization. Internal resource solutionsare divided into 7 sub-headings, namelyflat-for-land basis, revenue sharing, based on squatter law, agreement-based, cost-based, value-based and ministerial credit subsidy; while external resource solutions are divided into 5 sub-headings, namely bond issuance, infrastructure real estate investment trust, real estate investment fund, real estate certificate, and funding from international organizations.

One of the most preferred internal financing solutions is the "floor equivalent" model. On the basis of the model, the constructed areais shared between the rightholders and the contractor accordance with the construction area stated in the zoning plans. Local government has more regulatory effectiveness since it is frequently used for building-scale transformations. "Revenue Sharing" is another preferred model. The income from the project on empty public lands is shared between public or semi-public companies such as TOKİ, İLBANK, Istanbul Residence Development Plan Industry and Trade Inc. (KİPTAŞ) and the investor. Not paying for the land initially, ease of processing, ability to sell before the end of construction and tax exemption are the most attractive propertiesof this model. In the "Squatter-law-based" model, construction on public land is demolished and construction is carried out on the rights determined in the zoning plans. The owners of the building, have the right to pay for the remaining parts of the collapsed buildings after they have been deducted from the deed and, if any, the title deed. In the Agreement based model, while the area of urban transformation is declared, the reserve area is determined. Reconciliations are made on the structures in the reserve area with rights holders and existing buildings are emptied. The new phases of these areas are then discharged and the other phases of the project are financed. In this model, both private and public institutions and companies can be employed. For Value-based model, construction size is not a criterion. Property is accepted

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as a financial input. In the model, it is essential to share the new project value between thepartnersby taking into consideration the pre-project value of the current structure, the cost of the investor including the profit and the expenses. In the Value-Based transformation model, an agreement is made on the cost of construction by the right holder and the constructor persons or institutions. One of the partners is obliged to complete the construction and the other is to pay the construction cost to the other partners. The last one of the internal financial solutions is the Ministry Loan Subsidy. In this model, the Ministry of Environment is provided with interest support for the loans to be used under the Law No. 6306 for the purpose of encouraging the transformation of risky buildings.

Although the legal arrangements have been completed in the external resource solutions, they are rarely preferred due to the length of the procedure, our country's high risk perception by international institutions in accordance with the current world political conjecture, and lack of testing by internal institutions of Turkey.

All legal arrangements and alternative financing methods show that the transformation issue has 3 important stakeholders in our country. The public sector that manages the organization from the administrative point of view, the private sector that is responsible for the finance and construction activities, and the rights holders most affected by the process. The ability of partners to act together is directly related to the success of the transformation project. In this context, a mathematical model must be put forward regardless of the preferred financial method. The most important part of the model is the conversion coefficient that determines how and to what extent rightholders can benefit from the new project. The conversion coefficient can be defined as the size/value of the rightsholders' estate against 1m2 of the new building, or conversely, the area that the rightsholders can buy from the new building against their real estate's size/value. The success of the complex studies involving many actors such as urban transformation depends on the correct determination of the mathematical model and the conversion coefficients.

The most important factor in determining the method and model in the transformation practicescarried out in our country is the characteristics of the transformation area and the state of rightholders. Thus, it is not possible to talk about a general model for our cities where uncontrolled construction takes place in many different ways. However, whichever model is chosen, usually the residents of the area to be transformed do not have the necessary financial means to join in the transformation project. Accordingly, the residents can only join in via the value

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of their real estate. Although different models are used to asses the values of real estates, Yalpır(2007) classifies them in 3 main groups: traditional, statistical, and modern. Despite the differences of these methods, while the value of a real estate is sometimes assessed using environmental aspects such as distance to the city center, population density, environmental quality, noise pollution, distance to the commercial areas, transportation, location, demographic structure of the region; at other times it is assessed using the building's own parameters such as construction quality, number of rooms, parking space, age, existence of a swimming pool-elevator-parking lot, number of floors, view, ownership status and structure.

In this context, the Okmeydani Urban Transformation Project is a transformational area where it is not possible to approach the issue through mathematical methods used in the previous urban transformation practices in terms of ownership status, legal structure, demographic characteristics and location. However, as in other urban transformation areas, in Okmeydanı, the right owners only participate in the transformation project based on their real property value. Therefore, the values of real estates in Okmeydanı had to be determined by calculating both their cost and market values. However, during those calculations while some parameters had to be given more weight, some other parameters had to be ignored altogether; due to the characteristics of the area. Based on calculation results, the determinedconversion coefficients were calculated as the unit price to be used in the calculation for each 1 m^2 area to be offered to the right holders from the new project. Thus, it is aimed to conduct the transformation process in the field in a proper and fast manner, and an alternative distribution model proposal has been developed to be used in transformation areas with similar characteristics.

MATHEMATICAL MODEL ON TRANSFORMATION AND SHARING IN OKMEYDANI

Data on Okmeydanı Urban Transformation Area

Okmeydanı, which is located within the boundaries of Beyoğlu district of Istanbul, dates back to the conquest of Istanbul in 1453. It is one of the three regions where Sultan Mehmed the Conquerorraised his tent in order to manage the armies in which pre-conquest war preparations were made. (Bir *et al.*, 2006).

Okmeydanı after the conquest wasone of the oldest sports fields of the world where archery, wrestling, javelin, and track races wereperformed (Bir *et al.*, 2006), in addition to its usage for purposes such as collective entertainment, celebrations, gathering places during disasters and epidemics.

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In addition to being a sports center, the area is an important world cultural heritage center with its monumentals, which are aesthetic masterpieces that wereerected on the grounds where the competition records were broken. While the number of these monuments were 10-12 in the beginning, by the 19th century, their number went up to more than 300. However, this number was determined to be 60 by the General Directorate of Foundations in 1985. Most of these monuments were destroyed bythe infrastructure activities by either being used as building foundations or getting buried under the ground. The destruction of the monuments was similar to that of the stones erected around the border of the area in the 16th century. Today, only 8 of these stones remain(Bir et. al., 2006). In order to prevent all these destructions and to bring this area of great importance to future generations, Okmeydanı has been declared as a protected area with the decision of the High Council of Immovable Monuments and Antiquities dated 06.05.1961 together with all the historical monuments including monuments and border stones. After the decision, many positive and negative decisions regarding the area were taken by the Cultural Heritage Preservation Board. With the last decision dated 15.09.2010, the 14 site areaswere determined on the map and it was decided that the buildings on 14 site areas would be demolished and the regions would be organized as an openair museum. (Figure 1)

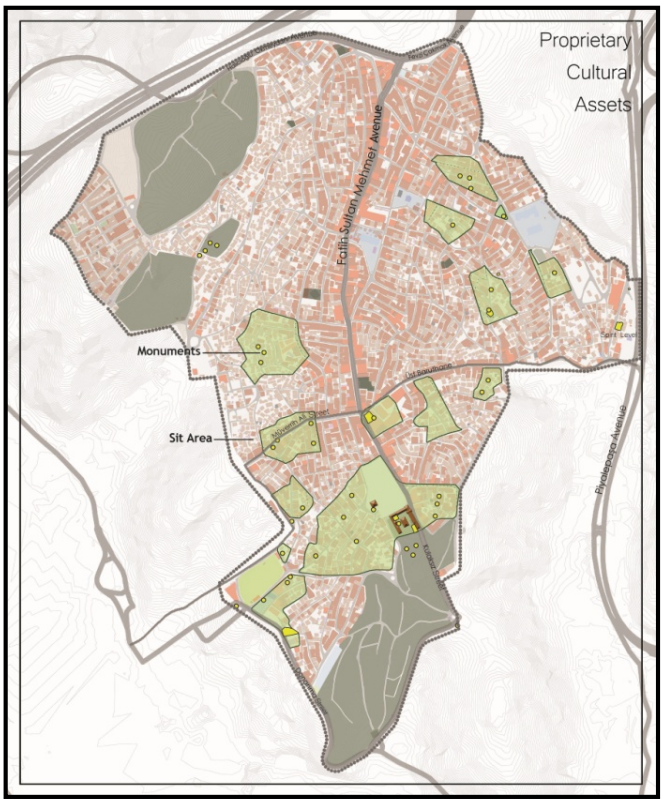

Figure 1. Sit areas and monuments in Okmeydanı

According to the records of the Prime Ministry archives, the area size of Okmeydani during the conquest period was approximately 140 hectares. Today, Okmeydanı, which does not coincide with an administrative border, is a regionthat is within the boundaries of Beyoğlu (85%) and Şişli (15%). The parts of Okmeydanıthat remain in Beyoğludistrict consists of Fetihtepe and Piyelapaşa neighborhoods, and a part of Keçecipiri, Piripaşa, Kulaksız and Kaptanpaşa neighborhoods. (Figure 2)

Development of Okmeydanı started with the settling of the poor immigrants who came to Istanbul after the Balkan War of 1913(Bir et. al., 2006). The single-storeyhouses built by workers from the industrial areas around Haliçand shipyards at Kasımpaşa to meet their housing needs, expanded slowlytowards Okmeydanı via Hasköy and Kasımpaşa. Therefore, Okmeydanıhas also started to be affected by the construction activities. However, Okmeydanı did not have a large construction activity until the 1950s. After this period, Okmeydanı was greatly affectedby the migration from rural to urban areas until the 1980s, and it was completely built up due to its closeness to the central business areas at that time (Eminönü, Beyoğlu, Şişli axis) and the intensity of industrial areas in the region. Constructions during this period were mostlylow-rise structures with gardens. After the 1980s, the construction continued uninterrupted, both in numbers and in floor height, until the 2000s. The policies implemented by local governments had a great influence on the structuring of this period. In the beginning, policies supporting developmentwere in favor, but later on prevention policies came into prominence. With the effect of the policies, there is almost no new construction after 1995. The structures that were builtby this time have largely come to the present day. (Figure 3)

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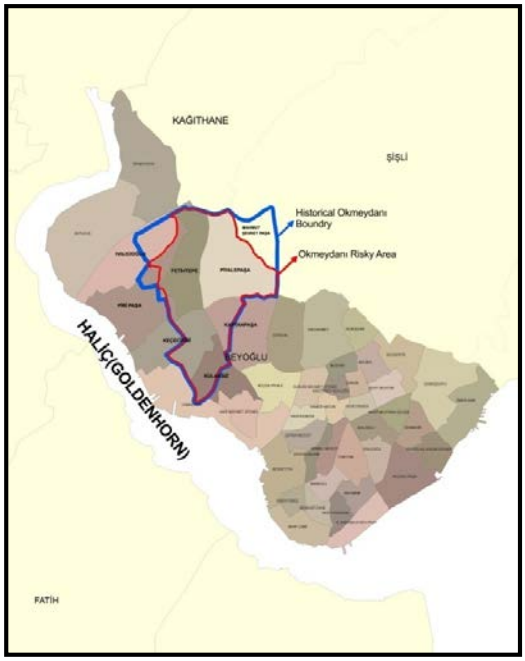

Figure 2. Okmeydanı location

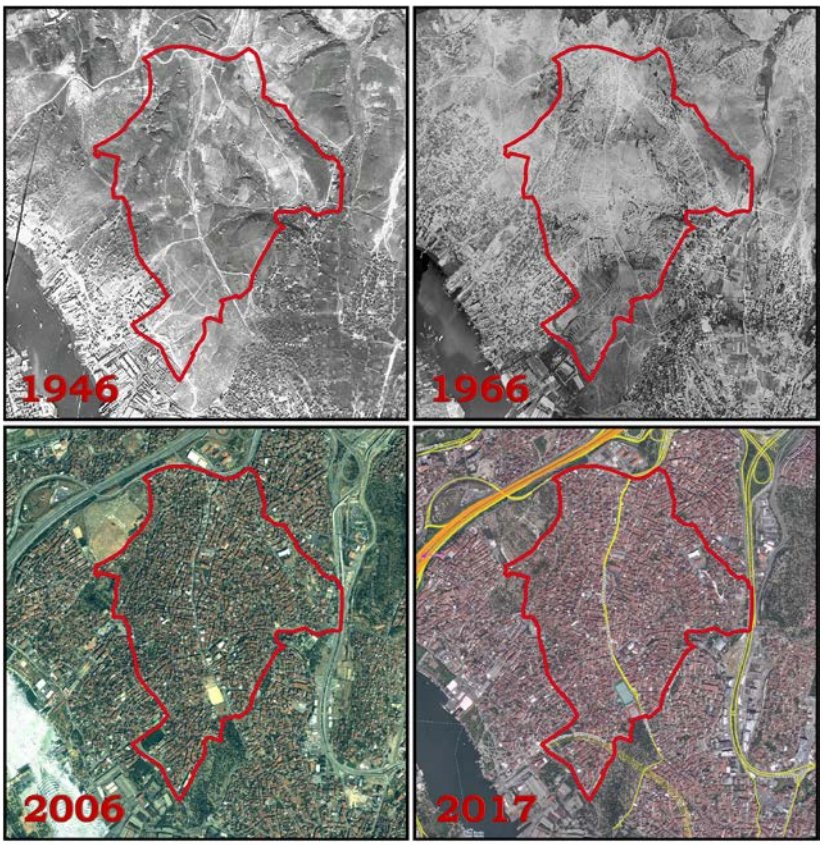

Figure 3. Periodic view of Okmeydanı construction process (1946-2017)

Planning tools used for development of Okmeydanı, which started in the 1950s and continued until the 2000s, were only The Reclamation Development Plan approved on April 25 1988, Parcelation Plan prepared in accordance with this plan and approved on 19 January 1989 by the decision of Beyoğlu Municipality Council and15th of December 1997 dated, 1/5000

and 1/1000 scaled master and implementary development plans for Dolapdere-Piyalepaşa Boulevard and Surroundings. However, Master and Implementation Development Plans were cancelled by a court decision 2 years later. Okmeydanı, where approximately 75,000 people live today, has no development plan prepared in accordance withmodern urban planning criteria and took its current shape with the randomness caused by the lack of inspections and only with the help of the Reclamation Development Plan.

The Master Plan and the Implementary Development Plan, prepared in accordance with the modern planning criteria and relevant legislation were approved on 13.08.2012 and 17.12.2012. These plans, whose primary aim is to improve the spatial, economic and social conditions in the region have been prepared by the central and local authorities in accordance with the planned urban transformation project targets for the whole region. In line with the target, arrangements for property were made simultaneously with planning. The first regulation is the sale of the lands occupied by the occupants in the field in accordance with the provisions of the Law No. 4706. The second one is the implementation of Article 18 of the Zoning Law No. 3194 in the region on 19.02.2013 by the decision of the Municipal Council. Approximately 4300 parcels have been created with the improvement and parceling plans. These parcels were converted to 88 parcels with the smallest size of 3.550 m^2 and the largest 35.035 m^2. 32 of these parcels are zoning parcels and the rest are urban facilities. The property of the parcels, which are allocated as urban reinforcement areas, is composed entirely of public and existing parcels belonging to the foundation. All rights holders in the region are included to the zoning parcels in the sense of ownership. With this arrangement, it is aimed that the right holders (48%) remaining in the existing land or building, urban facilities or substructure area in the approved zoning plan will remain in the urban transformation project area. (Figure 4). These regulations on property ownership actually coincide with the idea that the inhabitants of the region, which are at the core of successful urban transformation practices, continue their lives in the same region. However, this arrangement made in Okmeydanı also means that the construction in the future cannot continue individually.

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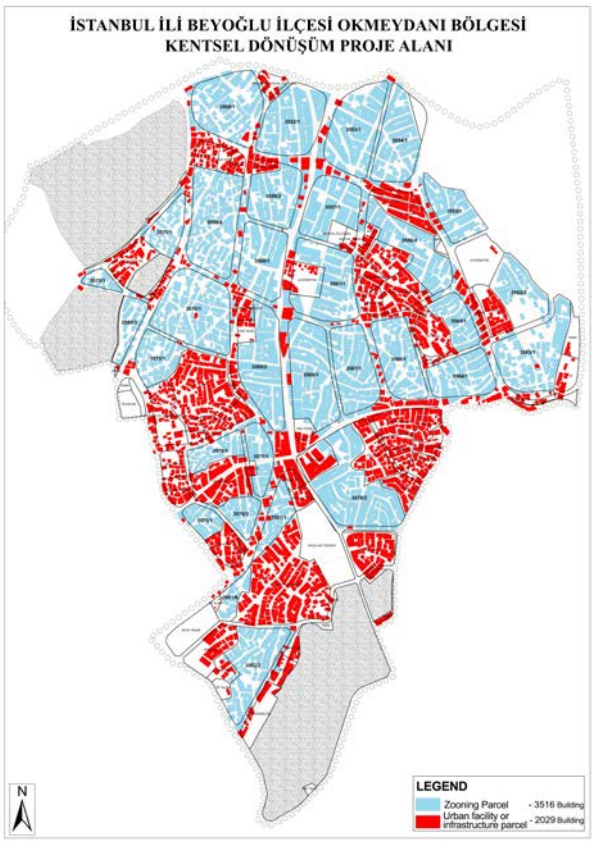

Figure 4. Urban Facilities in Zoning Plan of Okmeydanı (approved 2012)

Considering the quality and usage function of the existing building stock, it is almost imperative that the region is to be evaluated as a whole. The newest buildings (except for a few buildings) were built before the 2000s and they have expired their life cycle, both economically and technically. Furthermore, they were not subject to earthquake-based-construction obligations due to the fact that they were built before the 1999 Marmara Earthquake. Therefore, they are unlikely to be earthquake resistant. The ratio licensed buildings within the total number of existing buildings is approximately 0.1%. Most of the buildings were constructed without any engineering services, using poor quality materials due to economic concerns, and without any controls in accordance with the local government policies of the period. Additionally, various reports by universities state that the region would be heavily damaged if the often mentioned great Istanbul earthquake were to take place(Gazi University, 2015). In this report, experts have come to this conclusion by analyzing the risk situation for all buildings and by performing a detailed analysis of a sufficient number of reinforced concrete and masonry buildings from varied risk groups. In the same report, it is emphasized that it is not possible to transform the buildings individually, and that the region should be evaluated as a whole.

The need to act holistically is observed not only by considering the existing structure quality, but also by evaluating the physical properties of the buildings, location selection decisions and functions. In Okmeydanı where approximately 5550 buildings are located, 52% of the buildings are used as housing only, 40% as combined housing-commercialand 6% as commercial. Commercial use is mostly on the Fatih Sultan Mehmet Avenue, which is the main transportation axis of the region, and its parallel streets. The avenue divides the region in almost north-south direction and it is a topographically a flat and long ridge. On the two slopes that fall from this ridge to the east and west, more usage as housingis observed. As it is understood from the statistical distribution of the functions, the number of buildings reserved as urban facilitiesin the region is negligible. Urban facilities in Okmeydanı, where the density of the population is higher than the district and the city average, consist of 9 religious facilities, 4 educational facilities, 3 administrative facilities and 2 health facilities. There are also 2 outdoor sports areas. All these buildings are far below the standards in terms of capacity and size. The facilities of the relevant institutions and the fact that they are built with local government policies also affects the productivity negatively and the location of the buildings is far from scientific analysis. (Figure 5)

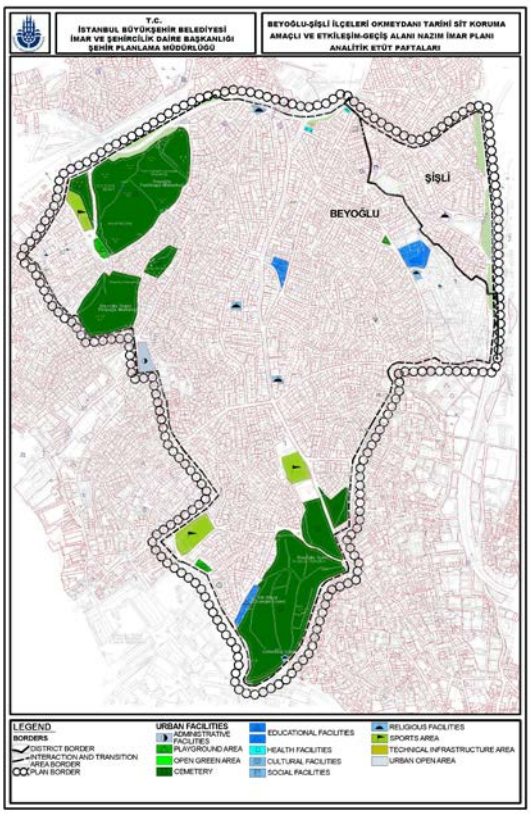

Figure 5. Existing Urban Facilities in Okmeydanı

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In commercial buildings, the number of floors is usually 4 or more, while the number of floors in residential buildings is less than 4. Another determinant of vertical growth in buildings is the socio-economic structure of the people of the region. Some rights holders remained as one-storeysquatter (28%) in the first construction, because they did not want to give up their garden structure in the regions they migrated, and others could not afford to make new construction economically. In case of need, additional building is constructed to the squatter in horizontal plane. But most of the buildings are shaped by adding an extra floor or rebuilding the existing buildings. One of the important determinants of the number of storeys is the number of children in the family. The social perspective of buildinga house for each child is one of the most common situations in Okmeydanı. Houses built more than the number of children are generally constructed to obtain rental income. As a matter of fact, the ratio of tenants in the region is approximately 34% and the rate of free use is 8% depending on their relative relationship. In the construction, where socio-economic data are determinative and the construction period has spread over years, buildings are 69% reinforced concrete building and 31% masonry construction system. The ratio of the floor areas of the buildings to the land area where they are located Floor Area Ratio(FAR) is 0,72. The ratio of the total construction area to the land area Gross Floor Area(GFA) is 2.93. These rates are an indicator of the high density of structures in the region.

Okmeydanı is far from offering the quality of life expected from large cities in terms of both infrastructure and upper structure inventory. This fact gives clues about the socio-economic condition of individuals living in Okmeydanı. The average household size (4 persons) in the region is greater than Beyoglu district (3.7 persons). The per person living areawhich should be at least 25 m^2 according to scientific criteria, is 14 m^2 in the region. The population between the ages of 15-64, except for the elderly and children groups, is 72%, which is greater thanboth Beyoğlu and İstanbul. According to the survey of households, the biggest reason for settling in the region is that it is close to the job opportunities with a ratio of 78%. Furthermore, 55% of those settled in the region with migration are from the Eastern Black Sea region, mainly from Giresun province, and 20% from the Sivas, a central Anatolia region. The ratio of female and male population is almost the same. The highest level of education is the primary school with 58%.The low level of education is reflected in the working life and thus the economy of the region. While 75% of the population work as wage earners, unfortunately 76% of those living in the region do not have social security. The largest business activity is wholesale and retail

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trade with 37%. Accordingly, 68% of the age group suitable for work is unemployed. While 60% of the employees earn between 500-1000 Turkish Liras, the rate of employees with minimum wage is 12%. Despite the advantage of being close to the city center and business opportunities, these findings are the greatest proof of the poor socio-economic conditions of the people of the region due to the high unemployment and low education level in Okmeydanı. All these data indicate that Okmeydani should be considered not only physically but also socially and economically as a whole in terms of urban transformation (İBB, 2012).

Transformation Method and Value Based Mathematical Model

Okmeydanı, which is declared a 'risky area' by the decision of the Cabinet, all construction related authority lies with the Ministry of Environment and Urbanization in accordance with the provisions of Law No. 6306. The Ministry delegated its authority to Beyoğlu Municipality in order to use the local dynamics more effectively and to speed up the implementation process. As a first step, the Municipality of Beyoğlu organized meetings to inform residents about the process of urban transformation. In almost 100 meetings, the subject of transformation has been discussed in terms of sociological, technical and administrative aspects by local residents, non-governmental organizations and expert teams. Expectations of the people of the region after the meetings were improvement of the construction quality in the region, increase in the number of urban facilities, not moving the current residents of the area to the another part of Istanbul, and not to be asked for resources during the construction process due to their poor economical conditions.

The transformation model was re-evaluated by the technical teams of Beyoğlu Municipality, taking into consideration the issues that stoodout in the meetings. In this context, the total construction area that can be implemented in the area was calculated first. Construction area that can be occupied in the whole area was calculated as 2.850.000 m^2 over the projects. In addition to this, with the parking area, technical areas and urban facilities areas, a construction area of approximately 4.500.000 m^2 is planned to be constructed within the scope of the transformation of Okmeydanı.

In the determination of the model of transformation implementation, the proposal of not asking for money at the construction stage was the decisive factor in the meetings held in the region. Considering the economy of the people of the region, this demand was welcomed by the administration and the idea that the construction process should be carried out directly by

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the government or by an investor in terms of the flat for land method has come to the forefront. However, the financial support provided by the ministry for the Okmeydanı Urban Transformation Project is just enough to use in matters such as reconciliation, determination of right owner, use of information technologies and rent assistance. Therefore, in the transformation of Okmeydanı, "flat for land" model was preferred in order to move quickly by taking the earthquake risk into consideration.

Exercising its authority, Beyoğlu Municipality met with investors from domestic and foreign countriesthat accept flat for land method and a protocol was signed with KİPTAŞ, who made the most appropriate offer. In fact, KİPTAŞ, as a semi-public company of Istanbul Metropolitan Municipality, approached the subject with a civic responsibility and kept the profit rate low. It has agreed to construct all buildings including urban facilities of 1.100.000 m^2, which corresponds to 38% of the total inhabited construction area in the region.In this context, it is possible to say that the transformation in Okmeydani was partly conducted by the state. However, considering the total size of the existing buildings in the area (2,391,861m^2), which will be distributed to the rights holders within the scope of the protocol, this means that the size of the area per owner will be reduced (1,750,000m^2). The average reduction ratio in Okmeydanı is around 28%. This ratio differs from the mathematical model on the building scale by the cost value of the immovable owned by the right holders.

Within the scope of the protocol, 1.710.000m^2 of the total inhabited area allocated to Beyoğlu Municipality has been distributed directly and 40.000$m^2$of area has been reserved. Based on the principle of fairness, the allocation of 1.710.000m^2 to be distributed directly to the rights holders is based on both the cost and market values of the real properties (buildings and land) owned by individuals. In order to determine the value, Cost Approach and Market Approach methods were used among different valuation models made by a CMB (Capital Markets Board) licensed company, taking into account the construction process and distribution model in the region(Harmoni, 2016). The results obtained by the Cost Approach method were used to determine the size of the residential or workplace to be offered to the rights holders, and the results obtained with theMarket Approach were used to make the location selection (betterment) of the designated residential or workplace.

The use of the reserve area (40.000m^2), which will be distributed indirectly to rights holders, is in two ways. The first is to compensate for the material errors that may occur during the measurements made within the scope of the distribution model.

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The second is an administrative decision to use in the improvements to be applied to one and two storey buildings in the area.Improvement ratesare formalized with the decision of the district council as. At least 35% more than the existing structure area in 1-storey buildings, and to be at least the same with the existing building area in 2-storey buildings.
In the Cost Approach Method, the value of the real estate gets calculated in 2 stages. In the first stage, the cost value of the building is calculated. Approximate building unit cost groups (between 1A and 3B) determined by the Ministry of Environment and Urbanization were taken into account in the calculation. In addition, the depreciation rate (amortization) was taken into account by considering the construction years and physical conditions of the buildings. The following formula was used to calculate the structure value.

Building Value = Total construction area (m^2) * Building unit cost (TL/m^2) * (1- AmortizationRate)

In the second stage, the land value of the building was calculated. In the calculation of land value, ownership status has been a decisive criterion. In the evaluation of a small number of privately-registered land, the entire land size was taken into consideration, while 72% of the land area was taken as the basis forthe valuation of land for non-registered lands. This ratio (72%) is the average of the the floor areas of the buildings to the land area(FAR). Thus in Okmeydanı, where there is unplanned construction, a balance between the differences in horizontally random construction was desired. Another point to be taken into account when determining the value of the land was that if a building occupied more than one parcel, thetotal parcel area was taken into consideration in the valuation. In case there were more than one buildings in a parcel, the parcel values were calculated in accordance with a building's parcel usage ratio. For the fair market value of the land, the official figures determined by Beyoğlu Municipality are taken into consideration. The following Formula was used to calculate the value of the land.

Land Value = Land area of valuation (m^2) * land market value (TL/m^2)

The value of the real property determined by the Cost Approach Method is equal to the sum of the land and building values detailed above in Okmeydanı. Total construction value of the 5552 buildings in Okmeydanı, which are calculated by the Market Approach, is 1.196.395.338 TL and the total value of the

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land is 375.107.476 TL. Total real property value is calculated as 1.571.502.814TL.

The value determined by the Cost Approach method is equal to the size of the area to be given directly to the rightsholders. Thus, the square meter unit price of the conversion coefficient to be used in the offer of residential or workplace to be made to the right holders is calculated.

$$\textbf{Conversion Coefficient Unit Price} = \frac{\text{Total Cost of Real Estate}}{\text{Total Area to be Granted Directly to Rightsholders}}$$

$$= \frac{1.571.502.814\ \text{TL}}{1.710.000\ \text{m}^2}$$

$$= 919\ \text{TL/m}^2$$

Proposal for a building within the scope of the transformation over the unit price is calculated by dividing the cost value of the building by the unit price. The proposed area for the whole building is divided between the housing and commercial areas of the building in accordance with their current area share. The results are then rounded up to multiples of 5 and the area to be offered to the rights holders is thus finalized.

The other issues that were taken into consideration in the offers to the rights holders were determined by the Municipality of Beyoğlu. Accordingly, the smallest flat size is $50m^2$. The difference in function does not affect the size of the offered area. In the approved zoning plans, considering the limitations imposed for the trade function, commercial area offers are made only for workplaces on the ground floor of the existing buildings. The offers for other rightsholders are the residential. Although it was not a part of the project in the beginning, in consideration of the criticisms and social dimension of the subject, it became possible to buy additional areas under special conditions. Accordingly, in case the flat offer to the rightsholders is less than $65m^2$, a maximum of $15m^2$ additional area can be purchased, provided that the totaldoes not exceed $65m^2$. The possibility of purchasing additional space is only valid for the housing function.

The market (goodwill) values of existing buildingsare decisive in the selection of the housing or workplace to be offered to the rights holders in the transformation area. The market value was determined by the benchmark Market Approach at the house/workplace scale. This method has a three-stage calculation. In the first stage, the mean GFA value of the buildings in Okmeydanı (GFA: 2.93) was determined. When calculating the market value for each building, the construction area determined

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by this ratio is taken as the basis. In the second stage, separate goodwill score was determined for each structure. In the calculation of this score, the location of the building, the transportation relationship, the property information, unit cost group of the building and the physical condition criteria were taken into consideration. The participation of the criteria in the calculation method is 40% for the land location; 15% for transport relationship; 15% for building unit cost group; 5% for building condition; 25% for the ownership. Based on these criteria, goodwill score was determined asthe least at 4.29 and highest at 8.85. The average goodwill score in the region was 5.77. The average goodwill score was accepted as equal to the average unit sales value (1200 TL/m^2) determined by examining the real estate sales in the area. The third stage is taken into account when the GFA value of the building is different from the average value. If the GFA value of the structure is more than the average GFA value, the construction cost area of the excess is calculated by adding the value to the value determined in the first and second stages. If it's less, the cost value of the missing part is subtracted from the value determined in the first and second stages and the final value is found. The formulas for all stages in calculating the market value of real property are as follows.

1stStage;

Calculated construction area = Land Area of the Building(m^2) * Average GFA Value (2,93)

2nd Stage;

If land has average GFA value (main formula);

Calculated construction area (m^2) * $\frac{\text{Building based goodwill score}}{\text{Average goodwill score}}$ * average unit sales value (TL/m^2)

3rd Stage;

If the structure is built on the average GFAvalue;

Mainformula + [(actual construction area - calculated construction area)(m^2) * building unit cost (TL/m^2) * (1-Amortazition Ratio)]

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If the structure is built below the average GFA value;

Mainformula - [(actual construction area - calculated construction area)(m^2) * building unit cost (TL/m^2) * (1-Amortazition Ratio)]

Method. According to the analysis made by a CMB licensed company, the new value in the post-transformation area will be approximately 25 billion Turkish liras. This value is expected to be divided between the rights holders and the investors by 50-50%. The total value of the dwellings or workplaces to be given to the rights holders over the rates is 12.5 billion Turkish liras. When this value is proportional to the current market value of the real estates owned by the right holders in Okmeydanı, an increase of approximately 4 times is observed. This rate of increase will be calculated separately on each zoning parcel and will be multiplied by the market value of the existing property of the rightholders and the maximum market value of the proposed area will be determined. The partner will select the proposed housing or workplace from this value or alternatives with less value.

$$\text{Offered house/workplace market value} = \frac{\text{actual house}}{\text{workplace market value}} * \text{Value increase rate in zoning parcel}$$

The summary of all the processes described above in relation to the distribution model to be used in the urban transformation application planned in Okmeydanı is as follows: The size of the house or workplace to be taken by the rights holders in the new project is determined by the cost values of the properties they own. The maximum market value of the house or workplace is determined by the market values. Both values of the rights holder are considered at the same time. After the urban transformation, the rights holder selects the housing or workplace alternative.

CONCLUSION AND EVALUATION

Okmeydanı is a region where urban transformation is inevitable due to its historical background, geographical location, construction process, unqualified building stock and socio-economic structure. At the same time, the solution is unlikely without approaching the issue hollistically. Problems related to properties(about 75% are non-registered), and the implementation of Article 18 of the zoning law in the region, makes it impossible for individuals to act alone. For this reason, a construction activity in the region within the scope of the

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transformation directly concerns the rights holders outside the construction area. Therefore, it can only be a dream to wait for the right stakeholders to come together for the urban transformation of Okmeydanı, where approximately 75,000 people live. In this context, it is inevitable to organize the urban transformation centrally.

With the preferred transformation model in the region the expectations of the inhabitants of the urban transformation area were fulfilled and the forced displacement of the people of the region, which are frequently seen in urban transformation practices, was prevented. However, it is inevitable to send the right holders to different addresses in Okmeydanı from their current location. Furthermore, the high number of renters in the area might also mean that the residents will move to different areas. On the other hand, the fact that most of the tenants are second generation Okmeydanı residents means that they will most likely prefer to stay in the area and there will not be enough moving to change the social structure of the area.

It is the mostrational approach to have Beyoğlu Municipality which knows the region best to organize the urban transformation in Okmeydani, which is the second largest region in the 58 regions declared by the Ministry of Environment and Urbanization in Istanbul. It is also parallel to the determination that the transformation projects should be made by the public organization highlighted in the Urban Planning Council. At present, Beyoğlu Municipality has designed all the protocols of the process from the beginning. As it can be seen from the protocols, the fact that it does not profit from the new project and prefer the semi-public company with low profit rate as an investor clearly shows that the urban transformation is not made on the basis of income and is considered as a civic duty.In fact, according to the transformation model, while the area distribution rate of the new construction is to be between 38-62%, determination of the 50-50% distribution of the value and thus maximizingthe size of the area to be offered to the rights holders by approaching the social transformation from a social point of view, and increasing the share of the investor in order to meet the financial needs for the completion of the project is a proof of thissituation.

Although Okmeydanı Urban Transformation Project is not an income-oriented transformation, it increases the density of the building due to the preferred transformation model. Additionally, the increase of urban facility areas in the region with the zoning plan means that the targeted construction areas for transformation can only be achieved by vertical growth, which in turn increases the density on building blocks. In spite of the increase in density, when Okmeydani is considered as a

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whole, there is no doubt that it will turn into a more livable place, but the burden of increasing density on the city will cause new problems. Therefore, a transformation project of this magnitude must be evaluated together with its environment. However, as there is not enough coordination between the relevant legislation and institutions, unfortunately the issue of transformation is limited only to the region where the riskyarea is declared, and its impact on the environment has not been analyzed.

In order to reduce the negative effect of the increase in density, all arguments, especially architectural project designs, should be used well. However, the transformation method and the distribution model developed accordingly restrict the ability of architectural projects. Because the distribution model through the total area size to be given to the right holders has been finalized. The use of scientific methods in the distribution of this area among the rights holders in terms of both interest and goodwill is a positive practice in terms of justice and transparency. However, as a result of the calculation, the acceptance of the fact that constant of the proposed area by the Beyoğlu Municipality increases the number of residential typologies in architectural projects. Moreover, the fact that the resulting housing typologies do not show a homogenous distribution makes architectural design extremely difficult. The issue of additional land purchasing, which is subsequently added to the distribution modelis culturally not very useful. This is because the minimum gross housing (2 + 1) typology is too small. In addition, the fact that there is no reserve area other than the right holder and investor shares determined on the basis of the distribution model raises the question of where to buy the space to be given to those who want to benefit from this right. In this sense, the main principles of the distribution model should be reviewed. In addition to these, paying attention to the goodwill values in the choice of place of residence or workplace to be given to the right holders makes the process of the design very difficult. All these challenges can only be overcome by the architectural design teams, real estate appraisers who will make the new project appraisal and the concurrent work of the Beyoğlu Municipality officials who manage the reconciliation process. Howeverin a large area such as Okmeydanı, it is not possible to provide this co-operation long-term.

The difficulties in the preparation of architectural projects as well as the housing typologies emerged within the distribution model show that the issue is not analyzed well in the socio-spatial sense. Given the existing family structure and size in Okmeydanı, housesoffered to the right holders arenot very useful in terms of current living standards. Especially the high

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amountof (1+1) typology flat offers (approximately 50%) hinders possibility of living in the area for the rights holders sociologically. Additionally, the only possible way is expropriation in cases where the size is less than 50m^2 and the issue cannot be solved by means of partnership or purchase. In both cases, taking into account the increase in the value of the new project, the rights holders would prefer to sell their rights and indirectly abandon Okmeydanı. This result contradicts with the aim of keeping the people of the region after the transformation.

As a result, Okmeydani Urban Transformation Project is a project with no alternative other than approaching the technical and social data in a holistic manner. This project is generally a successful practice with the approach of the competent authority and its non-income-oriented approach through the target model. Although the preferred model for transformation in Okmeydani is supported and enriched by scientific methods, it unfortunately increases the building and population density in the region as in many urban transformation projects carried out in our country.

Considering the magnitude of the region and decrease of the size of the rightholders house area ratio(28%), it is difficult to predict when the reconciliation process, which forms the basis of the transformation, will be completed. This situation means that the risk of the transformation process is present until the end of the project and it may grow. It also increases the risk of paving the way for gentrification.

As long as Ministry of Environment and Urbanization does not meet the investor share out of determined reserves in the city for transformation projects with flat for land model, these problems for the cities will continue. After the bad experiences in developed countries, the idea of dealing with the subject only in physical dimension was abandoned. In a period when the situation is evaluated in terms of social, economic and environmental aspects, unfortunately, the transformation practices in our country are far from this reality. In the application of transformation projects, the subject is approached mostly with mathematical solutions on technical data, and the socio-economic and environmental dimension of the process is ignored. Therefore, especially in the surveys conducted in the transformation areas, questions regarding the future expectations of the residents in all aspects of their lives must be included, and they should even be made mandatory by law. If the transformation projects in our country are not addressed in a multifaceted and more meticulous way especially on their social and economical aspects, it will be much more difficult to transform our cities in the future.

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VR-Based Interactive Learning in Architectural Education: A Case on Safranbolu Historical Bathhouse

Eray Şahbaz*

Abstract

Purpose

Historical buildings provide important information about the social life and architectural style of the era in which they were built. Perception of the effect of space by walkthrough is very important to perceive design philosophy of the structure for architecture students. However, for some reason, it may not be possible to see these structures in situ. VR technology has the potential to provide efficient solution to this problem. The study aims to provide an environment where students can learn architectural details and experience spatial effects of the historical buildings with the help of the VR technology as if they were in place.

Design/Methodology/Approach

In the scope of the study, an interactive VR program (IHVR) related with a historical Greek bathhouse has been developed and the effectiveness of it has been tested with a scientific experiment. A group of 45 volunteers from the architectural students were included in the study. The students were divided into three groups of 15 each called

Keywords: *Virtual reality; simulation; interactive learning environments; architecture; hypermedia systems;*

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VR, field, and classroom. The students in the VR group experienced the IHVR program with virtual reality glasses while the students in the field group experienced the building on site and the classroom group students are told by the traditional method.

Findings

According to the test results, the students using the IHVR had a significant success compared to the other groups. It was observed that the interactive structure of the software helped the students to learn the historical building more effectively. As a result of the study, it was seen that IHVR was an efficient hypermedia tool in learning the architectural details and functions of the building.

Practical Implications

Experiencing historical structures in virtual environment as in real helps students to learn the architectural details more efficiently and experience spatial effects of the structure in a realistic way.

Social Implications

The widespread use of virtual reality will facilitate architectural education to keep up with technology and accelerate its adaptation to innovative approaches. The use of these technologies in architectural education will help to attract the interests of students to the subject that is intended to be explained more easily.

Originality/Value

The study leads to the development of VR-based hypermedia tools in applied architectural education.

INTRODUCTION

The rapid developments in technology along with the information age have deeply affected everyday life in all areas. Computers, which were an indispensable part of the business life even when the internet is not common, has begun to penetrate deeply into our social life as the internet becomes more popular. This situation has brought with it the increasing uncertainty of the boundaries between the virtual world and the real world. Virtual reality (VR) technology has taken this one step further and has made these boundaries more uncertain. This effect of virtual reality on human perception makes it an innovative tool candidate for architectural education as well as many other types of education. In the last 20 years various experimental projects have been developed on the use of VR technologies in architectural education.In1998 Virtual Environments Laboratory (VEL) was setup by the Research Unit of the Department of Architecture and Building Science of the University of Strathclyde (ABACUS). The facility had a curved-panoramic screen which sized 5 x 2 meters and received a high-resolution computer-generated image from three coordinated video-projectors (Alvarado & Maver, 1999). The VEL was suitable for architectural education because of holding several students inside it for collaborative learning. Another example of using virtual reality in architectural education is the VRAM (Virtual

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Reality Aided Modeler) project. VRAM is an immersive, three-dimensional exploration and modeling tool (Regenbrecht *et al,* 2000). The project is designed to view, browse, edit, and create three dimensional models based on the Virtual Reality Modelling Language (VRML) (Donath & Regenbrecht, 1999).

In the early 2000s, Maria Roussou developed a VR project to teach Hellenic culture and history to primary school children. In this project, Roussou used ImmersaDesk, a kind of touch screen, and standard stereo glasses to create a low-immersive virtual environment (Roussou, 2001). With the help of a 3D software, children can see ancient buildings in 3D and get information by touching them.

In the Mid-2000s Texas A&M University Professor Mohammed E. Haque designed an application to present 3D visualization, animations, virtual reality, and walkthrough to demonstrate the construction process of various structures in Department of Construction Science (Brey, 2014; Haque, 2006). Around the same time, Jacobsen developed a VR game called Gate of Horus to lecture ancient Egyptian art and society using an educational learning game (Jacobson, 2008). The game is based on a simplified virtual model of an Egyptian temple.

Recently, Hyve-3D (Hybrid Virtual Environment 3D), an embodied collaborative sketching system that allows architectural design inside Virtual Reality by a new model of interaction through a 3D cursor was designed by Dorta, Kınayoğlu and Hoffman in Montreal University (Dorta *et al,* 2016). Project introduces a semi-spherical immersive 3D sketching environment based on spherical panoramas and uses 2D drawing planes that are intuitively manipulated in 3D space by the help of handheld tablets (Dorta *et al,* 2014).

The Problem and Aim

Therefore, historical buildings provide important information about the social life and architectural style of the era in which they were built, the preservation of historical buildings is as important as the designing of new structures in architectural education. It is important to preserve these buildings to ensure this information can be passed down to future generations firsthand. The preservation of historical buildings is also important insofar as it allows the spatial effect of the buildings to be experienced by walkthrough as opposed to simply reading about this effect in books or imagining it by looking at pictures. Taking a tour of the building offers the best opportunity to experience its architectural aura.

However, it may not be possible to experience a historical building in the field due to various circumstances. For instance, the building may no longer exist or too far away and therefore

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expensive to visit, or even if capable of being reached, entering it may be prohibited or dangerous because of dilapidation. In these cases, VR-based simulation applications have the potential to allow such structures to be experienced as if they were in place.
This research seeks to answer the question of whether VR-based computer simulations powered with interactive tools can be used as an effective method for learning historical structures. It is thought that the above-mentioned problems can be overcome by experiencing the spatial effects of historical buildings in the most realistic way with the help of VR toolkits.

INTERACTIVE HISTORICAL BUILDING VR (IHVR)

In the study, a special software (IHVR) has been developed with the help of VR technology to solve the problems mentioned above and to set an example for lecturing the historical structures with VR and the effectiveness of this tool has been evaluated by a scientific experiment.

Safranbolu Historical Bathhouse

By the impression of the Roman Empire, the bathing was an important ritual for both Greek and Turkish nations in history. For this reason, in Anatolia that hosted these cultures, the architecture of bathhouses was highly advanced. Those buildings provide large amounts of important information about the architectural styles and cultures of their periods. Safranbolu is a World Heritage city in northern Turkey, and a 'crossroad city' of Turkish and Greek cultures. The building is located in the Krandaros (Kıranköy) district of Safranbolu where the Anatolian Greek (Rum) population mainly settled during the rule of the Ottoman Empire.
The building is in a convenient position on the terrain where the ancient Safranbolu houses are located. It is accessed from the upper elevation and it has four floors which vertically sweep towards the canyon (Figure 1).

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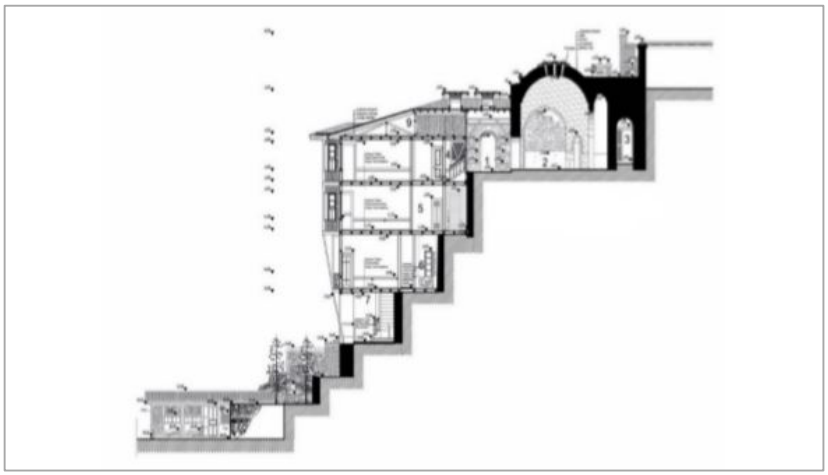

Figure 1. Section of the Old Greek Bathhouse

The building consisting of two main sections (Figure 2). One of these main sections is bath section, built in a Greek stone masonry style and where the bathing activity is made.

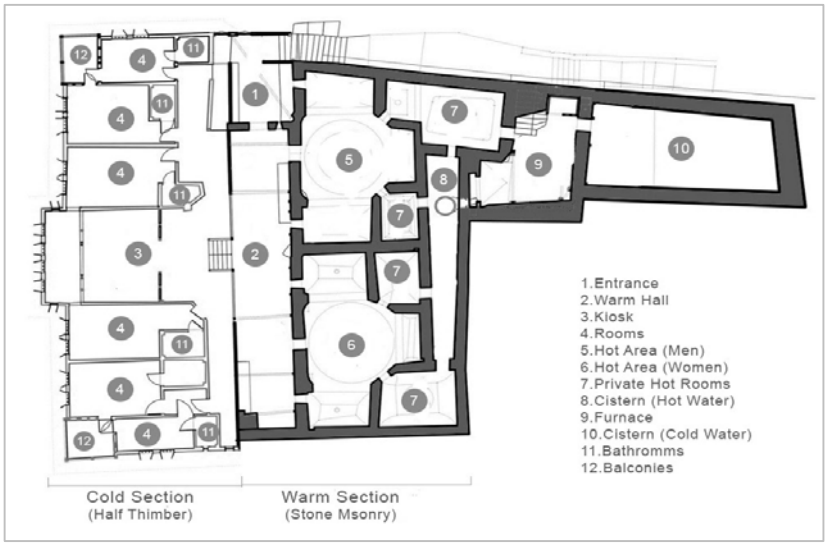

Figure 2. Plan of the entrance floor

The other section (half-timber construction) is the 'cold area' (soyunmalık), in which users would prepare to bathe (Figure 3). Beside its architectural, cultural, social and iconic value, the bathhouse was chosen for its special rooms and architectural details.

Although the bathhouse had been all but ruined, a conservation process started in 2006 and it was completely restored. In this study, the projects approved by Conservation Council of Karabük were used to create a realistic measured 3D model of the bathhouse. The building was modeled in Blender using these technical drawings. The program supports the 3D modeling, rigging, animation, rendering, compositing, simulation and game creation.

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Figure 3. The Front View of Safranbolu Historical Bathhouse

Development of IHVR

After the necessary arrangements were made, the historical Greek bathhouse, modeled in the Blender, was transferred to the Unreal Game Engine to develop VR platform of the IHVR (Figure *4*). Unreal is a powerful game engine for professional computer games and supports VR tools such as Oculus Rift, HTC Vive and more. Oculus Rift head mounted display (HMD) and its touch controls were used for VR experience in this study. The product adjusts the created image by the lenses to cover the entire viewing angle of the user. Thus, the user is feeling surrounded by the virtual environment. It also detects the movements of the user through the motion sensors.

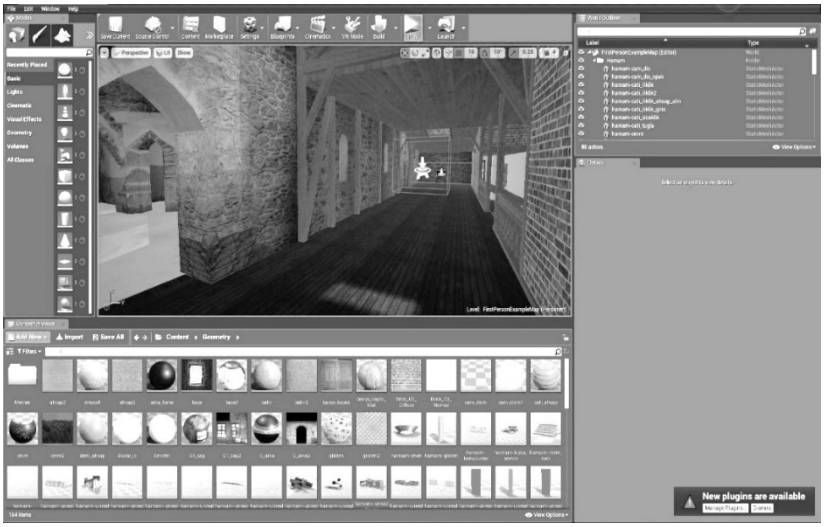

Figure 4. A Screen Capture from Development Process of IHVR

First-person shooter (FPS) games are very common among young people. For this reason, FPS interface, which is frequently used in computer games, is adopted as the user interface of the IHVR. In this interface a camera acts as eyes of the player and

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he/she sees the environment from his / her own eyes while moving the character.

Interactive Tools of IHVR

It is important to use interactive tools in learning process. Various interactive tools have been developed within the IHVR to enable students to interact with it and to encourage them to explore the building on their own by playing around with them. Students can interact with objects such as furnace, taps, walls, doors, ornaments, columns and beams within the program. With the help of these interactive tools, students have the opportunity to examine the spaces, layers, architectural elements and details that may not be possible to see in real life. For example, they can see the heat channels underneath the floor by hiding the its layer or they can switch on/off navel stone and basins which are not existing anymore in the current state of the bathhouse by touching the interactive switch button.

The most effective way of teaching something to someone is let him/her to do it (Schank *et al,* 1999). For this reason, one of the main objectives of interactive tools is to enable students to learn the functions of bathhouse not only by listening or seeing but also by doing.

In order to increase the students' desire to explore, some mysterious objects are scattered in various places. A student can use any of these objects if he / she discovers what it is used for by using his / her own knowledge gained from the architectural education. For example, when students find the matchbox laying on the ground, they can use it to light the heater in the furnace room. So, they can practically experience the functions of the furnace room (how the furnace burns, and smoke is evacuated).

The aim is to eliminate the limitations of the classroom environment with VR technology and to enable students to learn by experiencing the functions of the structure. Within the scope of the study, it was also evaluated the effect of these tools and activities on students' success rates.

IHVR VS TRADITIONAL METHODS

The experiment aimed to compare the success rates of the three methods applied separately on the three groups. The first method was the VR-based method supported by the IHVR. The second method was a traditional experiment method (visiting the building in the field). Lastly, the third method was the traditional teaching method, which was administered in the classroom.

The participants were randomly selected from the Architecture Department of a university in Turkey. In total, 45 volunteer undergraduate students who had never attended a

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lecture on the building in question before took part in the experiment. The volunteers were gathered in a classroom and informed about the research. The participants were then separated into three groups of equal size, with the separate groups being designated as “VR”, “field” and “classroom”. A pre-experiment test was administered to all groups to measure their current knowledge about the building in question. Every question had a value of 10 points, and the maximum value of points a student could gain was 100.

The mean scores obtained by the VR group, field group and classroom group were 10.67 (SD=10.50), 11.33 (SD=15.06) and 12.00 (SD=8.41), respectively. The test of homogeneity of variances showed that all groups were separated homogeneously (p=0.208). According to the Tukey honest significant difference test, it was confirmed that the difference between the groups was insignificant (p=0.987, p=0.947), as shown in Table 1.

Table 1. Multiple Comparisons Results of Pre-Experiment Test

(I) Group	(J) Group	(I - J)	Std. Error	P*	Lower Bound	Upper Bound
Field	Classroom	-.67	4.26	.987	-11.01	9.67
	VR	.67	4.26	.987	-9.67	11.01
Classroom	Field	.67	4.26	.987	-9.67	11.01
	VR	1.33	4.26	.947	-9.01	11.67
VR	Field	-.67	4.26	.987	-11.01	9.67
	Classroom	-1.33	4.26	.947	-11.67	9.01

*p value must be less than 0.05 for significant difference between groups

The Experiment Process

The aim of the experiment is to measure the effectiveness of IHVR against traditional methods used in teaching historical structures. For this purpose, IHVR has been compared with traditional methods such as lecturing the building in classroom and on site. In the first step of the experiment, a lecture on an historical bathhouse was presented in the classroom using traditional course materials, such as books, lecturing notes and slide shows. Architectural and technical details of the building were explained by comparing them to details from other buildings, and the different periods that the building had gone through were discussed in detail. The field group visited the Historical Greek Bathhouse as part of the traditional visit method. The lecturer explained and pointed out, on-site, each of the architectural details of the historic bathhouse, room by room, to the participants, as is done in traditional field lessons.

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The VR group met together in a computer laboratory and was briefly trained in how to use Oculus Rift VR toolkit (Figure *5*). After undergoing basic training, the students experienced the building through IHVR.

Figure 5. VR Group in training

A final post-experiment test of 15 questions was administered to compare the mean scores of the groups. The questions were categorized under three main categories to measure the success rates of the VR-based method in different architectural areas. These categories were architectural details, building construction and building design.

There were six *architectural details category* questions on the test, which were chosen on the basis of the cultural values and unique architectural details present in the building, such as the ornamentations, reliefs, wall paintings, skylights and stained-glassed windows. There were five *building construction category* questions selected on the technical details of the building, such as the materials, construction types, stairs, installations and roofs. Lastly, there were four *building design* questions, chosen from spaces, rooms and their functions in the building.

Test Results

Figure 6 shows the comparison of the mean success rates between the VR group, the field group and the classroom group. The results show that the post-test scores of all groups were higher than their pretest scores.

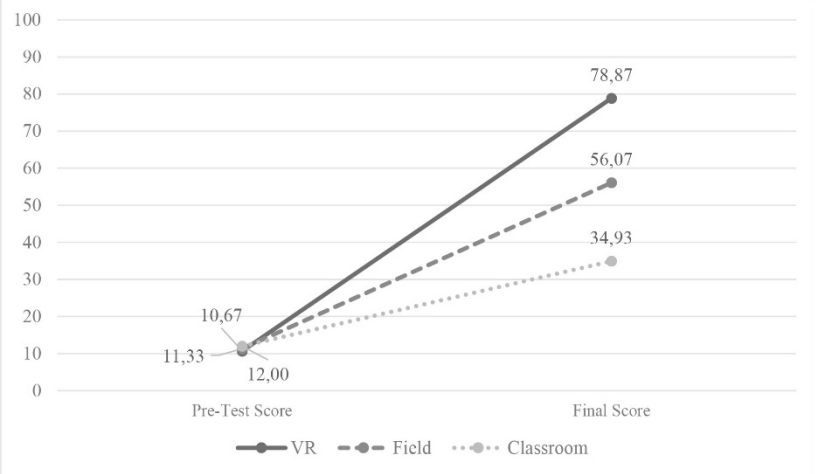

Figure 6. Comparison of the Pre-Test and Post-Test Scores of the Groups

A multiple comparison (Tukey honest significant difference) test was conducted to compare the mean scores of the groups. The posttest scores of the VR group (M=78.87, SD=19.12) were higher than those of the field group (M=56.07, SD=11.68) and the classroom group (M=34.93, SD=15.34), as shown in Table 2. According to the test results, the difference between the VR group and the field group was significant (p=0.007). The difference between the VR group and the classroom group was also significant (p=0.000).

These results confirm that the IHVR really does have an effect on experiencing the historical building. Specifically, the results suggest that when students played VR-based simulation, they obtained more knowledge about the building.

Table 2. Multiple Comparisons Test Results of Final Scores

(I) Group	(J) Group	(I - J)	Std. Error	P*	Lower Bound	Upper Bound
VR	Field	22.80	5.72	.001	8.89	36.71
	Classroom	43.93	5.72	.000	30.03	57.84
Field	VR	-22.80	5.72	.001	-36.71	-8.89
	Classroom	21.13	5.72	.002	7.23	35.04
Classroom	VR	-43.93	5.72	.000	-57.84	-30.03
	Field	-21.13	5.72	.002	-35.04	-7.23

*p value must be less than 0.05 for significant difference between groups

Table 3 shows the comparison of the mean scores between the three groups in terms of the architectural details category questions. The mean score of the VR group (M=34.40, SD=9.57) was significantly higher than that of the field group (M=22.93, SD=10.63, p=0.005) and that of the classroom group (M=15.60, SD=7.68, p=0.000). The mean difference between the classroom

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group and the field group was determined to be insignificant (p=0.093).

This, therefore, indicates that the students who had used IHVR obtained more knowledge about the architectural details category than others. It seems that the IHVR provided the projected success in this category.

Table 3. Multiple Comparisons Test Results on Architectural Details Category

(I) Group	(J) Group	(I - J)	Std. Error	P*	Lower Bound	Upper Bound
VR	Field	11.47	3.42	.005	3.15	19.78
	Classroom	18.80	3.42	.000	10.48	27.12
Field	VR	-11.47	3.42	.005	-19.78	-3.15
	Classroom	7.33	3.42	.093	-.98	15.65
Classroom	VR	-18.80	3.42	.000	-27.12	-10.48
	Field	-7.33	3.42	.093	-15.65	.98

*p value must be less than 0.05 for significant difference between groups

The VR group had higher mean scores (M =20.07, SD=8.02) than those obtained by the field group (M=16.40, SD=5.62) and the classroom group (M=10.00, SD=7.99) in the construction building category (Table 4). The difference between the field group and the classroom group (p=0.053) and the difference between the field group and the VR group (p=0.362) was insignificant. However, according to the test results, the difference between the VR group and the classroom group was significant (p=0.001).

Table 4. Multiple Comparisons Test Results on Building Construction Category

(I) Group	(J) Group	(I - J)	Std. Error	P*	Lower Bound	Upper Bound
VR	Field	3.67	2.66	.362	-2.81	10.14
	Classroom	10.07	2.66	.001	3.59	16.54
Field	VR	-3.67	2.66	.362	-10.14	2.81
	Classroom	6.40	2.66	.053	-.07	12.87
Classroom	VR	-10.07	2.66	.001	-16.54	-3.59
	Field	-6.40	2.66	.053	-12.87	.07

*p value must be less than 0.05 for significant difference between groups

Although the VR group became more successful than the classroom group in this category, the projected success rate was not provided. The results show that the VR group students obtained more knowledge about the building construction category than both of the VR and classroom group. It is

recognized that the VR group did not gain significant knowledge about this category. These results also confirm that the IHVR needs more development in building construction category.

In the building design category, the mean score of the VR group (M=24.27, SD=8.03) was significantly higher than that of the field group (M=16.80, SD=5.39, p=0.013) and that of the classroom group (M=9.33, SD=6.96, p=0.000), as shown in Table 5. The difference between the mean scores of the field group and the classroom group was significant (p=0.013).

This, therefore, indicates that the VR group obtained more knowledge about the building design category than other groups. The VR provided the projected success in teaching design principles of the historical building.

Table 5. Multiple Comparison Test Results on Building Design Category

(I) Group	(J) Group	(I - J)	Std. Error	P*	Lower Bound	Upper Bound
VR	Field	7.47	2.51	.013	1.37	13.57
	Classroom	14.93	2.51	.000	8.83	21.03
Field	VR	-7.47	2.51	.013	-13.57	-1.37
	Classroom	7.47	2.51	.013	1.37	13.57
Classroom	VR	-14.93	2.51	.000	-21.03	-8.83
	Field	-7.47	2.51	.013	-13.57	-1.37

*p value must be less than 0.05 for significant difference between groups

DISCUSSION AND CONCLUSION

In this study, it is examined whether VR technology can solve the problems encountered during the learning process of historical buildings. With VR technology, it is thought that the spatial effects of historical buildings will be experienced in a realistic way and even with interactive tools this experience can be taken one step further. To gain new knowledge, the students could interact VR objects (Roussos *et al*., 1999), do or make something, alone or in a collaborative group work (Jacobson, 2008). This hypothesis was tested by IHVR in Safranbolu Historical Greek Bath. Both test results and user feedbacks justified this hypothesis.

The experiment revealed that providing students with the opportunity to play with and be entertained by interactive hypermedia tools enriches and broadens both the scope of activity and scope of thinking. According to test results, the IHVR had a significant success rate in terms of how well the students learned about historical buildings and was also found to be more effective than traditional lecturing methods. The interactive user interface of the program had an important role in this success.

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The game-like structure of the program, which had the dual advantage of being able to lecture the students as well as entertain them, helped them to explore the building in a highly efficient manner.

IHVR helped students experience the structure in the most realistic way without seeing it in the field. With interactive features of IHVR the students could improve their observation, discovery and focusing abilities. IHVR provides students the opportunity to learn by doing and facilitates an enjoyable learning experience and aim to encourage students to explore, try and understand by playing an active role in the learning process (Jonassen, 1996). However, it should be remembered that VR features alone do not determine the whole learning process, all other factors, such as concepts or skills to be learned, individual characteristics, learning experience and interaction experience, all play a role in shaping the learning process and its outcomes (Salzman *et al,* 1999).

The test results show that VR-based computer programs are efficient hypermedia tools for giving students the opportunity to experience-based learning about historical buildings. The activities which students have chance to see the old and current condition of the spaces, get visual and audio information about the places and learn the activities by applying the functions of the structure, helped them to explore the building. Using these tools to support traditional learning methods can serve to enrich the content of the class (Kraten, 2015). These tools are efficient in drawing the attention of students to the subject at hand. The students were excited and motivated by the fact that they had the opportunity to have fun and explore the building, just as if they were playing a computer game.

The usage area of the VR tools in architectural education is not limited with the experiencing historical buildings. They have also a great potential to help architectural students improve their professional skills by distance (online) and cooperative training. Students could learn many things about their professions by collaborating and taking responsibilities as in online multiplayer games.

These technologies can be used as a modern, effective method in teaching both old and new production techniques in an applied way. 3D computer simulations help practically to teach construction techniques with the help of virtual reality technology. Also, in the lecturing of restoration techniques, these technologies have great potentials. Students can learn the special techniques of restoration with head mounted displays, as if they are inside the structure. In the preparation of the students for professional life, the architectural processes such as the operation of a construction site, the completion of a building

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from design to construction can be easily imitated by VR tools, as is done in IHVR.

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Resume

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Research Article

Restoration of the Greek Orthodox Churches at the End of the 19th Century in Istanbul: Case of Galatasaray Panagia Church

Ece Sönmez Pulat*
Deniz Mazlum**

Abstract

Purpose

The Westernization and its reflections could be observed in the architecture, urbanism and social life in Istanbul in 19th century. The Tanzimat Edict (1839), Vienna Protocol (1855) and Islahat Edict (1856) affected the lifestyle of non-Muslims, especially in the administrative, religious and educational sphere. These political, legal and social reforms had also affected the Greek Orthodox community living in the Ottoman lands and their architectural activities about the churches. Therefore, the purpose of this paper is to clarify the restoration works of Galatasaray Panagia Church conducted in the 19th century based on the archival documents.

Design/Methodology/Approach

The archival documents provide a comprehensive understanding of the changes, repairs, architectural implementations and formal procedure

Keywords: *Archival documents, Galatasaray Panagia Church, Greek churches, 19th century, restoration*

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of the restoration of the Greek Orthodox churches. The methodology of the paper is mainly to analyze the archival documents and do the field survey. The archival documents about the extension of the Galatasaray Panagia Church was analyzed in detail. Then field survey was done. Present-day conditions of the church was observed and compared with the archival documents. Moreover, the analogical research was done to understand the situation before the implementation in 19th century.

Findings

The archival documents were the important proofs of the interventions of the conservations, which were applied at the end of the 19th century. They give information about to the drawing techniques, characteristics of interventions, construction materials, construction sector, responsible authorities and the process of getting necessary permissions for the restoration and the details of labors. At the end of the 19th century, restoration process of the Greek Orthodox churches was changed with the removal of the restrictions. For example, the new construction materials were used from European countries.

Research Limitations/Implications

This study examines the archival documents to provide the information about the church and aims to underline the importance of these documents to understand the history of the church, as well as the conservation methodology and process in the 19th century.

Practical Implications

The archival documents are not merely materials to help understand the building better, but they also serve as tangible evidences of past restorations. The technical details that archival documents include, guide the decision process of the future interventions. Moreover, they provide reliable and valuable information about the later additions that must be conserved.

Social Implications

The Greek Orthodox community was one of the important non-Muslim groups, had a significant role in the Ottoman Empire. Considering the present-day conditions, most of the Greek Orthodox churches could survive owing to the extensive repairs, restorations or, in some cases, reconstructions. This study made an important contribution to the research on the Greek Orthodox churches, which has a small population today.

Originality/Value

Most studies on this subject is based on just classification of the archival documents. However, this study is focused to analyze the documents in detail with the observation on the structure. The originality of this study is both to analyze historical archival documents and to observe present-day conditions together. Thereby while the past restoration process was understood, future implementation are shed light on.

INTRODUCTION

The Greek Orthodox community was living in Anatolia since the establishment of the Byzantine Empire (Baskıcı, 2009, 40; Shukurov, 2016, 3-4; Tülüce, 2016, 31-34) Istanbul has been home to many civilizations and communities due to its privileged

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location and being the capital of the Byzantine and Ottoman Empires throughout its long history. Istanbul has a remarkable architectural diversity due to various ethnic groups that had lived together. The city was a Christian-Orthodox capital including different ethnic groups since the 4th century (Beihammer, 2017, 52; Cahen, 1968, 64-66; Vryonis, 1975, 57). After the conquest, the sultan of the Ottoman Empire respected the non-Muslim communities in terms of their religion and free worship. So thus, these religious rights were guaranteed by the legal regulations. The Greek Orthodox community, which was one of the important non-Muslim groups, had a significant role in the Ottoman Empire.

The Westernization in the Ottoman Empire, which started with the Tulip Era, was a long process, and resulted in many changes and developments in different fields. These developments had a particular impact on architecture, urbanism and social life in Istanbul. Especially the 19th century witnessed radical changes and reforms in the economic, political and social arenas in the Ottoman Empire. Another specific aspect of the 19th century was the influence of the Tanzimat and Islahat Edicts on the non-Muslim's lifestyle. The changes and reforms within these edicts were reflected in the architectural activity of the churches with respect to the political developments also.

The construction and restoration processes of the Greek Orthodox churches were also affected by the developments as a result of the edicts. There is a significant number of documents in the archives about the Greek Orthodox churches, which were damaged or repaired because of disasters such as fire, earthquake or usage of inappropriate materials during the conservation process. The information about the construction and restoration processes of the Greek Orthodox churches can be provided from especially two main archives. The first one is the state archive entitled 'The Presidency of the Republic of Turkey Ottoman Archives (BOA)' and the other one is the archives of the Greek Orthodox communities, which are the archive of the Patriarchate or the archives of the congregations of the churches. The documents recorded in the 19th century indicate the changes in the implementation and legal process of the construction or restoration of the churches. In addition, these documents clarify the construction and restoration history of the churches including the conservation techniques and administrative details. They help to comprehend the implementation's background and in this way, the probable conflicts about the past interventions are eliminated. This historical information also is being a guide for the future interventions. This article aims to examine the restoration processes of Galatasaray Panagia Church conducted in the 19th century based on the Ottoman Archives

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(BOA) and the Archives of the Beyoğlu Greek Orthodox Churches and Schools Foundation.

CONSTRUCTION AND RESTORATION ACTIVITIES OF NON-MUSLIM COMMUNITIES IN THE 19TH CENTURY

The Tanzimat and Islahat Edicts proposed 'equality' between the non-Muslim and Muslim communities. The Tanzimat Edict guaranteed equality before the law for all Ottomans, regardless of religion. All rights such as taxation, military service, criminal justice, life safety, honor safety, property right are the same for all communities (İnalcık & Seyitdanlıoğlu, 2006, 3). Therefore, non-Muslim communities procured the opportunity to construct new buildings or restore the existing ones. Even though the government provided legal freedom for these architectural activities, the non-Muslim communities were responsible to find budget, mostly provided by the financial donations or the budget of the foundation of the churches (Alemdar, 2012, 260). Before the 19th century, the churches were simple and independent from their environment, but after the Tanzimat Era and the declarations of the edicts, the interaction between the churches and their environments was highlighted. Furthermore, the churches have turned into a landmark in their neighbourhood, they were architecturally impressive and plan typologies and ornaments were freer and more diverse.

Before the Tanzimat Edict (1839), the churches were neglected for a long time and faced the risk of collapse due to mostly the climatic conditions. Then, they were comprehensively repaired because the congregations of the churches had legal support and permission. In this period, Shayk al-Islam and then Sultan's permissions were needed for the restoration of the churches (Şenyurt, 2012, 71). In some cases, the political and social facts resulted in delays in the construction and repair of the churches or other structures belonging to the non-Muslim communities. Therefore, the permission about the repair or reconstruction of more than one church is often specified in a single document to meet the patriarchates' requests (Şenyurt, 2012, 30). According to the documents, the repair permits of non-Muslim structures did not break the workflow of the governmental structures.

Constructing a new church was only possible when the church was ruined due to a fire or if an extensive repair was needed. Nevertheless, adding a new structure or space to the existing church or expanding the building was forbidden in these cases. Moreover, the existing materials were reused in the construction of the churches to reduce the cost (Şenyurt, 2012, 31). As underlined, before the Tanzimat Edict, the regulations about the construction of a new church were more rigid. For example, if a new church was going to be constructed instead of the old one,

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all the architectural dimensions had to be the same with the standards determined by the Ottoman administrators. All the façades and spaces were controlled by the responsible authorities, and any windows or doors could not be added to the building if they did not exist before (Şenyurt, 2012, 13).

However, after the Tanzimat Edict, non-Muslims had new rights for the construction of their structures. Previously, there was an inequality between the height of the storeys of Muslim and non-Muslim's buildings. These rules changed after the Tanzimat Edict and all communities became equal in terms of the construction of new buildings. Thus, the new construction methods were started to be implemented on an equal basis (Denel, 1982, 42). The process that began to change after the Tanzimat Edict has become more apparent with the Vienna Protocol in 1855. With this protocol, non-Muslims also gained new rights for the restoration of their buildings and the construction of new places for worship. According to this protocol, non-Muslims could have been able to repair their sanctuaries without permission, and build new churches in the areas where there were many Christian inhabitants. However, in spite of this issue, it was stated that a license should have been obtained from the Sublime Porte for repairing the existing buildings and for new constructions, which was declared in the Hatt-ı Hümayun, dated March 4, 1856. There is a statement in the Islahat Edict regarding the restoration of non-Muslim structures. It expresses that the repair or reconstruction of the churches, schools, hospitals or cemeteries in their original form and condition will be allowed in the cities, towns or neighbourhoods where the entire community belongs to the same religion. Although the Vienna Protocol of 1855 stated that construction of a new building was permitted, it came up in the Islahat Edict that the necessity of getting permission was still valid for the construction of new buildings (Madran, 2002, 33-34). After the Islahat Edict, new churches were constructed in various plan schemes, construction techniques and they had different ornamentations and stylistic features as a result of the remission of the restrictions (Karaca, 1996, 38).

The basic document explaining the conditions and rules about the construction or repair of the non-Muslim buildings belonging to the congregation, such as churches or schools, was the Islahat Edict in the 19th century. The construction activities of the congregation buildings increased in the second half of the 19th century. Thus, the Ottoman Empire tried to keep these activities under control regarding the regulations defined in the edicts. Important details about the construction or the restoration of the building were determined before the construction activities started. These details can be summarized as the location of the

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building, which was going to be constructed or repaired; the Greek population around; the plan and dimensions of the building, and the amount of taxes and the construction expenses to be met (Özil, 2010, 28).

BRIEF INFORMATION ABOUT THE GALATASARAY PANAGIA CHURCH

The Greek community wanted to build a new church in Pera because the Greek-Orthodox churches were far from their neighborhood especially Galata. So, the church was constructed with the donations of the Greeks in Pera on the Hacopoulos's plot, which was blessed to the name of Hagia Panagia. The first stone of the foundation of the church was placed on June 26, 1804, by Dimitrios Shinas who was the translator of the Sublime Porte, Skarlatos Sevastopoulos, Yordanis Kaplanoğlu, Efstratios Petrokokkinos (Kalaycı, 2014, 495). Galatasaray Panagia Church (Ton Eisodion) had two entrances since it was constructed with the permission of the Ottoman state. One of the entrances was connected to Beyoğlu district whereas the other one was connected to Tepebaşı district where the Cemetery of Catholics was located (Hovhannesyan, 1996, 38). Today, the church is located in Beyoğlu District, Asmalı Mescit Neighborhood and it has three entrances (Fig.1). Main entrance is on Emir Nevruz Street and the other entrances are on Meşrutiyet Street and the Han Geçidi Street (Fig.2).

Figure 1. Location of Galatasaray Panagia Church (Sönmez Pulat, 2019).

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Figure 2. Entrances of Galatasaray Panagia Church. (Reproduced by the Sönmez Pulat based on https://yandex.com.tr/harita access date 10.11.2019).

According to the inscription of the church, it was constructed from the foundation on September 18, 1804. In the beginning, the church had a single nave, it was simple and ornament free. However, in 1831, the church was enlarged and the roof was renovated during the reign of Sultan Mahmud II (1808-1839) (Karaca, 2008, 353). According to Karaca, the church was enlarged again towards the south and north directions in 1860. However, the archival research on this issue revealed that the date 1860 is not correct. According to the documents in the Ottoman Archive, the church was enlarged in 1894 upon the request of the Patriarchate in 1893. Additionally, it is known that the church was also restored in 1875, 1890 and 1904. The Greek architect Leon Casanova was responsible for the repair of the church in 1904. This repair was based on the general renovation of the church and restoration of ornaments owing to its centenary. The church was restored in 1946 by the architect Ch. Euthymiades, and the wall paintings and icons were restored by Charilos Xanthopoulos and Russian Nikolaos Perof in the same year. However, the church was damaged during the protests on September 6-7, 1955. Lastly, the structure was restored between 2007 and 2009, after the explosion, in 2003, in the vicinity of the church (Tsilenis, 2010, 449-450). After the explosion, the windows were broken and the main axis of the roof dislocated. In addition, the floor and structural system were damaged due to the water leak from the roof. Therefore, the primary issues were the repair of the roof, the consolidation of the structural system, the renewal of the floor coverings and the renovation of the wall paintings and icons (Kalogeras, Pavlatos, & Tsilenis, 2009, 62). Consequently, the church was reopened in November 2009 (Fig.3).

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Figure 3. Galatasaray Panagia Church (Sönmez Pulat, 2019).

Today, the church consist of a main naos, a narthex, a bema, a gynaeceum and a bell tower. The church has a five-aisled basilica plan scheme on the east-west axis (Fig. 7). The columns and square shaped piers separate the aisles. The columns are made of oak wood and the thick mortar layer surrounding the wooden core. Therefore, the cross section of columns has become larger. There are two stairs on the east side of the church to reach the gynaeceum section. The bema has three parts, the central apse is in the form of a half round on the east, and the others are straight. The pitched roof covers the naos, but the apse is covered by a flat roof. There is a bell tower on the east side and a bridge on the south side connecting the church to the priest house that is a later addition. The building has masonry structure and all facades are plastered and painted.

THE RESTORATION PROCESS OF THE CHURCH BASED ON THE ARCHIVAL DOCUMENTS

The documents in the Ottoman Archives were firstly reviewed in order to understand the history and characteristics of the Galatasaray Panagia Church's restoration process. According to the archival records, there were several correspondences about the restoration process of the church between the governmental organizations of the Ottoman Empire in 1893 and 1894. One of these correspondences reveals the administrative process and the institutions involved in the restoration of the church.

The first document about the restoration of the church has five pages. The document[1] dated August 12, 1893 stated the request of the Patriarch Neofitos VIII on behalf of the Patriarchate of the Greek Community (Patrikhâne-i Millet-i Rum) to the Ministry of Justice and Sects (Adliye ve Mezâhip Nezareti). This request is about the need of enlarging the church, because its capacity is

[1] BOA. ŞD. 2626/47. December 27, 1893. Permission about repair of Galatasaray Panagia Church.

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not sufficient for the Christian population living in the area. This enlargement would only be allowed without destroying the authenticity of the church during the inclusion of the two porticoes on both sides into the naos. A paper indicating the necessity of the examination on the repair and enlargement of the church was sent from The Secretary of the Municipal Council (Şehremâneti Meclis Kalemi) to the Ministry of Justice and Sects (Adliye ve Mezâhip Nezareti) with regard to the request on October 26, 1893. The Municipality of the 6th District (Altıncı Daire-i Belediye Müdüriyeti) clearly explained what has to be done with the detailed drawings and its cost, 215 Ottoman Liras, as a result of that examination. In addition, the cost estimation was presented including the expenses of that repair. Aleko Frenklink was the contractor of the lump-sum contract for this repair and this contract was supplied and submitted by Vasilaki Efendi and a respectable and loyal deputy of Zahariye Efendi who was the trustee of the church. On November 18, 1893, Rıza Bey, Minister of Justice and Sects, approved the intervention to the church, in the name of the Ministry of Justice and Sects, Directorate of Sects (Adliye ve Mezâhip Nezâreti Mezâhip Müdürlüğü). Additionally, a paper written by the Secretary of the Imperial Council (Divân-ı Hümâyûn Kalemi) on behalf of the Prime Minister (Bâbıâli Dâire-i Sadâret-i Divân-ı Hümâyûn) also stated that a permit was given for the restoration of the church on December 3, 1893. The second document about the restoration of church consists of four pages; one of them is a plan drawing, the second is cost estimation table and the remaining two are plain texts, bearing the stamps of the members of the Department of Internal Affairs (Fig. 4). These document[2] dated December 27, 1893, stated the approval of the Council of State, the Department of Internal Affairs (Şûrâ-yı Devlet Dâhiliye Dairesi) about the restoration of the church. Finally, the grand vizier and the head clerk of the Sultan approved the restoration of the church on behalf of the Sultan, and this approval was delivered to the Municipality (Şehremâneti), The Ministry of Justice and Sects by the document[3] dated January 30, 1894 (Fig.5). The last document is a registration summary.

According to the information gathered in the Ottoman Archives and Archives of Beyoğlu Greek Orthodox Churches and Schools Foundation, the church had its present-day plan during the restoration works conducted between 1893 and 1894. The characteristics of the interventions, the construction materials and the working groups and schedule of the restoration of the church were revealed in light of the archival documents.

[2] BOA. İ.AZN. 8/28. January 15, 1894. Restoration of the Galatasaray Panagia Church in Beyoğlu.

[3] BOA. BEO. 349/26119. January 25, 1894. Restoration of the Galatasaray Panagia Church in Beyoğlu.

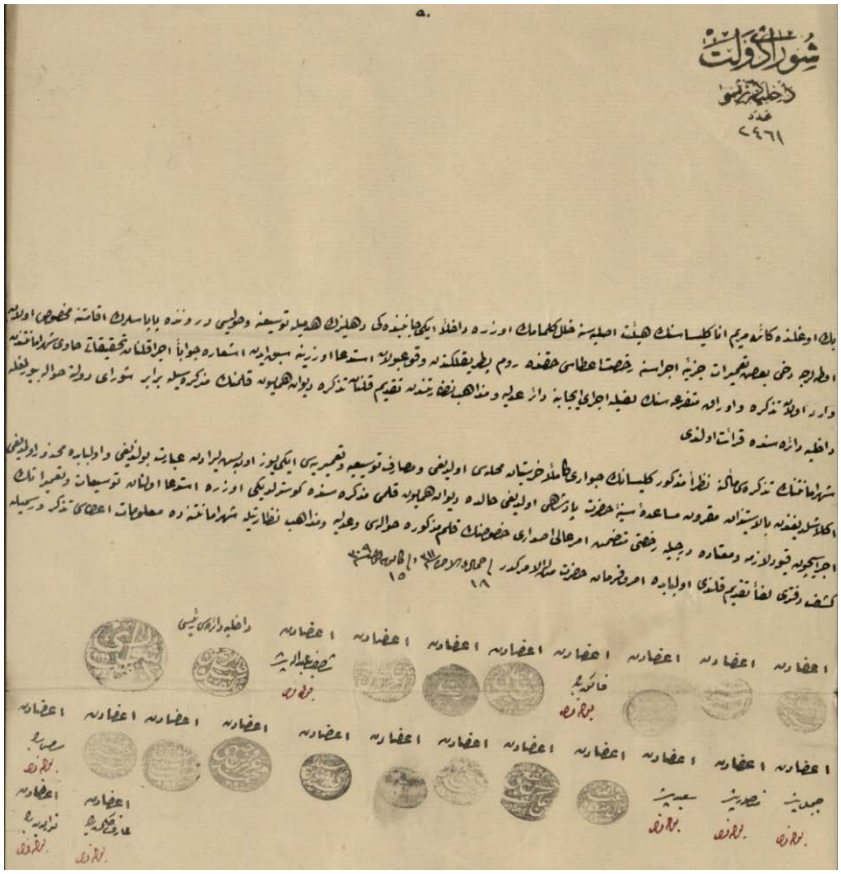

Figure 4. Sample of the document (BOA. İ.AZN. 8/28).

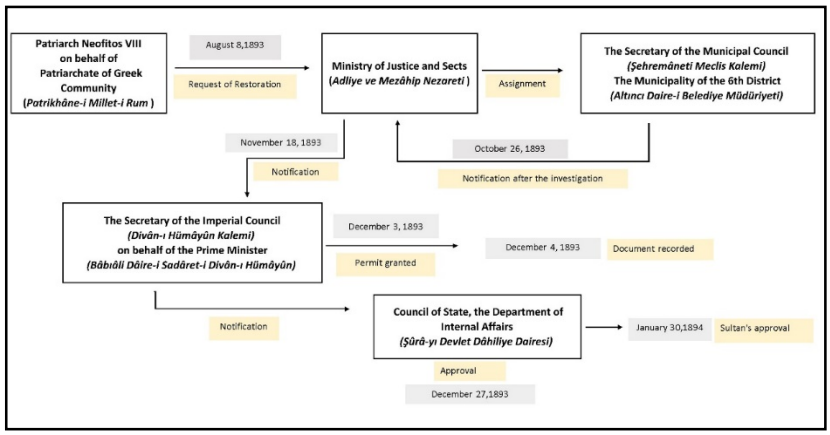

Figure 5. The diagram about the correspondence between the Ottoman Empire authorities on the restoration process of the Galatasaray Panagia Church. (Sönmez Pulat, 2019).

The plan drawings and cost estimation were attached to the document upon the request of the Patriarchate in 1893. The drawings prepared for the church are similar to the intervention sheet in the present-day understanding of conservation projects (Fig.6). These drawings were signed by the church trustee and engineer, thereby they were approved. The scale of the plan drawing is expressed as “Mikyas bir metro için iki santimetre alınmıştır” (the scale is 2 cm for 1 m) and there is a note as “échelle 0,02 par metre” on the drawing. These notes show that the scale of the drawing is 1/50. The drawing is in color and,

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includes the following explanation: The walls to be demolished are represented in yellow, whereas the walls and windows to be reconstructed are represented in pink. There will not be any difference in the length and width of the church following the repair. The terminology used for the naming of the spaces is remarkable. For example, while "direk altı (literally beneath the posts)" indicates the semi-open portico, "narteks diye tabir olunan mahal (the space called as narteks)" is used for the narthex. "Kilise derunu (interior of the church)" is used to name the naos. The terms used for naming the spaces in the 19th century are almost the same with the present-day church terminology. Only, the parts that would be intervened are represented in the drawing, and the openings and wings of the doors are not shown. The main door on the west side is called "büyük kapu", literally meaning the grand gate. Although the windows are drawn in detail to represent the existing situation, the doors and windows, which would be concealed within the walls because of the reconstruction, are not drawn. Only, some parts of the furnishing are represented, but there is no information about the floor coverings. In addition to the drawing, the table attached to the drawing is accepted as the first cost estimation that shows the construction materials and costs (Table 1).

Table 1. Cost estimation for restoration of Galatasaray Panagia Church in Beyoğlu

	Ottoman Lira
The cost for tearing down the walls and reconstruction of the walls in Marseille stone with a thickness of 45 cm with window openings	150
Relocation of the iron doors and placement of new Trieste door frames	15
For fifty new seats (pews)	25
Relocation of icons	18
Repair of floor coverings	7
Total cost	**215**

There are some differences between the old drawing of the church, dated 1893, and present-day plan. One of the is indicated in yellow on the second axis in both drawings. Archival drawing indicates that the wall is constructed on the second axis (Fig.6), but at the present time, there is no wall on this axis. There is a wall on the first axis, shown in red on the plan (Fig.7). This wall is considered as a part of the original structure with respect to its thickness and the existence of the doorways.

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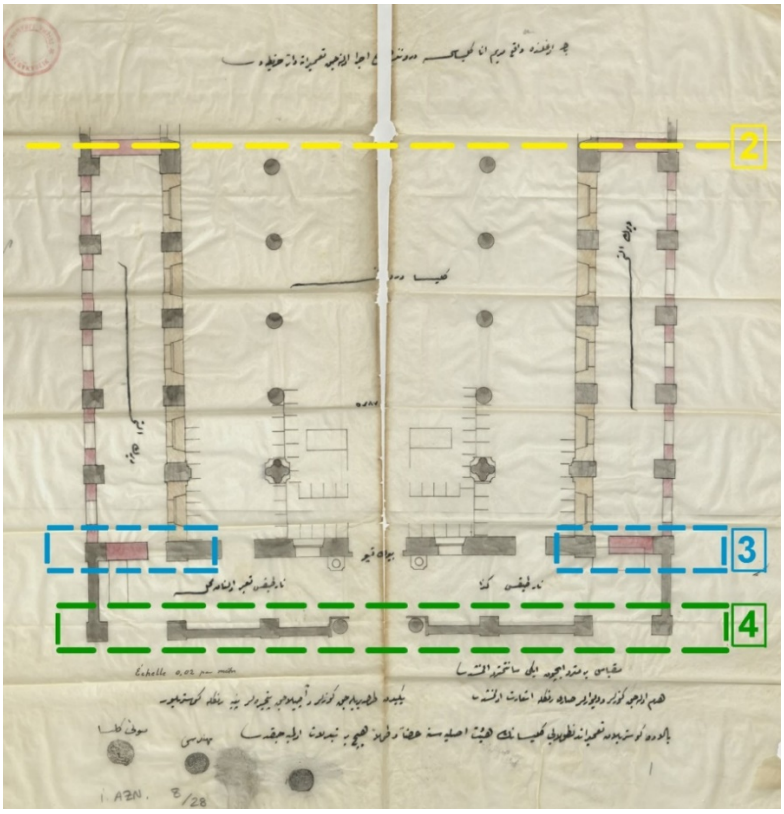

Figure 6. The document about the restoration of Galatasaray Panagia Church (BOA, İ.AZN. 8/28).

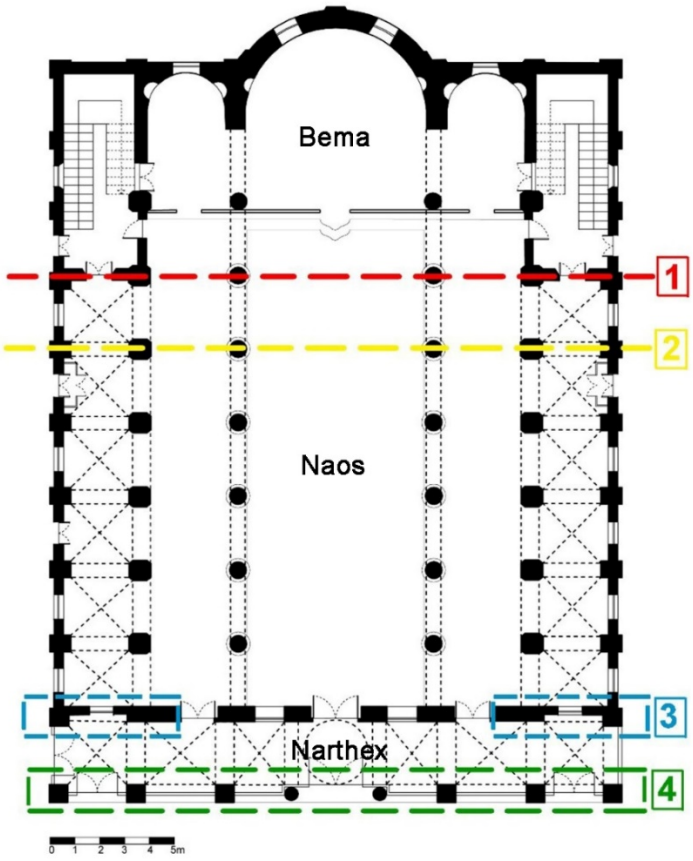

Figure 7. The present-day plan of Galatasaray Panagia Church (Reproduced by the author based on Karaca, 2008, 359).

Moreover, the examination on the similar churches having the same plan configuration and the existence of the gynaeceum

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(women's gallery) and the staircase reaching to this space before the exterior naves (which was called as *"direk altı"* in the drawing of 1893) support the claim that the wall on the first axis is original. Hagios Dimitri Church in Büyükada, constructed in 1856, has the same plan scheme with the first Galatasaray Panagia Church (Fig.8, Fig 9). The church of Hagios Menas in Thessaloniki, built in 1852, is a three-aisled, wooden roofed basilica. It has a colonnade and a gynaeceum on three sides and a single, pitched roof (Fig. 10, Fig. 11) (Vamvoukou Kambouri, 1979, 32). All of these examples have semi-open porticoes on north, south and west side. In addition, these similar churches give information about the form of the Galatasaray Panagia Church before its restoration in 1894. It is obvious that west, north and south façades of the church were open spaces before the enlargement of the church. Then these spaces were included to the naos (Fig. 12).The first floor of the wall on north, south and west façades were constructed during the intervention in 1894 (Fig.13). Therefore, the naos space has expanded and became five-aisled.

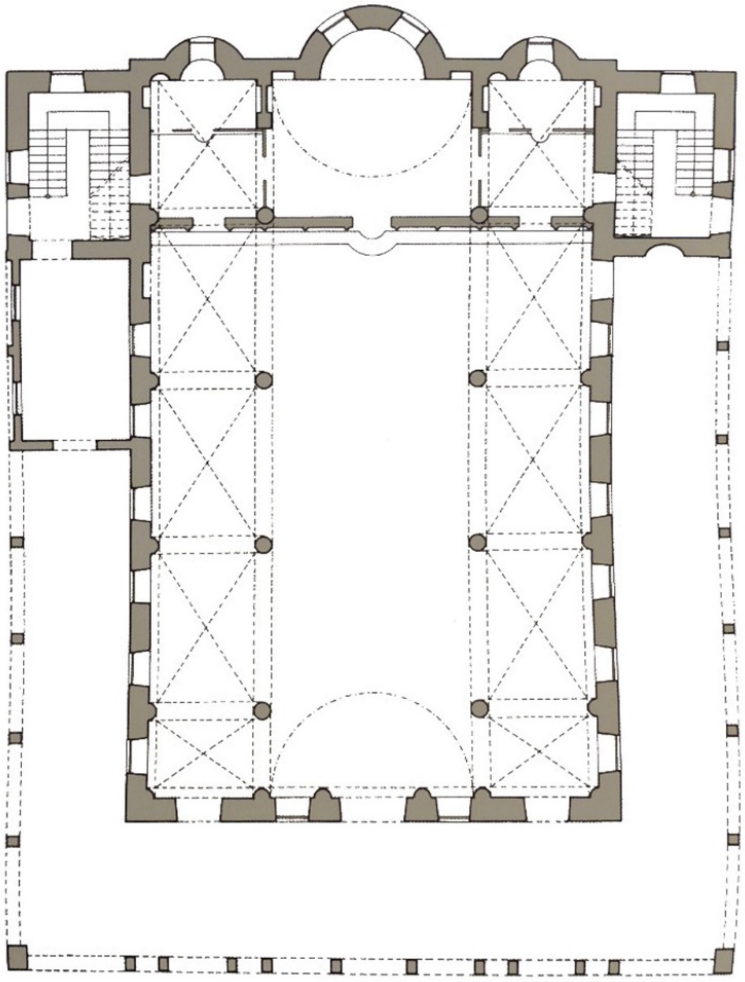

Figure 8. Büyükada Hagios Dimitri Church plan (Panagiotopoulou Mantopoulou et al., 2009, 22).

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Figure 9. Semi-open portico on west facade of Büyükada Hagios Dimitri Church (Sönmez Pulat, 2019).

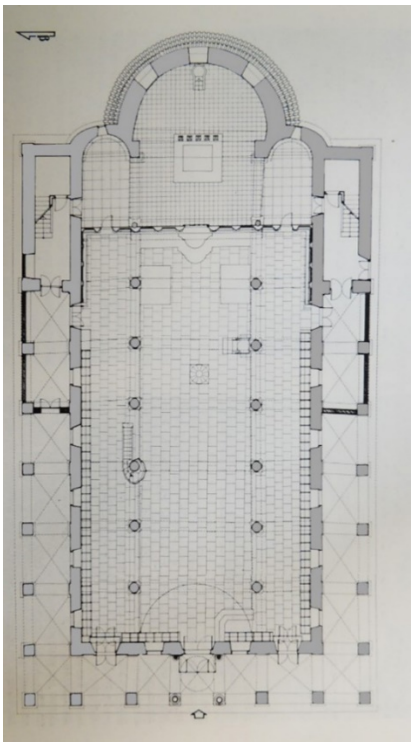

Figure 10. Thessaloniki Hagios Menas Church plan (Vamvoukou Kambouri, 1979, 15).

Figure 11. West facade of Thessaloniki Hagios Menas Church. (URL1).

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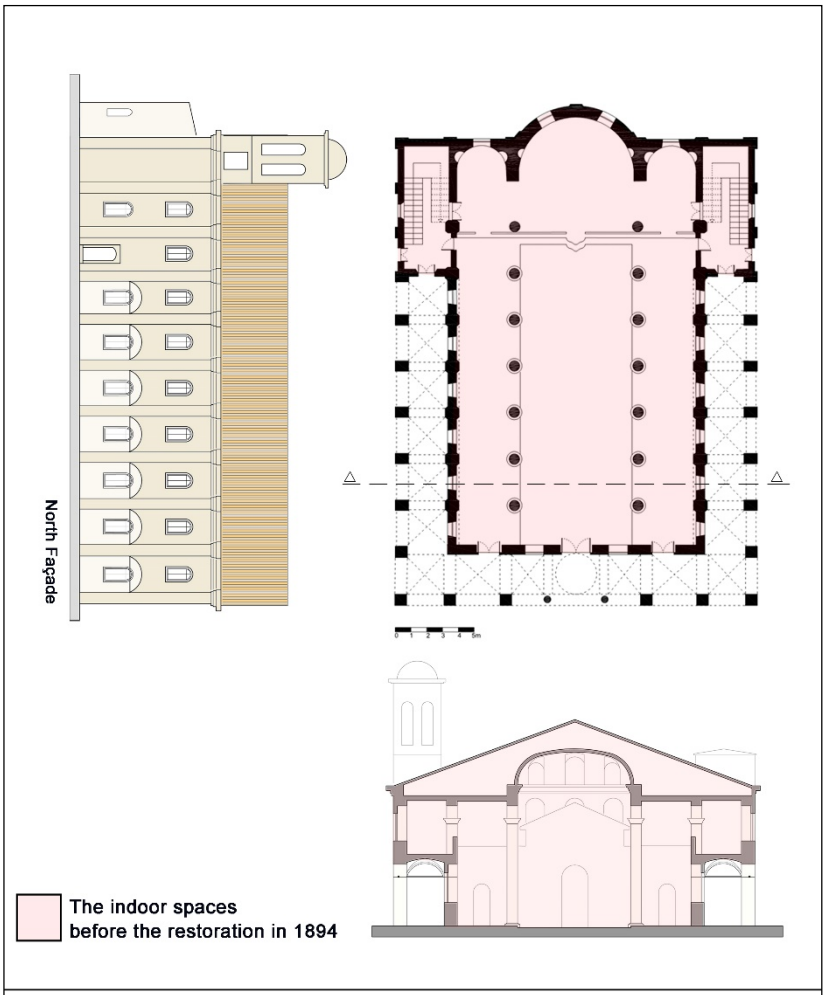

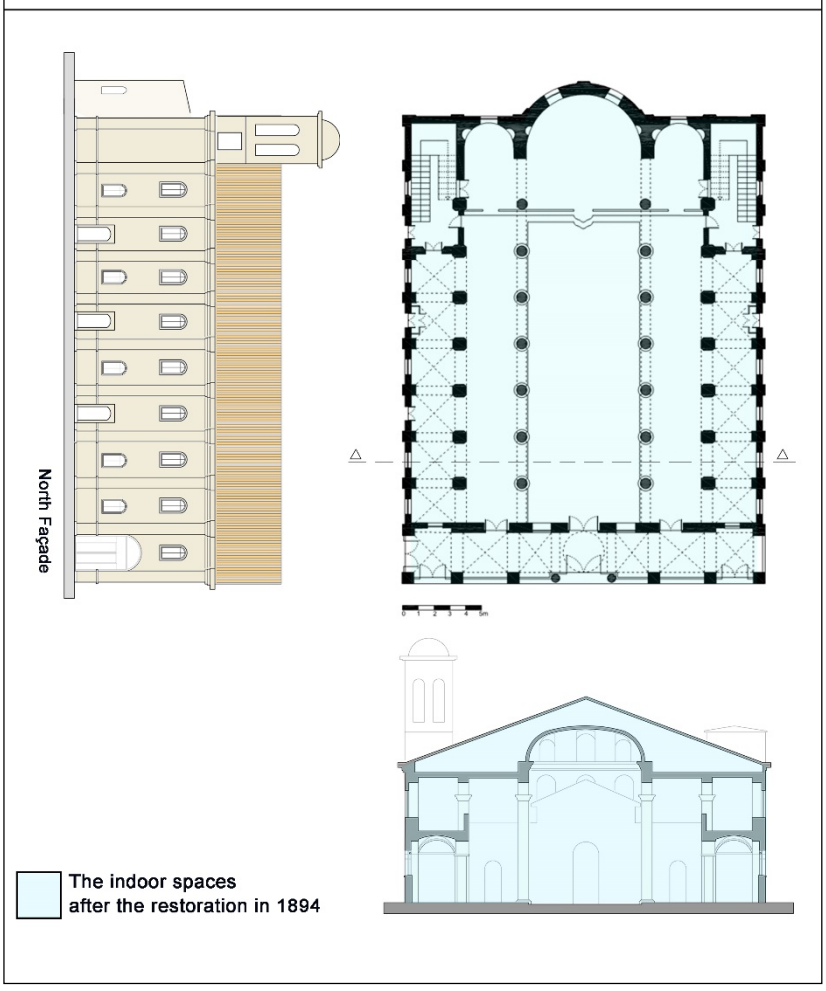

Figure 12. Changes of indoor spaces before and after intervention in 1894 (Sönmez Pulat, 2019).

Figure 13. The first floor of the wall on north, west and south façades (Sönmez Pulat, 2019).

Even though, the plan drawing dated 1893 includes the windows within the newly constructed walls, three of these windows are being used as doors. It is not certain either the intended window openings turned into doors as a result of another intervention after 1893 or a different implementation of the first estimation. There is another difference between the present-day plan and the old drawing, and that is on the wall between the narthex and exterior naves. This observation is shown in blue in the Figure 6. This part was expressed as doors in the drawing dated 1893, but currently, there are windows instead of the doors (See blue part numbered as 3 in the Fig. 7). Lastly, the walls, which are drawn without the windows surrounding the narthex (See, green part numbered as 4, in Fig.7), may not exactly match with the current status depending on the elevation of the plan section.

Consequently, the drawing dated 1893 and the table of the cost estimation provide an approximate information about the interventions and the expenses within the restoration process. Obviously, the main intervention is the inclusion of the semi-open sections of the church into the naos. However, there are differences between the present-day plan of the church and the drawing dated 1893. There can be two hypotheses proposed about these differences. One can suppose that this drawing is the first draft or the concept project that underwent some changes during the implementation. The second hypothesis is that the church might have been restored or intervened after 1893. Despite both these hypotheses, the inclusion of the semi-open sections into the naos, can be interpreted as a valuable contribution to the historic evolution of the church. Furthermore, besides the new spaces, construction materials and techniques of 1893 are also an addition of quality to be maintained in future restorations.

Some documents related to the construction of the church were found during the research in the Archives of the Beyoğlu Greek Orthodox Churches and Schools Foundation and they are mostly in Greek, rarely in French (Fig.14). The document seems to be a construction notebook with some missing pages. 48 pages have been found in the archive. These explain the types of the materials including the amount of the usage, where the materials were procured, and the assignment of the working groups involved in the restoration process. As stated by the dispatch

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notes and bills, the construction materials were supplied from H.G.Laghos and O. Derounian Company (Fig.15).

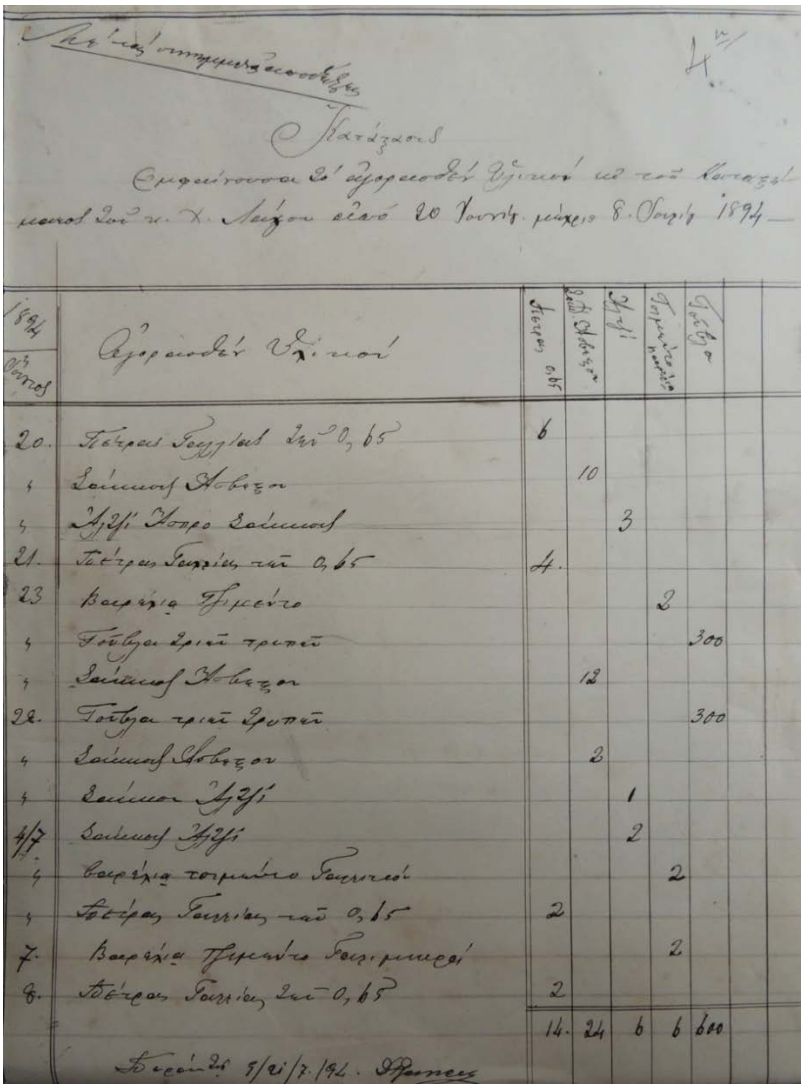

Figure 14. A page of the construction documents from the Archives of the Beyoğlu Greek Orthodox Churches and Schools Foundation.

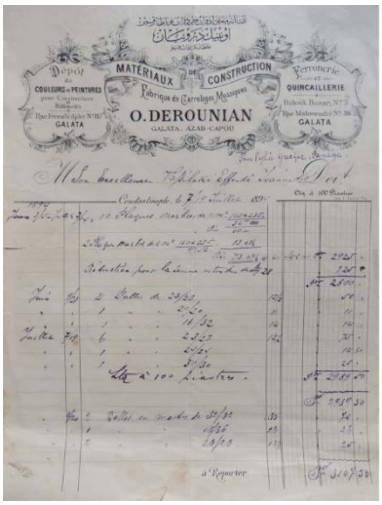

Figure 15. The sample bill of Derounian Company and the sample dispatch notes of Laghos Company from the Archives of the Beyoğlu Greek Orthodox Churches and Schools Foundation.

According to these documents, the construction materials used in the restoration process in 1893, were clearly presented on the

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Table 2. The construction material list gives the information about late 19th century implementation. As conformity to authentic construction materials is the main concern of the later restorations, these archival documents shed light on construction materials to be selected in future restorations.
The construction materials used in the restoration process of the Galatasaray Panagia Church.

Table 2. The construction materials used in the restoration process of the Galatasaray Panagia Church.

Materials	***Type / Production Method***	***Size / Amount***	***Production Place***
Stone	*French Stone*	size 0.65 (?)	Marseille (?) / France
		size 0.75 (?)	Marseille (?) / France
		size 0.90 (?)	Marseille (?) / France
	Trieste Stone		Trieste/ Italy
	Malta Stone	18 parmak (Ottoman's local unit measurement. It is approximately 56 cm)	Malta
	Marble Plate (Used for floor coverings)	size 24x24 (?)	Marmara Island
		size 23x23 (?)	Marmara Island
		size 20x20 (?)	Marmara Island
		size 16x32 (?)	Marmara Island
		size 30x30 (?)	Marmara Island
		size 18x36 (?)	Marmara Island
		size 20x40 (?)	Marmara Island
		size 32x32 (?)	Marmara Island
Brick	3 Holes Bricks	22x10,5x6,5 cm (?)	Mürefte
	6 Holes Bricks		Mürefte
Cement	Roquefort Cement	Package in 90 kg	Roquefort / France
	English Hollick Cement	Package in 180 kg	London/ England
Lime	Lime (hydraulic)	Sack	
Gypsum	White Gypsum	Sack	
	Local Mopboard	size 0.10 (?)	
	Red Local Tile		
	Plasters	size 2.5 arşın (Ottoman's local unit measurement. It is approximately 188 cm)	

The designation of the existence of many products imported from Europe in the restoration of the church demands deeper research in the archives and The Oriental Trade Annuals (*Şark Ticaret Yıllıkları*), and an examination on the similar

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architectural examples and contemporary implementations (Fig.16). The use of imported materials in the construction or repair during the Ottoman period is not specific to this topic. For example, according to the document from the Archives of the National Palaces, the stones imported from Trieste and limestone, specifically *küfeki*[4], provided from Şile, Büyükdere Kasap Çayırı and Bakırköy were used in the construction of the Çırağan Palace between 1863 and 1871 (Yergün, 2002, 135). The garden walls of the Çırağan Palace on the seaside pier are constructed with Marseille stone and Malta stone was used for the floor coverings (Can, 1999, 57). On the other hand, one of the Ottoman archival documents stated that Trieste and Malta stones were used in the construction of the Haydarpaşa Kasr-ı Hümayun by Sarkis Balyan in 1864 (Ekim, 2018, 312). Similarly, the archival document about the construction of the Ayazağa Kasr-ı Hümayun, which was constructed by the Balyan family and during the reign of Sultan Abdülaziz, also stated that the Trieste and Malta stones were used in the construction of the building (Ekim, 2018, 104). Another example concerns Yıldız Hamidiye Mosque, constructed between 1881 and 1885, where all the window frames and eaves are in Trieste stone according to the contract of the building (Can, 2014, 60). It is possible to multiply these examples based on the archival documents. For instance, the document[5] dated 1893, stated that the stones for the construction of the buildings of *Darülaceze* were provided from Trieste and Marseille instead of the limestone quarry in Bakırköy. In addition, the document[6] in the Ottoman Archive dated 1894, notes the use of the Trieste stone for the floor coverings in the kitchen and laundry of the Beyoğlu Kışla-i Hümayun.


CONSTANTINOPLE (GALATA). 1331

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Figure 16. a page from the oriental trade annuals

The use of imported materials such as the Trieste, Marseille and Malta stones in the construction or the repair of the buildings in the last quarter of the 19th century and the official records of

[4] Küfeki: It is a kind of limestone used as a construction material especially in Istanbul and Thrace. Because of obtaining around Bakırköy (Makriköy) in Istanbul, it is named as Bakırköy stone. It is a compact rock, light beige or white in general, fine grained and sandy appearance, high tension and shear strength. Lots of fossils and spaces provide calcite-featured texture. The other important point is high workability and after the air contact, durability of it increases. It is used not only for wall construction but also floor coverings, arches, portals interior (Sönmez, 1997, 65).

[5] BOA. DH.MKT. 124/4. August 31, 1893. In Order To Complete, the Construction of Darülaceze Buildings, the Necessity of the Stones, Which Cannot Be Obtained from Makriköy Quarries to Be Supplied from Trieste and Marseille Stones.

[6] BOA. İ.TPH. 2/25. February 27, 1894. Cost Is About Usage of Trieste Stone for Kitchen and Laundry of Beyoğlu Kışla-i Hümayun and Repair of Roof Pasha Apartment.

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these materials in the documents in the Ottoman Archives and The Oriental Trade Annuals are quite important to understand the case of the Galatasaray Panagia Church. Obviously, using stones imported from Europe in the construction or restoration of the buildings at the end of the 19th century was not unusual. The book entitled Notes Pratiques et Résumés sur l'art du constructeur en Turquie (Practical Notes on the Art of Building in Turkey and Summary Information) written by the French Architect Alexandre Raymond in 1908, is a very important source dealing with the construction market, material and labor conditions, technical and legal arrangements in the Ottoman Empire at the beginning of the 20th century. Furthermore, the construction materials, their market in Istanbul and the unit prices of the materials are also included in the book. In addition to the local materials, there is a wide range of materials that were brought from Europe in the market of Istanbul (Mazlum, 2013, 503). The construction materials used in the restoration of the church are also included in the list about the construction materials and the cost of labor. Raymond indicates that the London Hollick cement, the Marseille Roquefort cement, and Trieste and Arles stones are stated as the common construction materials used in Istanbul.

There are some unclear parts about the units describing the dimensions of the materials in the archival documents. For example, "size" is used to describe some materials, but there is mostly no specific unit of measurement. However, in some cases, the specific Ottoman units of measurement, such as "arşın" and "parmak" are used. In fact, "gram" as the unit of weight and "meter" as the unit of length were determined as the official units in the governmental institutions upon the regulation issued in 1869 and these units turned into countrywide units after the related regulation was issued in 1874 (Acar, 2004, 85-92). On the other hand, the different measurement units, both old and new, were met in the official documents dated between 1893 and 1894.The documents in the archives of the church had the previous measurement units, but in the Ottoman Archive document the thickness of the reconstructed walls were expressed as 45 cm. Consequently, this period can be considered as a transition period to adapt to the new measurement units.

The detailed material analysis of the church in terms of the kind, origin or peculiarity is not possible because the walls are plastered and painted in the present-day situation. However, it is still possible to identify some materials. For example, the marble floor coverings and red local tiles are clearly visible. These red tiles were used in the lower part of the square-shaped piers that remained from demolished walls (Fig.17). In addition, it is known that the red tiles had to be repaired based on the first cost

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estimation. Besides, the marble plates were purchased at different times according to the construction document found in the archive of the church foundation and this is related to the repair of the floor coverings. Still, there are different-sized marble plates in the church today (Fig.18).

Figure 17. The red tiles used in the restoration of the church in 1894 (Sönmez Pulat, 2018).

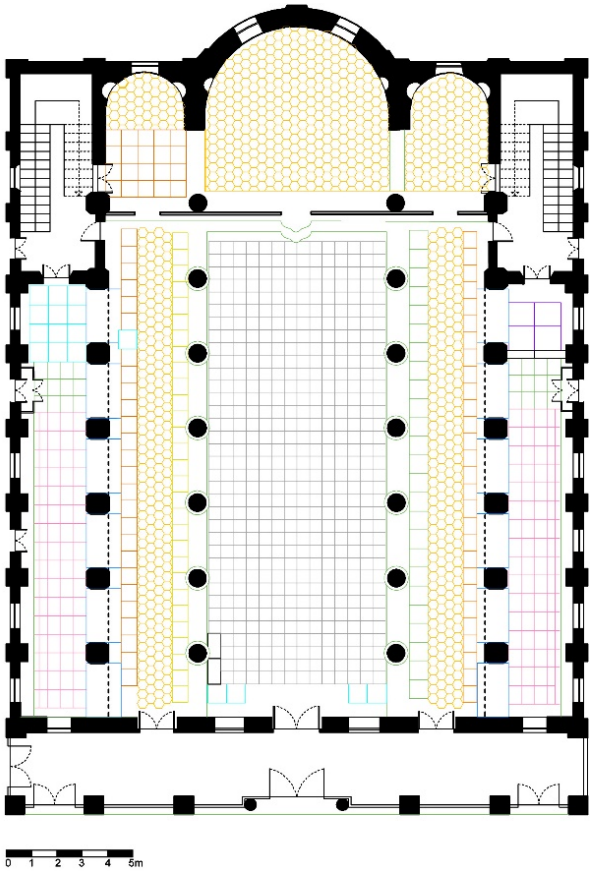

Figure 18. Plan of the church showing the floor coverings. (Reproduced by the author based on Karaca, 2008, 359).

Beyond the architectural details about the restoration of the church, there is also information about the details of the labor and the daily wages of the workers in the construction document found in the Archives of the Beyoğlu Greek Orthodox Churches and Schools Foundation. The workers and their practices are explained in detail, and these are the masons

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(duvarcılar/Κτίσται), stonecutters (taşçı/Λιθοξόοι), unskilled worker (düz işçi/Εργάται), plasterers (sıvacılar/Σοβατζίδες), cabinetmaker (ince marangoz /Λεπτουργος), cleaners (temizleyici/Καθαριστής), scrapers (raspacı/Τριπτης), carpenters (marangoz/Μαραγκός) and the secretary (yazman/Γραμματικός). The secretary was responsible for keeping records about the work schedule, attendance, overtime performance of the employees. Therefore, this occupation in the Ottoman period is considered as the tally clerk (puantör) in the present-day.

CONCLUSION

19th century is a specific period in the Ottoman history as well as Europe, and the major characteristics of this period were the developments and reforms in political, social or economic orders and also in art and architecture. Thus, the reflections of these reforms and developments in the Ottoman Empire can be observed in the construction and restoration process of non-Muslim structures. The archival documents, which are the basic evidences of these reforms, are very important because they reveal the specifications of that era. The restoration process of the Galatasaray Panagia Church, which is a worship place of the Greek Orthodox community, started in 1893 upon the request of the Patriarchate and was completed in 1894. The details of this restoration process were tried to be clarified based on archival documents. The basic findings in these documents are related to the drawing techniques, characteristics of interventions, construction materials, construction sector, responsible authorities and the process of getting necessary permissions for the restoration and the details of labors. These archival documents were the important proofs of the interventions, which were applied at the end of the 19th century. The restoration process was rather comprehensive and attentive due to including detailed drawings, construction material list, cost estimations and official permission documents. At the end of the 19th century, the philological restoration approach was prevalent in Europe. While interventions to the church seem to be compatible with this approach at some points, they contradicted at some others. According to the philological restoration, new additions were not necessary if they are not of historical and monumental content. The inclusion of the semi-open spaces to the naos in Galatasaray Panagia Church was mainly due to the increasing number of users and thus can be considered for social requirements. Although in philological restoration the intervention should not damage the authenticity of the building, it has not been the case.

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In the Ottoman Empire, only the original materials of the churches were allowed to be used in their restoration. However, it is seen that the European stones were also used in the restoration of the Galatasaray Panagia Church. The restoration decision was basically about the inclusion of the semi-open spaces into the naos. These newly added naves of the church were considered as a later addition specific to the end of 19th century. Afterwards, the authenticity of the space, the materials and construction techniques applied were the focal points of conservation processes of the church after the 19th century. The integrity of the church with its additions specific to the late 19th century has been the main concern of the later restoration processes.

During the last period of the Ottoman Empire, the Greek Orthodox churches were no longer constructed in a simple configuration and did not have plain ornamentations. They became more visible in the cityscape. The scale and the architectural style of the churches also changed along the 19th century. Therefore, this study examines the archival documents to provide the information about the church and aims to underline the importance of these documents to understand the history of the church, as well as the conservation methodology and process in the 19th century. These documents do not only give information about the history, they also can be considered as a guide for the future implementations. The archival documents provide reliable and valuable information about the later additions that must be conserved. Later additions specific to late 19th century were preserved during the restoration conducted after the end of the 19th century. The extension of the church was a necessity for the increasing population of Greek Orthodox community in the area at the end of the 19th century. Although the building continues to be a place of worship, the number of users is quite limited today. Even so, the intervention made in late 19th century is not reversed and all the additions of quality are preserved as a resource of information considering the spatial features, construction techniques and materials. Besides the information given by the building itself, the archival documents are the most important proof to understand the past restoration implementations and shed light on future restoration process with such technical details as construction materials and techniques.

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Resume

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Dr. Deniz Mazlum is graduated from architecture at ITU. She obtained her MSc and PhD degrees with thesis on the Ottoman restorations that followed the catastrophic earthquake of 22 May 1766 in Istanbul, essentially based on Ottoman archival documents from the same university. Professor Mazlum is member of ICOMOS Turkey, has several publications on history and theory of restoration, Ottoman restoration techniques and architectural terminology.

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ICONARP

Nanotechnology-Based Materials Applied in Curtain Wall System: A Case Study from Turkey

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Yeliz Tülübaş Gökuç**

Abstract

Purpose

Application of nanotechnology in construction sector brings innovation to building materials like self-cleaning and antifog. These features make it possible to shorten the maintenance and repair periods of building materials, and thereby reduce maintenance costs. The development of environmentally friendly building materials become very important to reduce air pollution and adverse effects. The competitiveness of companies in the construction sector is based on technological developments. Now, it is possible to reduce costs and respond to various customer demands owing to new technologies. Nanotechnology affects many sectors as a technology that contributes significantly to the development of the properties of materials, and it has also found its place in the construction sector. The purpose of this study is to examine the use of nanomaterials used in the construction sector in the context of glass and curtain wall systems. Also, the aims of this paper are to reveal the advantages of nanomaterials by examining the differences between the traditional and the nanotechnology applications used in

Keywords: *Curtain wall system, glass curtain wall, aluminum curtain wall system, nano-products, nanotechnology*

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glass and curtain wall systems, to remark nanomaterial applications in construction sector, and finally to expand awareness in this regard.

Design/Methodology/Approach

This study consisted in reviewing existing nanomaterials in the curtain wall system applications through projects, and conducting a survey. A preliminary letter and a 14-question survey were prepared. This study covers aluminum composite and glass curtain wall suppliers which were contacted by email. Face to face interviews were made with those who could not be reached by e-mail. The survey that was formed by the authors was sent to 68 participants working in the aluminum composite and glass curtain wall companies operating in the construction sector.

Findings

The findings of the study show that there are a limited number of structures using nanomaterials in Turkey. While these materials are used in many different parts of the structures, the most preferred in the outer shell design of the buildings (curtain wall systems).The construction sector should be considered as one of the critical sectors where nanotechnology can be practiced.

Research Limitations/Implications

The paper contains the normal limitations associated with the survey method including potential non-response bias.

Practical Implications

Potential of nanotechnology applications is growing in the construction field. There are large numbers of nanotechnology applications in the sector. However, construction sector is a traditional and cost oriented industry, rather than a technology focused sector. High cost of nanotechnology-based materials is a major obstacle to applications of nanotechnology in the construction sector. Even though some steps have been taken in the field of nanotechnology, the sector should be supported with incentives by government and research institutions.

Social Implications

The construction sector is the largest sector that causes environmental problems through construction, operation and maintenance of buildings. Due to its potential contribution to sustainability, it makes nanotechnology one of the most promising technologies in the green building area. Nanotechnology has much to offer the construction industry as it moves towards a more sustainable future. The effects of nanotechnological materials on the environment and human health are not clearly defined yet. More studies needed about that.

Originality/Value

Performing such a study is considered to be crucial for construction sector of developed and developing countries, so that the construction sector also avails benefits from this revolutionary technology.

INTRODUCTION

Nanotechnology is considered as the most important and fast developing technology of the twenty-first century. It has a strategic importance for countries, most particularly in the global competition environment. Nanotechnology brings innovation in many areas like medical sciences, materials

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science, defense industry, textiles, economics, computers, clean energy sources, sustainable energy, environment and food etc. Nanotechnology, which has the potential to foster in many disciplines, also takes place in construction sector in terms of production and use of nanomaterials. In the field of architecture, there have been considerable amount of constructive developments with the help of nanotechnology. It aims to develop stronger, better quality, longer lasting, cheaper and lighter construction materials comparing to traditional materials.

The nanotechnology-based materials used for the construction is the pioneer of the developments in the field of architecture and construction sector. It is found that the implementation of nanomaterials in buildings has great benefits in construction sector. Nanotechnology reduces both weight and volume of conventional materials, also allows the usage of materials more efficiently. Throughout the development, the new features that introduced into the materials prevent the damage, so that the necessity of maintenance and repair are reduced. As the production processes are decreased; resources are protected, raw materials and energy consumption are decreased.

The competitiveness of companies in the construction sector is based on technological developments. Now, it is possible to reduce costs and respond to various customer demands owing to new technologies. Nanotechnology affects many sectors as a technology that contributes significantly to the development of the properties of materials, and it has also found its place in the construction sector. The nanotechnology product market is growing at an ever increasing rate, and it is foreseen that nanotechnology will be one of the most important technology that will affect the global economy in the next 20 or 30 years (Özenbaş, 2006). Research studies have shown that nanotechnology can be a pioneer in improving the performance of traditional building materials such as concrete and steel. The construction sector is the largest sector that causes environmental problems through construction, operation and maintenance of buildings (Dixon, 2010; Enshassi et al. 2014). Due to its potential contribution to sustainability, it makes nanotechnology one of the most promising technologies in the green building area (Raj et al.,2017). Although nanomaterials are ready to be used widely in the construction sector, they have not made a significant impact in the sector, yet. This study explores the potential use of nanomaterials that can be used in the near future for curtain wall systems. The aim of this study is to determine the use of products improved by nanotechnology in glass and curtain wall systems. Also, to reveal the advantages of incorporating nanotechnology into a product, and to expand awareness on this issue by examining the differences between

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the traditional and the nanomaterial applications used in glass and curtain wall system are the other purposes of the study.
Understanding the adaptation of nanotechnology into the glass and curtain wall system, and evaluating the existing nanotechnology applications have great importance. This study consisted in reviewing existing nanomaterials in the curtain wall system applications, and then conducting a survey. This survey, which aimed to reveal how much nanomaterials are used in the curtain wall systems in Turkey, conducted among aluminum composite and curtain wall system suppliers.

NANOTECHNOLOGY

Nanotechnology involves the creation of materials and devices with novel or unusual properties by individual atoms or molecules. While combining science, physics, chemistry and biology with different engineering branches such as electronics, industry, mechanics, space, computer, building sector, it leads all disciplines to think at the molecular level in their own fields, then design into products. This view has increased the interest in nanotechnology, so that studies in this area have gained momentum (URL1; Tepe, 2007).
Nano comes from the Greek word "nanos," meaning dwarf. Nanomaterials have been defined as the materials which at least one of its dimensions is below 10 nm (Daryoush & Darvish, 2013). The nanotechnology field was conceived by Richard Feynman in 1959 at the annual meeting of the American Physical Society. The development of nanotechnology was induced by his lecture called "There is plenty of room at the bottom". The concept of nano-scale has revealed for the first time in the world. Feynman explained that atoms and molecules can be used in very small sizes by changing structures with very sensitive instruments. However, the name of this process, which was described at that time, has not been named as nanotechnology. In 1974, Norio Taniguchi introduced the term nanotechnology at an engineering conference in Tokyo. According to him, nanotechnology is mainly consisting of separation, consolidation, and deformation of materials by one atom or one molecule (Taniguchi, 1974). Nanotechnology is a thriving field of research with far-reaching implications for novel applications. Physics, chemistry, biology, engineering and many more disciplines feed the development of nanotechnology and related studies.

NANOTECHNOLOGY IN CONSTRUCTION SECTOR

Nanotechnology represents a major opportunity for the construction sector to develop new products, substantially increase quality, and open new markets (Halicioglu, 2009). The early applications of nanotechnology materials in the

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construction sector was seen in the mid-90s (Bozoglu & Arditi, 2012). After the first-generation nanomaterials were introduced to the construction markets, a forum was formed for discussing related studies in order to evaluate the potential and develop more realistic applications. The International Symposium on Nanotechnology in Construction, which held in Scotland in 2003, was the first event to combine the topics of nanotechnology and construction. As a conlucsion of this event, The Roadmap for Nanotechnology in Construction (RoNaC) was introduced as an aid for further applications, forecasting research and investment directions.

Many studies highlight the importance of nanotechnology (Sev & Ezel, 2014; Hossain & Rameeja, 2015; Olafusi et al. 2019; Tülübaş Gökuç & Turunç, 2019; Das et al. 2020; Ali, 2020). The implementations of nanotechnology materials mainly depend on large chemical companies. However, it could be stated that the demand for the nanomaterials is limited in the construction sector. The significance of nanomaterial implementations in the construction sector has not been clearly defined until recently. Comparing to other industrial sectors, the utilization of nanotechnology in the construction sector has been dropped behind due to the lack of awareness of its potential (Bartos, 2009). It is clear that it should be established a better understanding of the benefits of utilizing this innovative and promising technology. The fact that building and construction materials should be lighter and more durable than it's now, besides more flexible, longer lasting, and less harmful to the environment during the production processes. Deploying the latest techniques of nanotechnology relevant to construction materials will make a powerful contribution in the development of nanomaterials with these promising features (Candemir et al., 2012).

The most important materials that are used in civil constructions are concrete, steel, wood, and glass (Da Silva et al., 2011). With the developments in the field of nanotechnology, high performance construction materials can be obtained by mixing nanoscale materials with concrete or steel. Nanoscale materials have very different properties compared to macro scale materials. For instance, carbon nanotube, one of the most important nanomaterials, is approximately 100 times stronger and six times lighter than steel (Niroumand et al. 2013). One of the most important studies in construction sector is the nanocomposite research that aims to enhance the properties of concrete. Nanomaterials such as Titanium Dioxide (TiO_2), Carbon Nanotube, Nano Silica (SiO_2) and Nano-Alumina (Al_2O_3) can be used as concrete additive. These nanomaterials increase the strength and resistance of the building material by filling the

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empty spaces in the structure of the concrete. In addition, it has been found in many studies that hydration reaction in concrete production is accelerated by nanomaterials. Therefore, a new class of concrete composite with improved properties has been revealed by nanomaterials.

The main nanomaterials used in the construction sector are; Nano-Silica (SiO_2), Iron Oxide (Fe_2O_3), Carbon Nanotubes (CNT), Silver Nanoparticles (AgNPs), Titanium dioxide (TiO_2), Copper Nanoparticles (CuNPs), Aluminum Oxide (Al_2O_3), Clay, Magnesium Nanoparticles, and Aerogels. The construction sector benefits from the R&D activities of other sectors to a great extent, and makes use of nanotechnology developments in the same way. In the early 1990s, a Delphi study that conducted in England emphasized the importance of using nanotechnology in the projections of Swedish and UK construction sectors (Zhu et al., 2004). However, it could be stated that the nanomaterial demand is still inadequate in the sector. The applications and innovations of nanomaterials mostly depend on the large chemical and materials science companies.

Nanomaterials used in construction, scope of applications and prospective benefits are given in Table 1 below.

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Table 1. Nanomaterials used in construction, scope of applications and prospective benefits (expanded from Lee et al. 2010).

Nanomaterials	Scope of Application	Prospective Benefits
Nano Silica (SiO_2)	Concrete	Reinforcement in mechanical strength
	Ceramics	Coolant; light transmission; fire resistant
	Window	Flame-proofing; anti-reflection
Titanium Dioxide (TiO_2)	Cement	Rapid hydration; increased degree of hydration; self-cleaning
	Window	Superhydrophilicity; anti-fogging; fouling-resistance
	Solar cell	Non-utility electricity generation
Carbon Nanotubes (CNT)	Concrete	Mechanical durability; crack prevention
	Ceramics	Enhanced mechanical and thermal properties
	NEMS/MEMS	Real-time structural health monitoring
	Solar cell	Effective electron mediation
	Nano sensors	Real time monitoring of structures
Silver Nanoparticles (Ag)	Coating/painting	Biocidal activity
Copper Nanoparticles (Cu)	Steel	Weldability; corrosion resistance; formability
Alumina	Concrete	Improving mechanical and physical properties of concrete
Fe_2O_3	Concrete	increased compressive strength; abrasion-resistant
Clays	Asphalt	Increasing the viscosity of asphalt binders and the fatigue strength of asphalt mixtures
Quantum dots (CdSe)	Solar cell	Solar Energy Utlization
Aerogels	Insulation	Energy efficiency, space savings, moisture management, design flexibility

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USE OF NANOTECHNOLOGY IN GLASS CURTAIN WALL SYSTEMS AND SOME PROJECTS

There are three applications of nanotechnology-based materials for glass surfaces; self-cleaning feature, heat resistance, and indoor climate control. Working principles are similar to paints and coatings (Candemir et al.,2012).

Self-Cleaning Feature

Since the glass structures are constantly exposed to dirt, surfaces must be formed to prevent dirt from adhering to the surface and to let water flow off more easily. By adding silver nanoparticles or Nano Silica (SiO_2) on glass surfaces, a hydrophobic state is formed similar to the lotus effect seen on the lotus flower, and the dirty particles flow together with rain. The Lotus effect takes its name from the lotus plant's self-cleaning feature. Water drops move from the leaf surface and clean the dirt, this phenomena is known as the Lotus effect. The Lotus Effect significantly reduces the need for cleaning, and furthermore the surfaces that exposed to water remain clean. Cleaner appearance and significantly reduced maintenance costs are some of the advantages of this feature.

Another method of producing self-cleaning glass is coating of Titanium Dioxide (TiO_2). With the help of UV light, photocatalytic reaction starts and rain can remove any dirt from glass (Figure 1).

Figure 1. Photocatalyst TiO_2 glass coating before and after application (URL2).

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Heat Resistance

Coating the glass surface on with transparent and thin metal oxides, forming intermediate layer between the glass panels by adding fumed silica that lets the expansion in the case of temperature increases are the leading applications in the field of fire and heat resistance in glasses. Fire-resistant nano-glass is produced by using aerosol material in the form of filler material between several layers of glass. When the intermediate materials in the form of gels placed between the glass layers are exposed to flames, these materials become opaque and create thermal insulation. Thus, it is ensured that nano-glasses are effective against fire (Gür,2010).

In addition to being resistant to fire for a certain period of time, nano-glasses have some other advantages of being thin and light, high light transmittance, resistance to impacts, and being resistant to ultraviolet rays. Fire resistant nano-glasses are generally preferred in high-rise buildings, also in some certain areas (corridors, floors, foyers) that require fire safety. Located in Bonn, Germany, the Deutsche Post Headquarters is a striking building which is 160 meters high with more than two thousand employees (Figure 2). In the construction of the building, nano-glasses were used to provide protection against fire for both exterior and interior glass walls (Gür,2010).

Figure 2. Deutsche Post-Tower (URL3).

Indoor Climate Control

The ventilation system must be continuously activated in order to control the intensity of heat and light that enter through glass surfaces used on the facade of the buildings. The facilities that use nanomaterials in order to prevent heat and light from

entering the surface are divided into four headings, three of the solutions are active while one solution is passive. The passive solution method consists of thin coatings that absorb the undesirable infrared rays that cause the surfaces of buildings to heat up. Active solutions are provided by photochromic (light response), electrochromic (reaction to applied voltage) and thermochromic (heat response) methods. The substantial advantage in electrochromic methods is that the control is independent of the external effects. The tungsten oxide (WO_3) layer which is coated on glass surfaces by applying tension can absorb more infrared rays or glass can be convert to dark blue by adding hydrogen ion (Candemir et al.,2010).

Nanomaterials, which provide protection against ultraviolet rays, are formed using organic substances and certain additives. The appearance and color of the main material under the coating is not affected by the sun's rays, since the coatings, which keep the ultraviolet rays within the body and protect the material, have a transparent structure. In fact, the use of nanomaterials that provide protection against solar radiation minimizes the need for curtain. As a result of using nano-coating materials, energy is saved only by using electricity when needed (Lazim et al.,2008) and photochromic glasses make energy use more efficient (Figure 3).

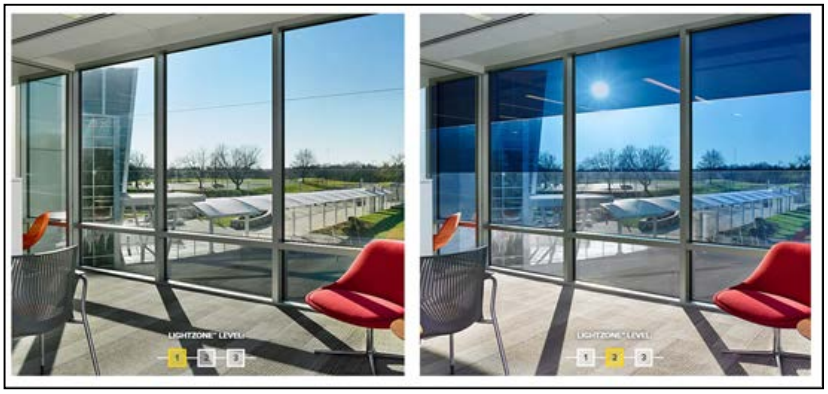

Figure 3. Photochromic glass coating (URL4).

The thermochromic layer and the coated glasses change color as seen in Figure 4 according to the change of the atmospheric conditions in the outdoor environment, provide the adjustment of the energy requirements and temperature in the indoor environment. By reacting to light and heat exchange, the color change of the glass is happened due to the polymeric layer (Savic, 2013). Figure 4 shows the glass curtain wall system that has changed colors according to sunlight and temperature during morning, afternoon and evening. This effect is achieved by thermochromic glass coating, and energy saving is provided in indoor lighting and heating systems, also thermal insulation and visuality are obtained.

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Figure 4. Morning, afternoon, and evening views of a thermochromic building (URL5).

Nano-products in Aluminum Composite Panel Curtain Wall System and Some Projects

The coating application of glass, metal and ceramic surfaces with TiO_2 has been patented under the name of HydroTect®. The HydroTect® coating provides the ability to clean the air by neutralizing the nitrogen oxides in the air, in addition to the ability to self-clean with rain water. The 1000 m^2 photocatalytic cladding is capable of cleaning as much as 70 trees can clean the air (Orhon, 2014). Two examples of structures where TiO_2 coating used is the Bertram and Judith Kohl Building (Ohio, USA, 2010, Westlake Reed Leskosky-Figure 5) with photocatalytic aluminum panel and Monte Verde Tower (Vienna, Austria, 2004, Albert Wimmer-Figure 6) with photocatalytic ceramic panel applications.

LEED Gold certified Bertram and Judith Kohl Building is used as a music conservatory, and The Monte Verde Tower is used as a residence (Orhon,2014).

Figure 5. Bertram and Judith Kohl Building photocatalytic aluminum facade (URL6).

Aluminum composite materials manufactured by Mitsubishi Chemical Corporation have Class A fire resistant properties. Conventional fire-resistant surfaces for both interior and exterior walls can be produced with this material. The outer surface of this material is produced from an alloyed aluminum plate with a thickness of 0.5 mm while the filling material is made of a high content non-flammable mineral core filler. Facade of Renaissance Biz Plaza shown in Figure 7 can be given as an example project (Mitsubishi Chemical, 2018).

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Figure 6. The Mont Verde aluminum facade (URL7).

Figure 7. Renaissance Biz Plaza aluminum composite facade (Istanbul) (URL8).

The molecular structure of the nano-coated composite panel's paint on the upper surface is changed, just like nano PVDF (polyvinylidene fluoride) panels. Thus, these panels have a self-cleaning feature and smooth surfaces. Nano PVDF panels are produced by using nano-polymers. The nano-coated surface of Nano PVDF panel does not retain any water or dirt. Thereby, the panels can remain clean for a longer period and can be easily washed in case of necessity. Also, any chemical that would be harmful to the nature is not required for cleaning. Figure 8 shows the building of the Spanish Power Company in Barcelona and, the Expo 2016 Tower in Antalya in Figure 9, are both used

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aluminum composite panels that can clean their facades and the air inside the buildings.

Figure 8. Spanish Power Company Building (Barcelona) aluminum composite panel cladding (URL9).

Figure 9. Expo 2016 Antalya Tower aluminum composite panel curtain wall application (URL10).

These types of curtain wall systems also contribute to sustainability by providing energy savings due to their photovoltaic properties.

RESEARCH METHOD

In the first part of this study, the nanomaterials used in buildings and their usage purposes have been discussed, and in the second part of the study, a survey has been conducted to examine which of these materials are used in the Turkish construction sector and to assess the level of nanotechnology awareness among the

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participants. Survey covers the suppliers of aluminum composite and glass curtain wall system. The questions related to nanotechnology in this research are directed to the general managers, managers, assistant managers, R&D managers, marketing managers, consultants, quality managers, and architects in the companies. The people working in these positions are the target respondents of the survey which was distributed via e-mail to authorized company officials who agreed to participate in the research. Face to face interviews were made with those who could not be reached by e-mail. The survey that was formed by the authors was sent to 68 participants working in the aluminum composite and glass curtain wall companies operating in the construction sector. The return rate of the surveys is 85% (58 surveys).

FINDINGS

In total, 58 (85% return rate) respondents answered the survey. The graphic that shows the positions of the survey participants is given in Figure 10.

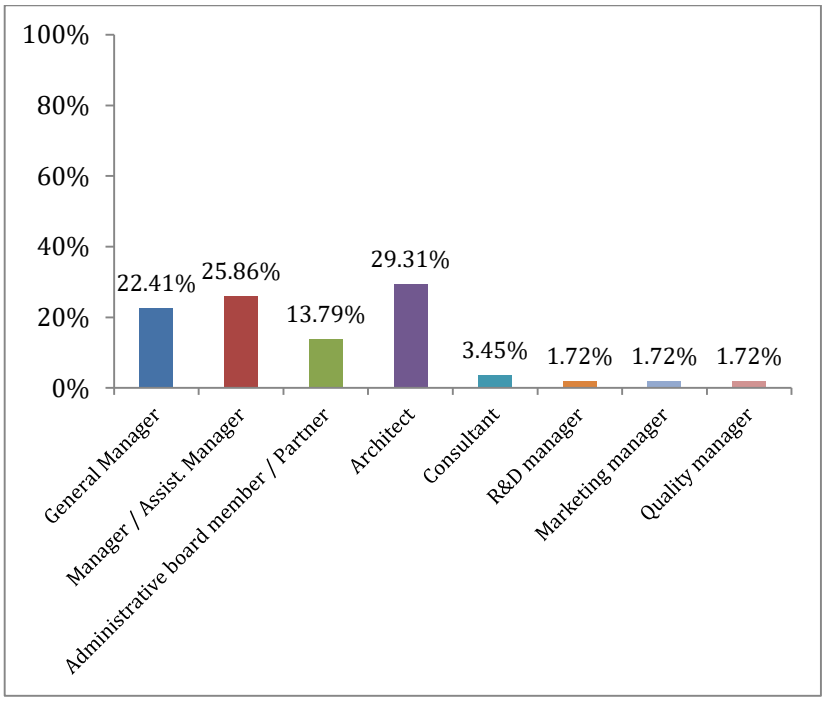

Figure 10. Employee positions in the companies

As seen in Figure 10, 29.31% of the participants are architects, 25.86% are manager or assistant managers, 22.41% are general managers, 13.79% are board members / partners, % 3.45% are consultants, 1.72% are marketing manager, and 1.72% of them are quality managers.

Figure 11 shows the experience of the survey participants in the industry. 1.72% of the participants worked for 1-3 years, 22.41% for 4-10 years, 15.52% for 11-15 years, 29.31% for 16-20 years,

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while the remaining %31.03 of them have been working in the sector for more than 20 years.

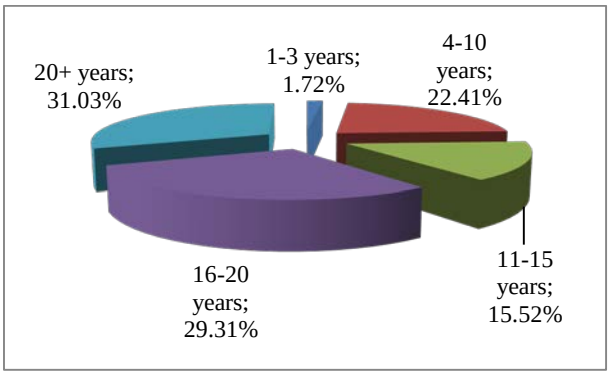

Figure 11. Distribution of employees' experience in the sector

General characteristics of companies that made curtain wall systems are given in Figure 12 and Figure 13. Figure 12 shows the distribution of the institutional ages of the companies. As seen in here; 5.17% of companies are 0 to 5 years, 17.24% are 6 to 10 years, 12.07% are 11 to 15 years, 8.62% are 16 to 20 years, and 56.90% are in the sector for more than 21 years.

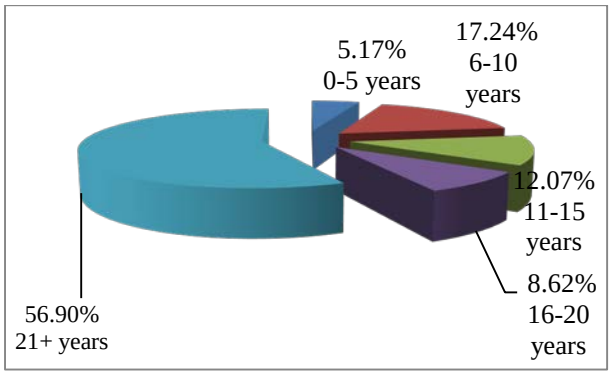

Figure 12. Distribution of companies by institutional age

The distribution of the companies participating in the research by cities is given in Figure 13. 52 of the 58 companies operate in Istanbul, 2 in Kocaeli, 2 in Izmir, 1 in Tekirdag, and 1 in Ankara.

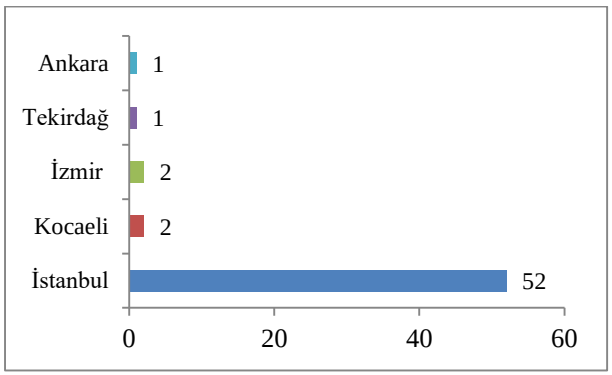

Figure 13. Distribution of companies by cities

Figure 14 shows the market shares of companies in their core business. It is seen that 8.60% of them have a market share of over 60%.

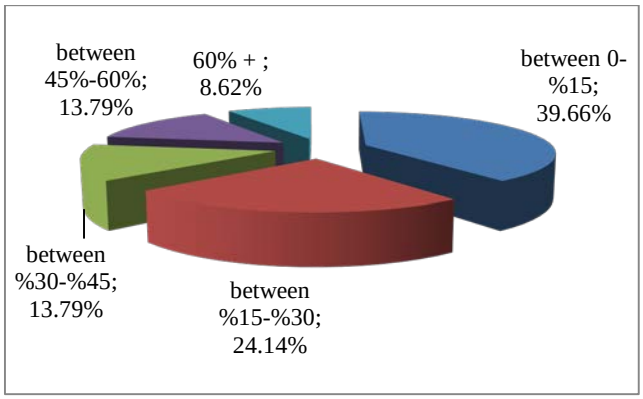

Figure 14. Market shares of the companies

Figure 15 shows the level of awareness of the participants about nanotechnology. 5.17% of the participants think that they are slightly aware about the subject, 44.83% are moderately aware, 5.17% are very aware and 1.72% are extremely aware, while 6.90% of the participants have no idea about the subject.

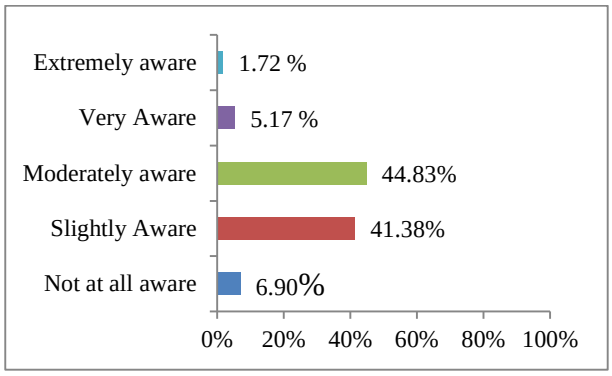

Figure 15. Awareness levels of participants about Nanotechnology

Figure 16 shows whether there is an R&D department working on nanotechnology products within the companies. Only 15.52% of the companies have R&D departments. 10.34% of them mentioned that an R&D office has been considered in their companies in the near future.

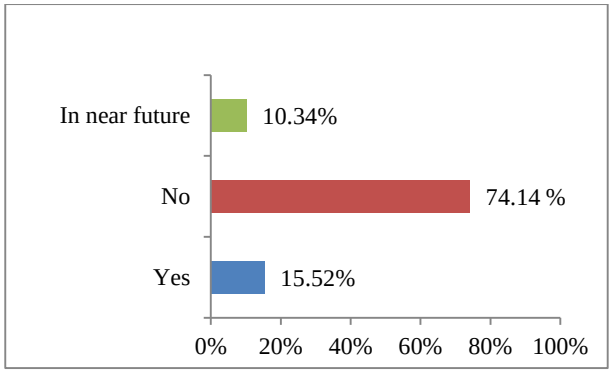

Figure 16. Existence of R&D Office on Nanotechnology in the company

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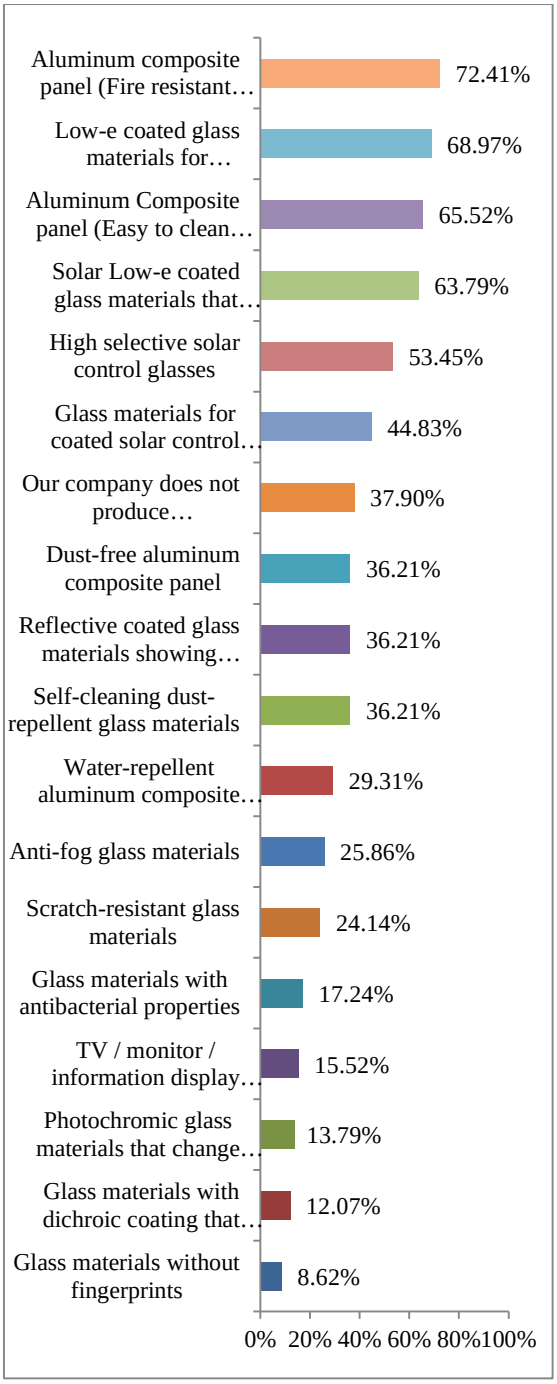

Figure 17. Nanotechnological Building Materials

Figure 17 shows the types of nanotechnology-based building materials that the companies produce. It has been observed that 37.90% of them do not produce any nanomaterials. The most widely used nanomaterials are; fire resistant aluminum composite panels with 72.41%, Low-e coated glass materials for temperature control with 68.97%, and easy to clean aluminum composite panels with 65.52%.

Figure 18 shows the factors that survey participants see as an obstacle to the use of nanotechnology-based materials. According to the responses of the participants; the most important three factors that prevent the use of nanomaterials in

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the sector are the high cost of these products (68.97%), contractors or investors not paying attention to the added value of nanomaterials (65.52%), and inadequate technical support and consultancy on nanotechnology products (55.17%).

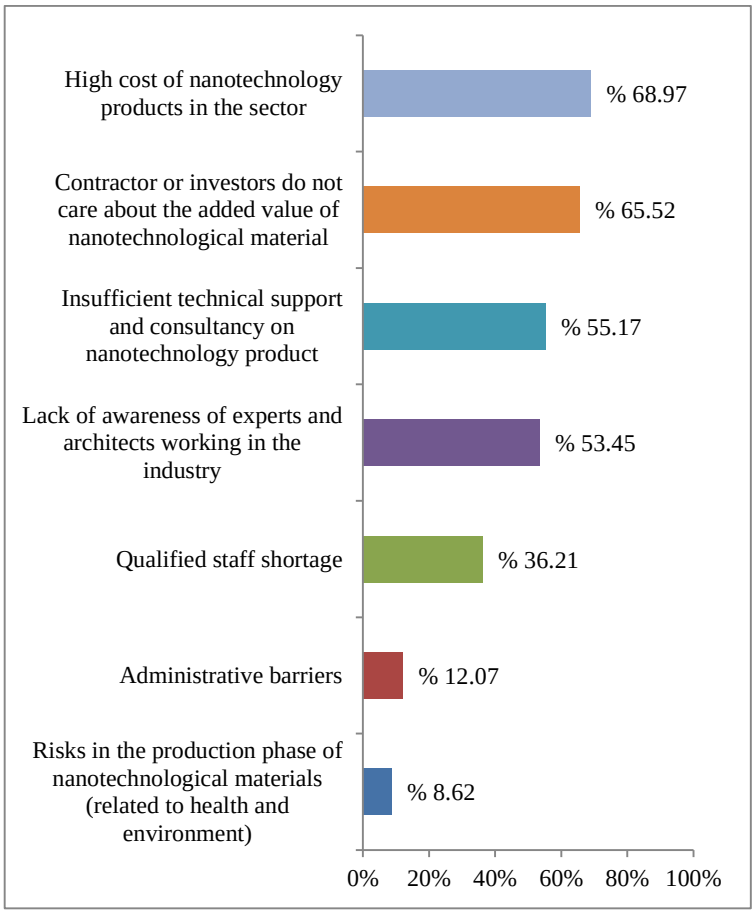

Figure 18. Obstacles to the use of Nanotechnological Materials

Figure 19 below shows whether companies without technical infrastructure can receive support from universities or trade associations related to the business. 70.69% of the participants stated that they could receive, while the remaining stated that they could not.

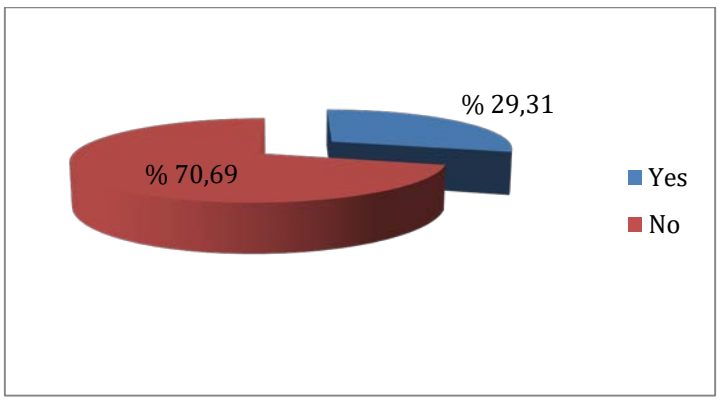

Figure 19. Can companies with insufficient technical infrastructure receive support from universities or trade associations?

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In the 11th question of the survey, the participants were asked, "Is it possible to reach institutions or organizations that can provide training in nanotechnology?" The answers given to this question are given in Figure 20 below. 56.90% of the respondents answered no, while 43.10% answered yes.

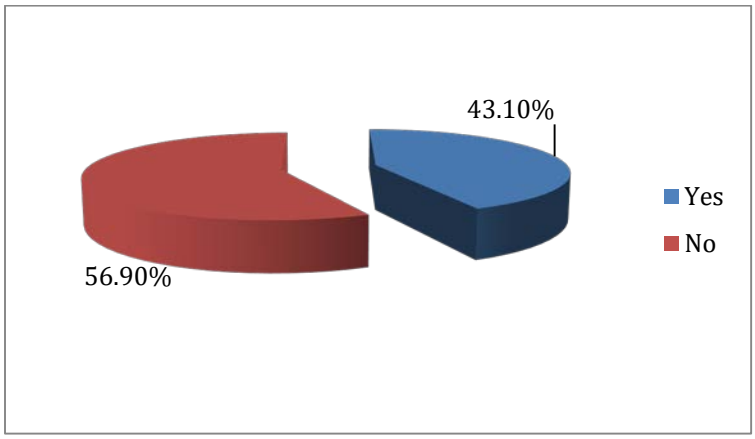

Figure 20. Is it possible to reach institutions or organizations that can provide training in nanotechnology?

Figure 21 shows the opinions of the participants on the incentive support regarding the costs and education expenses related to nanotechnology. 74.14% of the participants said that there was no incentive, while 25.86% said it was an incentive.

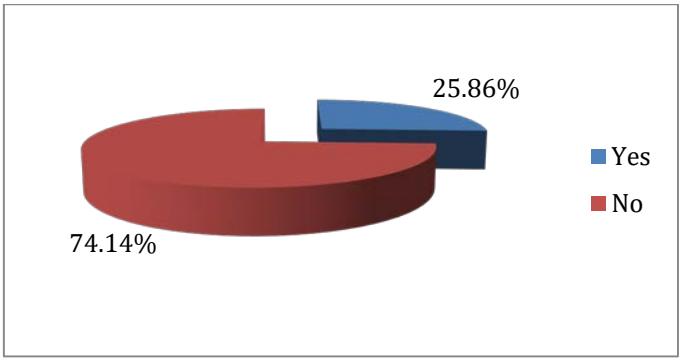

Figure 21. Can incentive support be obtained for the costs and education expenses related to nanotechnology?

The answer to the question of "Is there any competent companies/institutions regarding the classification, quality, standard and performance evaluation of nanotechnology products?" is given in Figure 22. 65.52% of the participants said no, while 34.48% said yes.

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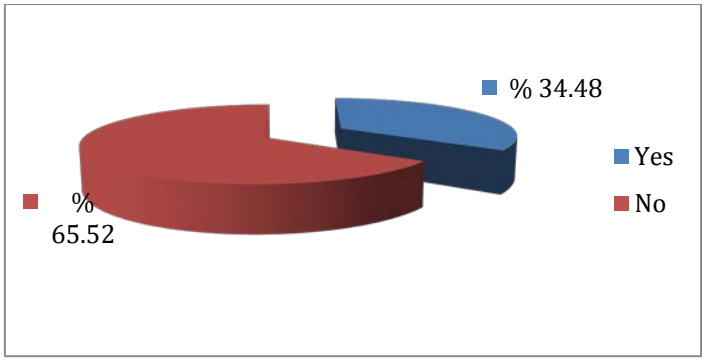

Figure 22. Are there any competent companies/institutions regarding the classification, quality, standard and performance evaluation of nanotechnology products?

In Figure 23, the answers given by the participants on the 5-point Likert scale are given to some statements asked in the survey. As the issue of sustainability is one of the most important issues of the agenda, the participants think that the adaptation of nanotechnology innovations is important (average = 3.88). In addition, they think that nanotechnology innovations will be vital in global markets (average = 4.14). Generally, it can be said that companies have made the necessary investments in nanotechnology (average = 3.31). Also, it is obvious that studies on nanotechnology in this sector are extremely insufficient (average = 2.52), and there are not enough experts or research groups working in this field in the companies (average = 2.41).

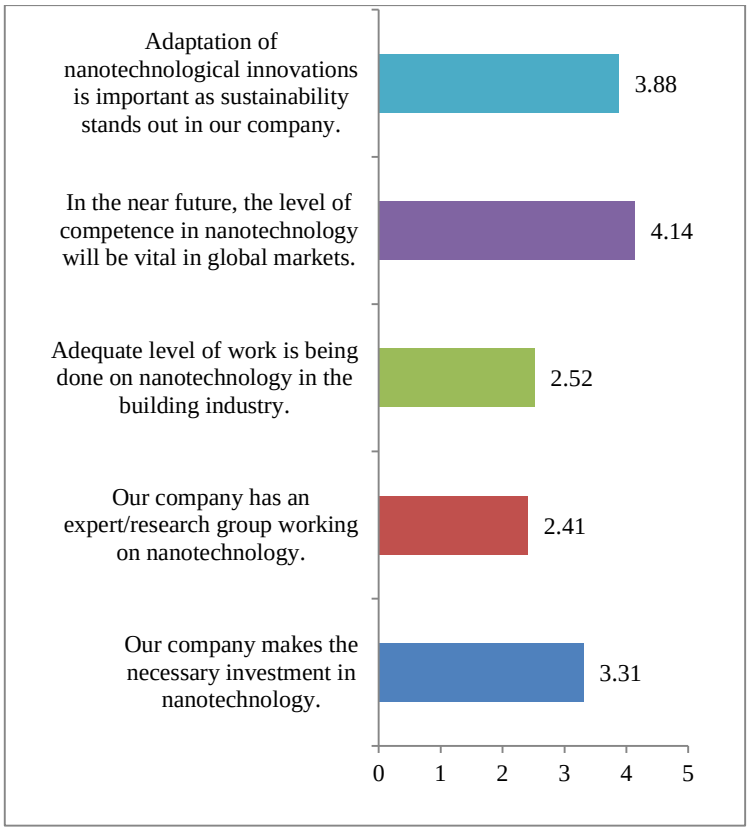

Figure 23. Indication of whether the participants agree or disagree with the statements given above (on a scale ranging from 1- disagree to 5 - totally agree)

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DISCUSSION OF FINDINGS

According to the survey, it is seen that the level of awareness of the participants about nanotechnology is not satisfactory. In parallel with the results of this study, some studies in the literature have also shown that one of the obstacles to the spread of nanotechnology in the construction sector is the lack of awareness of stakeholders regarding the opportunities offered by nanotechnology (Candemir, 2012). The results of this study show similarities with the results of the survey conducted by Van Broekhuizen's (2009). In the study, awareness of nanotechnology products is one of the important factors preventing the entry of nanotechnology products into the construction sector (Van Broekhuizen & Van Broekhuizen, 2009). Although nanotechnology developments have attracted the current and future praise of academic and scientific world with their creative solutions, the increase in the use of nanomaterials and devices only can be realized with the understanding of the relationship between the value engineering and technological developments by the construction professionals (Bozoğlu & Arditi, 2012).

There is no R&D department in 74.14% of the companies that the participants work for. Most companies do not understand that innovation is one of the key factors in competition, so investing in research, development and innovation do not seem attractive to them (Serpell & Alvarez, 2014). Since innovation is a very difficult and a painful process in the construction sector, companies generally do not want to take risks. Nanotechnology is seen as one of the most important technologies that will drive innovation in the construction sector (Genç et al., 2016). In some studies, insufficient R&D investment is presented as one of the weaknesses of the sector (Forbes and Ahmed, 2011). Since the sector is not R&D-oriented, R&D activities related to nanotechnology in the curtain wall system take place in multinational companies or research institutes such as AKZO-NOBEL, DuPont and Heidelberg (Van Broekhuizen & Van Broekhuizen, 2009). The Turkish construction sector is incompetent in innovation, and the government needs to lead the industry in innovation and R&D. It is seen through studies that there is a lack of trust in the construction sector against new ideas and innovation. It is necessary to establish legal obligations and standards, and ultimately create an awareness of innovation (Genç et al., 2016). It is important to go beyond the financial incentives and supports for innovation and should take steps to create a culture of innovation in the long run.

The products benefiting from nanotechnology that used in curtain wall system, which are the subject of this study, are widely used throughout the world. However, they are not yet

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widely used in Turkey, and not preferred due to their high costs. According to the findings of this survey, the biggest obstacle to the use of nanotechnology products in the sector is the high costs. This finding is supported by Van Broekhuizens's (2009) study. According to the survey that covers 14 European countries indicate that the high cost of these materials is the most important factor preventing the access of nanotechnology products to the construction sector (Van Broekhuizen & Van Broekhuizen, 2009). The cost of nanotechnology materials is relatively high compared to the cost of traditional building materials (Mann, 2006). In some studies, it is predicted that these costs will decrease over time as production technologies develop (Firoozi et al., 2014).

The negative effects on human health and the environment during the production of nanomaterials are not considered as significant obstacles for the application of nanotechnology products according to the participants (8.62%). However, there are no standards related to these products in Turkey, and their effects on human health and the environment in the future are uncertain. It is thought that the positive or negative aspects of these products will rise more clearly and accurately with the increase of the studies and the service life of the nanotechnology products.

One of the findings of this survey shows that companies do not exchange enough information with universities and professional organizations. Only 29.31% of the companies stated that they could get some support. Likewise, companies are not getting enough support from institutions to obtain their employees trained on nanotechnology. R&D activities for nanotechnology in Turkey are usually carried out through research centers at universities, and some specific institutions that supported by the public authorities. In addition, these activities are supported by studies within the scope of undergraduate and graduate programs involving researchers from many disciplines. One of the most important obstacles in establishing university-industry collaborations is the lack of information channels and information flow between both sides. This finding is also supported by the results of the Teizer et al.'s (2012) study which revealed a major gap between the construction sector and academia. This requires immediate attention (Teizer et al., 2012). It is important to enhanced interdisciplinary cooperation and follow the developments closely in order to reach international standards. It is critical for companies in the curtain wall sector to follow academic studies, and take big steps to improve nanotechnology through research studies with the universities.

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According to the survey findings, the participants are aware that nanotechnology will be an important competitive factor in the near future (average=4.14). This finding is supported by Andersen (2005) and Andersen & Rasmussen's (2006) studies. According to the results of these studies (Andersen, 2005; Andersen & Rasmussen, 2006), nanotechnology contributes to increase the innovation capacity and competitiveness of the sector.

The participants are aware of the potential contribution of nanotechnology to sustainability (average = 3.88) as can be seen from the results of the survey. The construction sector is one of the leading sectors that have the worst impact on the environment and climate change, considering the high energy intensity of production and the negative effects of construction materials throughout the entire life cycle. Its potential contribution to sustainability makes nanotechnology one of the key innovations in green building. Nanotechnological building materials provide significant contributions to sustainability due to their energy efficiency and longevity, environmental friendliness, and contributing to the protection of the atmosphere.

According to the participants, companies in the curtain wall sector make the necessary investment for nanotechnology (average = 3.31). Investments are vital for the access to market and adaptation of nanotechnology. Every investment in innovation takes companies to higher levels, increases their efficiency and strengthens them in global competition.

The participants think that there are not enough studies on nanotechnology in the sector (average=2.52). Research on nanotechnology is still in its infancy (Teizer et al., 2012). There are few experts or research groups working in the nanotechnology area (average = 2.41). Recent developments in the field of materials will affect the architecture, especially the outer shell design (curtain wall) closely. According to Rao et al. (2015), developments starting with the application of nanotechnology will completely transform the construction sector. It is obvious that there is a need for experts and research groups working in this field in the sector, and the companies will need qualified personnel in order to compete.

CONCLUSION

Nanotechnology is considered as one of the twenty first century's important technologies. It is seen that most of the nanotechnology products used in the construction sector have been developed by companies working in the field of chemical and materials science. Potential of nanotechnology applications is growing in the construction field. There are large numbers of

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nanotechnology applications in the sector. However, construction sector is a traditional and cost oriented industry, rather than a technology focused sector. The low investment for research activities in the construction sector is a major obstacle to nanotechnology. For this reason, the adaptation of nanotechnology applications into the construction sector has been limited. The results of the survey in this study also support this.

The market of materials and technologies that are used in green buildings will be shaped with the demands of architects and building contractors rather than nanotechnology products suppliers. The minimum level use of harmful substances like detergents for cleaning glass and aluminum composite curtain wall systems is very important for environmental sustainability. Air pollution caused by toxic gases released into the atmosphere also causes adverse effects on the facades of the buildings which leads to dust, dirt and deterioration of the facade surfaces (composite panel coating, glass, etc.). For this reason, the maintenance of the products used in curtain wall systems is very important in terms of product lifetime. In addition to these, it is possible to state that maintenance and repair necessities can be reduced by choosing nanotechnology products which are manufactured for the facades like self-cleaning, fingerprint-free and scratch-resistant, etc. It also minimizes maintenance costs during the operation of structures. Furthermore, it can be said that it will contribute to the decrease of industrial accidents.

Although the nanomaterials have been used for the last 15 years in developed countries, their use in Turkey is relatively limited. While these materials are used in many different parts of the structures, the most preferred in the outer shell design of the buildings (curtain wall systems). It is anticipated that the building materials (nanomaterials, nanocomposites, etc.) and more different products with many new features can be developed thanks to nanotechnology which is the scientifically accepted technology of the century we live in.

Considering the interviews with relevant experts, manufacturers, vendors and end-users, it is possible to state that nanomaterials used in curtain wall system have many positive features compared to other facade products used. Also, it should be highlighted that the cost difference cannot be ignored. Nanotechnological materials have different applications according to their usage areas. These are often used in buildings built on principles of innovative and sustainable design (green building). The market share of nanomaterials is about 5% compared to other traditional building materials.

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Risks such as the standards regarding nanomaterials have not been fully established yet, and detection of harmful factors in some products cause questioning of nanotechnology. It is thought that the future will be shaped by nanotechnology with the resolution of these seemingly negative effects, including high costs of the products, and the lack of sufficient technical staff for maintenance and their long training period. Apart from many disciplines (such as medicine, pharmacy, chemistry, biology, physics), nanomaterials will shape the future by leading to significant developments and changes in the building industry which is one of the strategic sectors where nanotechnology can be applied. Since sustainability and energy efficiency have become imperatives, it should be considered that nanomaterials can increase the competitiveness of companies.

Some facts like high costs, custom production, difficult production processes in nanometric scales and not easy to observe the scale, lack of technical staff for maintenance and inspection, inspection requirements, complex maintenance-repair methods, identification of harmful substances in some products, and not fully established standards for nanomaterials lead to the questioning of nanotechnology. It is foreseen that future will be shaped by nanotechnology by resolving these seemingly negative effects. In addition to multidisciplinary (medicine, pharmacy, chemistry, biology and physics), nanomaterials in construction will lead to important developments and changes and will shape the future.

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