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Editorial

Aliye Ahu AKGÜN • *Editor*

One year has passed already. Time flies and never comes back. The new normal is not normal at all. We digitalized our lives but a day remained 24 hours and is still not enough. For many women, the work overload became the real deal. Happy International Women's Day!

Not only the COVID-19 pandemic but also the new normal and ongoing global challenges we are facing need creative problem-solving and actions. The economic crisis at the door step, the lack of production and need for self-production, we try to manage affordable and sustainable solutions. The new normal has brought back the importance of design in our daily routines.

Facing challenges orients us more on coming up with creative solutions. Gürcan and Leblebici Başar, in their paper entitled "Understanding design creativity through pretence ability" offer the insights of creative problem-solving process. Their results show that the pretend play is very important not only in childhood but also in adulthood. They conclude that in adulthood pretend play, affordance-based pretence brings up more creativity.

The relation between affordance and creativity actually starts at birth where our perceptual-cognitive and social emotional processes develop. Most of us spend most of our lives in the school environment. Garip and Seymen with their paper "Research for evaluating perception of concrete material by using visual research methods in learning environments" demonstrate how the (visual) design of the physical environment plays a crucial role in the perception development of children.

Our children, the next generations, are affected the most from the global events, and it is our duty to create living environments in our homes considering that the new normal is not as temporary as it was originally thought.

Another affected group from the new normal is certainly the elderly. Bayar and Türkoğlu in their paper entitled "The relationship between living environment and daily life routines of older adults" shows us the importance of neighbourhood design in the elderly's daily routines. They conclude that the active life of elderly is influenced by both the living environment and the income.

We usually believe that better life can be found in a safe environment where we can be satisfied and happy with our lives. Oladosu and colleagues with their study "Hierarchical multiple regression modelling on predictors of neighbourhood satisfaction in violence-induced segregated urban environments" show that even in violence induced neighbourhood, there exists a satisfaction. They summarize that, besides safety and stability, neighbourhood satisfaction depends on social relationships as well as facilities and services.

Social and spatial segregation in urban environments depends on urban planning decisions. Taibi and Madani, with their article "Housing and urban continuity: The 1930s urbanistic experiments in Oran" exploit the importance of urbanism instruments. The implementation that is unique to the place remains integrated with the city while, among three districts, Yaghmoracen, inspired by the French urbanism, is the one generating the social and cultural segregation in the urban tissue.

Authorities can turn urban sprawl to a path to sustainability. Yavuz with her article "Urban sprawl: an empirical analysis for Konya Province-Turkey" indicates that although urban sprawl is caused by economic growth, it can be controlled through the city plans. Local authorities with the precautions taken by plans can take control of urban sprawl and use it as an advantage as in Konya's example.

Both urban planning and design contribute on the public use of the city as a whole. Yaylalı-Yıldız and Çil with their study "Issues in the planning and design of university campuses in Turkey" prove that at least for the case of campuses in Turkey. As knowledge producer and transmitter, universities occupy a large spaces which in time extend more as the population of their students and academicians increases. Both governmental plans and architectural design principles depending on the period, campuses' spatial configuration and its place in city have specific tendencies.

Experiencing global challenges in depth in the last decades, the construction sector is looking for new sustainable solutions. Among them, green building systems appear to be the most preferred implementation.

Akşit and Baştanoğlu in their study "A review of LEED green building certification systems in Europe and Turkey" con-

clude that in order to reach high standards especially for energy efficiency in the buildings, Turkey needs to be more cautious in terms of the used materials.

When it comes to the outdoor thermal comfort, Rad and Afzali, with their study entitled "Measuring effects of building orientation and vegetation on thermal comfort by ENVI-met in Maslak, Istanbul", show how urban design and morphology are one of the most important factors affecting outdoor thermal comfort. They conclude that controlling building orientation and vegetation could end up affecting outdoor thermal comfort positively.

Süzer, in her paper entitled "LEED certified mixed-use residential buildings in Istanbul: A study on category-based performances" focuses on the assessment of LEED certification and green buildings to overcome the negative effect of building industry on climate change. She looks at Istanbul's LEED certified mixed-use residential high-rise buildings as the new market of changing human behaviours and needs.

In cities, the actions taken to overcome the negative impact of global challenges do not exist only for the newly built environment. Sustainability's well-known 3 Rs (reduce, reuse, recycle) are also applied for the existing built environment. Ramaj and Nagammal, in their paper "Exploring the 'R's and constructing the big picture of 'recycling' in architecture and construction industry" explain how 3 Rs turn into 14 Rs by defining and classifying each of them separately. They put forward the need for a pre-process phase specific to developing engineered building materials with recycled content especially with secondary resources from domains other than the construction domain.

Acun-Özgünler and her colleagues, in their article entitled "The experimental works conducted on modern heritage and mixed system buildings with the purpose of the conservation and restoration", examine the use of reinforced concrete for the restoration of Istanbul University buildings. After the chemical, physical and mechanical analyses to determine the properties and deterioration of the materials, they recommend applications for similar buildings.

In the article titled "Şile and its castle: Historical topography and medieval architectural history" Sağlam presents, based on a fresh reading into primary and secondary sources, brand new information on the historic landmark which has been in the spotlight after a restoration in 2015.

Looking at another landmark, Özlü writes on the "Biography of a monument: Historical and morphological survey of the Tower of Justice (Adalet Kulesi)" in the Topkapı Palace. The article documents the evolving meanings of the tower throughout history based on archival research.

Ameur and Lakjaa, in their study titled "Qubba of the Ksour Mountains, between material and immaterial" articulate the physical and spiritual characteristics of the funerary monuments.

Lionar and Ediz, in their article titled "The influence of traditional Indian architecture in Balkrishna Doshi's IIM Complex at Bangalore: A comparative analysis using fractal dimensions and lacunarity" analyze the Indian Institute of Management (IIM) Complex in terms of its similarities with traditional Indian architecture. Their analysis focuses on the visual complexities of spatial orders in plan and show Doshi's possible cultural inspirations.

Inspired from cultural, traditional and historical design leads to successful results in contemporary architecture. Lionar and Ediz in their paper The influence of traditional Indian architecture in Balkrishna Doshi's IIM Complex at Bangalore: A comparative analysis using fractal dimensions and lacunarity, offers the influence of traditional Hindu design on contemporary Indian architecture. Thus, their findings confirms that the designer unorthodox spatial fabric brought up the success.

The contemporary design not only in architecture but also in fine arts tries to find its path. Alsaggar and Alotoom, with their article The dialectic of the instrumental and the aesthetic mind in the philosophy of Theodore Adorno and its representations in contemporary art, find that the emergence of hybrid artistic genres lead artists to use different technics rather than their original areas as the search for innovation and fame.

Design and space matters as well as the culture itself. But our focus is the new normal. But please try to clear your mind and enjoy our March 2021 issue!

ITU A|Z • Vol 18 No 1 • March 2021 • 1-16

Understanding design creativity through pretense ability

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Abstract

In cognitive psychology literature design activity is commonly described as a creative problem-solving process. This process is a transformative way of thinking, involving re-imagining the problem as set of possible states and creating alternative solutions to achieve the requirements of the problem space. Creative thinking is the main skill that facilitates the design process. Pretend play, in the context of developmental theories, is limited to early childhood and seen as the foundation of adult creativity. It is associated with the notion of affordances which is related to the "seeing as if" ability. This study aims to identify similar cognitive processes between designers' creative problem-solving and pretense ability and uses a designing activity to present how pretense, seeing as if, may exist in adulthood. To identify the features and similarities of childhood pretense and design process, first a comparative scheme was conceptualized and illustrated. Second, based on our "affordance-based pretense framework of design creativity," an experiment was designed to examine the relation of pretense (acting as if) ability to creativity measures. 52 participants completed a series of experimental tasks including a creative mental synthesis task and an alternate use test (AUT). Both Kruskal-Wallis H and Mann-Whitney U Tests showed that participants performing affordance-based pretense framework of design creativity tasks received higher creativity scores which suggests that exhibited higher degrees of creativity in terms of being able to see affordances in their object forms.

Keywords
Affordances, Creativity, Design, Design process, Pretend play.

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1. Introduction

The ability to think creatively is an essential function for human cognition. It enables individuals to think divergently and to make unexpected connections while finding alternative solutions to problems (Finke, Ward and Smith, 1992; Scott, Mumford and Leritz, 2004; Wang, Peck and Chern, 2010; Anoiko, 2011; Sawyer, 2012). From the perspective of problem-solving theory, while creativity enables an individual to find novel solutions to the problems, it also facilitates both defining a unique problem space as well as re-defining the problem. Design is most commonly defined as a creative problem-solving process (Simon, 1969; Thomas and Carroll, 1979; Dorst & Cross, 2001; Hasirci & Demirkan, 2007; Lawson & Dorst, 2009) and designers deal with ill-defined or wicked problems (Rittel & Webber, 1973; Cross, 1982). The ill-defined and complex nature of design problems require the ability of creative thinking since they cannot be solved using routine problem-solving procedures (Gero, 1996). As the central concern of design activity is being creative, enhancing creativity is a significant issue in design research (Lawson, 2005; Cross, 2006).

Creative abilities, including such as ideational fluency, novel ways of thinking, flexibility of the mind, and the ability to analyze and synthesize (Guilford, 1950), which are characteristics of creative people are also essential characteristics of designers. Enhancing the creative problem-solving process in design is associated with improving flexible and divergent thinking skills. These skills enable designers to break away from set patterns of thinking and formulate novel solutions to design problems. In a different area of creativity research, Russ (2014) states that many of these processes in creative production occur in the pretend play of children.

Pretend play, in the context of developmental theories, is limited to early childhood and is considered to be the foundation of adult creativity. In pretend play, children think divergently to see unique ideas and combine them in a new context of play as a key component of creativity (Singer & Singer, 1990). Pretend play or the pretense ability can be seen as a kind of acting *as if* something is the case when it is not (Leslie, 1987). As Dansky (1999) argues, adopting the "*as if*" frame in play may open the door to solving real world problems while enabling one to play with ideas and many different possibilities. Children deal with real-world issues while playing. The pretend play of children could be considered as an example of everyday creativity - in other words, little-c creativity (Zook, Magerko and Riedl, 2011; Russ, 2014). Accordingly, children can simulate and transform the routine events of everyday life in pretend play and find new possibilities while treating one object *as if* it is another, e.g., using a banana *as if* it is a telephone (Dansky, 1999).

Pretense, pretend play or acting *as if* are also associated with the notion of affordance (Szokolsky, 2006; Rucińska, 2015). Children are aware of the affordances of different objects around them and explore their various action possibilities for their different kinds of play activities (Szokolsky, 2006). Rucińska (2015) explained pretense with an enactive account of pretend play, "seeing-affordances-in". Affordance is generally defined as the possibilities for actions (Gibson, 1979; Turvey, 1992; Norman, 2013; Rucińska, 2015; Glăveanu, 2016). In pretend play, children see new affordances (possibilities of action) of objects through interaction with them, which means that pretend play enables them to see beyond the known uses of objects in different contexts (Rucińska, 2015).

The seeing *as if* notion in pretense recalls the situated account of design process, as a sequence of seeing-moving-seeing cycles (Schön, 1983; Schön and Wiggins, 1992). According to the situated account of design problem depiction, similar to the pretense process, designers examine and interpret the design situation, construct it by setting the dimensions of the problem space, see it from multiple perspectives and create the moves to find solutions (Schön, 1983; Schön & Wiggins, 1992). Lawson and Dorst has described the see-move-see sequence of the designing process as "the art of seeing the design situation in multiple ways or seeing *as if*" (2009, p.26). While designing, searching for

the visual emergence of objects allows the designers to look at these emergent visual structures from different perspectives and discover different possibilities hidden within the structures (Finke, 1990). In the design process, it's important to see different actions' possibilities in objects considering the interaction between an object and its user who enables the action. As there is no single or optimal solution to a design problem, to find new possibilities, Picciuto and Carruthers (2014) claim that it's essential to be open to alternative ideas or behaviors and concurrently bypass more obvious ideas to see the other possibilities.

In pretense, children are open to seeing numerous possibilities and they go beyond conventional thinking. In the design process, the designer aims to reach this flexible way of thinking. While children pretend spontaneously, designers learn to do so in the design process by re-developing some set of skills.

This study is an example of basic research designed to contribute to the field of cognitive design studies by exploring the relationship between childhood pretense as an example of acting *as if* and designers' initial form-giving process. Designing ability is a very complex thinking process involving many cognitive functions. This study opens a new perspective which has not been previously associated with pretense ability and design process. It is proposed that children's pretend play shares similar cognitive function to designers' creative problem solving processes. The current paper, which is a portion of this broader study, describes the similarities between "design process" and "childhood pretense" and presents a conceptual framework linking them based on affordance theory (Turvey, 1992). Although some developmental theorists like Piaget (1962) and Vygotsky (1978) argue that imaginative or pretend play is peculiar to early childhood, this study hypothesizes that pretense is not limited to childhood, since acting *as if* has significant similarities with designers' initial designing process. Finke's (1990) Creative Mental Synthesis Task is used to simulate childhood pretense as a method for the current study.

In the first part of the paper, to identify the features and similarities of childhood pretense and design process, a comparative framework is conceptualized and illustrated. In the second part, an experiment was designed to assess the affordance-based pretense framework of design creativity with two different measures of creativity, an alternate uses test (AUT) and a creative mental synthesis test. To compare the findings in terms of creativity, the experiment was conducted both with design and non-design undergraduate students. The reason to conduct the experiment with design and non-design students was to compare the results of the creative mental synthesis task, which was designed conceptually as a simulation of whether the affordance-based pretense process is related to creativity. The results of the task were evaluated within the framework of affordance-based pretense-creativity relationship and then discussed in regard to early design process and pretense ability.

2. Pretense, imaginative thought and creativity

> "Caught between divinity and animality,
> between what is and what it might be,
> it is the child who mediates the
> human possibility"
> *(Kennedy, 2006, p. 5).*

Children's pretend play is a fascinating research area related to creativity and has gained considerable attention recently (Russ, 1996, 2004, 2014; Russ, Robins and Christiano, 1999; Carruthers, 2002; Picciuto & Carruthers, 2014, 2016). According to Carruthers (2002), childhood pretense is an exemplar of human creativity which is related to the imagination of possibilities. Russ claims that "pretend play is a vehicle for the expression of many processes that are important in creative production" (2016, p.22). She also suggests there are many cognitive and affective processes which are related to creativity that occur in pretend play as divergent thinking, broad associations, cognitive flexibility, perspective taking, insight and problem solving, etc. (2014).

As a distinguishing activity of children, around the middle of their second year of age, all healthy children

commonly engage in pretense as a form of play (Carruthers, 2002; Picciuto & Carruthers, 2016). Perner's description of pretense is "knowingly acting *as if* the world were different than it really is" (Perner, 1991, p.43). In acting *as if* the object is another, the pretend object supports the pretend act with substitution. Object substitution is a kind of pretend play in which playing with objects involves treating one object *as if* it is another and can be defined as the active, playful manipulation of objects (Bjorklund & Gardiner, 2011). In their episodes of play, children pretend that a banana is a telephone that they are talking with or pretend a rectangular block is a car or pour pretend "tea" from an empty plastic teapot, etc. Children's behavior is driven by their imagination which is a capacity for seeing the world in a way that is different from how it really is (Nielsen 2015). Seeing one object *as if* it is another imaginatively assists them in transforming a function from one object to another (Vygotsky, 2004). According to Lillard (2002), "pretense is an act of projective imagining" (p.104).

Carruthers (2002) indicates that pretend play and adult creativity share a common basis in supposition (imagining). Both include "essentially the same cognitive underpinnings—namely, a capacity to generate, and to reason with, novel suppositions or imaginary scenarios" (Carruthers, 2002, p.229). Imagination is also related to counterfactual reasoning. Counterfactual reasoning enables people to shift from perceiving the immediate environment to an alternative imagined perspective (Van Hoeck, Watson and Barbey, 2015). Weisberg & Gopnik argue that pretense and counterfactual reasoning both involve considering events that have not occurred yet and thinking about what would be the case if they had (2013). They share the same mechanism: disengaging with current reality, and making inferences about an alternative representation of reality (Weisberg and Gopnik, 2013). Counterfactual alternatives are created when "what if" or "if only" scenarios occur as possible alternatives to reality (Byrne, 2016). Likewise, reasoning about alternative scenarios is seen in the design process; designers deal with questions like what might be, could be and should be instead of what is, how and why (Lawson, 2005). Designers try to broaden the point of view to find possible solutions in design process. The possible solutions associate with "seeing-possibilities," in other words, "seeing-possible affordances" in the creative design process.

3. Seeing possibilities and discoveries in the design process: The affordance-based pretense framework of design creativity

The concept of affordance is first introduced by Gibson as follows, "the affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or for ill" (1979, p.127). The environment consists of affordances, which are action possibilities formed by the relationship between an agent and its environment (Gibson, 1979). Shotter (1983) finds Gibson's view to be static; they are in the environment waiting to be discovered by "finders." Affordances of an object can be seen as "the set of all potential human behaviors that an object might allow;" they are "context dependent action or manipulation possibilities" (Brown and Blessing, 2005).

From another perspective, Chemero (2003) suggests that affordances are not properties of the environment but they are affiliations between features of the environment and the abilities of organisms. Supporting this view, Nye and Silverman state that "affordances may be considered dyadic relationships between an object and agent" (p.179), which means having an existential relationship between an agent and an environment (Nye & Silverman, 2012). Affordances could be understood as opportunities for action which are relational and dispositional properties of the environment (Turvey 1992). Christensen (2005) mentions that the creative process is a search for the possibilities and impossibilities of the real-world and to be able to follow how something comes to be something else in creative development. It's essential to focus on subject-object interactions because, as

he clarifies, "creativity does not come into being out of nothing (ex nihilo), but is grounded in knowledge of the world and its possibilities" (Christensen, 2005, p.196).

The possibilities of the world are related with Currie's (2004) account of pretense which involves imaginative transformations and the capacity to view the world from another perspective: seeing one thing as another. Rucińska (2015) elaborated on Currie's (2004) perceptual seeing-in (or experiencing-in) view and presented the enactivist alternative account for pretense: "seeing-affordances-in" (or seeing possibilities of action in). According to Rucińska (2014), while in the course of pretend play, a child sees the affordances (possibilities of action) in new situations by interacting with the object. For example, a banana may afford various actions for a child in different contexts, as eating for breakfast, playing "phone" when held to an ear or playing "hat" when held on the head. An object may offer a variety of potential affordances to be realized in relation to the individual's intentions and a child can discover many new affordances of an object by using it in different ways (Heft, 1989). This process of discovery, which entails seeing potential affordances of the circumstances, is an essential part of design creativity, as it enables one to see alternative possible solutions to design problems. Designing is an activity that is supposed to lead to new possibilities and creativity is a central aspect in design research, design education and professional practice in design (Dorst, 2003; Cross, 2006; Howard, Culley and Dekoninck, 2008; Lawson & Dorst, 2009). While dealing with uncertainty in early design stages, designers need to dissolve existing beliefs, habits and assumptions and play with new possible ideas and embody them for the future world. The central concern of design is "the conception and realization of new things" (Cross, 2006). As creative problem-solving is an exercise of "seeing as," which involves looking at something we already know in a different way (Olteteanu, 2015), designers should consider these possibilities with "seeing as" rather than only focusing on the intended function of an object form.

Similar to Currie's "seeing as" account of pretense, Goldschmidt (1991) asserted that the designer is "seeing as" when he/she is using figural, or "gestalt" argumentation while "sketch-thinking" in the early stages of design process. Schön and Wiggins (1992) describe the "seeing" process as "the designer not only visually registers information but also constructs its meaning - identifies patterns and gives them meanings beyond themselves" and this process happens in the "reflective conversation with the materials of a design situation" (Schön, 1992). For designers, sketching is a way that enables them to externalize their thought into bodily engagement with the environment (Hinton, 2015, p.46). Verstijnen et al., (1998) suggests that spontaneous externalizations of mental images while sketching assist designers in overcoming limitations and making creative discoveries in visual imagery. When a designer sketches a new feature intending it to hold a spatial relation with existing sketch features, unintended spatial relations are automatically produced and, in turn, these unintended relations may be discovered unexpectedly by the designer (Suwa, Gero and Purcell, 2000).

The similarities between children's pretend play process and designers' form-search process in conceptual design phase, as this study hypothesized, are illustrated in Figure 1. The children's pretense process and the hypothesized pretense process in the initial form-search process in designing activity is schematized. The act of "phoning" is met with a banana, a matching form of a phone. Similarly, designers search for the affordances of forms for the intended acts as well as intended user behavior. This search process is hypothesized as childhood pretend play. Designers, like children, try to discover new action possibilities in different use contexts. Children and designers, both pretenders, try to switch between ideas as they look for affordances.

4. Experiment overview

In this study, it's hypothesized that pretense is not limited to childhood and children's pretense or acting *as if* ability has significant similarities with designers' form-search or form-giving in the

conceptual design phase. To verify the differences of pretending or acting *as if* ability of design and non-design students, and to measure this difference in the framework of creativity, the "pretense" process is simulated with a creative mental synthesis task. According to the proposed pretense framework of design creativity, to compare the "pretense" or "seeing-affordances-in" ability, the creative mental synthesis task of Finke (1990) was conducted with design and non-design students. Both student groups had experimental and control groups. The control group's task was held in 5 minutes. The experimental group's task had two stages and each stage was held in 5 minutes (in total 10 minutes). The sketching behavior was also observed during the sessions. The participants were informed with a consent form and a verbal brief. The procedure was identical for every participant.

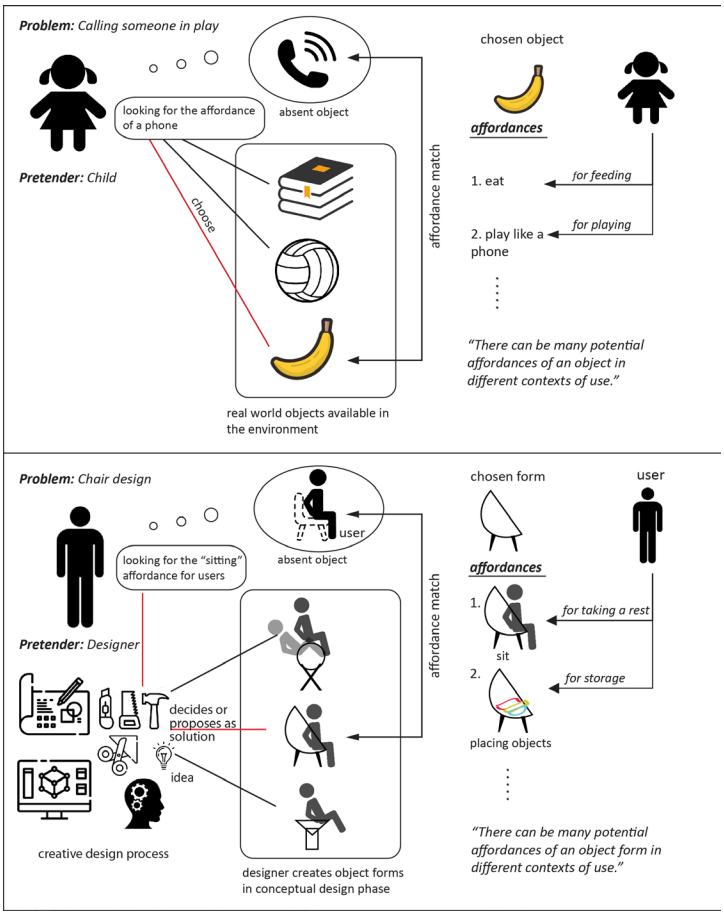


Figure 1. *Affordance-based pretense schema of form-search similarities of a child and a designer.*

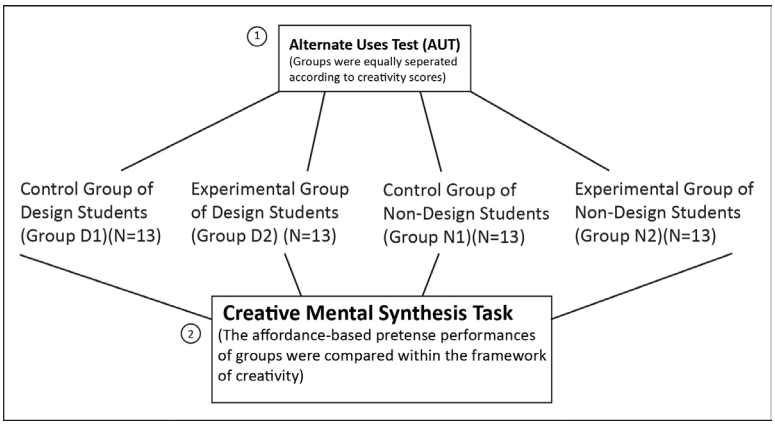


Figure 2. *The experiment overview.*

4.1. Participants

26 participants both from Design and Non-design undergraduate departments, totaling 52 third-year (junior) students participated in the experiment. The reason why non-design students were included was to eliminate the design-education effect on creativity measures. Before the experiment, all students were given an alternate uses test (AUT) and 52 sample participants were chosen according to AUT scores among 60 students. The groups were equally separated based on their AUT test results. The aim was to equalize the conditions for all the groups so their creativity level would not interfere with the results. They completed the experiment individually. All the task materials were provided by the experimenter.

4.2. Materials

Each of the 52 participants was given experimental materials which contained consent forms, alternate uses tests, procedure briefs and creative mental synthesis tasks.

The alternative (or unusual) uses test (AUT), created by J.P. Guilford in 1967, is a standard test of a measure of divergent thinking ability in which participants list alternative uses for common objects which can be used every day. The participants were given an A4 paper which includes five different objects' names and they were expected to write new and original uses for each one. The words "paper clip," "brick," "blanket," "barrel" "jar" were given in Turkish and participants produced original uses for these words.

In the creative mental synthesis task, participants were given A3 papers which include three of the 3D objects which were selected at random between fifteen objects, shown in Figure 3.

4.3 Procedure

The creative mental synthesis task

The creative mental synthesis task (Finke, 1990) is also known as "combination task." In this task, participants combine the given parts mentally and draw the final form. The task measures the ability to synthesize, which leads to the possibility of discovering new meanings from the combination of parts while creating a new whole.

The current experiment consisted of 4 groups (2 design student groups and 2 non-design student groups); each department had a control and experimental group. Before the experiment the participants received a document with instructions explaining the procedure of the experiment.

The control groups were given 5 minutes and the category name: "sitting unit" and then they combined the given parts so as to make an object that could reasonably be referred to as a "sitting unit" and drew the final form. On the other hand, the experimental groups spontaneously created object forms with the three parts in 5 minutes. After creating the forms, they were asked to interpret and draw one of the alternative forms to match the "sitting unit" category in 5 minutes. An example procedure schema of control groups and experimental groups is shown in Figure 4. The control group of design students was represented as Group D1; the experimental group of design students as Group D2; the control group of non-design students as Group N1; and the experimental group of non-design students as Group N2. The experimental design of the research is shown below in Table 1.

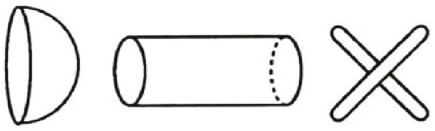


Figure 3. *Geometric objects that were given to the participants: a half sphere, a cylinder and an X-shaped object.*

4.4. Data analysis

AUT creativity measures analysis

The results of AUT were measured across three sub-categories: fluency, flexibility and originality scores, the totals of which were calculated. Fluency score is the total number of responses

Table 1. *The experimental design of the research.*

Design Students (26 Participants)		**Non-design students (26 Participants)**	
Control Group (Group D1) (13 Participants)	Experimental Group (Group D2) (13 Participants)	Control Group (Group N1) (13 Participants)	Experimental Group (Group N2) (13 Participants)
They are given an object category at the beginning of the experiment.	They are given the object category after combining the parts.	They are given an object category at the beginning of the experiment.	They are given the object category after combining the parts.

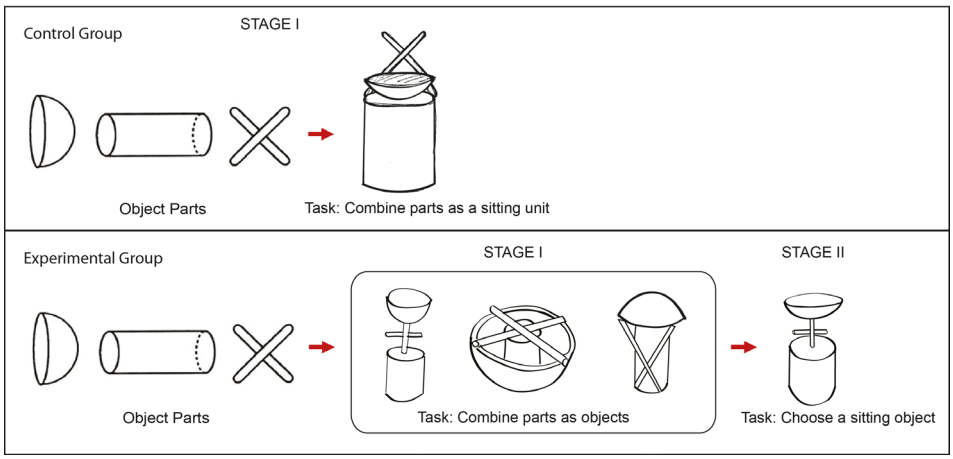


Figure 4. *Participants' experimental task sketches of Stage I and Stage II.*

to a stimulant given; flexibility score is determined by the number of conceptual categories the given responses fall into; and originality score is determined by statistical infrequency of generated uses. The total fluency, flexibility and originality scores and total AUT scores of the test were used in the statistical work.

According to the results of the AUT, there was no statistically significant difference between the total fluency, flexibility and originality and total AUT scores of the groups as demonstrated by one-way ANOVA, meaning that students were divided into equal groups on the basis of their creativity scores (For Fluency: $F(3,48)= 0.565$, $p = 0.641$ ($p > 0.05$); for flexibility: $F(3,48) = 0.567$, $p = 0.639$ ($p > 0.05$); for originality: $F(3,48) = 0.145$; $p = 0.932$ ($p > 0.05$) and the total scores of these categories (AUT total score) is $F(3,48) = 0.514$, $p = 0.675$ ($p > 0.05$)).

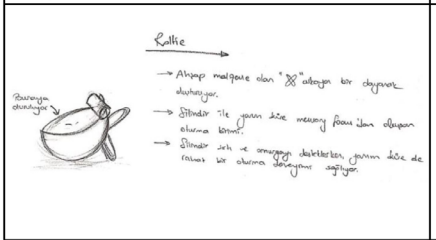
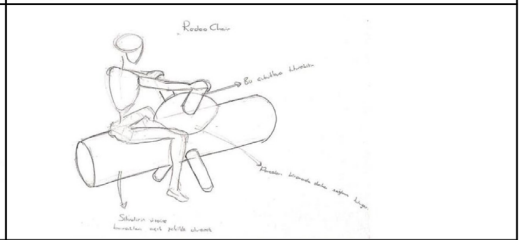
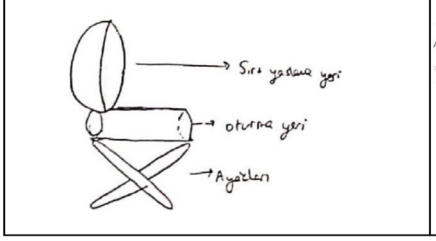
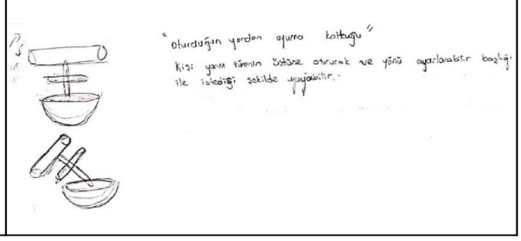
Creativity task data analysis

All "sitting unit" forms created by the four experiment groups were rated by three independent judges. The judges were academicians in industrial design. The evaluation criteria were based on the definition of creativity, the ability to produce work that is both novel (i.e., original, unexpected) and appropriate (i.e., useful) (Amabile, 1983; Sternberg & Lubart, 1999; Runco & Jaeger, 2012). Also, according to Finke (1990), "creative" discoveries are defined according to these two separate dimensions: the usefulness (or practicality) and the originality of an object. Thus the "sitting units" were evaluated in terms of usefulness (or practicality), defined as an object involving an actual use in a context, and originality, defined as being novel, unique and infrequent. To measure the degree of originality and usefulness, the 5-point Likert scale was used. Objects created by the participants were evaluated by an expert jury, on a scale ranging from 1 (not original) to 5 (very original) and 1 (not useful) to 5 (very useful). The composite scores were calculated from the ratings of each items. The reliability and correlation analyses were completed to understand whether there was an agreement or not. The "sitting unit" forms that were created by control and experimental groups are shown in Table 2.

5. Results and discussion

The reliability and correlation tests revealed that there was a significant agreement and positive correlation between the jury's ratings for usefulness and originality. Since the distribution of data is not normal, the level of agreement between judges is defined by calculating the mean of Spearman's rho correlations and Cronbach's alpha. The usefulness ratings of jury-1 positively correlated with jury-2 ($r = 0.726$, $p < 0.05$); jury-2 positively correlated with jury-3 ($r = 0.759$, $p <$

Table 2. *Sample sketches of the control and experimental groups of design students and non-design students.*

An example of a "sitting unit" by the control group of design students	An example of a "sitting unit" by the experimental group of design students
	
An example of a "sitting unit" by the control group of non-design students	**An example of a "sitting unit" by the experimental group of non-design students**
	

0.05); and jury-1 positively correlated with jury-3 ($r = 0.725$, $p < 0.05$). The originality ratings of jury-1 positively correlated with jury-2 ($r = 0.791$, $p < 0.05$); jury-2 positively correlated with jury-3 ($r = 0.778$, $p < 0.05$); and jury-1 positively correlated with jury-3 ($r = 0.771$, $p < 0.05$).

The interclass Cronbach's alpha (inter-rater reliability) of ratings for usefulness was 0.926 and for originality 0.908. This indicates a high level of internal consistency for the scale of this sample.

The Kruskal-Wallis H test showed that there was a significant difference for the usefulness ($\chi2(3) = 31.944$, $p < 0.001$), originality ($\chi2(3) = 35.011$, $p < 0.001$) and creativity (total usefulness and originality ratings) ($\chi2(3) = 38.132$, $p < 0.001$) between groups.

The experimental groups of design and non-design students (who designed sitting units without knowing the object category) got higher creativity scores compared to the matching control groups who designed the sitting units with a given object category.

The result of the comparison of the experimental group and control group of design students and non-design students were as follows: for "usefulness" ratings; Group D2 (N = 13, Mean Rank = 17.85) and Group D1 (N = 13, Mean Rank = 9.15) (U = 28.000, $p < 0.01$); Group N2 (N = 13, Mean Rank = 19.35) and Group N1 (N = 13, Mean Rank = 7.65) (U = 8.500, $p < 0.001$); for originality ratings; Group D2 (N= 13, Mean Rank = 19.12) and Group D1 (N= 13, Mean Rank = 7.88) (U= 11.500, $p < 0.001$); Group N2 (N = 13, Mean Rank = 19.46) and Group N1 (N = 13, Mean Rank = 7.54) (U= 7.000, $p < 0.001$); for creativity scores (total ratings of usefulness and originality); Group D2 (N= 13, Mean Rank = 19.38) and Group D1 (N= 13, Mean Rank = 7.62) (U= 8.000, $p < 0.001$); Group N2 (N = 13, Mean Rank = 19.81) and Group N1 (N = 13, Mean Rank = 7.19) (U = 2.500, $p < 0.001$). The experimental group of design students got higher scores on all criteria.

Also, the comparison of experimental groups of design students with experimental and control groups of non-design students were as follows: for "usefulness" ratings; Group D2 (N = 13, Mean Rank = 18.12) and Group N2 (N=13, Mean Rank = 8.88) (U = 24.500, $p < 0.01$); Group D2 (N =13, Mean Rank = 19.92) and Group N1 (N = 13, Mean Rank = 7.08) (U = 1000, $p < 0.001$); for originality ratings; Group D2 (N = 13, Mean Rank = 16.85) and Group N2 (N = 13, Mean Rank = 10.15) (U= 41.000, $p < 0.05$); Group D2 (N = 13, Mean Rank = 20.00) and Group N1 (N = 13, Mean Rank = 7.00) (U = 0.000, $p < 0.001$); for creativity scores (total ratings of usefulness and originality); Group D2 (N = 13, Mean Rank = 18.38) and Group N2 (N = 13, Mean Rank = 8.62) (U= 21.000, $p < 0.01$); Group D2 (N = 13, Mean Rank = 20.00) and Group N1 (N = 13, Mean Rank = 7.00) (U = 0.000, $p < 0.001$).

These results supported the previous "Mental Synthesis Task" results of Finke (1990) and revealed that when the participants are informed of the task after creating forms, they get higher "usefulness" and "originality" ratings. Both of the experimental groups showed better performances on pretense/seeing *as if* or seeing-possible-affordances ability than the control group of non-design

Table 3. *The significant differences of groups according to the result of the Mann-Whitney U Test.*

	Usefulness		Originality		Creativity	
	Asymp. Sig. (2-tailed)		Asymp. Sig. (2-tailed)		Asymp. Sig. (2-tailed)	
Experimental Group / Control Group	**D2**	**N2**	**D2**	**N2**	**D2**	**N2**
D1	$p < 0.01$	$p > 0.05$	$p < 0.001$	$p > 0.05$	$p < 0.001$	$p > 0.05$
N1	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$

students. To review the findings according to affordance, pretense and design association, experimental groups created free forms and afterwards tried to see those forms as if (pretend) they are sitting units; they found the sitting affordances of those objects which resulted higher creativity scores.

The control groups received lower creativity scores. Having been given the "sitting unit" brief in the first part of the experiment, they imagined more limited forms and created "sitting unit forms" with less creativity than experimental groups of their peers (See Figure 5).

When we look at the comparisons between control groups, the non-design control group showed the lowest creativity performance with the forms they created. The comparison of control groups of design and non-design students were as follows: for "usefulness" ratings; Group D1 (N = 13, Mean Rank = 18.88) and Group N1 (N = 13, Mean Rank = 8.12) (U= 14.500, $p < 0.001$); for "originality" ratings; Group D1 (N = 13, Mean Rank = 19.23) and Group N1 (N = 13, Mean Rank = 7.77) (U= 10.000, $p < 0.001$); for creativity scores (total ratings of usefulness and originality); Group D1 (N = 13, Mean Rank = 19.35) and Group N1 (N = 13, Mean Rank = 7.65) (U= 8.500, $p < 0.001$).

Both design and non-design control group participants started the form-giving process focusing on the "sitting function" of the combined parts considering the sitting affordances of the object in a flexible manner. This resulted in lower creative performance.

There is no statistically significant difference between the designer control group and the non-designer experimental group according to creativity scores (total ratings of usefulness and originality); (Group D1 (N= 13, Mean rank = 11.08) and Group N2 (N= 13, Mean rank = 15.92) (U= 53.000, $p > 0.05$). This result revealed that both the control group of design students and the experimental group of non-design students showed closer performances on creativity related with pretense

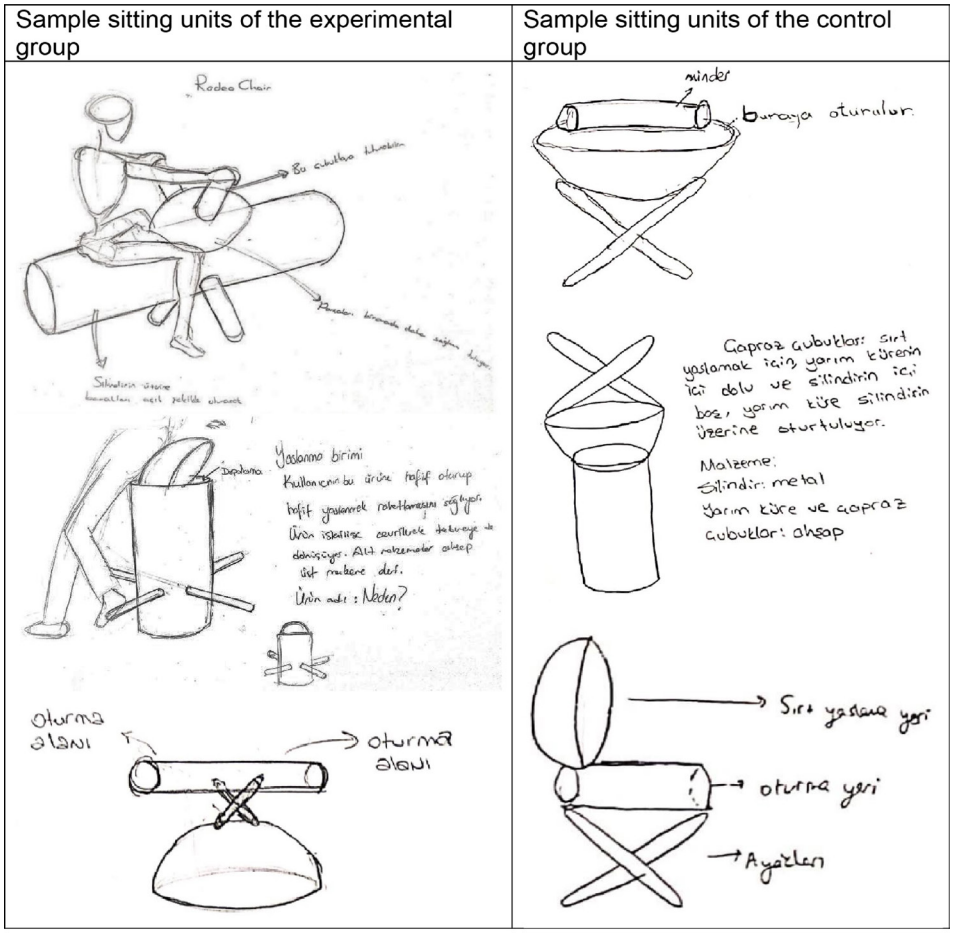


Figure 5. *A sample of sitting units designed by the experimental and control groups.*

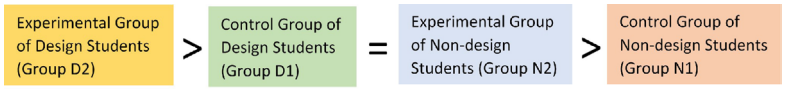


Figure 6. *A simple schema of the overall total creativity scores of groups.*

ability which is based on seeing possible affordances (sitting) in their forms.

The overall total creativity scores of the 4 groups are illustrated in Figure 6.

As a result, as shown in Figure 6, the experimental group of design students exhibited the highest level of creativity on the creative mental synthesis task compared to the other groups. This result supports the description of the relationship between "pretense" (acting *as if*) and early design phase as we hypothesized. Pretend play, which is normally assumed to be peculiar to childhood, is a part of design education in adulthood. Design education supports students by enabling them to think flexibly and develop skills in this direction. For this reason, in the experiment where the pretense process was simulated, the experimental group of design students exhibited the highest levels of creativity in pretense (acting *as if*) among the four groups. Designers always try to create possible world scenarios by thinking about the possible solutions suitable for the design problems they face with the "what if"/ "as if" perspective in order to achieve flexible thinking capacity like children. In other words, in the process of creating forms in the early design phase, they can produce creative solutions in a flexible way by seeing "affordances of objects", or "new possibilities of action". While designing new objects, designers take the role of "pretenders" and think/imagine action possibilities just as children, in their pretend play, assign affordance relationships to objects.

6. Conclusion

This paper proposes that there is a high degree of similarity between the "affordance-based pretense framework of design creativity" in the pretend play of children and the creative design process associated with the concept of affordance. Then experimental tasks – an alternate uses test (AUT) and a creative mental synthesis task – which are based on "affordance-based pretense framework of design creativity" were conducted to compare the result of the mental synthesis task results of design students and non-design students to pretense ability. This would verify the differences of pretending or seeing *as if* ability in mental synthesis task related to creative performances.

The findings of this research demonstrate that participants showed better performances when they spontaneously combine the parts and create free forms and then search for "sitting" affordances among these forms. This process could be interpreted as *searching for* and *discovery of affordances*. The result of the mental synthesis task" can be interpreted to be associated with the *seeing-as-if* or *seeing-affordances-in* ability (Rucińska, 2015) of subjects. The results support that the experimental group of design students, like children, try to discover new action possibilities and see affordances in objects in the context of use. They performed better in seeing "sitting" affordance in their object forms. Additionally, this study supports the idea that it is possible to increase the flexibility of the "seeing affordances in" ability, with which people perform mental figural synthesis and discover possibilities. This process is related to creativity because creativity often involves the ability to go beyond the immediate meanings and find hidden properties and possibilities.

The affordance or action possibilities-searching process could be seen both in the pretend play of children and in the experimental group in the mental synthesis task as shown in Figure 7. The child looks around for the affordance match of a phone in her play. Then she finds the banana and uses it as a phone in her play. It can be said that children can treat one thing as another because they see the action possibilities - in other words, affordances - in objects while playing in new contexts (Rucińska, 2015). In different pretend play contexts, a child can play with various kinds of objects by seeing the action potentials in them. Seeing the affordance potentials of objects' relation to the agent enables pretense behavior.

Likewise, the experimental groups in the mental synthesis task create some object forms spontaneously in the first

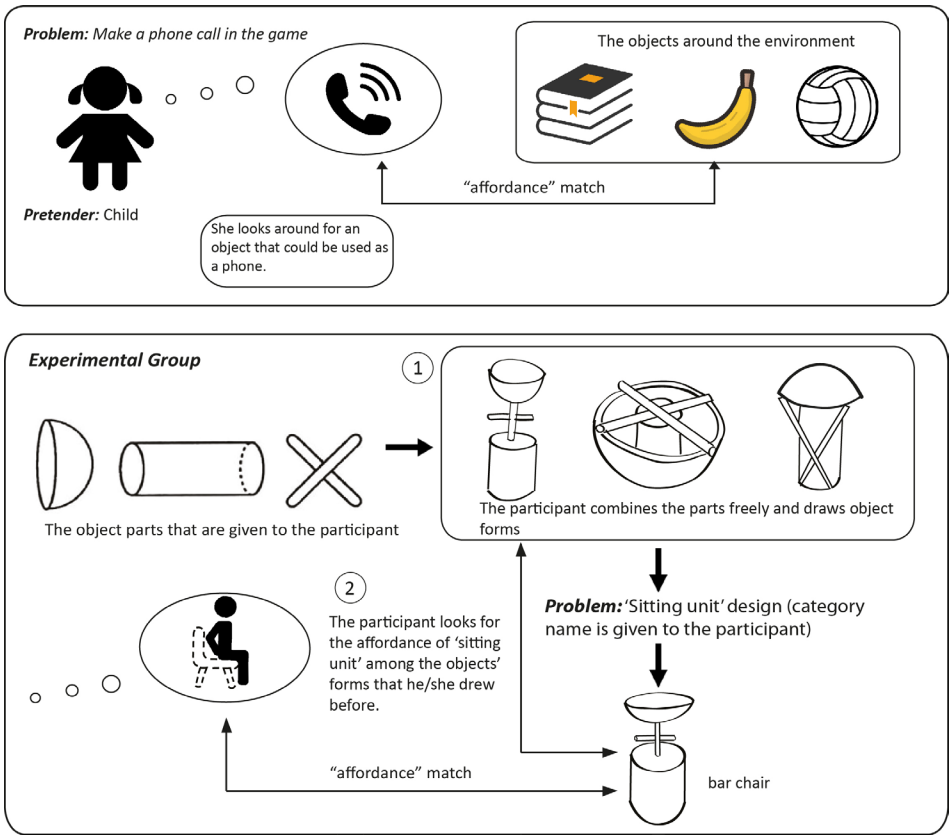


Figure 7. *The similarities between the pretend play of children and the procedure of experimental group in a creative mental synthesis task.*

part of the task. Then they are given the object category name: "sitting unit." Subsequently, they look for the affordances for "sitting" in their object forms which they drew previously. This process is related with creativity as the person imagines and combines object forms in new ways and sees new action possibilities.

In conclusion, Vygotsky (2004, p.10) claimed that "creativity is present, in actuality, not only when great historical works are born but also whenever a person imagines, combines, alters, and creates something new." Transforming the way of thinking, overcoming limitations and imagining possible solutions are complicated processes. Sometimes people are unable to see new ways of using objects (Purcell and Gero, 1996). Pretense encourages people to see new interaction possibilities in objects. While children can automatically pretend (Carruthers, 2002; Mitchell, 2002; Weisberg & Gopnik, 2013; Rucińska, 2015) and "see things as other things" in different contexts, designers learn this process while designing and try to see beyond the conventional uses of objects and imagine other possibilities. Pretense enables people to exercise the seeing *as if* ability for suppressing habitual or obvious responses and selecting more unusual possibilities. This is called bypassing the obvious and selecting the non-obvious (Picciuto & Carruthers, 2014). For example, when we see a chair, we first think it is for "sitting" because we usually use a chair for sitting even though we may use it in many other ways. Thus, "the concept of affordance challenges designers to avoid the reliance on symbols and cultural conventions in design" (You & Chen, 2007, p. 29).

In the design process, designers should pay attention to the possible meaningful interactions between products and users. Related with creativity, flexible thinking is essential for responding to unexpectedness in the design process. Therefore, taking an affordance-based view of pretense could allow designers to imagine and think about the possible user–product interactions and create the possible solutions to design problems and satisfy the varied needs of users. Furthermore,

pretense could be an effective practice to inhibit a pre-defined way of use and may lead to the discovery of new ideas in the design process. There are many possibilities for action that objects and may afford in terms of design. It's important to encourage designers to imagine and see these possibilities in different contexts of use to satisfy the varied needs of users.

As basic research, the current could make a significant contribution towards understanding pretense from a cognitive perspective, too. It is claimed that designers perform *as if*, act, and seek affordances as adults, similarly to early childhood pretend play. The results of this study, therefore, contrast with the traditional assumption that pretend play is only seen in childhood. Accordingly, this view merits consideration in further studies.

The results of this study seem to be valuable both from the perspective of design research and from the perspective of cognitive science in general. First, the relationship of design creativity and pretense was described in the framework of seeing-as if ability related with affordances. Second, as having a place in creative cognition literature the creative mental synthesis task was repeated from a new viewpoint and interpreted with the relationship of pretense ability and design creativity. The present study provides encouraging results for the research of the relationship between early design process and the pretense process of children.

Although the research has reached useful results to describe the affordance-based pretense framework of design creativity, there were some unavoidable limitations. First, the research was conducted only with small size of population (N=52) of university students. Therefore, to generalize the results for larger groups, the study should involve more participants at different design expertise levels and professions in future research. Second, and far more important, creative processes of human mind in cognitive studies are still being explored from multiple perspectives. This study should also be expanded considering relative processes such as analogy making, visual imagery, emotional intelligence etc., in design.

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Research for evaluating perception of concrete material by using visual research methods in learning environments

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Abstract

While perceptual-cognitive and social-emotional processes develop from birth to adulthood, the school environment has a vital importance in children's psychology and relationships with their environment. Considering the fact that most of the learning processes are spent in the school environments in the process of child development, the importance of research on these environments becomes evident. The field study which is presented within the article aims to reveal the attitudes and preferences of the students between the ages of 6-7 whose cognitive processes are in the development stage and to evaluate their perceptual performance of concrete material in learning environments. In this study, two classroom environments with differentiated interior materials modeled with VR technology were evaluated. The first classroom is designed in accordance with the "Minimum Design Standards Guide for Educational Buildings in Turkey", while the other classroom is designed as an alternative where concrete material is dominant as an interior design element. In the analyzed definitions, it was seen that the students' responses focused on the situational characteristics of the environment and the materials, illumination and cognitive factors remained in the background. This situation is considered as the pre-operational period of children in this age group concentrate on the identifiable objects they see rather than their own emotions and personal interpretations. In addition, the study showed that the physical environment was effective in the perception of the objects that it surrounds, and that the objects with the same properties can be perceived differently within different physical environments.

Keywords
Children's perception, Concrete, Learning environments, Visual preference.

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1. Introduction

The research of learning environments based on the psychosocial context of the classes has revealed important information as a field of study for almost half a century. In recent years, research on the learning environments is useful in solving many educational problems, and it has been emphasized that psychosocial factors in the classroom are important in creating productive learning environments (Khine et al., 2017).

In the period from birth to adulthood, while the perceptual-cognitive and social-emotional processes are developing, the school environment is of vital importance in the psychology of children and their relations with their environment. Considering that most of the learning processes are spent in the internal environments of the school in the developmental age of children, the importance of the research on these environments becomes evident. In Turkey, new school buildings, which have increased rapidly in recent years, provide an open laboratory environment to investigate the perceptual relationship between children and school environments. The outputs of the work to be carried out in this area will offer the potential to develop a preliminary guideline for the ongoing new school buildings and will obtain the driving force for the design of more qualified and learning-oriented structures.

Between 2012 and 2015, 44 new school buildings were built in Istanbul as part of the ISMEP Project (Istanbul Seismic Risk Removal Project). The bare concrete surfaces of the built schools are presented as a designer decision and appear as the designer's own suggestion. Especially bare concrete surfaces in the interior, which reveal a contemporary architectural language, dominate the general space, and become the frequent characteristic feature of the buildings. The use of bare concrete in school interiors and spatial elements is not a general situation in educational buildings. Especially social judgments and cultural perspectives make it important to investigate the effect of this material on the space. Based on this point, revealing the relationship between educational structures - child perception - concrete material is the main scope of the study.

According to Tabaeian and Einifar (2011), the mental and psychological effects of architectural frameworks on humans continue from the first shelters to the modern structures of today. Action areas are concepts that have both physical properties and experience for users and have psychological effects on users (Mahmoud,2017). Today, especially in the last twenty years, interior design spaces have affected the human sense in many ways, and therefore new developments, innovations related to technology and materials have changed the field of interior architecture and the perception of users. This effect of spaces on the psychology, moods and daily activities of people makes it critical and important to investigate the spatial experiences and the perceptual status of users (Sheemesh et al., 2015). On the other hand, the variety of materials, forms and functions, especially in interiors, provides more opportunities than ordinary places to practice different spatial experiences and enrich daily routine actions. The visual perception we have obtained with environmental experience is the most effective and primary sense in making sense and understanding of the environment.

According to Berger (1989), the sense of vision includes more than eighty percent of the information received from the environment for perception of the environment. It also has one of the most important roles in space perception because spatial elements such as color, texture, and form comprised the basis of visual perception (Aydınlı, 1986). The visual environment and perception ensure that the user touches the space and transforms into actions such as directing, navigating, experiencing, and responding by building a bridge between oneself and the individuals (Figure 1). An average person is exposed to more than 5000 photographs per day (Alawadhi, 2010). Perception mostly starts with a vision and continues with the help of different parameters. As seen in Figure 1, perceived space thought results in the perception of space with the effect of previous experiences such

as thought, memory, and imagination (Pop, 2013). In the process of visual perception, individuals experience a superficial acquisition process related to perceived concepts. This process is a two-dimensional perception. At this stage, individuals perceive images as width and height, but after this step, they begin to form a deeper model regarding the concept of visual perception. Within these processes, the perception of depth is included in the third dimension. This whole process gives meaning to the concepts with cultural background and the concepts identified (Erişti et al. 2013). The perceived reality gains meaning with an image produced by the understanding of society. At that time, image recall begins to form the basis of the concept of experience and perception in the social environment (Halbwachs, 1925).

School circles are the physical environments in which the development of their own cognitive processes occurs as well as the places where children perform the learning action. The development of senses such as seeing, hearing, taste, smell, and touch continues to develop with learning in the school environment. Children who touch the environment at any moment create their own world by using every information they receive from the environment. While having the most important stage of their psychological processes in schools, all of these situations increase the sensitivity of the educational structure from a social perspective.

The development of the senses such as seeing, hearing, taste, smell and touch have continued to develop along with learning in the school environment. Children who are in contact with the environment in every moment create a world of one's own by using every information they receive from surroundings. While they are spending the most important phase for their psychological process in schools all of these situations increase the precision of educational structure in social point of view. Therefore, educational buildings have importance on society and shape the future. Gür suggests that, child behaviors are determined by the psycho-social environment and space rather than their personal characteristics such as personality and intelligence (Gür, 2002).

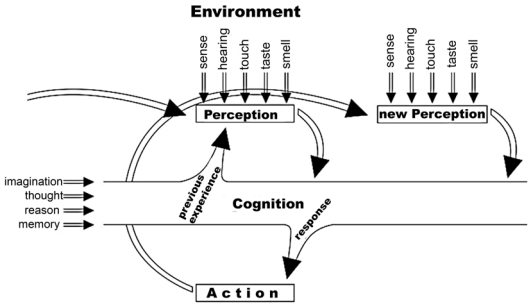

Figure 1. *Space Perception (Pop, 2013).*

Educational Structures Minimum Design Standards Manual – 2015, describes the features that educational structures should have in Turkey (Figure 2). Accordingly, the concepts of social facilities, workspaces, comfort, flexibility and sustainability come to the fore, and in this direction, every material and product used in the design should be suitable for the psychological, cognitive and mental development of children. However, the standards guide does not contain a description of possible new materials, possibilities and new technologies. Moreover, the research about the effect of interior materials on children perception are limited.

According to ESMDSG (2015), some of basic standards about material and color are listed below,

- All floor coatings have to be hard, stable, impact resistance, low maintenance and nonslip.
- Doors, windows and different floor heights must be highlighted with vivid and warm colors.
- Special color must be used on most single walls of each interior spaces and gender discrimination with the use of colors like pink-blue must be avoided.
- All ceilings and wall paints have to be water-based and must not contain chemicals that are harmful for human health.
- Metal cabinets must be painted with polyester or epoxy polyester powder coated painted with the electrostatic painted practice.
- In the facades, instead of dark and bright colors pastel colors must be prefered.

Figure 2. *A standard type of school interior.*

- In exterior facades, colors such as blue, navy blue, claret red, red, dark green must not be used.
- In facades without windows may be used little darker colors and consist of two colors.
- In facades with windows brighter colors must be prefered to use.
- In interiors, up to 1.50., oil painting applications should be in pastel colors like salmon pink, champagne, lilac etc. For surfaces above 1.50m, specified colors' tint should be used.

In this context, it becomes important to reveal the effects of new design trends and material choices on educational structures, students and development processes and to conduct research on the subject.

The use of materials in the design affects the perception process. Material is not only important because of the requirements such as aesthetics, production techniques, time, financial condition, sustainability, but also because it interacts with past experiences, social identities, cultures (Zuo, 2010). A study by Zuo reveals that physical parameters such as surface temperature, smoothness, softness and brightness of the material affect human perception and differentiate the relationship of users with space. Accordingly, the materials used in the space affect the definition of the space and help us understand the perception of the user. The material also helps users define the concept of perception and make sense of daily life by defining the space with physical words and senses.

Wastiels et al. (2013), in his field study, reveals that prejudices about materials are effective in the perception of space. In his study on 116 students, Wastiels et al. (2013) revealed that prejudices are effective especially in visual evaluation while evaluating materials within the scope of visual and cognitive perception. For example, concrete material, which is described as similar to wood material when touched and evaluated positively, was evaluated with negative adjectives such as cold and hard in visual evaluation. Wastiels et al. (2013) concludes that prejudices and stereotypes can disappear if physical properties are perceived similarly with different senses. While it is possible to discuss prejudice and past experiences in this study conducted with people between the ages of 17-25, it may be thought that the results will be different in children who are in the age of growth and whose cognitive development is not completed. Children with less previous experience may have different prejudices or appear less biased. It is precisely at this point how children, who have not completed the cognitive development process, perceive the environment and how they are affected by the environment they are in.

From another point of view, it is mentioned that the materials cannot be compressed into a single interpretation. According to Zumthor (2006), thousands of possibilities are hidden within a material. Materials open the doors of infinite perceptions with their components, states, colors, locations within the space. With this definition, it is concluded that the materials gained meaning along with their own context and content.

To understand the tendency of using concrete in design, it is important to look over the changing tendency of using concrete in history. Known as a durable material, concrete has a long journey in design history.

2. Concrete as a physical and phenomenological asset

Concrete is the second most consumed material after water (Essays, 2013). Considering the physical features and factors such as cost, process, durability, procurement, construction technique, workmanship, sustainability, concrete has great importance in terms of architecture.

In architecture, reinforced concrete has an autonomous role practically in all areas of building practice (Bake & Nolan, 2009). It is also an individually identifiable material within the structure in different forms. "Concrete had its own roles in this pattern of complex, chaotic political compromise and expedient bodging" (Calder, 2015). Beyond being a material since the period before Christ that concrete directs architectural trends, it continues to exist in different forms by increasing its importance and with the help of developing technology.

Since this material was made from natural materials in ancient times, modern concrete was created by industry which was introduced in 19th century. In that time concrete had been used only for bridges, piers and heavy walls. However, at the end of the 19th century it was begun to use it for creating high rise buildings thanks to reinforced concrete (Ambrose & Tripeny, 2007).

For the load-bearing systems, factors such as cost, duration, strength, exterior conditions, workmanship, ecology and sustainability should be considered in detail. Reinforced concrete structures produced by on-site casting system provide a continuous form. This form gives a different meaning and character to the structure. Due to fragmentary (jointed) structure of prefabricated systems, the cracks and hence deteriorations in the monolithic structure.

In the history, concrete has also been important for defense because of its physical endurance. In the Second World War, the blockhouses / concrete bunkers had been need to arise to defense against the developed war and attack technologies under that period's conditions. These structures were constructed at strategic locations in order to see the maximum area with minimum visibility and these structures had also thick walls and less gaps (Ocak & Tekin, 2019). Concrete has helped this type of structure -unlike previous defence structure – without joint, fragmentation and deterioriation as a whole and this has provided opportunity for better protection. The bunkers, which were built from concrete for protection were described by Virilio (Virilio, 1975) with their restrained volumes, rounded angels and rare openings. Today most of these bunkers are used as a museum and art spaces that put forth the duality between the cold atmosphere of bunker and new alternatives for art. In these structure concrete can be seen as a representation of robustness and safety. After the World War I, modernist architects utilized from concrete the deconstruction of new cities. Le Corbusier was the one of them. Corbusier fascinated using concrete as an architectural elements both in exteriors and interiors. Le Corbusier used the ability of concrete to create various molding forms, open floor plans, wide windows and free façades. These characteristics can be seen in the Villa Savoye. Tactual expressiveness of concrete took Le Corbusier's attention, which could provide primitive purity and wider scale building typology (Calder, 2016). That is why Corbusier used concrete as a poetic engineer, it can be seen at monastery of La Tourette and Chapel Ronchamp. It was the time that actually Le Corbuser processed the bare concrete, and then brutalism and new brutalism movement occurred. After than clearly can be said that, concrete material become something more than material, but also the way of looking to simplicity and clarity.

In the socialist era, concrete had his own new meaning and become a part of the new manifesto. Beside the durability and speed of construction, the perception of eternity and confidence became the main relation between social community and manifestation of strong nation. Concrete monuments and urban furnitures started to be seen in every point of the new designed socialist cities.

Nowadays concrete maintains its importance and designers still prefer to use the material both in buildings and in their interiors. When the concrete material is seen as a form of simplicity by architects, it will not be fair to expect the same from the users.

The tendency of governments of Turkey to design new group of schools in Turkey, gave the opportunity to investigate the students' perception of learning environments. More importantly, concrete which was the main interior material, create a new platform to discuss and investigate the impact of material on perception.

ISMEP project was created as an educational policy since Turkey is in the earthquake zone, and it is an innovative approach in the context of improving the educational structures, including 44 new schools, which are built in a short time and whose architectural projects are carried out by Uygur Architecture. The selection of school building interior material as concrete appears as one of the most characteristic features of the project (Figure 3). Uygur (2015) attributes the use of bare concrete surfaces indoors to physical properties such as fire resistance, easy availability, scratch resistance, impressiveness, courage and inspiration, and also underlines that concrete can be used as a creativity board. These schools, which are defined as "Local School" have been suggested to establish new relationships between students and the student-school space (Uygur, 2015).

With a preliminary study photograph and survey method that examines this new design concept based on reinforced concrete material on a group of 80 people with architectural education and without architectural education, Uygur discussed the concept of bias proposed by Wastiels et al. (2013) and the effect of materials on interior designations. The study revealed that students who did not have an architectural education considered the place to be more positive than those who received architectural education, and although the place was defined as "cold", it was not defined as a negative feature (Seymen, 2019). According to the results obtained, it was observed that the physical properties and architectural composition of the space, such as space volume, corridor widths, were more effective than the material features such as color and texture in the participants' preferences.

3. Method

Aim of the study is broadly about to understand both relation and results of material and perception concept together within the scope of environmental psychology and interior architecture. Furthermore, try to express the role of material is not only as a physical element but also as a metaphoric meaning of the material. Objectives of the thesis can be clarified as below.

- To introduce metaphorical and contextual relation between architectural interior spaces and perception
- To evaluate the effect of concrete on spatial perception in learning environment.

Within the scope of the article, a field study was conducted to investigate the tendencies and preferences of primary school students towards classroom interiors in order to evaluate the perceptual performance of concrete material in learning spaces. Considering the school environment, it can be said that students spend most of their time in classroom settings where learning ac-

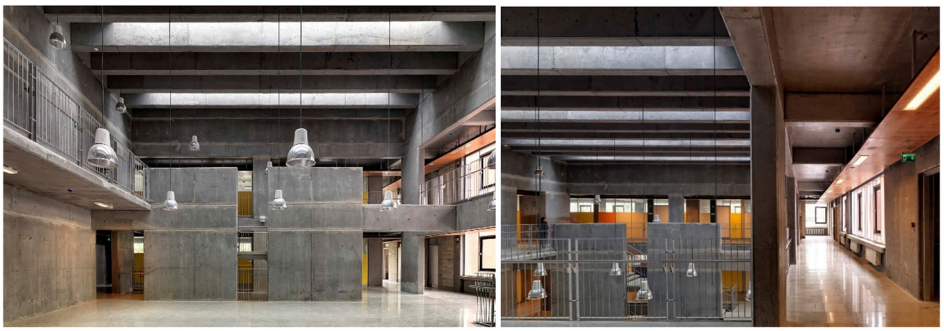

Figure 3. *Beşiktaş Yenilevent High School (An ISMEP project).*

tivity takes place rather than corridors. In the field study in which 33 first-year students were treated as subjects, two classrooms modeled with VR technology and interior materials differentiated were evaluated. While the first of the classes was designed based on the Educational Structures Minimum Design Standards Manual, the other class was created as the second option where concrete material is dominant as an interior design element. Students experienced classroom spaces through VR glasses and questions were asked to evaluate their perceptions with the face-to-face interview method. In the last stage of the study, the answers given by the students were analyzed and evaluated.

The reason of using VR method is to give opportunity for participants to feel the space more realistic and to give an objective line of vision. Virtual reality is defined as a 'real or stimulated environment in which perceiver experiences intelligibleness – telepresence. Telepresence is also defined as the experience of being in an environment through a communication medium (Mineev, 2017).

The children who are conducted in study were in operational period of perception and when they perceive the concrete classrooms they can not only perceive the concepts but also express their feelings objectively and without prejudices.

To understand and examine this ideas, two different classrooms were designed with material variations. For both classrooms, physical elements / furniture were remained same however material and texture changes were applied. The material discrepancies were practiced for only walls and floors which are architecture elements when desks, chairs, chalkboard, door and windows, which are physical elements, were identified same color/material for both classroom designs.

3.1. Case study

In the field study conducted within the scope of the research presented in the article, students between the ages of 6 and 7 were considered as the subject group. The most important reason for choosing this age group is that they have not completed their cognitive processes and in this context, their spatial or sensory bias is minimal. The period between the ages of 2-7 is when the brain is most open to the senses and can organize them. In this period, which is defined as the preoperational stage by Piaget, children can use word and image symbols to represent objects, be influenced by the images they see and classify objects (1969). In the period between 6-12 years old, the environmental image is processed in children (Özak, 2008). In the pre-procedure period, information about problem solving is gained and rules can be understood (Kol, 2011). During this period, non-congenital information based on environmental data is obtained. According to Piaget, they perceive the volume, weight, size, and concrete properties of objects and gain the logical thinking ability called "series" (Babaoğlu, 2007).

In the field study, where 33 first-year students were treated as subjects, the classroom environment that students will evaluate was modeled with VR technology and its interior was created with two different materials (Figure 4). VR is a technology that provides the environment we can be a part of and includes the space in real-time (Algahtani et al, 2017). In the modeling of the first class, Educational Structures Minimum Design Standards Guide was taken as reference (Milli Eğitim Bakanlığı İnşaat ve Emlak Dairesi Başkanlığı, 2015) and indoor material and color features were created based

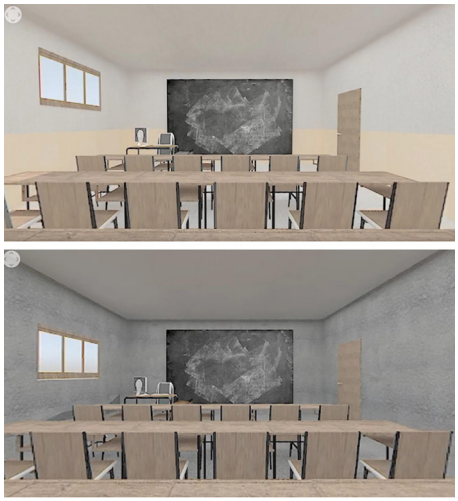

Figure 4. *Classroom interiors presented with VR technology.*

Figure 5. *Concrete texture which is used in renders.*

Figure 6. *Photograph was taken during the case study.*

on the given regulations. Tables, teacher's desk, chairs, windows and door material were determined as wooden texture, and the wall color is processed in two colors with bright and toned. Floors were determined as shiny ceramic texture.

The other class to be evaluated has been created as an option in which reinforced concrete material is dominant in the interior, regarding the class characteristics in primary schools prepared within the scope of ISMEP Projects. Textured surface material was used to increase the emotional appearance effect and strengthen the perception of concrete material (Figure 5).

The modeling of the two classes was carried out in 3DsMax, a 3D drawing software, created as a video for viewing in VR technology, and a playlist was created to allow the movements according to the user's requests. "Everest Vr Glas - VR022" model was used to display VR videos over the internet interface. As a methodology, the children used as subjects were asked to perform three different tasks in one-on-one interviews:

- Describe both classes with two words.
- In which class they chose to have their lessons
- They were asked to say for what reasons the selected class was chosen.

In the creation of tasks, sensitivity was shown to make the questions short, clear and understandable, and children who tend to be affected by each other to complete their duties separately.

In the first step, OCD or CDCD was showed to children and asked to express their thought in two words while wearing glasses. In second step, the image was changed to other classroom design and firstly asked about the classroom choice to attend a class and the reason of the choice. In the third and last step they are asked about their expressions in two words for second seen classroom. The reason for the asking about the choices before second video was to get first impressions and not forget to first video.

The main aim to ask their classroom choices that research about preference in terms of material perception. To compare with the previous case study, survey was evaluated by the concept of children's choices. Children who are at the beginning of perception development were preferred because they do not have prejudices in terms of preference.

3.2. Analysis and evaluation of data

The evaluation was carried out in two stages. In the first stage, the class preferences of the students were examined; in the second stage, the definitions made for both class types were grouped and presented. In which class the subjects prefer to have a lesson is graphically shown in Figure 7. Students preferred both classes almost equally (42%, 46%) and four students (12%) showed abstaining preferences.

In the next step, students' definitions of classes are grouped and examined and expressed in Figure 8. Positive and

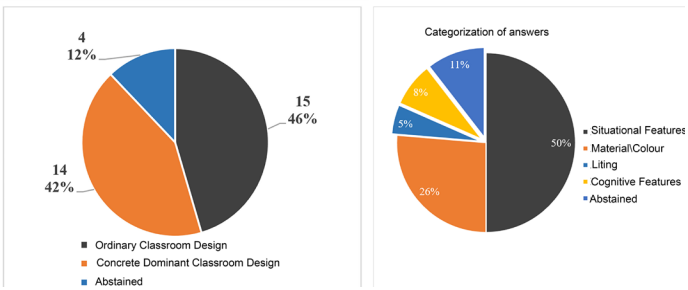

Figure 7. *Graphic that shows classroom evaluation for 33 students.*

negative judgments are put forward by grouping preferred class definitions and non-preferred class definitions. For example, if the "walls look different" assessment was made for the class of choice for the student, it provides a positive perspective, and if it is done for the class for which it does not choose the same definition, it is considered as a negative trend. While such a description table reveals with what adjectives of both classes are defined, it also gives information about the positive or negative usage tendencies of these adjectives (Figure 9).

The reinforced concrete class was evaluated positively with definitions such as "good environment," "few chairs," "beautiful rows," while the reinforced concrete wall was evaluated negatively with definitions such as "gray," "colorless," "black," and "closed" (Figure 9).

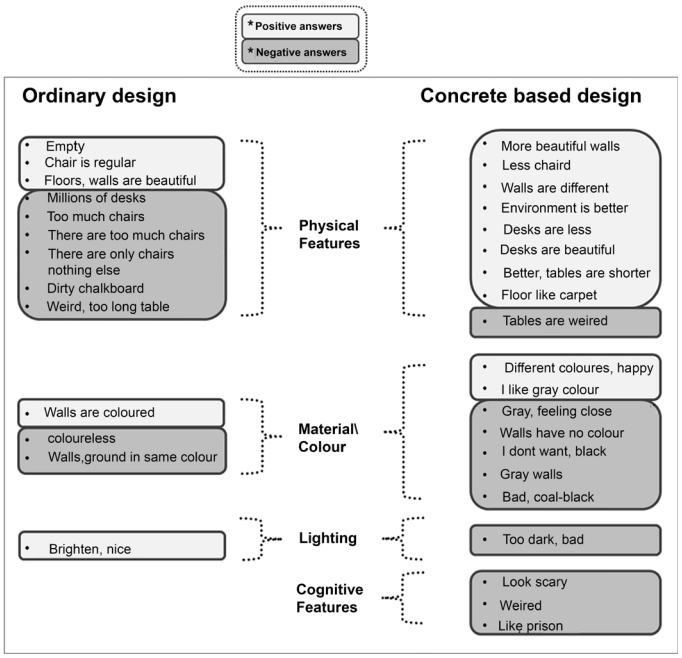

Figure 8. *Descriptions of two classrooms.*

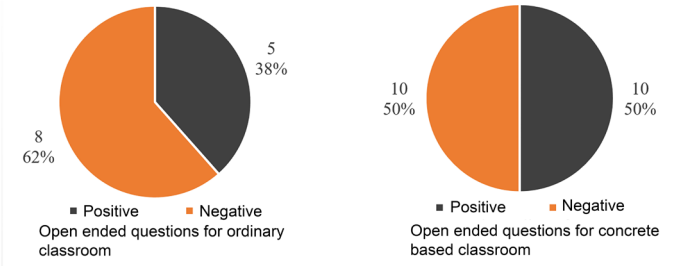

Figure 9. *Negative and positive responds to standard and concrete material used classrooms.*

Table 1. *Responses of abstaining students.*

Responses of abstaining students
- I dont want to attend a class in non of them, two classes are the same
- I dont want any of them
- I can attend the class in both of them, there is no difference
- Both are the same

While the standard class was considered negative with features such as a high number of chairs, high number of rows, it was evaluated positively with its regular and bright appearance. Overall assessment rates for both classes are given in Figure 7.

Four students, who refrained from a vote in their preferences, stated that they did not want to make a choice and that their thoughts were the same in both classes (Table 1). It can be said that these students do not see a significant difference between the two spaces and therefore did not respond.

When the definitions made for the class design with concrete material are grouped, mostly positive definitions about the situational properties of the space have been made, whereas negative comments have been centered upon color and material. Although the number of rows and tables is the same in both classrooms, in the standard class where the wall color and the table color are the same, the number of tables and chairs was perceived as excessive, and this came out as a negative feature. At this point, it has been observed that the physical environment is effective in the perception of the objects in it, and the same number of objects can be perceived differently in two different physical environments. Especially considering that wall colors form a background for human perception, their effects on general perception emerge.

In the definitions made for classes, it was observed that the responses focused on the situational characteristics of the space, and the material, illumination and cognitive factors remained in the background. This situation can be evaluated as the fact that the children in this age group, which is de-

fined as the preoperational stage, are focused on the identifiable objects they see rather than their own emotions and personal comments. Therefore, definitions such as "being large", "being small" and "crowded" can be seen as an expected situation. In the development of perception, children in the concrete operations period evaluated the place where they were located, as predicted in the hypothesis, independently of cognitive factors. Although reinforced concrete does not see the traces of social perception and prejudices predominantly, dark color feature and darkness features are emphasized in class descriptions.

4. Conclusion and discussion

Process of perception is started with the senses like seeing, smelling, touching and therefore spaces are perceive with the help of each element in design including material. Children perception is also affected from every impact from the environment in each perceptual stages. Therefore, children perception is not only important for their development, but also have significant impact on societies.

In addition to the fact that the concrete has many significant contributions to the structures physically, the areas of use is quite wide thanks to different forms and components. The importance of concrete in construction and design history also affects today's structure. Besides being used as the main element in structures, concrete is included in the designs as interior architectural elements. Therefore, the idea of concrete as a phenomenon provided research concept in this research.

While the learning activity is carried out in the classroom, the progress of the students is usually determined and performed through tests and exams, but the psychosocial aspects of the class spaces are often neglected in this process (Fraser, 2014). Classes can be defined as micro-community spaces that create their own ecosystem and affect cognitive outcomes during learning behavior (Khine et al., 2017). The theoretical background of the study presented in this article is based on perceptual development, learning spaces and material perception in children. Learning environments have many different parameters. These structures are the places where the most important stages of the development period in children take place, and children spend most of their time in these places. For this reason, while providing physical comfort ideally, psychological and perceptual development of children should be taken into consideration in the context of interactions with the space and should be included in the design processes.

Although design and use parameters of the educational structures in Turkey is defined in "Educational Buildings Minimum Design Standards Manual" these specifications do not have descriptive data on possible new trends and material alternatives. 44 new schools which are carried out within the scope of application and project of ISMEP Project in Turkey open up a new trend with the features they host and the places they offer. New materials and usage types in these schools, provides a platform to discuss concepts such as social habits, cultural judgments and spatial perception in school buildings. The information and findings to be obtained about these structures, which we can define as a "new type of project", can play a role in designing healthier and more effective education structures by feeding the design processes. Besides, these structures, which define new habits along with new materials, will also support the discussion of concepts such as social prejudice and cultural perception.

The field study presented in the article examines the preferences of students in the 6-7 age group who have not completed the cognitive development period about their class spaces, and especially focuses on the role of concrete walls in these choices. A study (Duyan & Ünver, 2016) investigating the effect of classroom colors on performance revealed the performance of different colors using the attention test, and revealed that different colors had different effects on students' attention. The study in question showed that the purple color shows the highest performance and the red color the lowest. This study, conducted in the 8-9 age group, focuses only on colors and discusses the

color scale. Besides, it will be useful to examine the materials with different environmental parameters as well as their physical properties.

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The relationship between living environment and daily life routines of older adults

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Abstract

The population has been ageing dramatically since 1950s. Therefore addressing age-friendliness has become an important approach in every country. Since a significant proportion of the global population lives in urban areas, it is necessary to highlight the importance of designing neighbourhoods to meet the needs of older adults. This study reveals the relationship between the urban environment and the daily routines of elderly people, differentiated in terms of income level. The study addresses not only the fundamental aspects of neighbourhood design in relation to ageing in place but also how income level affects the ability to be an active citizen in the community. This research used in-depth interviews to compare the experiences of older adults (aged over 70) living in Fatih and Nisantası, two neighbourhoods of Istanbul, Turkey, which are divergent in terms of both income level and urban design features. The findings reveal that living in an neighbourhood that does not support basic needs, such as green open space, housing, social activities, may lead older adults to isolate themselves from community. On the other hand, being able to access urban facilities easily and having a higher income level or financially independency increases older people's engagement in paid leisure activities, engagement to the city and level of sociability. This paper delivers that the ability to be active in later life is considerably influenced by both living environment and income. Also, enhancing the physical infrastructure of poorer neighbourhoods may have a proportionally greater impact on older people's wellbeing.

Keywords
Age-friendliness, Population ageing, Active ageing, Ageing in place.

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1. Introduction

Due to declining birth rates as well as death rates, investments in medical research, availability of pension funds and urbanisation, a rapid increase in population ageing has been experienced globally during the last century. According to a United Nations report (2017), the number of older people is expected to reach 2.1 billion in 2050 - nearly double the number in 2017. Since an increasingly ageing population is seen as inevitable worldwide, it has become a subject of debate in many disciplines. The transition in the demographic share of elderly people is bringing new requirements in urban structure, such as ensuring accessibility to basic services, improving green infrastructure and providing a healthy environment. Governments should be prepared for ageing populations in order to achieve sustainable development goals and targets such as improving wellbeing and health services at all levels of age, gender equality, accessibility to decent work for all and reducing poverty and inequality within each country. Governments need to create new policies and plans for including older people in development goals, specifically public services, health services and environmental design.

This study aims to highlight the relationship between the urban environment and older adults' daily life routine. This research claims that urban space can influence elderly people's activities in many ways, for example, either by isolating them from the wider community or by promoting active ageing. Additionally, this work examines the ways in which income level affects the ability to engage in later life activities and questions the impacts of neighbourhood design on the daily routines of elderly people living in different urban environments and with different levels of income through a depth-interview with older adults aged 70.

2. Literature review

In order to provide an organised literature review for this study, I have defined the specifications of age-friendly communities and environments into three categories: 1) aiming to ensure that age is not an obstacle for older people to continue their social and outdoor activities over the long term; 2) providing access to adequate living accommodation that meets the physical, social and health needs of older people; 3) providing support for older people to engage with new opportunities to enhance their wellbeing (Lehning, Chun, & Scharlach, 2007).

Category 1 is concerned with the line between the health issues of older adults and their living environments such as urban design and safety. Ross and Mirowsky (2001) suggest that living in a disadvantaged neighbourhood is associated with weakened health. Also, elderly people are more open to vulnerabilities relating to urban structure because adverse urban environments can directly influence their physical and psychological health and contribute to chronic diseases (Beard et.al., 2012). Balfour and Kaplan (2002) support this idea by expressing that the loss of lower-body function is strongly associated with residing in a neighbourhood with multiple problems such as inaccessibility to green open space, inadequate public transport, and lack of community support and leisure activities. Older people are generally eager to be active and remain independent in their society as long as possible, however, their ability to do this depends not only on their condition of physical and mental health but also on the state of their urban environment. Therefore the urban environment should be specifically designed and managed to meet older people's needs (Lawton & Nahemow, 1973). This means that if an older person has a lack of physical ability to perform their desired daily routine, the city can provide an environment that still allows them to remain active and independent in their society. For instance, a well-designed street with suitable disabled access and transportation facilities between different services can help older people live their life independently. In other respects, a positive environment also provides community engagement and other activities that allow older people to be more integrated and continue to contribute to society. The existence of green public spaces and their accessibility from residences also increases social interaction and well-being (Kweon, Sullivan, & Wiley, 1998).

This kind of evidence has led researchers to a new perspective called healthy ageing which is defined as *"the development and maintenance of optimal physical, mental, and social well-being and function in older adults"* by Lang et al. (2006, p. 3).

A person's health can be seriously affected by a deprived neighbourhood (Ross and Mirowsky, 2001). For example, urban environments with adverse conditions such as heavy traffic, high noise levels, crime and inadequate design can cause health impairment for older people (Balfour & Kaplan, 2002). In order to address not only the needs of older people but also to increase quality of life for all in communities, neighbourhoods should be attractive and inclusive in terms of urban design, safety, walkability and accessibility to all activities; they should also have adequate public transportation and provide greenery (Hunter et al., 2011). Additionally, The American Association of Retired Persons (AARP) defines a liveable community as one that *"has affordable and appropriate housing, supportive community features and services, and adequate mobility options, which together facilitate personal independence and the engagement of residents in civic and social life"* (Kochera, Straight, and Guterbock, 2005, p. 60). Many older people want to remain where they live for their lifetime; therefore, neighbourhoods should include suitable facilities in public spaces, such as outdoor spaces created from natural landscapes and topography, and natural planting schemes. Additionally, streets need to be visually clear; good lighting is important for safety and accessible urban furniture should be provided in a pedestrian-friendly environment (Lee, 2007). As well as the importance of adequate design, a neighbourhood needs to provide grocery stores, green and open spaces, social activities and health services such as pharmacies within a walkable distance of residences; and should be efficiently connected to other neighbourhoods, enabling elderly residents to visit friends and family.

In terms of neighbourhood safety, elderly people are more vulnerable to abuse and crime, which may adversely affect both mental and physical health. For example, Quinn (2008) states that older people may be afraid to step outside and walk around when they perceive high levels of violence and crime in their neighbourhood.

A liveable community needs to have several mobility choices in order to allow all ages from the community to connect with each other and join in activities. Being able to commute independently helps older people to be better connected to their communities, which enhances their mental health (Panter et al., 2011). For this reason, the accessibility of public transport is vital for non-drivers aged 50 or older to connect them with relevant activities. Many older people require public transportation to be *"affordable, accessible, adaptable, available and acceptable"* (Kochera et al., 2005). In an attempt to guarantee mobility freedom for older people, an efficient public transportation network needs to deliver commuting between neighbourhoods, as well as access to daily needs such as grocery stores and other shops, leisure activities, healthcare facilities and social activities. In terms of mobility freedom, streets must be barrier-free. Neighbourhoods should not restrict or exclude the participation of elderly citizens in daily social and economic life (Beard et al., 2012).

Category 2 refers to the importance of adequately designed homes, which enable occupants to live without facing an obstacle based on their changing needs over their lifetime; furthermore, Universal Design (UD) principles, created by professionals in North Carolina State University in 1997 to be adaptable to different disciplines such as communications and urban design, highlight the need for good design of structures, products and neighbourhoods that ensure individuals can perform daily activities and routines despite functional disability (Hunter et al., 2011).

UD produces seven comprehensive principles (Story, 2001): equitability, flexibility, simple and intuitive use, perceptible information, high tolerance for error, low physical effort, size and space approach to use to make products and environments accessible; moreover, it brings older people and disabled people together and aims to deliver design solutions that are equitable and inclusive

and do not stigmatize them (Lee, 2007). UD created seven major principles for all disciplines focusing on the built environment and products to guide the design process, providing guidelines for education and evaluation of designs (Story, 2001).

The major aim of these principles is creating a notion that embraces the diversity of human nature and can be applied to all design disciplines. So older people's needs and demands can be adopted within housing design. For instance, houses need to be step-free at the front entrance or lifts should be available; a lower platform should be provided in the bathroom, and tables and stores in the kitchen should be easily moveable. UD principles are the main guidelines available for architects to design homes suitable for older people (Salmen, 2001).

Category 3 emphasises the importance of sociability and community support, both of which can be directly linked to the concept of active ageing that was developed by World Health Organisation (WHO) at the end of the 1990s. Active ageing has positive effects on physiological and physical health, helping to prevent chronic diseases, as well as increasing life satisfaction. Sociability plays a key role in maintaining psychological wellbeing and reduces emotional stress (Khosravi, Gharai & Taghavi, 2015). It is defined by Gehl (2011) as informal gathering with people in a place for activities such as eating, sitting, chatting together. When these activities are also supported by built environment features, the physical and mental health of older people can be improved and this may result in reduction of social isolation and feelings of loneliness. Additionally, sociability that is linked to physical activity such as walking also has positive effects on wellbeing (Parra et.al., 2010). Therefore, the ability to socialise easily also needs to be enhanced by urban design and environmental features in order to increase the wellbeing of older people.

To sum up the literature, the key concepts relating to the relationship between ageing and the built environment are elaborated and organised in figure 1 to provide a theoretical framework. Firstly, the essential needs or an older person are listed as keywords and categorized into themes. Health issues and environmental interactions lead us to a range of design principles, the need for adequate housing and public transportation which can be explained in terms of comfort and images of an urban environment where an elderly person can easily engage in their necessary and/or preferred outdoor activities. Social aspects of life also need to be supported by the living environment that supports older adults to engage with the wider community. As a result, we have determined four essential points as a starting point of this study. These are *sociability, accessibility, comfort & image and outdoor activities.* The structure of the framework is influenced by the diagram developed by an organisation of Project for Public Spaces which provides a diagram for people to critic a place good or bad (PPS, n.d.).

Figure 1 represents the main theoretical framework of this research which we have drawn from the literature. The keywords in the figure are also directly related to interview questions that participants were asked to give information about their daily life in the urban environment.

Sociability relates to the social and cultural activities of elderly people in their daily lives. This section questions whether or not elderly people are participating in organised group activities - for example, spending time in a social venue or gathering with friends or relatives for a group activity such as a picnic or playing a game. It also relates to the ability to access certain facilities provided by the urban environment, such as museums, cinemas or theatres and reveals the social network of older adults. Briefly, this theme is concerned with more collective activities that are performed with the person's social network and experienced within the urban environment. As explained in the literature review, social interactions are the key to the quality of life and healthy ageing.

Accessibility represents the ability to access key services such as different modes of public transport, health services and social services and green spaces, in terms of the existence of the services, their physical accessibility

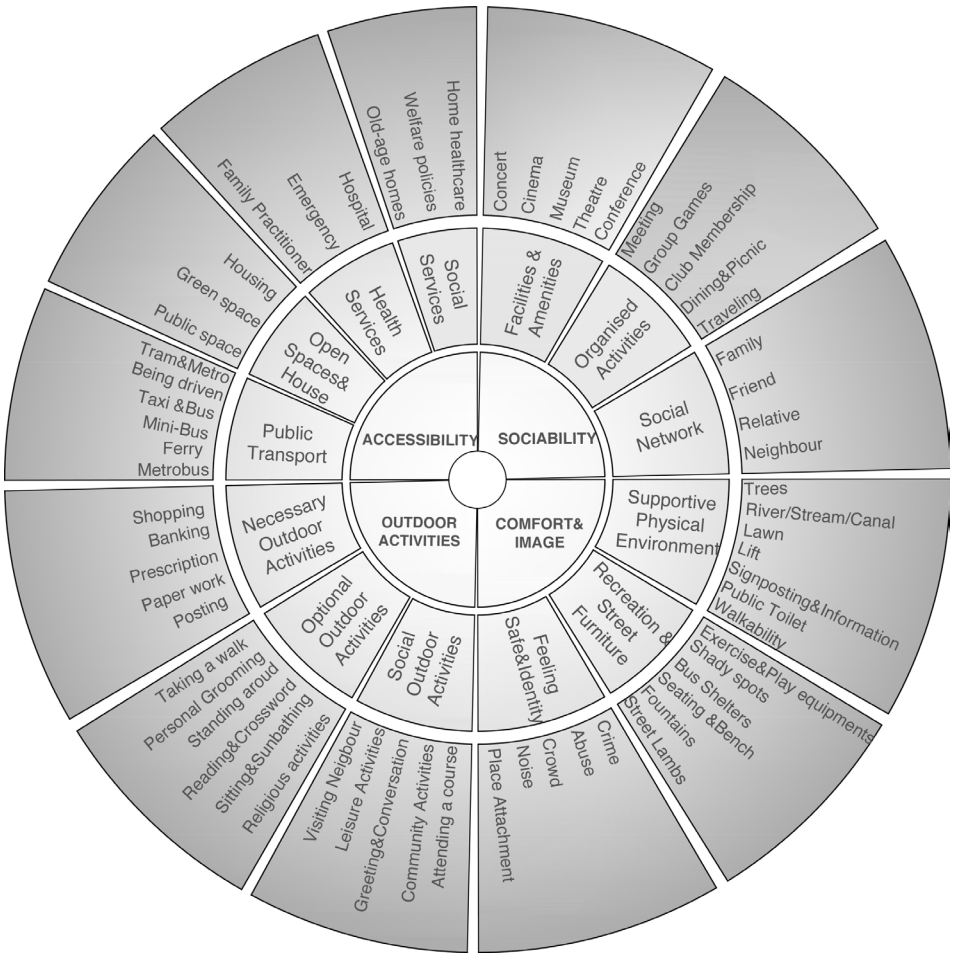

Figure 1. *Theoretical framework of the research.*

(e.g. distance from home) and their affordability. In later life, accessibility to these services is fundamental since it supports retention of mobility. This theme is an external factor that has a strong influence on an older person's life. In parallel with this, accessibility to urban needs and retaining mobility is the first step to sociability that carries individuals to venues for socialising, enhances participation and strengthens the social network. In order to complete daily activities such as shopping, religious activities, personal grooming, etc, the living environment needs to provide sufficient infrastructure such as walkability, quality open space and safety.

Comfort& Image aims to highlight neighbourhood quality to support the activities of older people. These can include the availability of green environments and facilities such as public toilets or lifts. Examples include shady spots, benches or other kinds of seating areas help elderly people to rest while having a walk and encourages them to spend more time outside of the house. Additionally, more age-focused design features such as open green parks and enhanced walkability of urban environment support active ageing. Also, since they feel more vulnerable and fragile, feeling unsafe for any reason related to the urban environment can easily affect older people's health and can lead them to isolate themselves from the urban environment and being active in outdoor activities.

Outdoor activities here is used as suggested by Gehl (2011) based on relativity to the urban environment. Necessary outdoor activities such as shopping, banking and posting can be done regardless of the quality of urban space. On the other hand, optional outdoor activities such as taking a walk, sitting & sunbathing, religious activities need to be encouraged by the design of the place to a significant degree. Usually, necessary and optional outdoor activities can be performed un-

accompanied. Social activities can also happen spontaneously in urban place; however, take place with other people; for example, greeting each other, meeting with a neighbour, attending courses. Thus, the outdoor activities section aims to reveal the daily activities of older adults in the urban environment.

3. Methodology

Istanbul, as a metropolitan city in Turkey, has been experiencing population growth as well as demographic changes since the 1960s. In 1960 the population was only 1.5 million and it reached more than 15 million by 2018 (TUIK, n.d.). According to statistics in 2018, 15 million people live in Istanbul and it is expected to increase by 16.3 million in 2023 (TUIK, n.d.). Furthermore, the number of older adults has been increasing dramatically over the last few decades. In 1990 the number of people aged 55 and above was 699,331 and it was expanded to 964,394 in 2000. In 2010 and 2018 the volume is more than a million, 1,738,203 and 2,253,713 respectively (ibid). As well as population, urbanisation in Turkey has also been increasing rapidly since the 1950s and since the 2000s local governments and national government in Turkey have been promoting age-friendliness.

In order to understand how the living environment affects the activities of older people, two neighbourhoods in Istanbul, which differ in terms of income level and life standards, were selected as research areas. Fatih and Nisantası are the oldest and most popular neighbourhoods in the city and have historically been compared and criticized by novelist, academic, popular culture etc. over a long period. There are apartments in both areas but in Fatih, many apartments do not have lifts and are really old structures so they lack of basic needs of older adults. Also, social facilities are not in walking distance. Additionally, compare to Nisantası, income level is lower. In Nisantası, there are many facilities within walking distance, life standards are higher than Fatih and housing structure is comparatively new than Fatih.

In Turkish literature, the well-known novelist Peyami Safa published a book in 1931 named 'Fatih&Harbiye', which contains a comparative analysis of Fatih and Nisantası (also known as Harbiye) districts in terms of their cultural and economic differences. The history of Fatih goes back to the Byzantine and Ottoman period (Fatih Municipality, 2018). The area is also named Golden Horn, which is the core historical area of Istanbul. Golden Horn was the capital of the Ottoman Empire, therefore the urban structure and environment were shaped by the palace, madrasah, mosques and cistern. The structure of the area has been continued to the present time: there are many educational facilities, administrative buildings and a relatively supportive urban infrastructure.

After the Tanzimat reform era, the capital was located to the Beyoglu and Tesvikiye which now forms the centre of Nisantası today. Firstly, in 1856, the palace was moved to Dolmabahce and Yildiz, at the same time, all the high level of government officers started to locate in the Nisantası (Maggönül, 2006). Beyoglu triggered Nisantası to become more westernized. In the Beyoglu, there were many stores where people can find European items being the centre of nightlife and having more cosmopolitan demography. For many years, Nisantasi was the most popular area to live in, for those people who wanted access to these Western luxuries and lifestyles. There are many stores with luxury worldwide brands, expensive cafes and restaurants, as well as apartments with high rent values. It is also easily accessible via several forms of public transport and is a key connection point for other important areas such as university campuses, schools and parks.

We decided to conduct qualitative research for this study, in order to gather more detailed information about the daily life of older adults since it is more controllable and flexible. The participant can be led by the researcher to express more of their thoughts. Additionally, the in-depth interview is a qualitative research technique that can be used with a small number of participants in order to unveil their perspective relating to a specific idea, notion or situation (Boyce & Neale, 2006). Therefore, interviews are the key data

collection method of this research that can reveal a deeper understanding of older adults' daily life. The interview questions were generated from the theoretical framework of this study (figure 1) in a semi-structured format. We selected questions that were clear and not too complicated and also should not be defined with very explicit lines, to enable the elderly participants to express their thoughts without being unduly influenced by either the questions or the interviewer. The interviews were conducted during the summer of 2019 at the participants' homes; also, some participants were approached in public spaces to have an interview. The study required participants to be willing to take part in the study, therefore participants were selected based on the researcher's social network and their connections. The interviews were recorded by an audio recorder and were transcribed in Turkish and translated into English by the researcher.

According to the World Health Organization (WHO), the common definition of an elderly person is age 65 and over and this is accepted by most developed countries. It is also subdivided into age groups, as follows; 65-74 is defined as the *Young Old*, 75-84 is *Old* and 85+ the *Oldest-Old*. Gorman (1999) indicates that although chronological time has a vital role for old age, the retirement age (which is roughly the age of 60-65 in many countries) is accepted as the beginning of the old age. Therefore, the importance of chronological time receives less attention in many countries. He adds that the other meaning of old age is linked to the decreasing ability of physical roles, which is a significant distinction between age stages. In other words, old age starts when an active contribution is no longer possible. So, this study decided to interview older people aged 70 and above.

The interview transcripts were analysed based on the thematic analysis approach. The data for each neighbourhood was organised and listed under the four headings and compared critically. Participants were anonymised and coded randomly. Afterwards, the findings were evaluated and visualised on radar charts that support and conceptualise the findings. The thirteen subheadings, defined in Figure 1, were embedded in the chart. Each of them was graded from 1-7 (1 = lots of improvement needed and no contribution to the topic; 7 = no need for improvement), based on the answers given by each participant. Radar charts deliver a visual understanding of findings for readers and help to compare research sites.

4. Results

The results are presented through linking the thematic analyses and visualisation of findings on radar charts. For each participant, a chart was used to show the level of place attachments. Figure 2 and 3 represent how participants feel about their living environment based on categories; the findings can be used to underline specific policy and planning areas for improvement. Numbers in brackets indicate the age of participants. The results for each site were divided into the four themes outlined in figure 1: sociability, accessibility, comfort & image, outdoor activities, and compared with each other.

Sociability

With regard to sociability, the differences between the two neighbourhoods can be seen in Figures 2 and 3. Participants in Fatih tend to have less connection with existing *facilities& amenities,* are not willing to be part of *organised activities.* On the other hand, participants in Nisantası (Figure 3) show greater engagement with the city, participate in activities more often, and gather together with friends, colleagues and relatives for activities such as a trip to another city.

The participants in Fatih expressed that having conservations with friends who are also their neighbours while going shopping or walking route to the desired destination is the favourite way to socialise. The majority of participants said that they do not go to the museum, theatre or concerts and they do not travel abroad or other cities of Turkey at all. Most activities are performed inside of the home, such as having guests round or knitting. The key reason stated for this is that they think going to the cinema, concert etc. are for the younger generations, not for

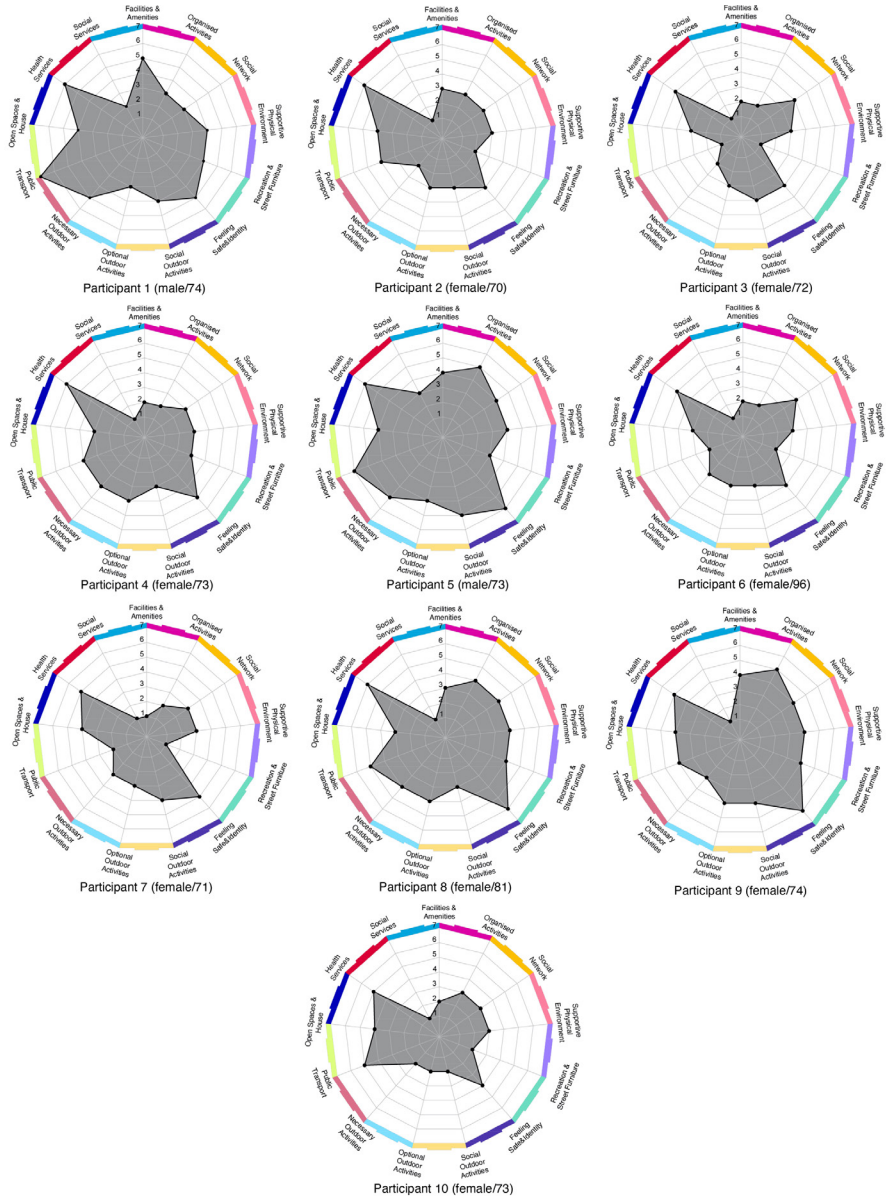

Figure 2. *Analysis of findings in Fatih district.*

older people. They enjoy having a little chat with their neighbour or a shopkeeper in the area. Although emotional attachment to the living environment is strong in both areas, the urban lifestyles are considerably different. Participant 1 (74) who retired from a bank office, in Fatih, describes his social life as *'with my friends, we see each other and talk while we are walking to somewhere we want to go, otherwise, we don't go anywhere else.'* Also, Participant 8 (81) who is a retired plumber says that *'Every day, I come and sit at the park because I need sun, read my Quran and in the evening I go to the mosque'.*

On the other hand, findings in Nisantaşı show a marked difference in lifestyles: participants spend more time with friends and socialise outside of the home. Participant 16 (90) who is a retired lecturer, in Nisantası, indicated that he spends time with his ex-work colleagues in discussing various subjects. He has many friends and relatives, whom he meets at the café and also enjoys going to the theatre, concerts and musicals with them. Participant 13 (79) and Participant 17 (85)-both have the highest level of retirement pensions, also said that that they have many friends and they often meet with them to go to the cinema

and for breakfast. Participant 12 (71) has visa and immigration consultancy office added, *'I have many shopkeeper friends on the street where I live, we see each other every day and have quick little chats'*. The interesting expression made by Participant 20 (73) was that *'I like chatting with my friend while sitting in a café. Being able to talk to each other is the best thing for our mental health.'*

Accessibility

As it can be seen in Figure 2 and Figure 3, the participants in both areas have common concerns in terms of public transport. Since public transport is free for people aged 65 and over, money is not an obstacle; however, due to some health restrictions among older people, taking a bus or underground can become a problem. Participant 4 (73) housewife with a pension, in Fatih, said that *'I could not use the tram before but now I am taking the pills I can easily take the bus but I cannot go far'*. Some challenges go beyond health issues - for example, Participant 3 (72) housewife with no income, said that her husband is so jealous that he does not let her use public transport and he gives her a ride every time. In Nisantası, participants highlighted another issue: even though there are enough public transport modes, older people prefer to take a taxi to avoid crowded places, but the problem is that the taxi drivers do not stop very often because they are waiting for tourists.

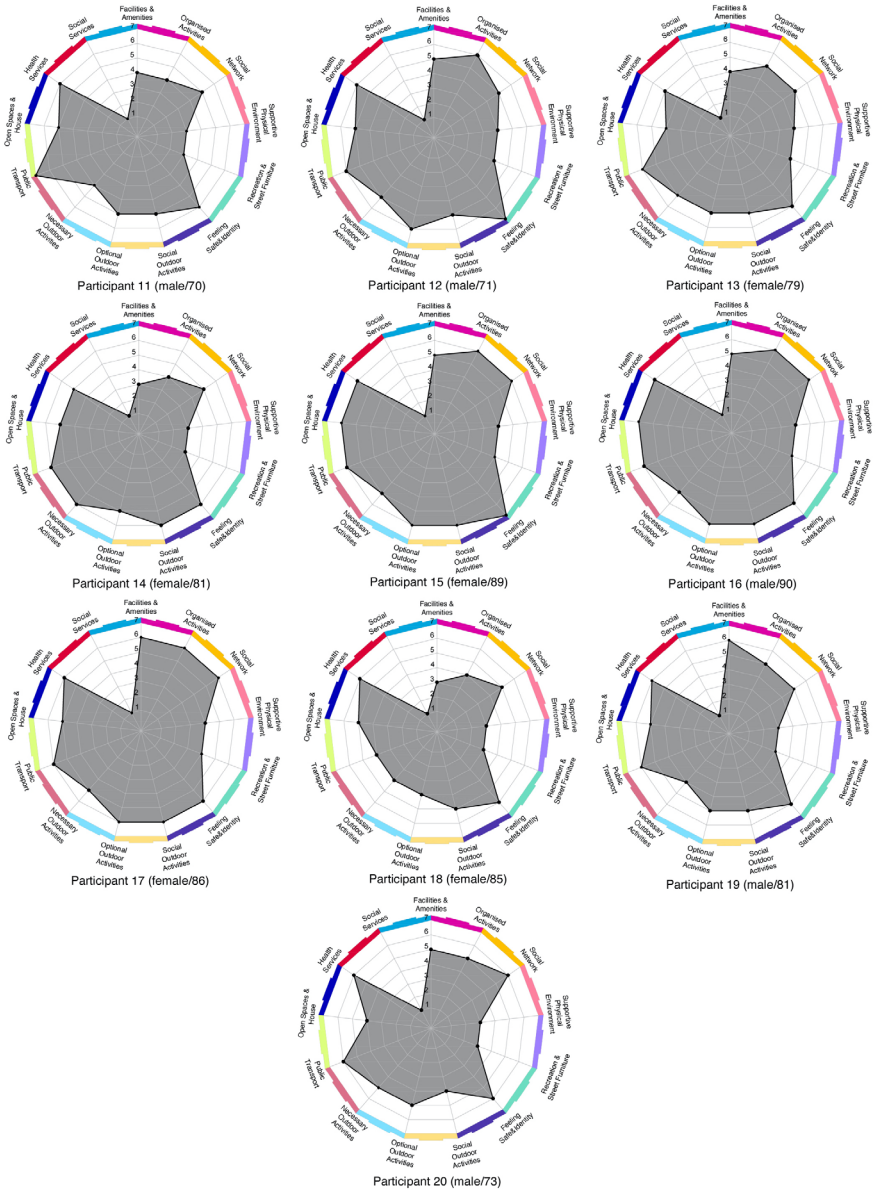

Figure 3. *Analysis of findings in Nisantası district.*

Not being able to access open green space is also a common problem. Participant 1 (74) and Participant 2 (70) housewife with no income, in Fatih, said that even though there are not enough parks, there is nothing they can do about it. Participant 6 (96) who has retirement pension and Participant 3 (72), both in Fatih, raised concerns about safety issues. Participant 3 (72) said that *'Yes there are parks around here but I have never sat there and never will. Refugees are everywhere. We are not the kind of people that sit outside, only at home.'*

The participants in Nisantası also have complaints about the lack of green open space. Although there is a park, participants expressed that it is not enough regarding to size and it is not even within walking distance of their homes. Instead of sitting in a park, they prefer to sit in a café where they are known by the other customers and staff. Participant 11 in Nisantası (70), has a hardware store, said *'the park has been abridged like abridging kite tail'*. Participant 14 (81) added that there is a park but it is not sufficient enough, and she could do nothing about it.

Housing structure in Fatih is old, and many buildings suffer from lack of daylight and no not have lifts. For example, Participant 8 (81) said, *'Every day, I leave my house early in the morning and come and sit in the park because I need sun and my flat on the ground floor doesn't have enough daylight'*. The participant also expresses that he would like to move to a new flat if he had enough income. Participant 4 (73) said that *'I am a tenant and I wish I could buy my flat, then I could live on my own, but I only receive a retirement pension which is not enough*'. Participant 7 (71) has widow's pension also moved to a flat on the first floor as there was no lift at the apartment. Participants in Fatih, therefore, show that they have adjusted their lives according to the urban environment due to the lack of adequate housing and their lower incomes. However, in Nisantası participants have access to several housing options and are usually more financially able to move to another flat if required.

In terms of accessing health services, participants in each neighbourhood highlighted that they do have easy access to the hospital or to a practitioner from where they live, therefore they are not willing to move to another neighbourhood (where access might be more difficult). Additionally, all participants expressed that they would never want to live in a care home or facility for older people. They also added that the social services provided by the local government are only for older people who are bedridden or lacking in mobility.

Comfort& Image

The main concerns raised about comfort and image are a lack of open green space, neighbourhoods not being walkable due to the height of the pavements and lack of public seating areas.

In Fatih, Participant 9 (74) who has retirement pension said, *'pavements are high but I try to adapt myself as much as possible and I try to find level areas to walk'*. Participant 6 (96) indicated that she cannot walk on the street without her walking stick and she takes a bus or taxi to the park to watch the fountains. Instead of visiting parks, many participants in both areas prefer to spend time with a friend sitting at home or in a café or restaurant. Another reason for not walking is that they cannot find a bench in the streets, only in the parks. In Nisantası, some hilly parts of the area make it difficult to walk around. Participant 16 (90) in Nisantası underlined that the heights of pavements are much too high for older people. Both areas are considered to be well-designed in terms of lightning and signposting.

All participants indicated that they are not willing to move to a different neighbourhood, or even a different home, because they have lived in their homes for a long time so they have memories associated with their own home and neighbourhood that are important to them. Participant 10 (73) in Fatih said, '*I love this place. Everybody says "hi" when they see me*'. The responses are similar in Nisantası. Participant 15 (89) retired lecturer thinks that *'Nisantası is a place where you can go everywhere anytime you want. We*

can go to the cinema, the theatre. We can go for a walk after midnight. Even if you are alone as a woman'. Participant 17 (86) also added that *'This is a nice neighbourhood. Everybody greets each other. My children live here and I do not want to move. I have spent 15 years here*'. None of the participants were driving, so traffic was only a problem in terms of noise and pollution. However, safety is perceived as an issue in Fatih. Many of the participants expressed their reluctance to visit green open spaces and cited fear of immigrants as a key reason for this. Participant 6 (96) said, *"Why would I go to the park? The world has changed and people are different. They ask me if I live alone, where I live. These are bad times. I do not trust them…If I find a store I take a rest; there is a fountain pool at Aksemsettin. I sit there and watch the pool.'*

Outdoor activities

This theme questions the daily routines of older people in the urban environment. Necessary activities such as banking, posting and picking up prescriptions are mainly handled either by participants' children or by a janitor in both neighbourhoods. In Fatih, shopping at local markets, doing daily housework and visiting neighbours are the usual activities of the day. Walking to a certain place is considered as engaging in 'sport', and they do not have any impulse to do sports for health. They do not want to attend a course and they did not specify a reason. Social activities such as going to the cinema, visiting a museum are not preferred because of personal choices; Participant 10 (73) in Fatih said, *'the sound of the cinema annoys me, and besides I do not want to go alone. If it was free, it would cause a stampede*'. Participant 8 (81) also indicated that *'I can watch everything on TV, so why I should go to the cinema? Besides, even if it is free, I would never want to go*'. In Nisantası, outdoor activities and urban life are different from Fatih. During the weekend, Participant 12 (71) spends time with his wife, goes for a drink or to the weekly fish bazaar at Beyoglu. He rides his bike for four months during the summer season and he swims. During winter he walks around the Osmanbey and Pangaltı and also visits Aghia Sophia, Sultanahmet and Topkapı Palace on Wednesdays. Participant 13 (79) attends lectures on Byzantine and Ottoman history at Istanbul University as a visitor. Participant 15 (89) is an active member of the university foundation. She is happy to go to the theatre if she can find a seat. Participant 16 (90) is a retired lecturer but still gives lectures on Tuesdays and Fridays until midday as an emeritus professor at the universities. Participant 17 (86) likes reading, watching movies and always looks out for new movies at the cinema. She also makes handicrafts to help raise money for educational scholarships.

5. Discussion

Active ageing is simply defined as people remaining where they are as they age (Davey et.al., 2004; Lecovich, 2014). Life satisfaction, active engagement and positive adaptation are the key components of healthy ageing (Phelan & Larson, 2002). On the other hand, Dowd (1980) highlighted that social participation and involvement in leisure activities is shaped by personal interests and that social activities are strongly influenced by the length of formal education the person has received and their field of occupation (Antonucci, Ajrouch & Birditt, 2006). Moreover, the level of income also affects the degree of active living and engagement with the urban environment. Ceylan, Kurtkapan and Turan (2015) indicate that due to receiving low increases in their retirement pensions, older people are facing more economic problems and therefore their living conditions are being negatively impacted. When older people have a high enough income level to provide for basic needs such as housing, mobility and healthcare, life satisfaction increases and their level of social engagement grows stronger (Ilgar, 2008) because depending on relatives or friends, either practically and/or economically, creates psychological pressure on older people that can trigger feelings of isolation (Onur, 2007). Poverty not only restricts people economically, but it also makes them more likely to feel apart from society (Kalınkara, 2016). Therefore economic conditions are also an essential factor for elderly people in terms of active living and engagement with the urban environment.

In this study, four essential aspects of living environment - sociability, accessibility, comfort & image, outdoor activities were analysed in order to reveal connections between the daily lives of older adults and living urban environment. These were examined in two neighbourhoods differing from each other in the type of urban environment and the educational background and living standards (especially income level) of their older residents.

Beginning with sociability: in Fatih, when it comes to the social perspective of older residents, although the urban structure provides facilities and amenities, the core social activities practised by older people consist of gathering together at home, or having conservations with friends while walking to a local place or visiting local bazaars. Their social networks mainly consist of neighbours as the people we interviewed did not have many relatives left and they do not leave the neighbourhood often. Therefore, social activities and group activities are reduced to taking place within their usual living environment. In contrast, the participants we interviewed in Nisantası have strong relationships with friends from their previous work and (for women) people whom they met through their husbands, rather than their direct neighbours and relatives. They generally choose to spend time together in different venues rather than meeting at home. Cinema, theatre and travelling as a group are the main activities mentioned. They often book travel tickets online and travel to other cities.

Having a more active social life also requires being able to travel around, which should be supported by the accessibility of the physical urban environment. Since travelling and mobility are important determinants of quality of life for elderly people (Banister & Bowling, 2004), the urban environment should deliver adequate public transport and multiple travelling modes. In both neighbourhoods in our study, public transport is frequently used by elderly people, however, findings in Fatih underlined that mobility can also be restricted by health problems or even jealous husbands. Therefore, as there is a strong relationship between the social and cultural participation of elderly people and urban environment (Richard et al., 2009), the immediate living environment needs to encourage walkability to basic facilities such as restaurants, corner shops, cafés and parks. Participants in Fatih underlined how they feel relaxed and happy while having a walk with their friends and consider this activity as the best thing for supporting their mental health. But they also added that being able to use public transport as they desire would enable them to connect to the city.

Adequate design of the housing is also an essential factor in the wellbeing of elderly people. Size, heating/cooling, insulation, availability of lifts in buildings and access to sunlight are some of the essential influences in the quality of the home environment for elderly people. Lack of appropriate (and affordable) housing stock for all income groups of elderly people can affect their health negatively (Howden-Chapman et al., 1999). Moreover, ageing in place can take place successfully in an urban environment where adequate housing and health care facilities are provided (Wiles et.al., 2011). In both neighbourhoods, participants pointed out that they have easy access to health care facilities in their neighbourhood but some participants would prefer to move to another step-free home in the same neighbourhood where they could receive more sunlight. As we mentioned earlier, the housing typology in Fatih mainly consists of old, detached properties and apartments with no lifts. Although participants are not willing to leave their neighbourhood, if they could afford to rent or buy a new place, they would want to live in a better standard home. It appears that due to receiving low rates of increase in of retirement pensions, elderly people are facing economic problems and therefore their living conditions are negatively affected (Ceylan, Kurtkapan, & Turan, 2015).

While housing, public transport, health services and social facilities are considered to be essential infrastructure capacities that should be provided within each neighbourhood. However other kinds of services and environmental conditions such as the

provision of street furniture such as benches, street lighting, public toilets, and levels of traffic and noise can also directly impact on the quality of life of elderly people (Phillips et al., 2005). In both neighbourhoods, participants commented that when they feel tired of walking they sit on a chair in a café or restaurant because there are no benches on the street. In rare instances where public benches are provided on the street, they are appreciated by elderly people. For example, in Fatih, Participant 4 (73) enjoys sitting on the bench right in front of her apartment, chatting with neighbours and she believes it is better than being in a park.

Since Fatih and Nisantası are central districts in Istanbul, it was unsurprising that participants were all aware of high levels of traffic congestion and noise. However instead of raising objections to this problem, they tolerate it, for example, Participant 1 (74) said, 'if you live in the centre of the city, you have to accept this situation'. They also consider that they are unable to do anything about the lack of green parks. Moreover, some participants in Fatih highlighted their fear of crime in parks due to the presence of immigrants and refugees. Some of the people we interviewed said that they did not want to visit parks because there are many immigrants and they do not feel safe. So isolation and exclusion of elderly people can also be triggered by fear of crime or abuse because they feel restricted to leave their homes (Scharf et al., 2003). Therefore, the safety of neighbourhoods needs to be considered as an inseparable factor from the state of the urban physical infrastructure (Pain, 2000).

There are some limitations to this study. First of all, interviews were conducted during the summertime, so this study does not specifically refer to the effects of adverse weather conditions such as cold, snow or rain that are likely to have a significant influence on daily life routines during the winter months. Additionally, none of the participants were disabled or had a severe limitation in their mobility; therefore there are no findings relating to the experiences of disabled persons within different urban environments.

This paper contributes to existing research through delivering evidence about the different levels of engagement with the city, showing that outdoor activities of older adults can vary based the nature of the urban environment and income level because it increases life satisfaction among elderly significantly (Aquino et.al., 1996). This paper suggests that improving urban environment in poorer neighbourhoods and supporting needs of older adults, would help enhancing the well-being and health of elderly people and also encourage them to get out more and socialise. Because findings in Fatih underlined that they spend more time walking in the streets rather than visiting social venues.

Although this paper focuses on the impacts of the urban environment on elderly people, findings also revealed another perspective. Cultural differences may also influence the daily life routine of elderly people. Because understanding and experiencing the living environment and the level of life satisfaction are influenced by individuals' background and experiences (Marans & Rodgers, 1975). Therefore, getting involved in new kinds of activities and exploring new places may not be an option for an elderly person. Therefore, old habits tend to remain the same, and older people continue to live in the same neighbourhood even if the urban infrastructure is not supportive of their physical needs.

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Hierarchical multiple regression modelling on predictors of neighbourhood satisfaction in violence-induced segregated urban environments

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Abstract
Violence-induced segregated urban environments (VISUE) are quite unique urban centres for their characteristic of neighbourhood sharing among residents before the resultant parting triggered by violence. Yet, not much is known about the neighbourhood satisfaction of inhabitants in this type of urban setting. Such knowledge can provide hints on the factors to be prioritized in planning for improvement of neighbourhood satisfaction of residents in these cities. This paper thus examines the key predictors of neighbourhood satisfaction in a VISUE. Household heads (n = 289), cutting across the three identifiable types of neighbourhoods in Jos, Nigeria, expressed their level of satisfaction on a 71-item self-administered structured survey instrument. The principal component analysis with varimax rotation option explored 10 factors to represent the examined attributes of the neighbourhood environment. The third (final) in the sequence of hierarchical regression models estimated, indicates that none of the socio-economic and demographic attributes and dwelling attributes is significant in predicting neighbourhood satisfaction in VISUE. Three factors: neighbourhood safety and stability, social relationships, and neighbourhood facilities and services, emerge as the key predictors of neighbourhood satisfaction. On the basis of these findings, these three attributes are required to be given precedence in any policy action aiming to improve residents' satisfaction with their neighbourhoods in VISUE.

Keywords
Hierarchical regression models, Jos, Neighbourhood satisfaction, Predictors, VISUE (violence-induced segregated urban environment).

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1. Introduction

As a place where people's homes are situated and much of the off-work time is expended, satisfaction with the residential neighbourhood has been empirically established to occupy a central place in a person's overall life satisfaction (Batson and Monnat, 2013; Youssoufi and Feltete, 2013). This perhaps is why many researchers have explored the determinants of neighbourhood satisfaction in varying environmental contexts. Boeckermann et al. (2017) notes that despite the fact that several researchers have reported associations between neighbourhood satisfaction and some social and physical attributes, gaps still exist in determining which specific or a category of attributes is stronger in predicting neighbourhood satisfaction than the others. Dassopollous and Monat (2011) in an earlier study had similarly called for further studies to determine which factors of the physical and social environment are more central to neighbourhood satisfaction. They argue that findings of such researches can facilitate focused intervention to address the most fundamental attribute that affects neighbourhood satisfaction which may impact such issues as overall wellbeing, psychological health and residential stability. Predictors of the subject in violence-induced segregated urban environment (VISUE), appear yet to be properly defined in this unique urban setting where, as a result of violence, people who previously shared common neighbourhoods and socio-cultural atmosphere, later regrouped into separate enclaves along ethnic, religious or ethnoreligious divides within the same city,

Jos city in Nigeria was well known for peaceful co-existence among her vast ethnoreligious groups numbered over 50 (Ostien, 2009) especially when compared with other urban centres within the northern zone of the nation. It was however bedevilled with series of urban violence with the maximum intensity recorded between 2001 and 2010 (Krause, 2011) leading to a complete alteration of the neighbourhood arrangement of the city with different ethnoreligious group subsequently occupying different sections of the city (Aliyu et al., 2015; Higazi, 2011). There is therefore the need to understand the attributes of the neighbourhood that determine residents' satisfaction in their new residential environment.

Neighbourhood satisfaction is mainly driven by the attributes of the physical and social environment (Hur and Morrow-Jones, 2008; Ibem et al., 2017; Oshio and Urakawa, 2012), neighbourhood facilities and socio-economic and demographic factors (Basolo and Strong, 2002; Ibem, et al., 2017; Lee et al., 2016; Sirgy and Cornwell, 2002). This is why Francescato et al. (2002) describes the subject as a multi-dimensional construct with multiple attributes, making different researchers and scholars to be interested in different aspect of this phenomenon. Parkes et al. (2002) holds that despite the high level of significance attached to the need to understand the attributes that most predict neighbourhood satisfaction by the policy makers, it is not an easy question to answer because satisfaction researches vary greatly in data sources and analysis' techniques. Baum et al. (2010) however notes that the central theme in the discussion of the topic by the contemporary researchers is subjective assessment of who is satisfied and who is not with the neighbourhood, even though some explain the causal relationship within the demographic variables, dwelling and physical neighbourhood attributes. The objective of this study is to therefore define the key predictors of neighbourhood satisfaction in VISUE as established through subjective perception of the residents of Jos.

2. Theoretical background

Cities are known for attracting people as a result of their potentiality for economic prosperity, education, access to good housing, facilities and services as well as enhancement of social contacts. This often results into the development of multiethnic or pluralistic ethnoreligious cities which are found across the various regions of the world even though there are variations in the background history of such cities. Relationships among residents in most of these cities in the contemporary world are however fragile and as such inhab-

itants often experience different forms of challenges that emanate from the complexities created by the ethnic or ethnoreligious and/or socio-cultural mix of the inhabitants. One of the common challenges that has been identified with these cities by scholars, is urban violence or social conflict (Hur et al., 2015; Kasara, 2015; Rakodi, 2012). According to Bhavnani et al. (2014), recent reports of outbreak of violence across many of these multicultural cities in different parts of the globe is an open testimony to the fragility of the relationships among resident groups in the cities. De Vita et al. (2016) also observes that modern cities are faced with the challenge of social conflict as a result of the presence of different groups divided by cultural, religious or ethnic issues. There is therefore increasing concern with pervasive everyday violence in many cities worldwide (Moser and Horn, 2011; Pieterse, 2010; Rodgers, 2010). Infact, Bosker and De Ree (2014) submit in their research report that ethnically divided countries are potential homes for civil conflicts. This possibly was why Asiyanbola (2010) opines that ethnicity as a mobilizing agent, is among the most important questions of this century as conflicts linked to ethnicity have led to significant loss of life and injuries in many urban centres.

A major resultant consequence of the violence in recent times, is neighbourhood segregation along ethnic, religious or ethno-religious divides (Gambo and Omirin, 2012). Since 1960s according to Corvalan and Vargas (2015), a significant proportion of intra-state urban violence involves different ethnic, religious or ethno-religious groups. In Belfast, the capital city of Northern Ireland for example, urban violence resulted into a clear residential neighbourhood segregation where neighbourhoods in the eastern section of the city are almost exclusively occupied by the Protestants while those of the western part are hugely inhabited by the Catholics. This according to Mac Ginty (2001), prevents the two religious groups from further conflicts and thereby restricting the conflict to the shared districts in the northern part of the city. A situation described as two communities living together but not living with one another. Segregation largely increased to the extent that at a point, up to 50% of the residents lived in areas where members of their religious group constitute at least 90% (Bhavnani et al., 2014). Social contact became highly minimized and segregation reflected in other aspects of the urban life including schooling, shopping and recreation. Infact, segregation became obvious that it was recognized and institutionalized by the town planning authorities as partitions were erected between the contending rivals and neutral zones such as freeway and parks were created (Kasara, 2015). Housing allocations in a particular district was also exclusively reserved to the dominant group of the area in order to minimize social contact. In essence, segregation of residents along residential neighbourhood lines was well accepted as a very effective measure for minimizing urban violence.

There have also been several cases of both intra and inter-ethnoreligious violence in many Nigerian cities and more intensively in the northern part of the country. These violence often result into segregation of the cities or deepening the existing ones that were created during the colonial administration (Muhammad et al., 2015). In a case in 1999 for example, urban violence ensued between the native Hausa in Kano (a northern city) and the Yoruba (a major immigrant ethnic group from the southern part of the country). The violence eventually transmitted into a full scale conflict between the Muslims and the Christians (Human Right Watch, 2005) thereby increasing the initial segregation pattern which mostly restricted the Yoruba to a section of the city.

Jos, a city in the North-central geo-political zone (middle-belt) of Nigeria and the study area for this research, is a highly cosmopolitan city due to its central location and history of tin mining which became a pull factor to citizens from all parts of the country either as labourers or traders in the mining industry (Dung-Gwom and Rikko, 2009). The city experienced a long period of peaceful co-existence among all ethnic and religious groups

but was sadly engulfed in series of violent urban conflicts all through the first decade in the 21st century (Higazi, 2011; HRW, 2001); the first of which occurred from 7th - 12th September, 2001. The violence event was very famous because of its coincidence with the September 11 attack in the US (HRW, 2001). There was re-occurrence of the crisis in other times such as 2002, 2004, 2008 and 2010 apart from the silent killing spree and intermittent uprisings all along between the periods. This eventually resulted in neighbourhood segregation of the city along ethno-religious divides (Higazi, 2011; Krause, 2011; Magaji, 2008). This created neighbourhoods that are homogenously Muslims or Christians with few others retaining their original mixed nature.

Despite the above theoretical and empirical facts that some world cities including Nigeria and Jos to be specific, are segregated along residential neighbourhoods on the basis of urban violence, it appears scholarship research has not been much focused on the aftermath events of such segregation. One of such areas noted to be very important and calls for concern because of its contributions to the wellbeing, quality of life and overall life satisfaction (Campbell et al., 1976; Misun and Hazel, 2008; Oktay and Marans, 2011; Porio, 2015) but is given less attention by the previous researchers, are studies evaluating the neighbourhood satisfaction of residents in these violence-induced segregated cities. In these cities, residents had earlier lived together, shared common neighbourhoods and the same socio-cultural environment but all of a sudden and usually within a short period, fall apart and live in separate neighbourhoods that are homogenously bound by common characteristics usually ethnicity or religion (Aliyu et al., 2012; De Vita et al., 2016; Gambo and Omirin, 2012). There is therefore the need for an investigation of the neighbourhood satisfaction of residents of such cities. The interest of this research is to therefore as a result of these observations and reports, examine this missing gap in neighbourhood studies using violence-induced segregated Jos city in Nigeria as the study area.

3. The study area

This study examines Jos, the Nigeria's most cosmopolitan urban centre. It is a well-known city that was ridden off her long period of peaceful co-existence among the various ethnoreligious groups due to series of large scale urban violence beginning from the turn of the century in 2001. As indicated in Figure 1, the violence eventually resulted into social segregation, leading to occupation of separate neighbourhoods by the two main ethnoreligious groups (Krause, 2011; Ostien, 2009).

Situations in the city presents a unique urban scenario similar to the case of Belfast in Northern Ireland, where the two groups live together but not with each other. This makes it to be much suitable for studying neighbourhood satisfaction in VISUE. Unlike previous relevant studies that examined neighbourhood satisfaction of different racial or socio-economic groups, this study involves residents who have once shared the same neighbourhood environment before parting along ethnoreligious divides as a result of violence.

4. Data and methods

The approach and procedure employed for collecting and handling the data used for the study are highlighted in this section. The preliminary analysis conducted towards reliability and validity of the findings of the research are equally explained.

4.1. Research approach

A deductive approach is employed for the examination of the issue of concern. Hence, the independent variables used in measuring the neighbourhood satisfaction (the dependent variable) were largely derived from the existing literature on satisfaction in varying environmental contexts. The choice was informed by the need to ensure the reliability and generalizability of the findings. On that premise, we employ three key parameters: neighbourhood physical environment attributes (NPEA), neighbourhood social environment attributes (NSEA) and neighbourhood facilities and public utilities (NFPU) as the main variables for the examination. Meanwhile, in or-

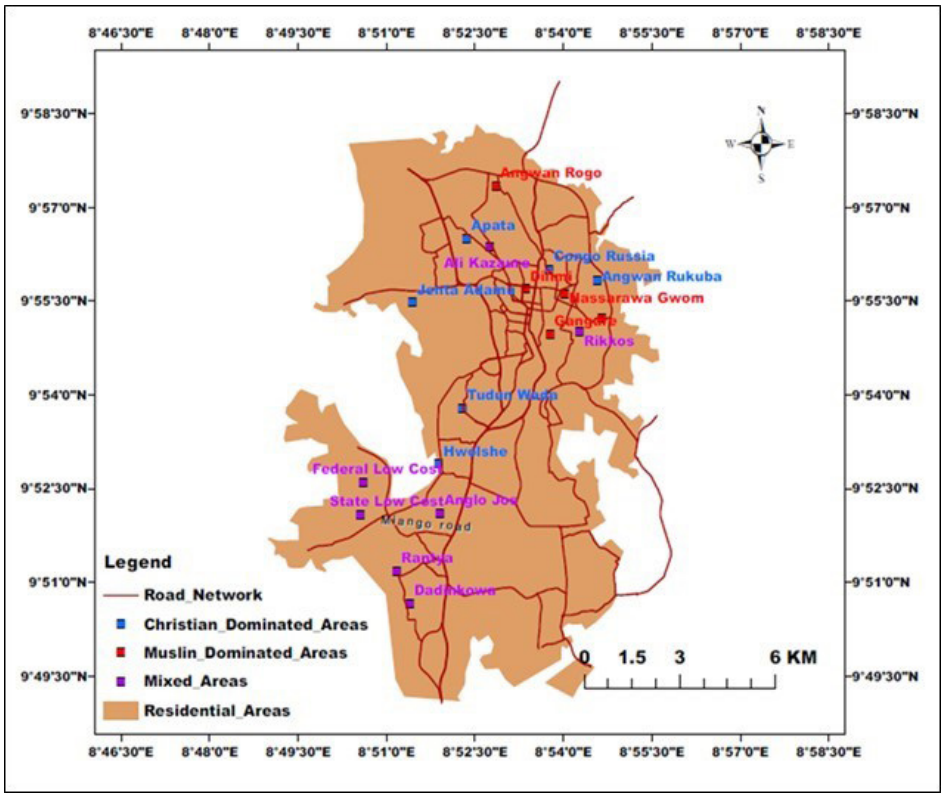

Figure 1. *Location of the three types of neighbourhood in the residential area of Jos.*

der to prevent reporting of superfluous findings, two blocks of variables were controlled for as extraneous variables. First, is the socioeconomic and demographic attributes (SEDA) of the respondents, considering that they have been reported to wholly or partly impact on neighbourhood satisfaction derived by residents in some previous studies (Ibem et al., 2017; Parkes et al., 2002; Sirgy and Cornwell, 2002); and second, some dwelling attributes (DA) which might influence the satisfaction level expressed by the residents for their neighbourhoods.

4.2. Data sources

This study relies on the data collected through a survey based on self-administered questionnaire that was conducted in Jos from February to July, 2018. Selection of the samples which aimed to generate ethnoreligious representation, was based on the three distinctive types of residential neighbourhoods (Figure 1) that developed due to the violence as identified by Krause (2011). Based on the table of sample size determination of Krejice and Morgan (1970) cited in Davoudi and Allahyari (2013), a sample size of 384 was required for administration in the study area with a population of 115,142 households, at 95% confidence level (CL) and 5% error margin. We however increased the required sample by 25% considering the experience of inadequate completion reported in previous studies like Ibem and Aduwo, 2013; hence, 480 questionnaires were administered. A total of 454 (94.6%) of the total questionnaires administered were successfully retrieved from the respondents. However, only 289 (63.7%) of this were meaningfully analysable. The remaining were observed not to be adequately completed by the right household heads or completed with less concern for its research essence. This response rate was a bit low compared to the desire of the researcher; nonetheless, it is well above 52.7% average obtained by Baruch and Holtom (2008) in their analysis of 490 researches that employed survey questionnaires in collecting data from individuals. Most importantly however, the potential source of bias which would have been over/underrepresentation of some ethnic groups, were considered immaterial to our results since all the three ethnoreligious segments of the city were adequately represented within the valid samples as contained in Table 1.

Table 1. *Sampling frame for the study.*

Type of neighbourhood	Number of households	Sampled household	Returned questionnaires	Questionnaires valid for analysis
Muslims	37767	187	182	116
Christians	45135	158	144	84
Mixed	32240	135	128	89
Total	115142	480	454	289

The participants responded to 71 questions subdivided into 4 sections. The first section consists of the main independent variables that are used for the examination of the research problem while the next two sections are made up the attributes that are controlled for in the study. In each of the questions, respondents were required to express their level of neighbourhood satisfaction with a given attribute on a Likert scale of 1-5, where '1' = strongly not satisfied, '2' = not satisfied, '3' = fairly satisfied, '4' = satisfied, and '5' = strongly satisfied. As similarly obtained in previous studies (Lee et al., 2016; Mouratidis, 2017; Wu et al., 2018), the last section consists of only one question which is the dependent variable. The respondents were asked to, in consideration of whether the current neighbourhood fulfils their broad neighbourhood desires or not, rate their overall satisfaction level with the neighbourhood, using a similar scale to the above.

4.3. Procedure of data analysis

The version 23 of the SPSS statistics for Windows was employed for the analysis. The data was subjected to normality test using both skewness and kurtosis, as a prerequisite for the parametric tests that were conducted. All the items in both the dependent and independent variables were found to be within ±2 recommended by Field, 2013; Galvatta, and Wallnau, 2014. Aside the description of the respondents, two main analyses, exploratory factor analysis (EFA) and hierarchical regression analysis (HRA) were conducted. Each of these was however initially examined against the background analyses of its basic assumptions. The EFA was used to extract the composite factors, thereby reducing the number of the main independent variables to a manageable number of uncorrelated factors using principal component analysis with varimax rotation method. The HRA was run to explore the predictors of neighbourhood satisfaction as subjectively perceived by the residents in a VISUE.

5. Results and discussions

The results of the profile of the respondents, the EFA and HRA are analysed and discussed in this section of the survey report.

5.1. Respondents of the survey

70.6% of the respondents of our survey are males while 29.4% are females (Table 2). Most of them, 72.6% are within the active age of 31-60 years. Those below 31 years make up 12.3% while others who are above 60 years make up 15.1% of the total respondents. This reflects on the marital status with 79.2% married and about 87% having children below 18 years. The result equally shows that about 69% have degree or higher certificates. This is below what was obtained in other neighbourhood satisfaction studies in Nigeria such as Ibem et al. (2017b) who had 95.6% of their respondents in this category. The difference is believed to be due to differences in neighbourhood contexts as they conducted their study in formal public housing neighbourhoods while this study surveyed household heads across open neighbourhoods.

On the basis of the nation's minimum wage which is ₦18,000.00, 51.3% of the respondents are low income earners while 38.6% fall in the middle income group with only about 10.1% in the high income cadre. The large proportion of the respondents of our survey, 42.7% who are employed by the private sector suggests a reason for the seeming disparity between the level of education and income groups because the bye-law on minimum wage is weakly implemented on the private employers in the country. A slightly above 50% of the respondents

Table 2. *Socio-demographic attributes of the respondents (n = 289).*

Attribute	Variable	%	Cumulative %
Gender	Male	70.6	70.6
	Female	29.4	**100.0**
Age (Years)	18-30	12.3	12.3
	31-45	50.4	62.7
	46-60	22.2	84.9
	61+	15.1	**100.0**
Marital status	Never married	6.4	6.4
	Married	79.2	85.6
	Divorced	7.4	93.0
	Widow	7.0	**100.0**
Highest education	1st degree & above	69.3	69.3
	Secondary	15.4	84.7
	Others	14.2	98.9
	None	1.1	**100.0**
Employment	Public sector employed	48.4	48.4
	Private sector employed	42.7	91.1
	Unemployed	8.9	**100.0**
Income level (₦)	Low (40,000 & below)	51.3	51.3
	Medium (40,001-120,000	38.6	89.9
	Upper (120,001 & above)	10.1	**100.0**
Housing tenure	Owner-occupier	50.9	50.9
	Renters	42.3	93.2
	Others	6.8	**100.0**
	7 & above	21.3	21.3
	5-6	28.4	49.7
Children < 18 in	3-4	16.0	65.7
household	1-2	21.2	86.9
	None	13.1	**100.0**
	Hausa	39.4	39.4
Ethnic group			
	Natives	28.7	68.1
	Yoruba	13.5	81.6
	Igbo	10.4	92.0
	Others	8.0	**100.0**
Religion	Muslims	54.7	54.7
	Christians	40.1	94.8
	Others	3.5	98.3
	None	1.7	**100.0**

*$1 = ₦359 as at May, 2018

own their houses while about 42% are renters with 6.8% having other forms of tenureship. The large percentage of renters is believed to reflect the consequence of the recent segregation of the city where many residents relocate to new neighbourhoods.

The Hausa ethnic group is dominant in the survey representing 39.4% while the natives constitutes 27.2%. The other two groups, Yoruba and Igbo are respectively made up of 14.5% and 10.4% of the respondents while other minority groups constitute 8.0%. The respondents are largely Muslims, (54.7%) while the Christians make up 40.1%. Other religions constitute 3.5% while 1.7% practices none.

5.2. Composite factors of neighbourhood satisfaction

EFA was conducted to identify fewer factors that can be used to explain the overall neighbourhood satisfaction from the list of neighbourhood attributes responded to by the participants. Suitability of the data for EFA was properly examined before main analysis. A sizable number of the correlations between the dependent and independent, and among the independent variables, were 0.3 and above, implying a good strength of internal relationships among them \as subscribed to by Pallant, 2011. Aside, Kaiser-Meyer Olkin (KMO) and Bartlett test of sphericity (BTS) were examined. The data were suitable with KMO value indicating sampling adequacy of 0.843 and the BTS revealing an approximate chi-square value of 3869.183 which was significant at 0.000 at 95% confidence level. This falls within the acceptable range (Pallant, 2011; Tabachnick and Fidell, 2013).

Having ensured that the data was considerably suitable for the analysis, the main EFA was conducted. Meanwhile, in line with the suggestion of Yong and Pearce (2013), nine of the variables were deleted in the process of the analysis either for reasons of appearing as complex variables or indicating non-significant loadings. The scree plot diagram (Figure 2) was considered in selecting the number of factors. As contained in Table 3, the analysis yielded exploration of ten factors with eigenvalues of 1 and above. The ten factors explained 60.13% of the total variance explained across the 41 variables. Only variables with factor loadings above 0.5 were selected. Similar loadings were adopted by Hadavi and Kaplan (2016).

The ten principal component factors extracted with the factor loadings, eigenvalue, and the percentage of variance explained by each of the principal components are contained in Table 3. The principal component 1 is 'neighbourhood safety and stability' with eigenvalue of 7.963 and it explains

19.422% of the total variance explained. It comprises of seven sub-factors: safety from inter-ethnoreligious violence (0.753), safety of lives and properties (0.684), level of peace within the neighbourhood (0.678), overall stability of the neighbourhood (0.662), ethnic composition of the residents in the neighbourhood (0.627), contact with members of other ethnoreligious groups (0.615) and liveliness of the neighbourhood (0.611). The second principal component which is tagged 'social relationships', also loaded with seven sub-factors having eigenvalue of 3.398, and explains 8.589% of the total variance with level of co-operation among members of the neighbourhood having the highest loading (0.638). Others are participation in social organization activities (0.629), proximity to family and relatives (0.608), contact with members of ethnoreligious group (0.597), interaction among members of neighbourhood (0.588), trust among members of neighbourhood (0.572) and contact with friends (0.568).

The third factor named 'public facilities and services' has an eigenvalue of 2.631 and explains 6.916% of the variance explained. It consists of five sub-factors which include access to public schools (0.705), access to police station (0.644), access to public library (0.610), power supply (0.554) and water supply in the neighbourhood (0.507). Noise and recreation which is the fourth factor is made up of three sub-factors: level of noise in the neighbourhood (0.689), access to recreational facilities (0.651) and access to public toilet (0.584). It has an eigenvalue of 1.878 and explains 5.481 of the total variance. The fifth called housing and aesthetics factor also loaded with three sub-factors, with an eigenvalue of 1.688 and explains 4.418% of the variance. The three factors are density of housing in the neighbourhood (0.592), physical condition of houses in the surrounding (0.513) and aesthetic appearance of the environment (0.485).

Transport and financial institutions is the sixth principal with two sub-factors: access to bus/car station (0.767) and access to bank and other financial institutions (0.753). The factor explains 3.638% of the total variance and has an eigenvalue of 1.491. The next, which is the seventh relates to the environment and is named environmental sanitation with eigenvalue of 1.336 and 3.558% variance explanation. It is made up of solid waste collection (0.664), illumination of the neighbourhood at night (0.585) and availability of open spaces (0.507). The eighth component named distance to places has two sub-factors

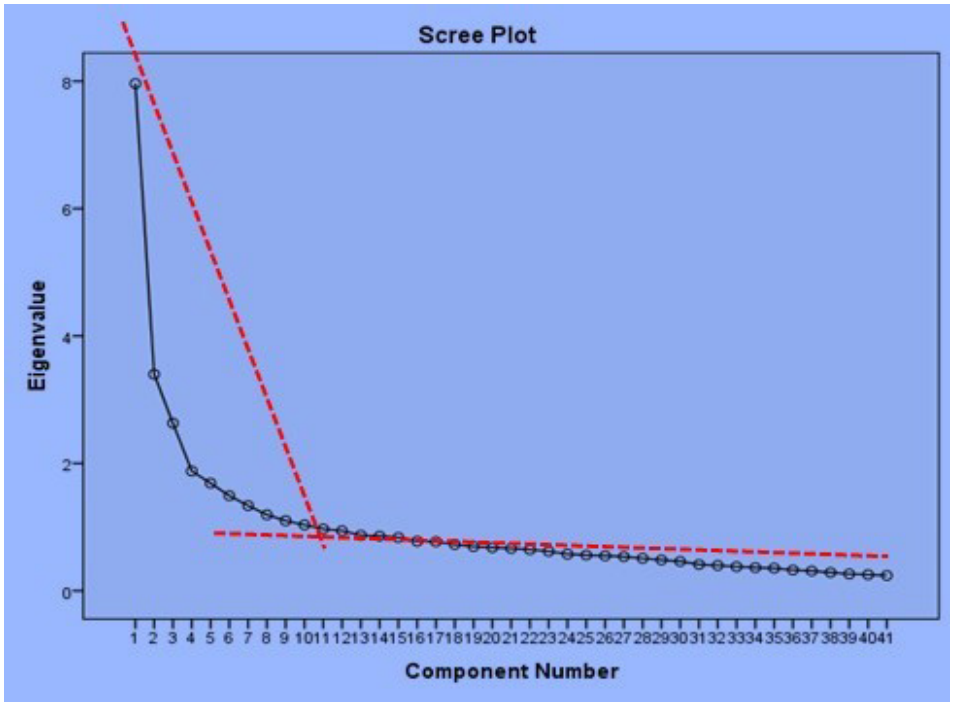

Figure 2. *Scree plot diagram indicating ten component factors.*

Table 3. *Factor analysis of responses to satisfaction with neighbourhood environment.*

Attribute	Variable	%	Cumulative %
Gender	Male	70.6	70.6
	Female	29.4	**100.0**
Age (Years)	18-30	12.3	12.3
	31-45	50.4	62.7
	46-60	22.2	84.9
	61+	15.1	**100.0**
Marital status	Never married	6.4	6.4
	Married	79.2	85.6
	Divorced	7.4	93.0
	Widow	7.0	**100.0**
Highest education	1st degree & above	69.3	69.3
	Secondary	15.4	84.7
	Others	14.2	98.9
	None	1.1	**100.0**
Employment	Public sector employed	48.4	48.4
	Private sector employed	42.7	91.1
	Unemployed	8.9	**100.0**
Income level (₦)	Low (40,000 & below)	51.3	51.3
	Medium (40,001-120,000	38.6	89.9
	Upper (120,001 & above)	10.1	**100.0**
Housing tenure	Owner-occupier	50.9	50.9
	Renters	42.3	93.2
	Others	6.8	**100.0**
	7 & above	21.3	21.3
	5-6	28.4	49.7
Children < 18 in	3-4	16.0	65.7
household	1-2	21.2	86.9
	None	13.1	**100.0**
	Hausa	39.4	39.4
Ethnic group			
	Natives	28.7	68.1
	Yoruba	13.5	81.6
	Igbo	10.4	92.0
	Others	8.0	**100.0**
Religion	Muslims	54.7	54.7
	Christians	40.1	94.8
	Others	3.5	98.3
	None	1.7	**100.0**

*$1 = ₦359 as at May, 2018

and explains 2.908% of the variance with an eigenvalue of 1.192. It has factor loadings of 0.766 and 0.729 respectively for distance to work place and distance to city centre. In the ninth factor, parking and circulation, two sub-factors are loaded, has an eigenvalue of 1.100 and explains 2.682% of the total variance. The two factors are access to parking facilities (0.586) and road network (0.553). The last factor has an eigenvalue of 1.034 and explains 2.521% of the total variance explained by the 41 items. It has two sub-factors, condition of access roads (0.781) and traffic congestion in the neighbourhood (0.587) and is referred to as traffic, as contained in Table 3.

5.3. Hierarchical models: Predictors of neighbourhood satisfaction in VISUE

The data was at first examined for non-violation of basic assumptions of multiple regressions. A minimum sample size of five observations to one independent variable (Hair et al., 2013) was adopted. Hence, a minimum of 150 samples was required for the analysis; 5 observations by 30 variables (12 SEDA, 8 DA, and 10 factors explored through EFA). This is far lower than 289 (sample size for this research). The EFA that was earlier conducted removed the effect of multicollinearity. The collinearity statistics, Tolerance and VIF values that were generated alongside the regressions, were respectively within the acceptable ranges of > 0.1 and < 10. In addition, the normal probability plot (P-P) of the regression standardized residual (Figure 3) which was requested as part of the analysis suggested there was no major deviation from normality as it can be noted that all points reasonably lie on the diagonal line from the bottom left to the top right.

For the main analyses, in consistence with previous studies (Cao and Wang, 2016; Du et al., 2017; Fleming et al., 2016), the first set of control variables (12 SEDA) were entered into the equation. These attributes are age, gender, marital status, ethnic group, religion, education level, employment status, income, presence of children in the household, household size, length of stay in neighbourhood and housing tenure. With these variables entered into the equation, the R2 generated was 0.065 (Table 5), implying that the first model explains 6.5% of the variance. In the model, only age with beta value of 0.141 was a significant predictor of neighbourhood satisfaction at 0.020.

In the second model, the list of 8 DA was entered into the equation as proxy for residential satisfaction. These attributes include type of house, physical condition of the house, location of the house within the neighbourhood, privacy in the house, number

of rooms, size of the living space, size of bedrooms and provision for toilets and bathrooms. In this model, the R2 value is 0.244 and the R2 change is 0.178 (Table 5). This indicates that the dwelling attributes explain additional 17.8% above the variance explained by the SEDA. In the model, neither age that was significant in the first model nor any of the SEDA is significant in predicting neighbourhood satisfaction in VISUE. This implies that having controlled for the effect of residential satisfaction, none of the SEDA of residents was a predictor of neighbourhood satisfaction. However, three DA which include type of house, number of bedrooms, and provision for baths and toilets were respectively significant at 0.002, 0.007 and 0.000.

In the final model, the ten factors explored through EFA were added into the regression equation with a view to detecting the overall key predictors of neighbourhood satisfaction for the entire segregated city. Having entered these factors, none of the SEDA and DA was statistically significant for predicting neighbourhood satisfaction in VISUE at $p < 0.05$. Ultimately, only three of the ten factors entered, were statistically significant after controlling for the effect of SEDA and DA at $p < 0.05$. Therefore, these three factors which include neighbourhood safety and stability, social relationships and public facilities and services remained the significant factors capable of enhancing neighbourhood satisfaction in the VISUE.

The final model (model 3) explains 55.6% of the total variance ($R^2 = 0.556$) and uniquely explains additional 31.2% (R^2 change = 0.312) of the total variance after statistically controlling for SEDA and DA (Table 5). This is a statistically significant contribution as indicated by the significance F-change value for the third model (0.000) and compared with reports in previous studies such as Turkson and Otchey (2015). The ANOVA table is significant $F(30, 251) = 10.476$, $p < 0.000$.

The non-significance of SEDA in our model is in part, supported by previous research findings. Permentier et al. (2011) for instance found some of their variables (length of stay

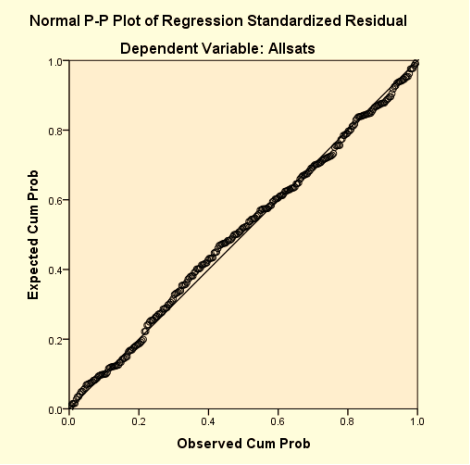

Figure 3. *Normal P-P plot of regression standardized residual of neighbourhood satisfaction.*

Table 4. *Model summary of the hierarchical regression models.*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics			
					R Square Change	F Change	df	Sig. F Change
1	.256[a]	.065	.024	1.282	.065	1.568	12	.010
2	.494[b]	.244	.186	1.171	.178	7.689	8	.000
3	.746[c]	.556	.503	.915	.312	17.656	10	.000

in neighbourhood, presence of children in household and tenureship) in Utrecht, Netherlands as significant predictors of neighbourhood satisfaction and others (income, level of education, employment and ethnicity) insignificant in the same study. Similarly, Ibem et al. (2017) discovered that marital status, employment status and tenureship significantly contributed to neighbourhood satisfaction in Nigeria but respondents' gender, age, education qualification, income size, duration of stay in neighbourhood and household size were not significant. It therefore suggests that in segregated cities rooted in violence, socio-demographic and dwelling characteristics appear to be less important in determining residents' satisfaction with their neighbourhoods. Rather, inhabitants hinge on safety and factors that support the attainment of such safety.

The sub-factors in the three significant factors that are contained in Table 6 show that a total of 19 units of attributes (14 social environment and 5 public facilities and services) predict neighbourhood satisfaction in the VISUE. It should be noted that there is no single physical environment attribute that is statistically significant in predicting neighbourhood satisfaction in

the study area at $p < 0.05$. It suggests residents are generally not disposed to the physical environment as being important to their neighbourhood satisfaction possibly due to the root of their segregation experience which was violence, thereby making them to give preference to the aspect of social environment. This is supported by the previous research reports (Aliyu et al., 2015) who found that safety became the sole consideration of neighbourhood choice at the wake of the violence in the city. This finding seems to be peculiar to violence-induced segregated urban environment as it disagrees with findings of some previous studies such as Lee et al. (2016) and Hur and Morrow-Jones (2008) who found most of the physical environment attributes in their studies to be significantly associated with neighbourhood satisfaction in their sampled neighbourhoods in the US.

Neighbourhood safety and stability is the most important predictor of neighbourhood satisfaction in VISUE. Previous studies such as Tapsuwan et al. (2018) also reported that neighbourhood safety was found as one of the two most desirable neighbourhood features to residents in Cambera, Australia. According to Table 5, it has a beta value of 0.599 and is significant at 0.000. It is 3.6 times more important as a determinant of neighbourhood satisfaction than the second factor which has a beta value of 0.165 and 5.3 times more important than the third factor with a beta co-efficient of 0.113. This factor is made up of seven sub-factors which all have factor loadings above 0.6 (Table 4), indicating they all have high strength as predictors of neighbourhood satisfaction in the segregated environment. The sub-factors in order of loadings on EFA (Table 4), comprises of safety from inter-ethnoreligious

Table 5. *Hierarchical regression models (predictors of neighbourhood satisfaction).*

	Model 1				**Model 2**				**Model 3**			
Variable	Beta	Std error	t	Sig.	Beta	Std error	T	Sig.	Beta	Std error	t	Sig.
Constant		*.779*	*3.744*	*.000*		*.799*	*1.977*	*.049*		*.699*	*.142*	*.888*
Age	.141	.087	2.334	.020*	.094	.081	1.674	.095	.033	.064	.735	.463
Gender	-.027	.171	-.440	.660	-.046	.158	-.822	.412	.029	.126	.652	.515
Status	-.025	.118	-.426	.671	-.037	.110	-.672	.502	-.057	.088	-1.299	.195
Ethnic group	.077	.065	1.256	.210	.103	.061	1.812	.071	.021	.049	.450	.653
Religion	-.048	.125	-.763	.446	-.041	.115	-.706	.481	-.060	.093	-1.278	.202
Education level	-.010	.106	-.160	.873	-.036	.098	-.606	.545	-.020	.079	-.425	.671
Employment	-.086	.124	-1.398	.163	-.064	.115	-1.124	.262	.025	.091	.562	.574
Income	.090	.063	1.471	.142	.046	.060	.801	.424	.054	.048	1.153	.250
School going children	-.023	.055	-.383	.702	-.013	.051	-.226	.821	-.032	.040	-.713	.476
Household members	.095	.055	1.585	.114	.044	.051	.785	.433	.087	.041	1.963	.051
Length of stay in neighbourhood	-.053	.078	-.870	.385	-.089	.073	-1.561	.120	-.060	.058	-1.326	.186
Housing tenure	-.078	.119	-1.283	.201	-.051	.109	-.912	.362	-.047	.087	-1.068	.286
Type of the house					.183	.073	3.066	.002**	.016	.060	.330	.742
Physical condition of dwelling unit					-.034	.086	-.517	.606	.017	.070	.312	.755
Location of your dwelling in the neighbourhood					-.087	.088	-1.268	.206	-.067	.071	-1.229	.220
Privacy in the house					.095	.072	1.490	.137	.068	.057	1.335	.183
Number of bedrooms in the house					.173	.077	2.702	.007**	.087	.062	1.683	.094
Size of the living space in the house					-.075	.082	-1.104	.271	-.073	.065	-1.338	.182
Sizes of bedrooms					-.116	.091	-1.521	.130	-.093	.072	-1.536	.126
Provision for baths and toilets in the house					.340	.093	4.441	.000**	.161	.025	1.795	.074
Factor 1: Neighbourhood safety and stability									.599	.087	10.526	.000***
Factor 2: Social relationships									.113	.108	-2.055	.041***
Factor 3: Public facilities and services									.165	.085	3.006	.003***
Factor 4: Noise and recreation									-.105	.081	-1.880	.061
Factor 5: Housing and aesthetics									.059	.089	1.075	.284
Factor 6: Transport and financial institutions									.011	.059	.221	.825
Factor 7: Environmental sanitation									-.010	.084	-.209	.835
Factor 8: Distance to places									-.029	.068	-.620	.536
Factor 9: Parking and circulation									-.054	.077	-1.006	.316
Factor 10: Traffic									.066	.068	1.310	.191

Dependent variable: overall neighbourhood satisfaction * Significant predictors in model 1 ($p < 0.05$) ** Significant predictors in model 2 ($p < 0.05$)

*** Significant predictors in model 3 ($p < 0.05$) **R^2** = 0.556 (55.6%) **R^2 change** = 0.312 (31.2%)

violence, safety of lives and properties, peace level in the neighbourhood, overall neighbourhood stability, ethnoreligious composition of residents, contact with members of other ethno-religious groups and liveliness of the neighbourhood.

These seven sub-factors are well interrelated. They are generally connected to safety of the residents which no doubt, is based on their past experience. The situation that led to the segregation of the city does not only provide an explanation for this but equally justifies it. As noted in the introduction to this study, Jos that was well known for its rich cosmopolitan nature and peaceful co-existence among residents of different ethnoreligious groups for several years was stricken by deadly ethnoreligious violence intensively between 2001 and 2010, leading to massive relocations and huge lives and property loss. This finding has therefore unveiled that safety from such violence is on top of the determinants of neighbourhood satisfaction of the residents. This explains why safety of lives and property is equally considered the next most important determinant by the residents. Safety from violence will no doubt bring about peace in the neighbourhoods and as such making neighbourhoods to be stable. Ethnoreligious composition of residents in the neighbourhood however matters in achieving this target for safety and peace; hence, its rating as a factor by the residents as well. However, despite their desire for safety as a pre-requisite for neighbourhood satisfaction, contact with members of other ethnoreligious group still appears to matter to them, suggesting that their previous experience of the cosmopolitan city lingers in their memory; therefore, it is still considered as a key determinant of their neighbourhood satisfaction by them. Although a section of the city

Table 6. *Overall key predictors of neighbourhood satisfaction in violence-induced segregated urban environment.*

Factor	Sub-factors
Neighbourhood safety and stability	❖ Safety from inter-ethnoreligious violence
	❖ Safety of lives and properties
	❖ Peace within the neighbourhood
	❖ Overall stability of the neighbourhood
	❖ Ethno-religious composition of residents in the neighbourhood
	❖ Contact with members of other ethno-religious groups
	❖ Liveliness of the neighbourhood
Social relationships	❖ Level of co-operation among members of the neighbourhood
	❖ Participation in neighbourhood social activities
	❖ Proximity to family/relatives
	❖ Contact with members of ethnic group
	❖ Interaction among members of the neighbourhood
	❖ Trust among members of the neighbourhood
	❖ Contact with friends
Public facilities and services	❖ Access to public schools
	❖ Access to police station
	❖ Access to public library
	❖ Power supply
	❖ Public water supply

(mixed neighbourhoods) possibly still enjoys some level of this, a larger proportion who live in the homogenous Christian or Muslim neighbourhoods are possibly currently not having sufficient contact with other ethnic groups other than the ones in their neighbourhoods.

The second overall key predictor of neighbourhood satisfaction in VISUE as revealed by our model in Table 5 and highlighted in Table 6, is social relationships. This is a very important factor that can make residents to derive maximum satisfaction from their neighbourhood. This factor also consists of seven interrelated sub-factors: co-operation among members of neighbourhood, participation in neighbourhood social activities, proximity to family and relatives, contact with members of ethnic group, interaction among members of the neighbourhood, trust among neighbourhood members and contact with friends. The segregated status of the city similarly provides an insight into why residents should perceive social relationship as an important determinant of their neighbourhood satisfaction. Residents who reside in neighbourhoods that are homogenous in nature possibly enjoy close contact with members of their ethnic groups, friends and family as revealed by some previous studies like Tajfel (1981). Those in mixed sections possibly enjoy the same since members of such neighbourhoods did not relocate and have established such contacts within the neighbourhoods over a long period. Li and Wu (2013) for example, found a relationship between neighbourhood attachment and neighbourhood satisfaction in their study in China.

Close contact among residents at different levels enhances trust among them and this might have resulted into positive interactions, co-operation and participation in neighbourhood social activities; all of which can eventually enhance the neighbourhood satisfaction of the residents. Findings regarding these attributes are generally consistent with reports of the previous researches in different environmental contexts. Temelova and Slezavoka (2014) and Afacan (2015) found good relationships and interactions among neighbours as significant predictors of neighbourhood satisfaction. Similarly, trust was found to be a determinant of neighbourhood satisfaction by Osborne et al. (2012) and Oshio and Urakawa (2012). There is also consistency between these findings and the stance of Kasarda and Janowitz (1974) in their systematic model noting that attributes of the social environment had higher influence on neighbourhood satisfaction than the neighbourhood density, while contending the density-dependent theory.

Public facilities and services is the last significant factor that predicts neighbourhood satisfaction in the study area based on the regression results (Table 5). Five sub-factors make up this factor. These are access to children's school, police station and public library as well as power and water supply. Although some parts of this factor was not expected. However, accessibility seems to have been assessed in terms of availability in some cases by the respondents. The interpretation of the researchers was therefore based on this assumption. Public schools are actually available to some extent in different parts of the study area and residents' access to such schools portend not a serious problem even though the quality of services rendered and the quality of the environment are not of good standard based on the researchers' observation while on the field for survey.

Police stations possibly played a significant role in the period of violence in the city and in the process of the segregation, most especially in uprisings between the periods of the major inter-ethnoreligious violence that culminated into segregation of the city. This is a suggestive factor of why it emerges a significant predictor of neighbourhood satisfaction. Two main public libraries are found in the study area; one owned by the federal government and the other by the state, apart from those owned by individual tertiary institutions which are quite many in number. The two public libraries are strategically located, one in the city area and the other at the intermediate location between the suburb and the central area

of the city. The combination of these portends a possible ground for why residents' neighbourhood satisfaction is also predicted by access to library. Power supply as a predictor of neighbourhood satisfaction in Jos is not a surprising outcome because power supply in Nigeria is generally quite unsatisfactory. Respondents' consideration in this regard possibly rests on their desires for better power and water supplies as predictors of their neighbourhood satisfaction.

6. Conclusion and direction of future studies

In this paper, we have indicated the need to understand factors that determine neighbourhood satisfaction in every environmental setting considering the role played by the latter in the overall wellbeing of humans. Hence, we modelled the predictors of neighbourhood satisfaction in VISUE. Hierarchical regression models were estimated to identify the overall key factors that predict neighbourhood satisfaction on a representative sample of the three types of neighbourhood identified in Jos This is to enable identification of the attributes that are needed to be prioritized to improve neighbourhood satisfaction of the residents. In doing this, extraneous variables that might lead us to getting superfluous outcome from the analysis, were controlled for. On this basis, three regression models were estimated. 12 SEDA were input into the regression equation in the model 1 and only age was significant on the model. In model 2, 8 DA were added in addition to the initial SEDA. Neither age nor any of the other SEDA was significant on the model. 3 DA: type of house, number of bedrooms, and provision for baths and toilets, were however significant on the model.

Having controlled for the influence of the two blocks of variables (SEDA and DA) contained in model 1 and 2, model 3 which was the final model was estimated with all the attributes in the first and second models together with the 10 factors explored through the EFA. In this model, three factors (neighbourhood safety, social relationships, and neighbourhood facilities and public utilities) were revealed as the overall key predictors of neighbourhood satisfaction in the study area. The three factors are made up of 14 items of NSEA and 5 NFPU.

NSEAs are therefore generally more significant in predicting neighbourhood satisfaction in VISUE than both the NPEA and NFPU. Both the SEDA and DA are also not important predictors of neighbourhood satisfaction in this type of urban environment. This seems to decline from some previous studies such as Basolo and Strong (2002) who conclude that neighbourhood satisfaction is driven by personal household characteristics and quality of the physical environment. This implies that for any city planning programme or policy instrument that aims at improving neighbourhood satisfaction in this type of cities to be effective, NSEAs must be given utmost priority. This finding appears to be peculiar to VISUE as previous studies have well reported attributes of the physical environment as more important to residents' satisfaction with their neighbourhoods. This revealed knowledge will enable city planners to strategize in planning for the segregated inhabitants as their emphasis will be on the specific factors identified under the social environment and public facilities and services rather than guessing. It provides hints to urban planners and policy makers in this type of city, that policies can be made to improve neighbourhood satisfaction of residents without recourse for consideration on SEDA such as income level, education level, age, duration of stay in neighbourhood tenureship and others.

Also worthy of note in the findings of this study is the revelation that NPEAs are of less importance in predicting neighbourhood satisfaction in VISUE. Notwithstanding, it has posed a challenge to both city planners and policy makers on the need to improve on these attributes in order to integrate them with those of the social environment so as to have a more robust living environment for residents in these cities. This is quite essential since previous studies have reported relationship between physical environment attributes and neighbourhood satisfaction and it appears residents' previous experience of urban violence seems to be centrally responsible for the findings obtained.

The methodological process of this research and its result outcomes have triggered other aspects of neighbourhood satisfaction studies that need to be investigated in order to further enrich knowledge on neighbourhood satisfaction studies, both in theory and practice. It will be of interest to examine predictors of neighbourhood satisfaction in other violence-induced segregated cities that possibly have taken place fewer years than that of Jos, where residents can still be able to vividly recollect their level and determinants of their neighbourhood satisfaction in their previous neighbourhoods. In other words, there is the need for a longitudinal study that will make comparison between neighbourhood satisfaction of residents in their current neighbourhoods with those of the previous ones. This type of study can provide a broad based knowledge upon which to conclude whether the same sampled population are more satisfied with homogenous neighbourhood than their previous mixed neighbourhood experience. The suggested study may equally be combined with cross-section analysis to draw more robust conclusions upon which policies can be made.

Although previous studies (Lee et al., 2016; Mouratidis, 2017; Permentier et al., 2011) have established the importance of subjective assessment over objective evaluation in neighbourhood satisfaction studies; since none of these studies was neither conducted in a developing nation nor a violence-induced segregated urban environment, it is recommended that future studies should conduct an objective evaluation of neighbourhood satisfaction in a violence-induced segregated city most especially in the developing countries. It should however be noted with emphasis that unlike a city like Jos, such a study can only be carried out in an organized urban setting where adequate measurement can be taken. It is also recommended that future studies should look into the possibility of examining the relationship between neighbourhood satisfaction and specific attributes of socio-demographic characteristics such as age, income, education, tenureship, and duration of stay in neighbourhood in any VISUE. This will give room for a more detailed analysis and possibly further revelations on whether these attributes individually contribute to neighbourhood satisfaction in such an urban setting as well as specific variations that may exist between neighbourhood satisfaction and subsets of each of these attributes.

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Housing and urban continuity: The 1930s urbanistic experiments in Oran

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Abstract
By drawing attention to the beginnings of Urbanism in France, this work aspires of replying the problems experienced by today's Algerian cities, which fail to produce a coherent and harmonious urban tissue, and whose urbanism instruments replicate models copied on the 1950s Grands-Ensembles. The 1930s in France correspond to a period of theoretical and regulatory upheavals in the making of towns, where a new generation of city thinkers, the urban planners, develop for the first time Urban Plans for French agglomerations. Considered revolutionary, their concepts will be better received on the southern shores of the Mediterranean, especially in Oran, where a new world is under construction. This article's objective is to verify the following hypothesis: the 1930s Oran's urban tissue was built in a context favorable to experimentation, in a logic aiming the city's homogenization and its urban continuity, through the design and construction of autonomous housing agglomerations. Having exposed the Oran's first enlargement urban qualities, I'll reduce the field of study to the Choupot district, located between the city-center and the ZHUN Yaghmoracen. These three urban strata will be then compared through their forms, their history and their mutual articulations, applying many tools such as maps and aerial photographs analysis, revealing for the urban tissues designed in the 30s, a high urban density and a typological diversity of housing and urban forms, which integrate with the city-center. Conversely, the Yaghmoracen district, whose scale and functioning are evocative of the Grands-Ensembles, generates social and spatial segregation of the urban tissue.

Keywords
Housing, Social habitat, Suburbs, Urban fabric, Urban growth.

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1. Introduction

The Habitations à Bon Marché (H.B.M) or low-cost housing of Paris, recognized today for their urban and constructive qualities, were part during the 1900s, of a conceptual approach where housing and its implanting participate in the construction of the urban tissue (Bigorgne et al., 2017; Dumont, 1991). The promulgation of the law for the realization of *H.B.M* housing was voted in Algeria on July 22, 1922, and was followed by the introduction of Henri Sauvage's processes by the President of the Algerian federation of *H.B.M*, in companies and offices which wore this designation[1] (Almi, 2002).

Jean-Baptiste Minnaert's work on Sauvage's patents (1997) exposes the visionary nature of this architect's works and the difficulty he encountered in France in putting them into practice. The case of this architect illustrates a period rich in experimentation where the pioneers of modern architecture and urbanism, a new science at this time, found themselves confronted with the conservatism of corporations and political leaders (Jelidi, 2014; Almi, 2002). At the same time, this work and its experimentation received a favorable response in North Africa.

The Plan d'Aménagement d'Embellissement et d'Extension d'Oran or Plan of Beautification and Extension *(P.A.E.E)* was part of a set of experiments carried out in the North African countries where a continuous back and forth had settled between mainland France and its colonies. Promulgation of Laws, development of theories and operational experiments carried out on less restrictive territories in terms of lands availability and troublesome activities have multiplied (Benkada, 2004). This ideology will mark a late theoretical renewal in France, giving an avant-garde character to the big cities of the *Maghreb* and to colonial urbanism (Saidouni, 1995; Chaouch, 2013). The pioneers of this current were, for the most part, former engineers of the Military Engineering and of the French Society of Town Planners *(S.F.U)* (Picard, 1994). In the latter case, writings, collaborations[2] and common influences[3] have made it possible to outline the main lines of urban planning, both scientific and landscaped.

Thus, the city of Oran produced its first extension in application of the Cornudet law, outside its outlying walls, in the 1930s. The agency for the regulatory plans of the Danger brothers and sons was then committed by Paul Ménudier, mayor of Oran, to take up, between 1931 and 1936, the plan drawn up in 1927 by Georges Wolff, architect of the city and member of the *S.A.M*[4] (Almi, 2002 ; Merit Heddi, 2016). The work carried out by the Danger brothers made it possible to standardize a heterogeneous whole with a landscape vision forming, in a way, a synthesis of the theories of urban planners Eugène Hénard, Jean Claude Nicolas Forestier and Henri Prost[5] (Frey, 2004 ; Bennani, 2012 ; Labii, Bensaad, 2015). Indeed, the design of the Oran *P.A.E.E*, in which the multidisciplinary nature of spatial planning intervenes for the first time, was the result of decades of research on Cities.

As for the cities of Aleppo, Beirut, Alexandretta, Antioch, Damascus and many others, the design of the Danger plan starts from the existing and integrates the pedestrian and the motorist simultaneously (Friès, 1994). The districts of the first crown of Oran gravitate around roundabout[6] garden squares and are connected to the town center by a *Tour de ville*, a tree-lined promenade of several kilometers. Oran appeared at this time to be one of the most successful cities in town planning in France (Frey, 2004). The innovative character of this initiative lies in the use of housing and habitat as tools for building the urban tissue. Likewise, the multidisciplinary vision of the Danger brothers considerably enriched this approach. As such, the first crown of Oran which extends the town center beyond its former perimeter walls does not mark at any moment an urban rupture. Hence the interest in the careful study of this experience. The diachronic urban analysis of the *Choupot* district carried out in this contribution illustrates my demonstration.

This research emphasizes the experimental nature of the first extension of Oran while showing the conditions and the actors that allowed the

conception and the realization of this socio-spatial evolution. It is a question, in particular, of bringing out the elements of understanding of the phenomena of urban continuity / rupture by housing through the comparison of three urban strata, including *Choupot*, crossed by the first and second peripheral boulevards of Oran. The studied area is marked by the 1930s *P.A.E.E*'s Urbanism, this of the 1950s *Habitations à Loyer Modéré* or low-income housing *(H.L.M)*, and that of the model erected after the independence of Algeria in 1962, the *Zones d'Habitat Urbain Nouvelles (Z.H.U.N)* or New Urban Housing Areas, a model that reproduces the same pattern as their French counterparts in the 1950s. Indeed, the rural exodus and a very significant demographic growth led the State towards the adoption of urban forms modeled on those of the *Grands-Ensembles*, where the *H.L.M* building constitutes a democratic model, remodeled today according to the implemented town planning instruments (Frey, 1988; Madani, Kadri, 2015).

The problematic developed here is concerned with the frenzied sprawl experienced by the Algerian cities on the outskirts of former town-centers and whose unique function is reduced to housing. The method used analyzes the extension of the urban tissue by housing with its various components: public spaces, urban roads, gardens and parks, economic activities, urban density, public facilities, public transport networks, typology of the land to be urbanized and layout of buildings. Mapping constitutes, from the start, an important tool for visualizing the hypothesis developed in this research. The demonstration carried out in this contribution is structured in three sequences: the first part examines the conditions and the actors of the growth of Oran; the second takes a look at the articulation between the *P.A.E.E* of Oran and the housing achievements while the last part is devoted to the case study. The names of streets and districts used in this contribution are those in use during the period when the first extension of Oran took place[7].

2. Urbanistic and architectural experimentation of the 1930s in Oran

History is present in this analysis: we appeal the past to support my hypothesis, looking for the internal and external factors underlying the development of the city of Oran outside its former walls. Indeed, the writings and works on the gradual birth of the current town center, which have existed for almost a century, constitute precious materials for retracing the urbanization dynamics of the city under construction. This approach allows understanding the chronological progress of the spatial stratification of the extensions of Oran.

The French colonies, of which the city of Oran is a part, became, at the beginning of the 20th century, a field of experimentation where a generation of young architects and entrepreneurs upset the bedrock of the discipline. The possibilities allowed by reinforced concrete and steel in crossing large spans, and the relative ease of implementation (pouring - assembly by rivets or bolts) frees buildings from spatial and sanitary constraints. The emergence of new conceptual approaches and the birth of a Scientific Architecture are becoming possible (Dumont, 1998).

The elements of architectural composition are separated and then arranged according to an organizing logic. Load-bearing structure, fenestrations, frame elements and partition walls are used according to their ornamental possibilities, making obsolete any added decoration: moldings, embossings, veneer elements, etc. A deep schism is established between the old and the new generation. The position of the architect Auguste Perret - considered to be the father of the modern movement - reflects this divide (Laurent, 1998):

"We find the modern facades too bare, and yet those that make this effect are generally dressed - dressed with coatings or veneerings; they are more naked than naked. So let's no longer hide under these coatings or veneerings the important parts (posts, beams) which are the noblest elements of architecture and its most beautiful, its most legitimate ornaments" (Fabiani, 1925).

This revival in architecture was followed by a large-scale reflection on cities and their sprawl, and by the vote of the Cornudet law in 1919[8]. In addition, other sciences such as sociology have been integrated into the territory planning process. Today's Urbanism owes much of its multidisciplinarity to the changes that took place at that time. This revolution was initiated by engineers and geographers of military engineering, who had carried out an exploratory phase rich in lessons during their missions in the colonies (Vacher, 1999).

On this occasion, they did not fail to realize the importance of built heritage matters, its conservation and its physical integration into the city in construction[9] (Malverti, Picard, 1988). Then, the logical and functional dimension of the city is articulated with a landscape approach in which the theorists of the *S.F.U* have acted (Paquot, 2013). Some have worked for a long time in the Maghreb and were therefore deeply marked by Mediterranean cities.

The Danger Brothers Planning Agency[10] is undertaking the revision of the first Plan for the extension of Oran drawn up in 1927 by Georges Wolff, Oran city official architect and member of the *S.A.M.* The Danger had at that time devised the Extension Plans for Bône, Constantine, Alger, Tripoli, Alexandrette, Antioch, Beirut and Aleppo. A complete planimetric and altimetric survey of Oran, on triangulation and polygonation, was started by the Danger on the 24th of February 1931, and was completed in 1932. It was finally reviewed, completed and delivered in 1934. This new version of Oran's *P.A.E.E* is distinguished by the socio-demographic analysis of the population, neighborhood by neighborhood, and the establishment of building regulations. The present and future zoning of the city, the opening up of Planteurs district, the development of the first outlying boulevard and an alignment plan which provides for the layout of a second crown[11] (Frey, 2004), are also included in this document.

The *P.A.E.E* of Oran aims to connect the suburbs and the town center by means of a crown through a hierarchy that allows physical transition during passages from neighborhood to neighborhood and when the old meets the new. The land is divided into plots, of which must imperatively maintain an empty part reserved for green spaces and gardens. Danger brothers designed the following urban composition modular system for the Oran *PAEE*: the urban tissue evolves on blocks of 150 m by 50/60 m divided into plots of 12 x 20 m nearby the town center and 15 m x 25 in the suburbs. The width of the sidewalks is set at four m for boulevards and avenues and only two m for streets. This configuration allows 40 m wide boulevards, 16 m wide avenues, and streets of 10 m wide. Public squares represent multiples of a module of 40 m x 40. But the ingenuity of this intervention lies above all in the use of housing as a constructive unit of the periphery based on the establishment of a dialectical relationship between housing and the workplace.

The complementarity and interconnection of the elements that make up the city of Oran, and the connections between the former and the new, are made possible by its *tours de ville* or outlying boulevards (Lespès, 1938). The radioconcentric shape of the contemporary city is a result of the reviewed *P.A.E.E* by Danger brothers. However, at first glance, it seems to evolve from the multiple pre-existing conditions. This impression is partly true because the vision adopted by René Danger is part of the continuity and integration of all of the site's data in the conceptual approach. All the strata of the city are taken into account: old urban tissue, local population way of life, agricultural areas, natural water resources, and local management of land rights.

In this context, the agency does not deviate completely from the *hygiéniste* trend of the *S.F.U*, but tends to divert the tools favored by the latter towards the well living in the city. Many sciences are involved in the inventory: climatology, demography, economics, geography, geology, history, hygiene science, jurisdiction and administration, local physiology and aesthetics, politics (Labii, Bensaad, 2015). An importance is given to the traffic plan in the management of the economic activities of the city but also in the succession of

the planned urban sequences. In this context, René Danger tends neither towards the urbanism of perspectives nor towards that of the curved line, but rather prefers to adapt to the specifications of the site and the possibilities it offers through its topography, its trails, its nature and its inhabitants.

3. The urbanization of the first crown of Oran by housing

The chronological and cartographic analysis, the cross-checking with postcards and photography, allow observing the city in motion. The first urban core of the French colonial period was established in *Sidi-El-Houari* below the *Karguentah* plateau[12] [Figure 1]. It became, with the radioconcentric spread of the city, its geometric center. We must remember the importance of this site by the passage of *Oued Rehhi* and the many water springs (including Ras El Ain, Ain Blal, Cherchara) which determined the anchoring of the city in these places and not in *Mers El Kebir* (Bekkouche, 1998). Its forced extension at the end of the 19th century and the physical constraint represented by the *Murdjadju* Mount led the growth of Oran to climb on the *Karguentah* plateau, a triangular portion included between the cliff overlooking the White Ravine on one side and the other's Green Ravine[13] (Lespès, 1938).

These two ravines connect Oran to the cities of *Aïn Témouchent* and *Tlemcen* to the west, on one hand, and *Mostaganem* / *Orléansville* / Algiers to the east, on the other. They guarantee it a first-rate geographical position between Spain on the one hand and Morocco on the other[14]. By connecting its extensions as it is urbanized with outlying boulevards, a consistent spread is made possible. Towards the end of the 19th century, the commercial development forced the municipality to provide the city with a railway line connecting the port of Oran to that of Algiers [Figure 2]. The arteries of the city, their ramifications and crossings with the two crowns of Oran, punctuate the new peri-urban districts of which *Choupot* is a part, the case study in this contribution.

The planning project on Oran's first outlying boulevard begins at the city's former physical limits, on the railway road from the commercial port to the

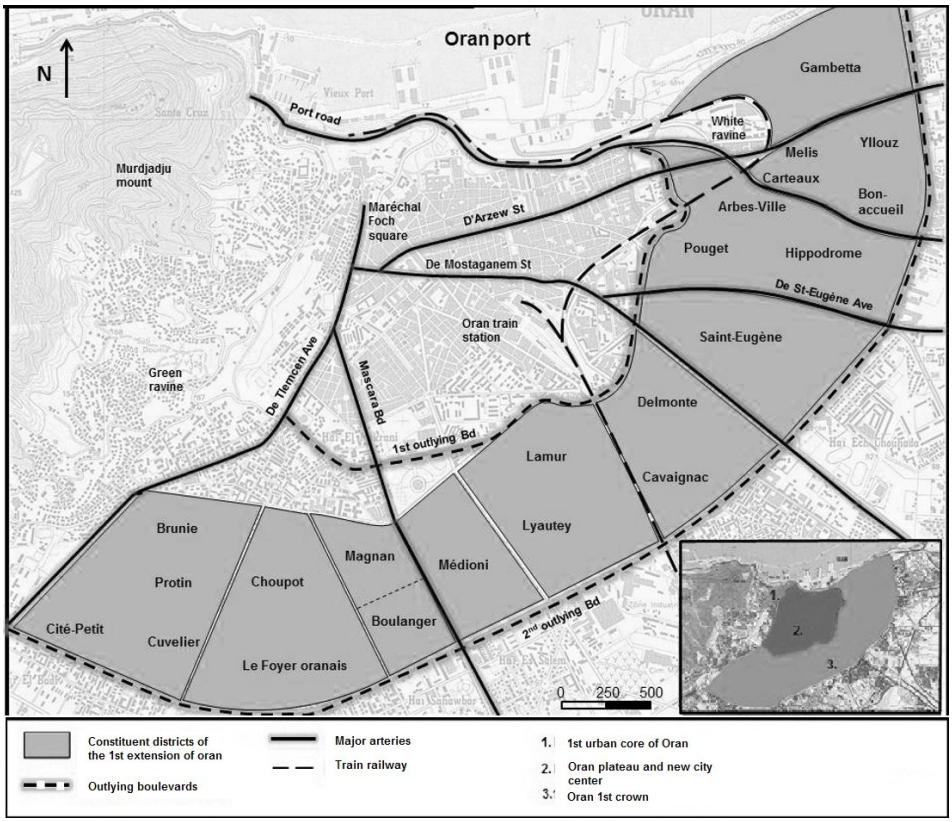

Figure 1. *Articulations between town center of Oran and its 1st outlying crown. Shaping: Taïbi (2019). Background: Map from the Guide bleu (1942).*

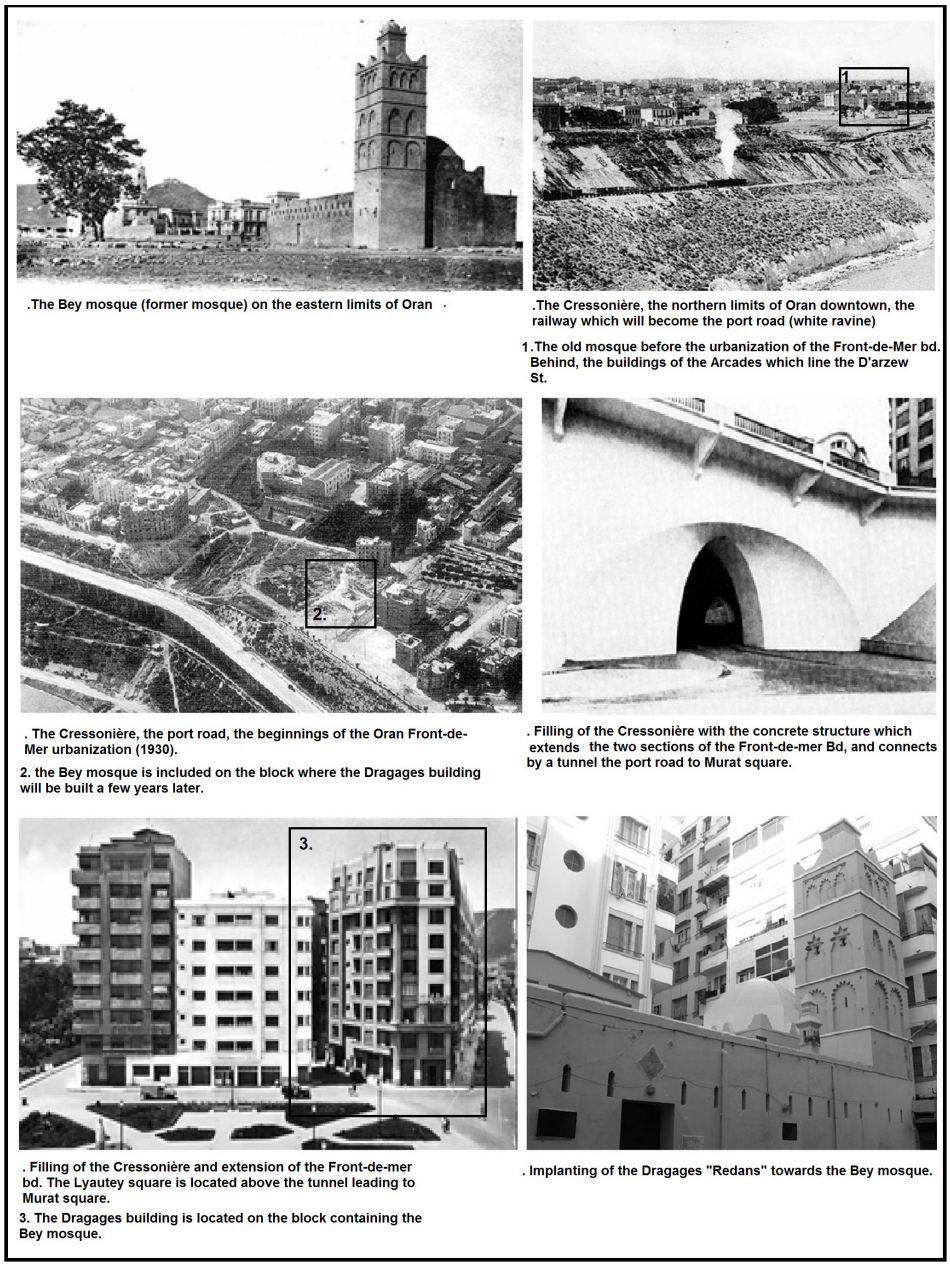

Figure 2. *Progressive construction of the urban tissue surrounding the Bey mosque between 1900 and 2019. Shaping: Taïbi (2019). Retrieved from Oran des années 50 : http://forgalus.free.fr/LE%20COIN%20DE%20GEORGES%20VIEVILLE/index.html*

new *St-Michel* Plateau train station[15]. Aerial images from the 1930s show an urbanized waterfront around the construction project that connects the port road to *Murat* square [Figure 2], at the place where a few years later will be built the *Dragages* housing building and a set of *H.B.M* prototypes. At the same time, the neighborhoods adjoining the *Plateaux* civilian hospital are growing at a similar rate. These areas are connected by the large 40 m tree-lined boulevard called bd *De Lattre De Tassigny*. As it spreads out, this outlying circuit will connect the suburbs with the indigenous districts, in a global project of beautification and homogenization of the urban tissue, building an urban belt which extends the town center.

The land typologies of Oran first crown are declined in time and space according to the proximity with the Hyper-centre. It should be remembered that the first belt of the Oran plateau begins at *Lamoricière* high-school and the Square *De la Victoire*, to stop at *Fort Saint-Philippe* and Oujda avenue. The second crown, meanwhile, starts from the former location of the

Batterie Gambetta and ends at *Fort-de-Vaux Boulevard* and *Cité Petit*. The area between these two circle arcs encompasses the first extension of Oran but in reality represents a heterogeneous whole reorganized by the Plan of Danger brothers[16] (Frey, 2004).

The blocks first typology in the extension of Oran dates back to the beginning of the 20th century and is found on a band included between the streets of *De la Vieille Mosquée* and *Alsace-Lorraine* [Figure 3]. Spatial distribution's done on radiating axes, not on the orthogonal ones. The streets of *El-Moungar,* De *Montauban*, De *Mulhouse* and De *Besançon* are part of this scheme, constructing blocks entirely occupied by housing buildings. In fact, we are coming out of a parsimonious management of the land in favor of a town planning engendered by a landscape and aesthetic vision. This orientation is reminiscent of the first prototypes of hygienic housing *à Bon Marché* of Paris former outlying crown (Dumont, 1991). Urban parks and public spaces are also given great importance by including them in housing operations. The most representative example in Oran is the former Artillery Park which has become the Rosary Experimental Garden, a green rectangular area surrounded by buildings, offering residents a view and calm (Bekkouche, 2010).

More imposing, the *Dragages* housing complex is another variant of this blocks planning [Figure 2]. Built in the late 1930s by the maritime works company of the same name, the *Dragages* is part of a serie of real estate operations intended to accommodate housing for executives working on major shipyards of that time (Oran's port extension in 1930 for that example). The block hosting this building is trapezoidal. This geometry of the land allows in its establishment to multiply the perspectives and facades of the building, in addition of including an ancient monument of the city of Oran: *the Bey mosque*[17].

Stepped facades enlightened by a courtyards system are grafted onto a bar which runs along the *Front-de-Mer* bd for 80 m. Built on a marble-plated base entirely dedicated to commerce, this complex promotes a certain participation in the life of the city.

The second land typology of the 1930s peripheral Oran is an area made up of old Spanish neighborhoods and suburbs. Serviced at the beginning of the 20th century during public works, all empty land will be integrated by the *P.A.E.E* to the first crown. They are then urbanized during the settlements policy which tends to encourage the acquisition of individual property (Lespès, 1938). The municipality built *H.B.M* complexes and *H.B.M* Public Offices in *Delmonte* and *le Foyer oranais*[18]. The surface of the plots varies between 240 m² close by the center and 600 m² on the outskirts of the first belt. The work undertaken in these districts aims to harmonize the new settlements planned, with private one-storey housing buildings and Spanish *Maisons de ville.*

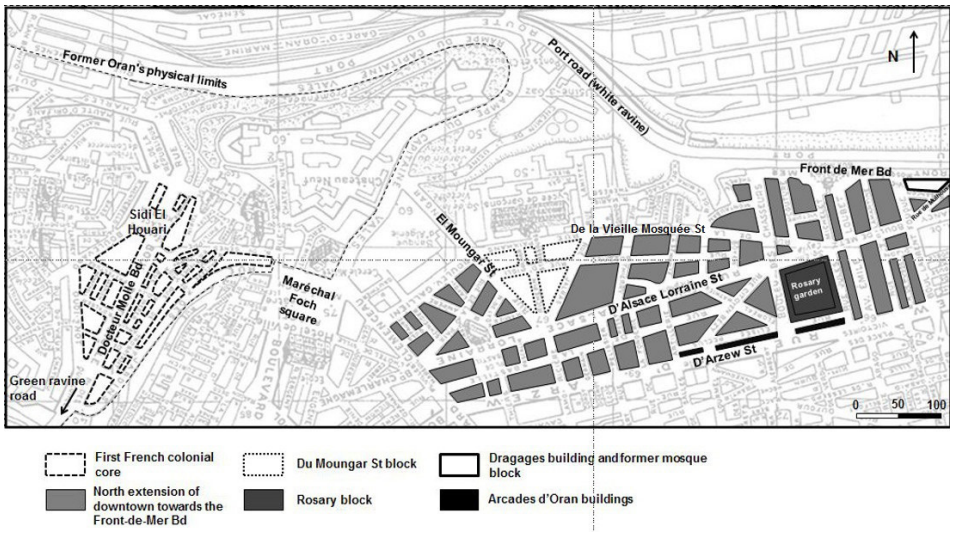

Figure 3. *Plot division of the urban tissue of Oran before 1930. Shaping: Taïbi (2019). Background: Monumental plan of Oran (1951).*

The multifunctional complexes combining workplaces and housing constitute the third and last urbanization model of the first crown of Oran. The former *H.B.M* cities of *la Garde Mobile* (motorcyclist gendarmerie) and the navy are among them. These complexes include individual houses, three to four storeys buildings, administrations, barracks, etc. Some of these buildings, depending on their size and program, are masterpieces of urban composition and balance of the masses, such as the unit built in Oran in the mid-1940s[19]. The *Art-Déco* buildings designed by the architects G. Wolff and F. Bienvenu revolve around a monumental square where access and traffic are skillfully sequenced. Thus, in *Saint-Hubert*, this big complex is integrated into the plots division of the settlements district. This diversity of land and typology of housing makes the first extension of Oran one of the best urban planning experiences in this city until today.

4. The choupot district: A condensate urbanistic coherence example

After this presentation of the historical construction of Oran, the emergence of its first extension and its experimental nature, as well as the key characters and events in the genesis of this project, we will now take an area from the first crown of Oran in order to analyze it basing on the criteria already presented. The objective is to demonstrate by facts the hypothesis advanced in this contribution. The working method is to select an area of the extra-mural city which includes, within it, the limits of the first, second and third peripheral circuits of Oran, in order to compare the stratifications and articulations of urban tissues built in different eras. Proceeding this way allows us to check the consistency of the extension of the town center on the outskirts. We naturally choosed the *Choupot* district for the following reasons:

- Its location at the entrance of the city by the the green ravine western gates.
- The richness of the architectures and the typological variety of the habitats that constitute this place, its important urban density and its social mix between natives and migrants (Spanish, Italian, French, and Portuguese).
- The economic importance of this territory on a city scale.
- The physical continuity and articulation of this district with the hyper-centre, in particular by an efficient network of buses and trolley-buses [Figure 4] .
- The financial crisis which affected France and, consequently, Algeria, during and after the Second World War, did not tuch the operation of this district, which was urbanized from the former works of Oran first crown.
- Finally, the comparison of urban tissues built during the application of the *P.A.E.E* and the *H.B.M* policy - in the case of the *Choupot* district - with those of the *Z.H.U.N*s for *Yaghmoracen* district, both articulated through the second outlying boulevard, allows identifying elements for understanding the extension of cities by housing from two different scenarios.

Thus, the physical crossing beyond the former perimeter walls of Oran, towards Choupot, is not felt between the town center and the periphery[20], which allows urban continuity by the roads and consistency of the buildings design. Likewise, the districts constituting the first extension of Oran become autonomous thanks to the presence of facilities, public spaces and a diversified commercial economy. Despite this superficial analysis of the different construction mechanisms of the first crown, the determining role of housing (in particular *H.B.M*) prevails. Finally, it should be noticed that the general conception of the *P.A.E.E* of Oran anticipates the future sprawl of the city in its landscape dimension from its original design.

The Choupot district is bounded by the avenues *Jules Ferry* at the west and *Albert premier* at the north, national road No 6 at the east and the second peripheral circuit at the south [Figure 5] . The construction mode of the urban space which connects *Choupot to Maréchal Foch* square - heart of the city of Oran, is developed in the following

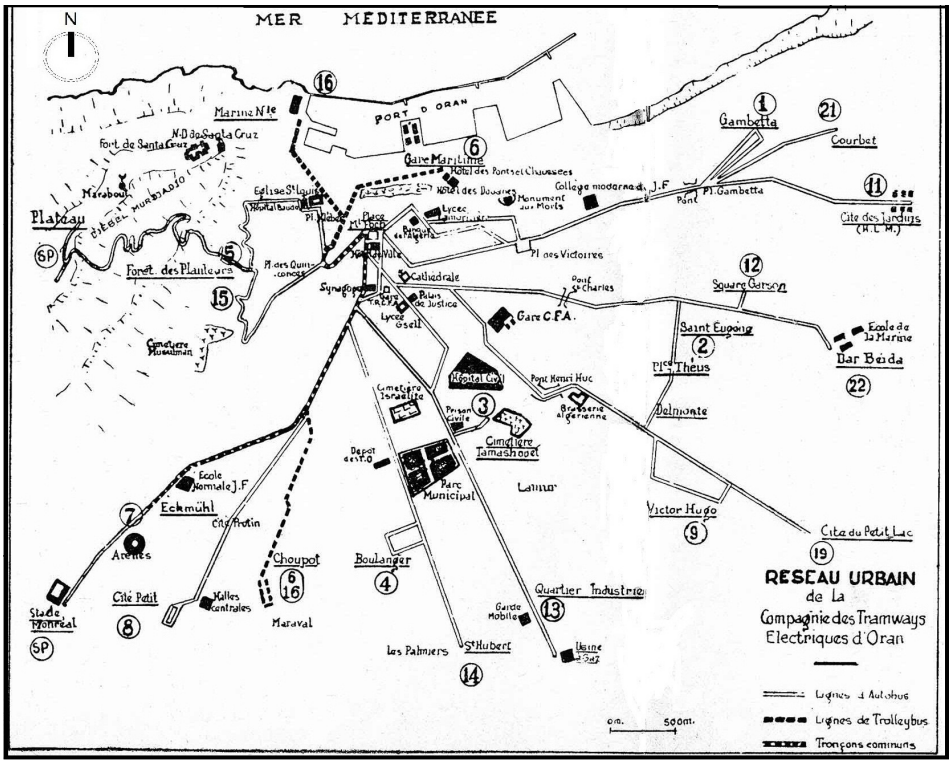

Figure 4. *1940s Oran's urban transport plan. Retrieved from Archives of the Company of Electric Tramcars of Oran : http://lesruesdemontpellier.fr/imagine/eckmuhl/carte_transports.htm*

way[21]: buildings constructed on plots including housing and commercial activities, align with the urban roads and public space, and fit on a linear axis of perspectives directed towards the natural reliefs of Oran, in particular Mount *Murdjadju* and *Santa Cruz* fort.

In addition, facilities tend to guarantee the autonomy of the *Choupot* district[22], with a rhythmic life during the French occupation of Algeria (and even today) by the commercial activity of *Aristide Briand* Ave. The typological diversity of the habitat built on this axis and its crossing with *du Foyer oranais* Ave - where are also a whole *O.P.H.B.M*[23] and the *H.B.M* of Protin and la Ruche *P.T.T* (Posts, Telegraphs and Telephones), offer a global vision of the housing policy of the 1930s in Oran.

Le Foyer Oranais H.B.M housing complex contrasts with the plots housing system in the Choupot district. Indeed, this set of buildings and pavilions evolves on a series of blocks instead of following the surrounding urbanization scheme. The 45° plotting of the blocks from the main axis of *Choupot* - which is oriented north-south, determines the implanting of the pavilions of the complex and gives it its uniqueness. The 5000 m² double-square blocks are occupied by housing units with a gangway distribution system, articulated by interior courtyards, totaling eight pavilions per block and four apartments per pavilion. The subtle layout of the buildings on the diagonals of the plots [Figure 6] breaks with the alignment of housing estates and ancient Spanish Maisons de ville[24]. The coherence of the town planning regulations of the Oran *P.A.E.E* allows a varied urban landscape and a typological diversity of housing without causing disorder.

The *H.B.M* complex of l*e Foyer* oranais contains 188 apartments. It was built at the same time as the *Delmonte O.P.H.B.M*. These two housing complexes (Delmonte and le Foyer oranais) were enlarged in the 1950s. In fact, the urban density of the district was increased by the municipality thanks to the construction of *H.L.M* bars within the *H.B.M* sets. Two four-storey buildings and two other bars long of 75 m will be built beside to this *H.B.M* complex. These *Grands-Ensembles* complex buit in *Choupot* give a proportioned use of the density of housing and its location: sets of 300 dwellings designed

in dense urban cores, which respect the regulation of town planning, and create public spaces due to the implanting of the building, avoiding an excessive sprawl and an urban rupture (Chemetov, 1991).

The program of the *H.B.M* complex includes 32 one-storey Pavilions, two four-storey buildings, and the Public Office. The administration bureaus are located on the street in the groundfloor. Each building includes six apartments with four *T4* (three bedrooms, a living room and a bathroom) arranged on the wings and two *T3* in the center with the stairwells. The four apartment's pavilions each are located on the diagonal of the blocks, along the cardinal axes. As a result, interior courtyards (one large and two small) and private gardens contribute to the enrichment of the urban landscape. The groundfloor access is on the street side, while gangways carried on the interior courtyards lead upstairs. The implanting on diagonals of buildings affects the rest of the houses in the neighborhood (aligned on the street); this arrangement generates a multiplicity of urban sequences. The architecture of the *H.B.M* complex of *le Foyer* oranais results from geometrically proportioned masses as well as from a thoughtful layout of the buildings. Clearly, the enrichment of the urban tissue and the enhancement of public space are sought.

The enlargement of the *Aristide Briand* Ave planned in the second extension of Oran, is carried out after the independence of Algeria. The urbanization of the districts adjoining this axis was done in the 1980s on the model of the *Z.H.U.Ns* [Figure 5] : "the change of cape in 1979, the new policy of economic openness, attentive in the first place to catch up with social needs, housing in particular, initiated a major national program of housing construction, from which the wilaya of Oran benefited a fairly appreciable slice" (Benkada, 2001).

Five *Z.H.U.Ns* are urbanized in Oran: U.S.T.O (201 ha), *Seddikia* (90 ha), *Maraval-Yaghmoracen* (252 ha), *Haï Khémisti* (112 ha) and *Dar El Beida* (147.5 ha) (Benkada, 2001). The *Yaghmoracen* district, in the image of the *Z.H.U.Ns* of Algeria, is mainly made up of housing buildings (four to five storeys) built on vacant land or near to *Grand-Ensembles* complexes realized before independence, arranged according to the sunshine requirements

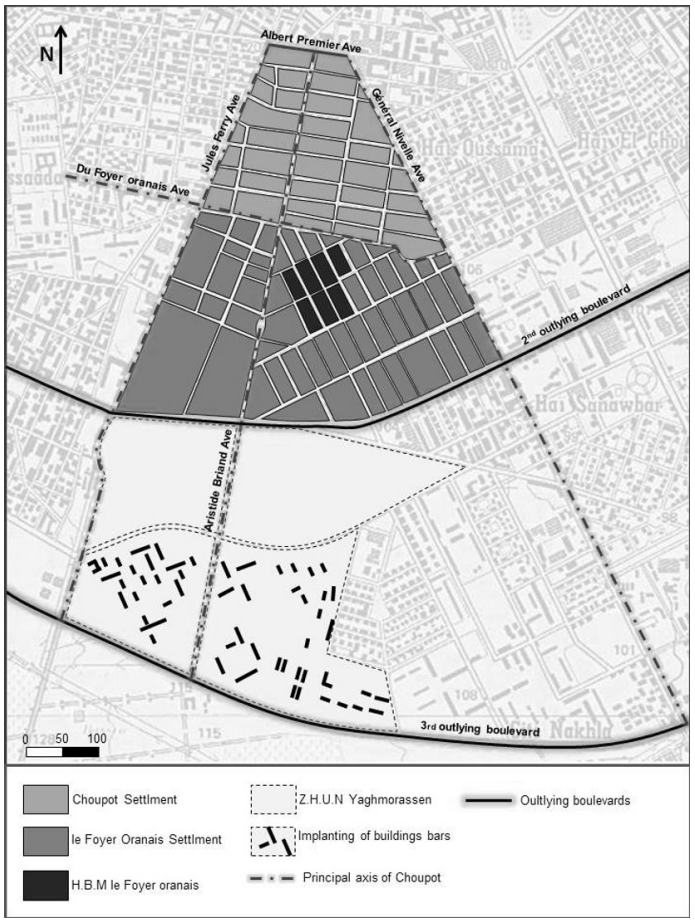

Figure 5. *Connections between the Choupot district with the Z.H.U.N Yaghmoracen. Shaping: Taïbi (2019). Background: Map of Oran established by the National Institute of Cartography (1986).*

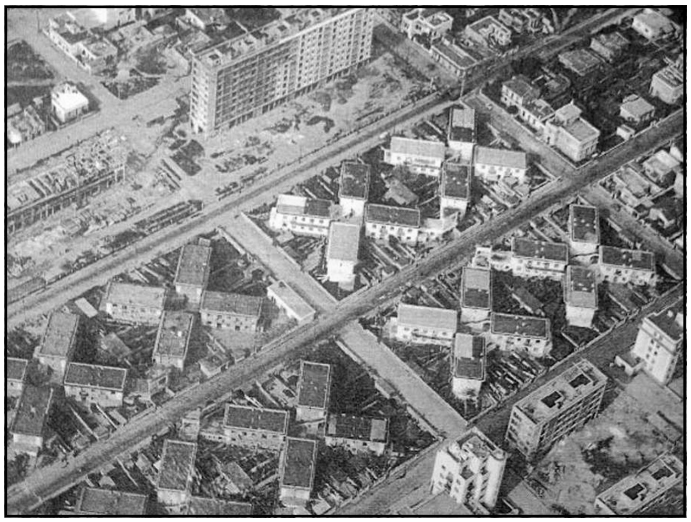

Figure 6. *Aerial view of the H.B.M le Foyer oranais and their enlargement with H.L.M bars in 1950*
Retrieved from Oran des années 50 : http://forgalus.free.fr/LE%20COIN%20DE%20GEORGES%20VIEVILLE/index.html

and an outline suggested by the crane path. The land occupation coefficient *(C.E.S)* of the urban tissue in town center of Oran and *Choupot* is 88%, for only 10% for the *Z.H.U.N* Yaghmoracen (Musy, 2011), whose low urban density expresses the radical change in urban planning instruments as well as a lack of reflection on the urban landscape. In contrary to the many elements of composition of the urban tissue proposed by the *P.A.E.E* (wealth and hierarchy of the public road, plots adaptable to multiple scenarios, landscape reflection on the built / unbuilt articulations), the traffic routes in the *Z.H.U.N* complexes are the result of gaps created by the purely functional implanting of buildings, neglecting the urban form.

Thus, the buildings seem to be located at random in this district. Very quickly, a physical and visual rupture manifests itself with the immediate environment and with the town center. If, instead of the *Z.H.U.Ns*, the urban tissue of *Yaghmoracen* had grown beyond the second outlying ring, as an extension of *Choupot,* following the urbanization scheme of the first extension, the expansion of the town center and the changes generated within this district[25] would have generated an urban tissue similar to that of *Arzew St*, which is located in town center and whose length is 1643 m, while the principal axis of *Choupot* is 2113 m long on a straight line.

5. Conclusion

The difficulty encountered by the urban planning instruments adopted by the Algerian authorities, since the country's independence, in controlling and managing the urbanization of cities (Madani, 2002), is a sign of their inability to regulate the frenzied sprawl of Algerian cities outskirts. The development of laws and models for town planning copies the schemas initiated by France in the 1950s, which later resulted in a dismal failure. Indeed, France emerging from the Second World War adopts in Algeria new models of regional planning and industrialized construction, giving no interest to the attempts of French architects and urbanists in Algeria to think differently about the city and the housing issue (Picard, 1994).

The spatial discontinuities characterizing today's Algerian cities express this impossibility of the current urban planning instruments to bring up complex realizations with a global vision of the city's future (Chaouche, 2013). Current urban outskirts projects can be summed up to dormitory towns. The negation of the site's identity and the anonymity engendered by the unfolding of standard plans accentuate this rupture between the former and the new. The role of the authorities is to establish a plots layout system, create institutions and equipment, and harmonize buildings exteriors with public spaces, for the benefits of an urban aesthetic (Frey, 1988). Conversely, through standard plans and standardization, the Algerian authorities favor quantity and urgency and abuse of housing as an element of social peace, to the detriment of the beauty and quality of urban tissues (Safar-Zitoun, 2012).

As a first experience, the extension of Oran beyond its outlying former walls marks the genesis of this theoretical approach as well as its development in a global context favorable to experimentation. The generation of modern architects and urban planners perceived in the French colonies, including Oran, the place where the 20th century technological and ideological advances could be put to the service of a new vision of the city and architecture. The synchronic articulation in the first extension of Oran between H.B.Ms and *P.A.E.E*[26] is a positive example in this city of the design of the urban tissue by housing: "We can regret the not much research works concerning *HBMs* in Algeria, especially as this ancestor of *H.L.Ms* and other housing in *Z.U.Ps* (Zones to Urbanize in Priority) and *Z.H.U.Ns* offered properly architectural qualities which have unfortunately been lost since" (Frey, 2004).

Thus, the Oran first crown construction works, in particular through the execution of the *Front-de-Mer* project, show the complexity of this operation, the objectives of which tended towards the realization of major housing programs while taking care of maintaining a coherent structure of the city as well

as an urban aesthetic. To this, a thorough reflection on the parcel divisions is carried out, in order to fall in adequacy with the desired programmatic richness.

Let us note the revolutionary character of this approach by replacing it in its time, where applied concepts result upon following the architectural competition organized by the Rothschild Foundation in 1906 (Dumont, 1991). Since then, the housing complexes realizations for large numbers of people through urban development operations, using concepts such as those of the "open courtyard", have shown since their urban qualities. The typological multiplicity of housing in *Choupot* and the *H.B.M* complex of le *Foyer* oranais which was the subject of a brief analysis here, give an overview of the first extension of Oran urban qualities and the construction mechanisms of the urban tissue by housing.

The *P.A.E.E* drawn by the Danger brothers is an intelligent assemblage of several dissimilar urban tissues, separately executed and articulated through urban parks in the form of gardens and planted boulevards. This dissimilarity of the urban tissue is felt in the typological richness of the built housing complexes during Oran's first extension, varying between individual houses on the outskirts and housing complexes whose density increases as we get closer to the city-center. The *H.B.M* housing complexes Art-Deco style adds to the quality of the designed districts, where moderate height buildings adapt to the identity of the site, and articulate around urban spaces combining private and public, whose geometry and dimensions vary according to the needs, and where the activities that are planned there promote urbanity and autonomy.

The 1930s French and Algerian urban policy, in synchronic adequacy with that of H.B.Ms, has since shown its superiority in comparison with the urbanization models adopted after the Second World War. This period in the history of Oran conceals a significant in-situ experiential potential, for the thinking on the cities sprawl, and the future planning and extension projects through housing.

Endnotes

[1] Sauvage is one of the founding members of the Society of Modern Architects *S.A.M* and of the magazine of the same name. In 1925, he created the rapid construction company and patented, between 1924 and 1931, 14 innovative construction systems, in particular prefabricated steel cells, or *the immeuble à gradins patent.*

[2] Henri Prost, Eugène Hénard, and Jean Claude Nicolas Forestier, founders of the *S.F.U*, theorize around urban and architectural regulations and the landscape vision of the urban tissue. The plans devised by the latter, notably for the city of Paris and its embellishment by a system of public parks, results from the influence of Mediterranean flora and fauna on the ideas of these urban planners during their stay in North Africa (Mehdi, Weber, Di Pietro, Selmi, 2012).

[3] René Danger and Henri Prost, both members of the *S.F.U*, gravitate around Hubert Lyautey, general resident of the French protectorate in Morocco in 1912 and Minister of War during the First World War.

[4] Structure founded in 1923 by H. Sauvage, Frantz Jourdain, Hector Guimard, Joachim Richard, Pierre Sézille, Louis Brachet, and Tony Selmersheim. Many of its members will work in Algeria until its independence, among which are Auguste Perret, Marcel Lathuillière, Charles Montaland, Albert Seiller, Léon Claro, Camille Lopez, Francois Bienvenu, Xavier Salvador, Jean Paravisini, Georges Wolff, Pierre Marie, José Ferrer-Laloë and Pierre Bourlier.

[5] The plans drawn up by the Danger are responses to a specific context. They do not reproduce any standard plan. An importance is given to the traffic plan in the management of the economic activities of the city but also in the succession of the urban sequences. The conceptual approach of this agency starts from the existing taking integrating headlands, natural lookouts, axes of sunrise and sunset, by subsequently projecting in these sequences gardens and architectural orders. The curve is used to absorb the slopes while being dedicated to the pedestrian promenade. Conversely, the right perspective

is used to facilitate cars movement. The Oran plan was developed into linear walks, roundabout public squares and urban parks - concept of J. C. N. Forestier.

[6] Invention of Eugène Hénard (Alonzo, 2005).

[7] The materials used in this article mostly date before 1962. The reader will find by clicking on the link ending this footnote, a document drawn up by the association *Bel Horizon d'Oran*, which presents an inventory of the names carried by the streets and districts of Oran over time. https://www.guideoran.com/index-des-rues- quartier-oran / index% 20oran.pdf

[8] The vote of the Cornudet law imposing a *P.A.E.E* to cities with more than 50,000 inhabitants comes out of a set of theories and research carried out at the beginning of the 20th century by the members of the *S.F.U.* Among them, one of the founders, Henri Prost, worked notably in Morocco on the implementation of laws and instruments for the management and the construction of the urban tissue (Frey, 2004). The need to expand cities beyond the former limits and the increase in population draw attention to the need of building housing for the bigger number and the difficulty of doing so with plots as a marking tool (Dumont, 1991). Here, housing becomes an instrument around which all the functional and landscape elements necessary for its autonomy are built. The urban policy of the 1930s is elaborated in close collaboration with this of the *Habitations à Bon Marché* (Carriou, 2005).

[9] Among which is René Lespès, author of one of the most complete works on the city of Oran, which denounces the behavior of the French authorities with regard to the cities of the Maghreb, and the *Néo-Mauresque* architecture style that he finds grotesque.

[10] This company employed at this time more than 60 people, including: René Danger - member of the *S.F.U*, his brother Raymond - *D.P.L.G* land surveyor and Professor at the School of Public Works, Thérèse Danger - Power plant Engineer, and Paul Danger - Professor at the School of Public Works and the Conservatory of Arts and Crafts.

[11] The innovation of the Danger plan lies in the equitable distribution of the facilities which participate in the social life of the various districts.

[12] Location of the former market named after the Arabic origin name's place. A study relating the conditions of realization of this public building describes precisely the geological and land nature of this plateau (Curtet, 1888).

[13] Current *Planteurs* slum.

[14] Oran is 303.9 km from Alicante, on the other side of the Mediterranean.

[15] Building designed by the chief architect of Algeria Albert Ballu, and built by Perret Brothers Company.

[16] Heterogeneity expressed by housing: There are private real estate, *Offices Publics H.B.M,* Medium Rent Buildings *I.L.M*, housing built by public companies, vernacular housing, and housing settlments - tool used mainly for urbanization on the outskirts.

[17] 18th century listed monument.

[18] The Public Office of *Habitations à Bon Marché* O.P.H.B.M is the authority responsible for the construction, supervision, and regulation of housing production at the regional level.

[19] The barracks of the *Saint-Hubert* motorcyclist gendarmerie were remodeled in 1944 following the April first decree of the reorganization of the 19th legion. Everywhere in Algeria, the units of the gendarmerie corps, and in particular of departmental ones, are undergoing enlargements in order to welcome more recruits within the troops, and to modernize at the same time the image of the corps of the French gendarmerie.

[20] A few statistics show the size of the first extension of Oran in relation with the town center. The area of the intramural city is 378 ha. That of the first crown: 973 ha; and the area including *Choupot* and *le Foyer oranais*: 78 ha. The distance roamed from *Maréchal Foch* square via *Maréchal Joffre* Bd, *De Tlemcen* Ave, *Jules Ferry* Ave, to the gates of *Choupot*, is 2060 m. As for the *Aristide Briand* Ave, commercial axis crossing *Choupot* - actually *Lieutenant Smaïn*, it offers a straight line perspective of 2113 m, the limit of which is the Oran third ring.

[21] The former *Choupot* trolleybuses line follows the same route.

[22] Indeed, *Choupot* of the 1950s is already autonomous towards the town center. The urbanist *Gaston Bardet* identifies there during a study of the social topography of the city, the following facilities: schools for girls of *Eckmühl* and boys for Magnan, teachers training school, college on *Pierre* St, *Maraval* high school, the covered market of *Eckmühl*, the central market of *Cuvelier* and a church on *José* St. Also found in this area are the municipal park, the *Hammam Bouhadjar* train station, *Le Mondial* cinema hall actually *Tassili* and the new torero arenas in Oran (1948).

[23] The *O.P.H.B.M* is built at this location to supervise the production of West Algerian housing wearing the designation *H.B.M*.

[24] *Choupot* in particular and Oran in general were inhabited in the 1940s by a predominantly Spanish population during the French occupation.

[25] In particular by an urban renewal of the first outlying crown (absorption by the town center and replacement of the houses by dwelling buildings).

[26] In 1913, the municipality issued a vow for the application to Algeria of the law of July 22, 1922 on hygiene regulations for private roads and the compulsory establishment of owners unions. Almost at the same time, another wish was presented to the Council for the creation of an *Habitations à Bon Marché* public office, in accordance with the laws of April 12, 1906 and December 23, 1912. The decree of January 5, 1922, which made applicable to Algeria the law of March 14, 1919, came about very aptly to determine the Municipality to design a *P.A.E.E* of the city, as prescribed by this law (Lespès, 1938).

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Urban sprawl: An empirical analysis for Konya Province-Turkey

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Abstract

This study aims to determine the drivers of urban sprawl, additionally environmental impacts and socio-economic impacts of urban sprawl for Konya province in terms of three central counties. A comprehensive questionnaire, consistent with Analytical Hierarchy Process (AHP) technique, was designed to get the knowledge, experiences, values, interests and suggestions of experts as the key stakeholders of urban development regarding the urban sprawl problematic occur in the city. A total of 73 local authority experts participated into the survey. The findings show that urban sprawl was accepted as a threat for Konya by the experts. Macro-economic factors such as economic growth was envisaged as the primary driver of urban sprawl. The absence of upper limit for controlling urban sprawl has been highlighted. Thus, "Development of long-term integrated plans promoting sustainable development and the limitation of urban sprawl" was proposed as the most useful precaution for combating urban sprawl that could be taken by stakeholders. On the other hand, "conserving agricultural lands" was admitted as the most significant precaution at the scale of local authorities and Ministry of Environment and Urbanization for combating urban sprawl. Experts' overall evaluations regarding the level of urban sprawl explicitly show that Karatay was the most sprawled county conversely Selçuklu. The applied methodology also separately enables the weights of urban sprawl effect factors for each county. Results revealing the drivers, effects and the dimensions of urban sprawl in Konya are useful for local municipalities to route urban expansion in a sustainable manner.

Keywords

Analytical hierarchy process (AHP), Impacts of sprawl, Konya, Sustainable development, Urban sprawl.

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1. Introduction

Uncontrolled and sprawling growth in physical space is one of the primary problems of metropolitan cities (Serdaroğlu Sağ and Karaman, 2014). During urbanization, urban areas began to change as a response for changing living conditions and growing population. Consequently, cities began to exploit and make the maximum use of the natural areas to suffice the rising living standards of the people (Rezefar and Kramaz, 2014). One of the major effects of rapid urban growth is urban sprawl (Clara, 2008) which is responsible for changes in the physical environment, and in the form and spatial structure of cities (Bhatta, 2010). Today, urban sprawl is one of the contemporary issues of cities all over the world (Kumari, 2015). Resnik (2010) states that urban sprawl is an increasingly common feature of the built environment in the United States and other industrialized nations. Urban sprawl is a longstanding phenomenon. According to experts, urban sprawl is a phenomenon that began in the United States, although it is now seen to a lesser but still significant extent around the world (Daniels and Lapping, 2005). The phenomenon is one of the most important types of land-use changes currently affecting Europe (Couch et al., 2007). Sprawl dates back to the late 1800s, when suburbs popped up outside major cities on the East coast of the United States (Hoyt, 2008) and it accelerated greatly during the last half of the 20th century (Frumkin, 2002).

Urban sprawl has become a controversial issue raising numerous concerns due to the negative impacts it creates on a person's health, the environment, wildlife habitat, and economic disparity among several other issues in terms of sustainable urban development (Davodi-Far, 2014).

1.1. Definition of urban sprawl

Urban sprawl is commonly used concept to describe spatial expansion of urban uses into rural areas. Sprawl was described as 'the physical pattern of low-density expansion of large urban areas, under market conditions, mainly into the surrounding agricultural areas' by the European Environment Agency (2006a). Urban sprawl has been at the centre of current debate on urban structure. In the literature of urban planning or urban economics, there is a big debate on even the definition of urban sprawl itself (Kumari, 2015). Despite the fact that there are several definitions by the authors, their joint view is that urban sprawl occurs as a result of with uncontrolled (Jander, 2013; Kumari, 2015; Majid and Yahya, 2010; Terzi and Bölen, 2010; Travisi and Camagni, 2005), uncoordinated (Kumari, 2015; Terzi and Bölen, 2010), unplanned (Kumari, 2015; Majid and Yahya, 2010; Terzi and Bölen, 2010; Travisi and Camagni, 2005), and rapid peripheral growth of cities in a discontinuous manner, leaving urban voids and spreading onto (Polidoro et al., 2011) surrounding precious agricultural/rural areas (European Environment Agency, 2006a; Polidoro et al., 2011; Suzuki, 2015; Weerakoon, 2014) and urban sprawl leads to unsustainable urban expansion patterns (Travisi and Camagni, 2005) via destroying open spaces (Bhatta, 2010; Travisi et al, 2010) and putting valuable wildlife habitat and species at risk (Suzuki, 2015) and leads to inefficient spatial planning (Correia and Silva, 2015).

Correia and Silva (2015) have defined sprawl as 'the development of low-density mono-functional urban forms on rural areas surrounding urban agglomerations, centered on private car and road infrastructure and without effective spatial planning'.

Urban Sprawl refers to the outgrowth of the urban area, caused by the uncontrolled and uncoordinated and unplanned urban growth along the periphery of the cities, along highways, and along the road connecting a city (Kumari, 2015).

According to Travisi and Camagni (2005) a central component of most definitions urban sprawl is the uncontrolled spreading out of a given city, and its suburbs, over more and more rural or semi-rural land at the periphery of an urban area. They have pointed out that the sprawling process of expansion is typically disordered, unplanned, leading to often inefficient and unsustainable urban expansion patterns. Additionally, differently from traditional

urban expansion, the migration-more densely populated-is directed from core to towards the periphery of urban settlements.

1.2. Characteristics of urban sprawl

Urban sprawl is thought to be the antithesis of progressive urbanism. This uncontrolled outspread cheap haphazard housing threatens the future of entire regions (Jander, 2013). Sprawling cities are the opposite of compact cities-full of empty spaces that indicate the inefficiencies in development and highlight the consequences of uncontrolled growth (European Environment Agency, 2006a).

The urban sprawl phenomenon is largely characterized by patchy, scattered and strung out, segregated-single-use and automobile-oriented (Litman, 2015) urban fringe development with a tendency for discontinuity (European Environment Agency, 2006a; Litman, 2015) and extensive mix of residential, commercial, transport and associated land uses (European Environment Agency, 2006a) with random population densities in rural perimeters. Sprawl refers to commercial development in corridors (Polidoro et al., 2011) and regional, consolidated, larger services (shops, schools, parks, etc.) require automobile access (Litman, 2015). Galster et al. (2001) proposed 8 dimensions that characterise sprawl: density, continuity, concentration, clustering, centrality, nuclearity, mixed uses and proximity.

1.3. Causes&catalysts of urban sprawl

Causes&catalysts of urban sprawl differ region to region. Therefore, it is essential to determine causes forcing urban growth and the causes that are responsible for undesirable pattern or process of urban growth, for the analysis of urban growth towards achieving a sustainable urban growth.

Bhatta (2010), who has comphrehensively discussed the causes&catalysts of urban growth and sprawl, argued that increase in urban population, independent decisions of the competitors (government and/or private), expansion of economic base, industrialisation (transition process from agricultural to industrial employment), speculation, expectations of land appreciation at the urban fringe, land hunger attitude, legal disputes (e.g., ownership problem, subdivision problem, taxation problem, and tenant problem), physical geography, underpricing of urban infrastructure, lower living and property cost, lack of affordable housing, demand of more living space in the countryside, lesser controlled and loosely regulations in countryside, transportation routes to the countryside, road width, single-family residences, transition from joint family to nucleus family, credit and loan facilities to buy homes, government developmental policies, lack of proper planning policies, country-living desire, housing investment, and large lot size encourage excessive spatial growth of cities. Polidoro et al. (2011) tackles the characteristics of urban sprawl in three heading: (1) Sprawl as land-use standard. (2) Sprawl as a consequence of land-use. (3) Sprawl as a result of government structure/actions.

1.4. Impacts of urban sprawl

Sprawl have various environmental, socio-economic positive and negative impacts (benefits and costs) to the urban and rural population. However, the environmental and social costs of urban sprawl phenomenon are increasingly attracting attention in spatial planning.

A sprawling city creates environmental, social and economic issues affect the city, its region and the surrounding rural areas (European Environment Agency, 2006a). Environmental impacts of urban growth and extent of urban problems have been growing in complexity and relevance, generating strong imbalances between the city and its hinterland (Bhatta, 2010). It increasingly creates major impacts on the environment, on the social structure of an area and on national and local economies. (Couch et al., 2007; David Suzuki Fundation, 2003). Urban sprawl, once thought of as just an environmental issue, is currently gaining momentum as an emerging public health issue (Pohanka and Fitzgerald, 2004). There is a strong relationship between sprawl and its adverse effects on public health (Bray et al., 2005; Resnik, 2010; Suzuki, 2015).

The urban sprawl's resource impacts have been quantified and monetized in many studies. Concerns largely focus on negative consequences for residents and the local environment. There is substantial evidence that urban sprawl causes major and severe environmental and socio-economic costs/impacts.

Costs of sprawl mostly mentioned in the relevant literature are;

Environmental impacts such as; land conversion from farm and wild lands to housing and commercial development (Burchell et al., 2002); destruction of natural resources/agricultural lands (Couch et al. 2007; European Environment Agency, 2006a; Weerakoon, 2014); loss of soil biodiversity & natural capacity (European Environment Agency, 2006a; Maier et al, 2006; Polidoro et al., 2011; Rezefar and Kramaz, 2014); increases in resource use (European Environment Agency, 2006a); destruction of forests and consuming/reducing open-space areas (Bhatta, 2010; Couch et al. 2007; David Suzuki Fundation, 2003; Rezefar and Kramaz, 2014; Travisi and Camagni, 2005); diminution of landscape quality (Jaeger et al., 2010); ecosystem fragmentation (Couch et al., 2007); biodiversity (native flora and fauna) damages (David Suzuki Fundation, 2003) due to loss of agricultural land; imposing stress on ecosystems through noise and air pollution by the increased proximity and accessibility of urban activities to natural areas; displacing agricultural activities to the less productive areas (European Environment Agency, 2006a); disruption of farm economies due to the complaints of suburbanites about the odors, the dust, the pesticides, fertilizer, and the other externalities of agricultural production (Keene, 2001); destroying the wildlife (David Suzuki Fundation, 2003; Gurin, 2003; Hoyt, 2008; Resnik, 2010); loss of water permeability due to increased impervious areas (Frumkin, 2002) such as parking lots, roadways, driveways, residential areas, roofs, lawns and sewer lines (Gurin, 2003); water quality and quantity declines by increasing the amount of surface runoff (Daniels and Lapping, 2005; David Suzuki Fundation, 2003; Frumkin, 2002; Haase and Nuissl, 2007; Hoyt, 2008; Resnik, 2010); interfering with the recharge of groundwater (David Suzuki Fundation, 2003); esthetic degradation of landscape (Couch et al. 2007); eliminating the link between city-dwellers and the hinterland (Gurin, 2003) due to reduced open spaces; encouraging the growth of the oil and gas sector and emissions (Couch et al. 2007; Rezefar and Kramaz, 2014; Travisi et al, 2010) due to increased transportation demands (Daniels and Lapping, 2005; Gurin, 2003; Hoyt, 2008; Rezefar and Kramaz, 2014); the increase of abandoned and polluted lands (Rezefar and Kramaz, 2014); growing consumption of energy due to the increasing consumption of land and reductions in population densities (Gurin, 2003); contributing to climate change (David Suzuki Fundation, 2003; Gurin, 2003) and air pollution (Camagni et al. 2002; Daniels and Lapping, 2005; Ewing and Hamidi, 2014; Gurin, 2003; Pohanka and Fitzgerald, 2004; Resnik, 2010; Travisi and Camagni, 2005; Travisi et al, 2010) via excessive energy consumption in building roads or tracks and transportation (Gurin, 2003); having little regard for the natural environment (Gurin, 2003), and

Socio-economic impacts such as; promoting unimpeded and disorganized growth (Jaeger et al., 2010); monotonous suburban landscapes (Bhatta, 2010); destroy of urban and rural charm by replacing the unique qualities of places with the universal sameness characterized by roadside franchises thus creating places are lack of sense of place (Gurin, 2003); generating more segregated residential areas due to income and exacerbating urban social and economic divisions (European Environment Agency, 2006a); lifestyle changes (Couch et al., 2007; European Environment Agency, 2006a) such as raise in the number of households, greater consumption of resources per capita; higher disparities on wealth and loss of sense of community (Correia and Silva, 2015); neglecting urban centres (Couch et al., 2007); segregating houses from shops and workplaces (Gurin, 2003); increasing the distances between destinations, thus increasing per capita vehicle travel (Litman, 2015); increasing the auto-

mobile dependency (Daniels and Lapping, 2005; Gurin, 2003; Pohanka and Fitzgerald, 2004); high traffic of streets (Rezefar and Kramaz, 2014); raising local public-service costs (Bhatta, 2010; Burchell et al., 2002; Correia and Silva, 2015; Couch et al. 2007; Polidoro et al., 2011) such as providing police, fire, sanitation, snow removal (Gurin, 2003), emergency response (Ewing and Hamid, 2014), garbage recollection, recycling, urban cleaning, mail delivery, street light (Correia and Silva, 2015), school busing, and public transportation etc. services in low-density areas; higher costs of construction, management, operation and maintenance of infrastructures such as laying sewer, water and gas pipes, and building roads, electric grids, utility, school, etc. in suburbs (Camagni et al. 2002; Correia and Silva, 2015; Gurin, 2003; Polidoro et al., 2011); higher taxes for all municipality population due to the heavy financial burden (infrastructure&service costs) for municipalities (Couch et al., 2007); increased vehicle travel and associated costs (Travisi et al, 2010); lack of social capital (Ewing and Hamid, 2014); raised private-vehicle commute distances and times (Bhatta, 2010; Ewing and Hamid, 2014; Hoyt, 2008; Pohanka and Fitzgerald, 2004; Suzuki, 2015); underutilizing the infrastructure due to large urban voids and vacant lots (Polidoro et al., 2011); distributed production (Couch et al., 2007); real estate development costs (Burchell et al., 2002); issues of scale (Couch et al., 2007); energy inefficiency (Bhatta, 2010; European Environment Agency, 2006a; Gurin,2003); variations in residents' quality of life such as poor air quality and high noise levels (European Environment Agency, 2006a); hazards and stress-related mental health and/or physical health problems (European Environment Agency, 2006a; Resnik, 2010) including obesity (Couch et al. 2007; Ewing and Hamid, 2014; Pohanka and Fitzgerald, 2004; Resnik, 2010), diabetes, higher cardiovascular disease rates (Couch et al. 2007; Resnik, 2010) due to physical inactivity/ the sprawl lifestyle (Ewing and Hamid, 2014), higher asthma and other lung disorder rates (Hoyt, 2008; Pohanka and Fitzgerald, 2004; Resnik, 2010) due to greater air pollution (Pohanka and Fitzgerald, 2004), increased heat and quantity&quality of drinking water decline (Gurin, 2003); higher probability of motor vehicle crashes (Gurin, 2003); congestion (Travisi and Camagni, 2005); pedestrian injuries&-fatalities and anxiety due to increased danger and stress of long commutes (Frumkin, 2002); social isolation-the degradation of social relations, isolating the elderly, etc. (Frumkin, 2002; Morris, 2005); greater tendency for depression (Morris, 2005).

1.5. Policies against urban sprawl

It is essential to incorporate all adverse effects of sprawl (from environmental, socio-economic effects to health effects) into policy making (Frumkin, 2002). Smart growth is thought to be a rational way to create a planned community, and avoid the issues associated with urban sprawl (Daniels and Lapping, 2005; Frumkin, 2002; Hoyt, 2008; Resnik, 2010). Smart growth is defined as a policy framework that fights against sprawl via promoting an urban development pattern characterized by higher density- increased density (Resnik, 2010) via density bonuses, inclusionary zoning, incentive zoning, land assembly, graduated density zoning etc. (Qureshi and King, 2015)., adopting more contigous and more spatially compact development to minimize farm and ecologically productive land displacement (Litman, 2015), protecting natural resources-open spaces (Hoyt, 2008; Keene, 2001; Resnik, 2010) and heritage features from development impacts, maximizing land permeability of lots to absorb rainfall (David Suzuki Fundation, 2003), mixed land-use (Bhatta, 2010; Resnik, 2010) and clustered activities policy instead of isolated islands (Bhatta, 2010), creating walkable neighbourhoods thus increasing physical activity (David Suzuki Fundation, 2003; Resnik, 2010), adopting planning policies that reduce greenhouse gas and smog causing emissions (Bhatta, 2010; David Suzuki Fundation, 2003) such as limited road construction (Resnik, 2010), providing environmentally friendly multi modal transportation policies

supporting walking, cycling and public transit (Hoyt, 2008; Resnik, 2010), reducing society's private automobile dependency and more fossil fuel consumption and thereby pollution, etc. (Bhatta, 2010), limitations imposed on infrastructure (David Suzuki Fundation, 2003; Keene, 2001), more diverse and affordable housing options (Litman, 2015), avoiding to create spatial/architectural & socio-economic segregation/ heterogeneity via planning between central city and periphery (European Environment Agency, 2006a), limiting growth at the metropolitan fringe (Keene, 2001), encouraging inner city revitalization to promote environmental justice (Keene, 2001), adopting local urban growth boundaries contribute to more-compact regional growth (Burchell et al., 2002) and effective, coordinated regional planning.

This study aims to determine causes & consequences of urban sprawl in Konya from the perspectives of local authority experts as the implementer actors of urban planning process. The study contributes to achieve a sustainable urban growth in Konya city via determining the causes that are responsible for urban sprawl process, evaluating the consequences or the impacts of urban growth, and developing policies in response to sprawl.

2. Materials and methods

This study aims to identify the causes & consequences of urban sprawl being experienced by a rapidly growing urban area in Konya, lost its productive agricultural lands due to rapidly growth despite the city is commonly being known as an agriculture city and is called as 'crop storehouse' of Turkey. The methodological framework includes the use of Analytic Hierarchy Process (AHP) in evaluating the impacts of urban sprawl via prioritizing urban sprawl effect factors with the pairwise comparison technique compatible with AHP. Additionaly Google Earth images were compared to show the dimensions of urban sprawl in three central counties (Karatay, Meram and Selçuklu) of Konya.

2.1. The study area: Konya

Konya is among the most economically developed agricultural and industrial cities of Turkey. Konya is wheat / cereal warehouse of the country. The city is also important with its natural and historical riches. Çatalhöyük, one of the world's oldest settlements and a UNESCO World Heritage Site, is in Konya. The city was the capital of the Anatolian Seljuks and Karamanoğulları. Konya is one of the Turkey's most important industrial cities. Konya is the largest province in terms of its surface area and the seventh most populous city in Turkey (Figure 1).

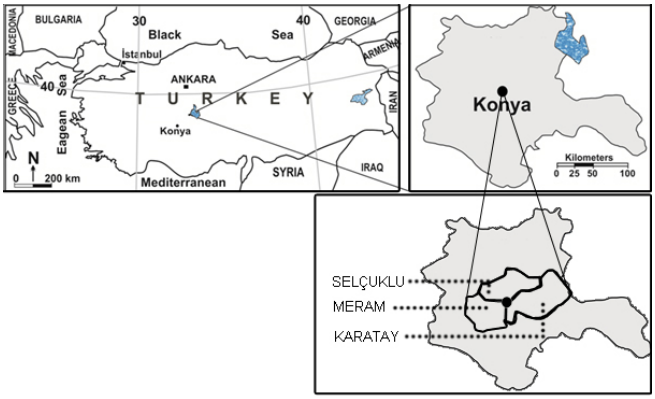


Figure 1. *Location of Konya city in Turkey.*

According to TUIK's 2019 data, 2.232.374 people live in Konya, consisting of 31 counties. The population of Konya's central counties (Karatay, Meram, Selçuklu) is 1.346.330 (60.3% of Konya Metropolitan Area) in 2019. Selçuklu is the most crowded central county (29.69%) than Meram (15.43%) and (Karatay (15.18%) (Table 1). The city has a rapid population growth from 1950s and this raising growth still

Table 1. *Konya Metropolitan Municipality central county populations.*

	Karatay		Meram		Selçuklu		Konya Metropolitan Municipality	
Years	**P**	**%**	**P**	**%**	**P**	**%**	**P**	**%**
2009	235.958	23.52	292.422	29.14	474.993	47.34	**1.003.373**	100.00
2010	242.495	23.41	298.169	28.78	495.363	47.81	**1.036.027**	100.00
2011	251.272	23.40	305.331	28.43	517.188	48.16	**1.073.791**	100.00
2012	256.455	23.15	311.312	28.10	540.119	48.75	**1.107.886**	100.00
2013	286.355	13.77	333.988	16.06	565.093	27.18	**2.079.225**	100.00
2014	295.332	14.00	340.817	16.16	584.644	27.72	**2.108.808**	100.00
2015	302.392	14.19	343.384	16.12	604.706	28.38	**2.130.544**	100.00
2016	308.983	14.30	346.366	16.03	622.846	28.82	**2.161.303**	100.00
2017	315.959	14.49	345.813	15.86	639.450	29.33	**2.180.149**	100.00
2018	323.659	14.67	342.315	15.52	648.850	29.42	**2.205.609**	100.00
2019	338.976	15.18	344.546	15.43	662.808	29.69	**2.232.374**	100.00

Source: TUIK-Address Based Population Registration System
*With the enactment of the Metropolitan Law No. 6360 in 2013 the authority and planning limits of the metropolitan municipalities have become the provincial property limits.
**P: Population

continues. In this process, the city has tended to spread outwardly due to the lack of a specific natural threshold (Akseki and Meşhur, 2013). Konya metropolitan area has three central counties: Karatay, Meram and Selçuklu. The plans, having been laid out since 1966 in Konya province, have directed the urban development toward the north in order to preserve the fertile agricultural lands in the south. However, a large amount of agricultural land has been built on due to the economic policies and tools which were insufficient to save agricultural lands in contrast to urban pressure. Konya's urban area expanded greatly after the 1950s. After the 1970s, a large amount of agricultural land, approximately 15.000 hectares, was urbanized (Akseki and Meşhur, 2013).

2.2. Method: Analysing urban sprawl via AHP

AHP is a commonly used multi criteria analysis technique to resolve complex decision-making processes which include multiple criteria, scenarios, and factors. AHP is a mathematical method for analysing complex decisions with multiple criteria (Bozdağ et al., 2016). It has been translated into the level of analysis by Thomas Saaty. The technique has become a widely known and used method for solving discrete multiple criteria problems (Saaty, 2001).

AHP is applied to the decision problem after it is structured hierarchically at different levels, each level consisting of a finite number of elements (Srdjevic, 2005). Fundamentally, AHP works by developing priorities for alternatives and the criteria are used to judge the alternatives (Saaty and Vargas, 2012). The estimation of the priorities from pairwise comparison matrices is the major constituent of the AHP. The importance or preferences of the decision elements are compared in a pairwise manner with regard to the element preceding them in the hierarchy (Mikhailov, 2000).

In this study an analytical hierarchy for Konya city to evaluate urban sprawl process (in terms of reasons and effects) based on AHP to estimate a global value for each (Yavuz & Baycan, 2013) central county has been structured. In this framework AHP methodologies carried out in five stages (Figure 2):

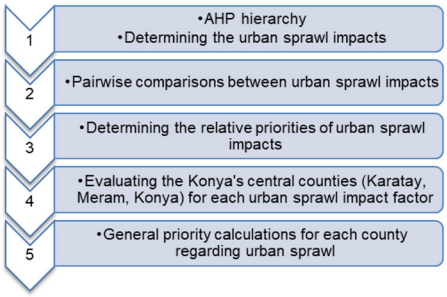


Figure 2. *Flowchart of AHP methodology.*

1st stage–developing AHP hierarchy: The aim of AHP application is to measure urban sprawl for three central counties of Konya city. Thus, urban sprawl impact groups are described in six categories: Loss of environmental resources, efficiency of compact areas vs. sprawled areas, natural, protected areas and rural environments, the quality of urban life and health, social impacts, economic impacts. Additionaly, these impacts are detailed. Table 2 shows the urban sprawl effect factors.

2nd stage–Pairwise comparisons between urban sprawl impact factors are performed using Saaty's (2008) nine-point scale (Table 3) separately within each urban sprawl impact group. The comparisons are used as input to the scope and then the relative priorities of urban sprawl impact factors are calculated using Eigen vector approach of AHP technique.

3rd stage– The next stage is calculation of a list of the relative weights, importance, or value of the urban sprawl impact factor groups (Loss of environmental resources, Efficiency of compact areas vs. sprawled areas, Natural, protected areas and rural environments, The quality of urban life and health, Social impacts, Economic impacts). In this process if "Loss of environmental resources" is absolutely more important than "Efficiency of compact areas vs. sprawled areas" and is rated at 9, then "Efficiency of compact areas vs. sprawled areas" must be absolutely less important than "Loss of environmental resources" and is valued at 1/9. These pairwise comparisons are carried out for all SWOT factors to be considered and the matrix is

completed. Relative priorities of urban sprawl impact factor groups are based on Eigen vector values of the pairwise comparisons.

4th stage–Evaluating the counties for each urban sprawl impact factor. At this stage, the relative priority value of each urban sprawl impact factor group is separately multiplied by the relative priority of each of the urban sprawl impact factors in this group. Thus, the overall priority value of each urban sprawl impact factor in related urban sprawl impact factor group is derived. This process is repeated for each urban sprawl impact factor groups. Finally, the overall priority values of all the urban sprawl impact factors of which total value is equal to 1 are obtained.

5th stage–General priority calculations -multiplying each priority of an alternative by the priority of its corresponding criterion and adding over all the criteria to obtain the overall priority of that alternative (Saaty, 2003)- for each county regarding urban sprawl.

2.3. Urban sprawl questionnaire

A comprehensive urban sprawl questionnaire within the scope of the research was performed to get the knowledge, experiences, values, and interests of experts, considered as the operators of urban development for the field survey. The survey was conducted in local authorities&official organizations related with urban development. The urban sprawl questionnaire consisted of two sections regarding the dimensions of urban sprawl in Konya. In the first section descriptive questions (occupation, institution, the places of work and home, transportation types, etc.) were asked, whereas in the second section, questions which were consistent with AHP, regarding drivers and environmental, socio-economic impacts of urban sprawl were asked. Urban sprawl survey conducted by European Environment Agency (2006b) was a good exemplary while designing the questionnaire questions. The cited questionnaire was adapted through improving after a comprehensive literature review and transforming it into a structure suitable to AHP methodology. For statistical analysis of the questionnaire, SPSS 16.0 (Statistical Package for the Social Sciences) and a Microsoft Office Excel worksheet which makes AHP calgulations possible were used. Descriptive statistics of participants were derived from SPSS. In order to evaluate the relation between the variables, chi-square test (x^2) was performed.

Table 2. *Urban sprawl effect factors.*

Factor groups:	Factors:	
Loss of environmental resources	ER-1	Loss of land and soil
	ER-2	Consumption of concrete and other building materials
	ER-3	Expansion of quarries near to natural reserves
	ER-4	Loss of soil permeability
	ER-5	Loss of soil biodiversity
Efficiency of compact areas vs. sprawled areas	CUA-1	Growing consumption of energy
	CUA-2	Increase in travel related energy consumption
	CUA-3	Growth in CO_2 emissions
	CUA-4	Distance to public service
	CUA-5	Growing consumption of water
Natural. protected areas and rural environments	R-1	Loss of natural habitats
	R-2	Loss of best agricultural areas
	R-3	Increase in the use of water and fertiliser in less productive areas
	R-4	Increase in water consumption in remote areas
	R-5	More noise in rural areas
The quality of urban life and health	UQ&H-1	Increase in air pollution
	UQ&H-2	Increase in respiratory problems (such as asthma)
	UQ&H-3	High noise level
	UQ&H-4	Traffic congestion
	UQ&H-5	Residential areas. establishments and commercial centers being away from each other and separation with sharp borders
	UQ&H-6	Reduction of availability and becoming as an automobile-dependent settlement depending on the expanding urban areas
	UQ&H-7	The lack of transportation options. inefficient public transport network
	UQ&H-8	The absence of functional open spaces within the city
	UQ&H-9	Increase in identical. unqualified. monotonous residentials
Social impacts	S-1	Exacerbation of social and economic division
	S-2	Segregation of residential areas
	S-3	Less social interaction
	S-4	Concentration of poor quality neighbourhoods in the inner city
Economic impacts	E-1	Increase in household expenditure due to commute long distances from home to work
	E-2	Lack of a strong downtown
	E-3	Cost of congestion for business in sprawled urban areas with inefficient transportation
	E-4	Additional costs of extension of urban infrastructures (transport. waste. waste water…) including utilities and related services. across the urban region
	E-5	No savings in provision of water and sewage facilities

Table 3. *Scale of two-paired comparison at AHP (Saaty, 2008).*

Intensity of Importance	Definition	Explanation
1	Equal Importance	Two activities contribute equally to the objective
3	Moderate Importance	Experience and judgment slightly favour one activity over another
5	Strong Importance	Experience and judgment strongly favour one activity over another
7	Very Strong Importance	An activity is favoured very strongly over another; its dominance demonstrated in practice
9	Extreme Importance	The evidence favouring one activity over another is of the highest possible order of affirmation
2. 4. 6. 8	Intermediate Values	Intermediate values

3. Empirical results

3.1. Urban sprawl problematic in Konya

The city of Konya is situated in fertile agricultural land, in the east of the renowned Meram vineyards and the two dam lakes supplying water to the city. However, a large amount of agricultural land has been urbanized and almost the entirety of Meram vineyards has turned into a residential area remaining within the city. This area, the greatest part of which consists of trees and agricultural areas divided up into plots in the 1970s is currently used as a

residential area. On the other hand, the urban area is getting closer to the dam lakes on the west. These growths in the urban area of Konya reflect the typical characteristics of urban sprawl. After the 1970s, the city made a leapfrog development toward the north. Urban functions which raise the population such as Selcuk University campus, bus terminal, and industrial areas are situated in the north. In time, idle spaces have become as built areas and the building density throughout the city has decreased. Consequently, the city covers a wider area with lower density (Akseki and Meşhur, 2013). Karakayacı and Karakayacı's (2019) analyses, aimed to determine urban sprawl boundaries in Konya and to identify the factors of affecting farmland value of urban sprawl, indicated that urban sprawl expands towards to the fertile farmlands in the south.

Akseki and Meşhur (2013) revealed that the urban area which emerged under 1966 plan increased by 191% by 1983, and the urban population has increased by 266% according to the planned period of land use dispersions. In the years 1983-1999, the urban area showed an increase of 440%, and the urban population growth remained at 27%. Depending upon the plans urban area has risen more than population growth. Consequently, urban density has decreased and the city has become automobile-dependent as there has been an urban sprawl above the population growth projected in the plans.

1/25.000 scaled Kon-Plan 2020, approved in 1999, is the first upper scale plan that forms Konya city's macroform. Master Plan, covering approximately 29.000 hectares, foresees the estimation of the urban population will be 1.8 million in 2020. 1999 plan envisages the settlement's size at the level of metropolitan city will be achieved via the development of new residential areas and also the addition of villages and towns to the city macroform (Figure 3). In this context, three sub-regions are planned for urban development aspects. The first is the north-northwest corridor on the highway Istanbul including Selcuk University Campus and its surroundings. The latter is northeast corridor which is developed on Ankara and Aksaray highways and defined as teknopol area. The third is the southern corridor envisaged along the Konya-Eregli and Konya-Karaman highways (Yenice, 2012). But, the 2009 urban population has exceeded the plan's envisaged population for 2020 due to the rapid urbanization.

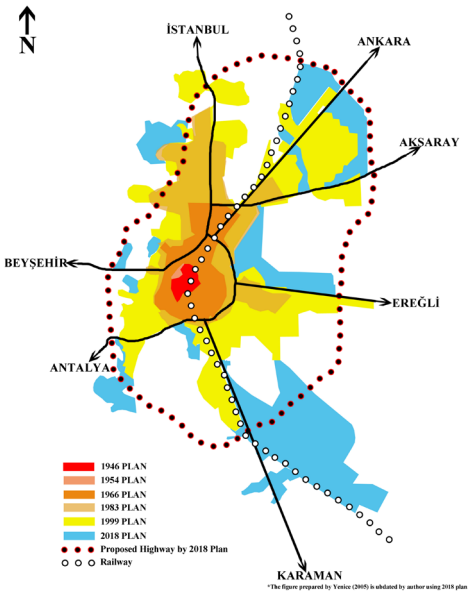


Figure 3. *Development of Konya urban macroform.*

In 2018 a master plan which was at 1/100.000 scale is approved. Konya-Karaman Planning Region 1/100.000 Scale Master Plan Revision (Figure 4) was approved (Turkey's Ministry of Environment and Urban Planning, 2020). New settlement areas are allocated for increasing population due to urban transport system and density decisions are re-edited by this plan. According to this plan the Konya metropolitan city centre population is estimated as 2.354.753 [Karatay: 519.417 (22,06%), Meram: 509.312 (21,62%), Selçuklu: 1.326.024 (56,32%)] in the year of 2043 (Konya Metropolitan City Municipality, 2016) in the year of 2043. This projection means that in Konya, urban areas will go more and more increasing to supply the demands of projected population (additional 1.000.000 people) during two decades in future.

Nowadays Konya has become a vehicle-oriented city with growth&spread process in urban areas. The urban area from north to south has reached to 30

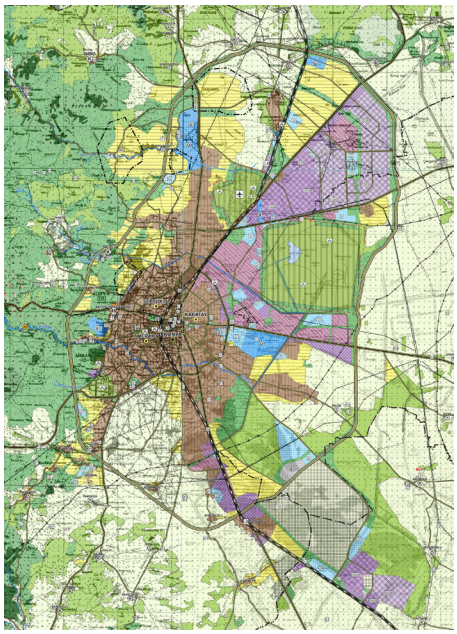
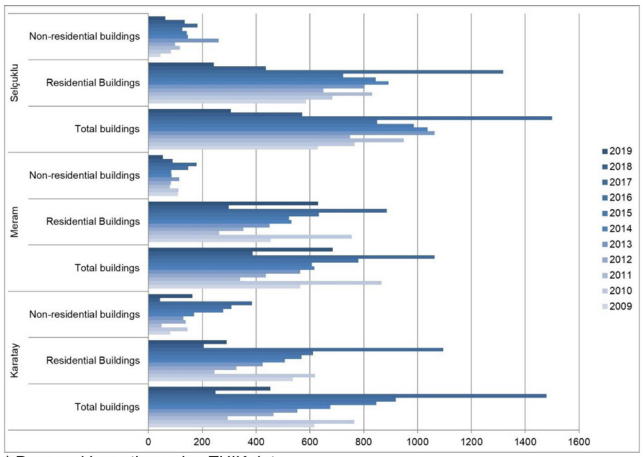


Figure 4. *The envisaged urban macroform of Konya for 2043 via Konya-Karaman Planning Region 1/100.000 Scale Master Plan (Konya Metropolitan City Municipality, 2016).*

km as well as the length of urban area from east to west has reached to 15 km. The problem of vehicle-oriented life between three central counties also goes for inside of the county. For example, residential areas at the northern of Selçuklu County have 17 km. distance to city centre. Additionally, residential areas located in the southwest of Meram County are 17 km away from the city center. As a result of extended macroform, the amount of motor vehicles has risen in the city. TUIK's data (2020) shows that vehicle ownership rate per thousand people in 2019 is 157 in Konya, which is above the Turkey rate (150 cars per thousand person) and Konya is located at 26th rank among other cities with this rate. The vehicle ownership rate per thousand people has increased by 40% (from 99 to 157) in the last decade.

Construction has increased due to the population growth in the city center. According to TUIK data regarding construction permits in Karatay, Meram and Selçuklu counties in period of 2009-2019, the construction permits issued for Selçuklu (9.407; 40%) are much more than the construction permits issued for Karatay (7.317; 31%) and Meram (6.911; 29%). In the last decade, residential construction permits issued for Selçuklu (8.009; 42%) is much more than the residential construction permits issued for Meram (5.776; 30%) and Karatay (5.431; 28%). Figure 5 explicitly shows the raise in construction permits in the period of 2009-2019.



* Prepared by author using TUIK data

Figure 5. *Development of construction permits in Karatay, Meram and Selçuklu (2009-2019).*

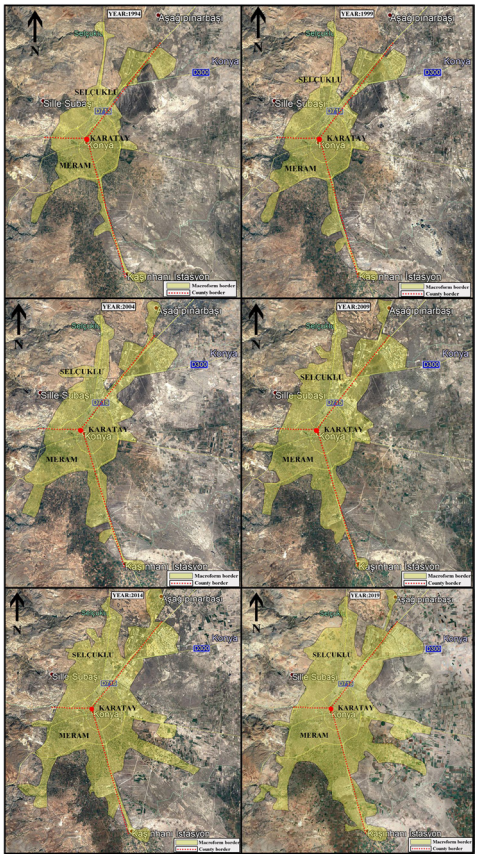


Figure 6. *Comparison of urban sprawl in Karatay, Meram and Selçuklu according to Google Earth data of 1994-2019.*

Figure 6 shows the rapid urban development and urban sprawl in Konya enabling a comparison of urban sprawl in Karatay, Meram and Selçuklu counties according to Google Earth data of 1994-2019 years.

Karatay is the county where traditional Konya urban texture is located in. There are 1-2 storey houses having semi-rural character at low density in the urban periphery. However, 6 and 8 storey, high density residential environment is being created in new settled and / or urban renewal areas. *Meram* is the county where population density has increased in recent years. There are residential areas at very low density in the county has a natural protected status. Multi-storey (more than 10 storey) houses are being built in urban transformation areas such as Ahmet Özcan and Şefik Can Streets also at the Havzan District. The residential areas have increased towards agricultural areas at the southern of the city and a social housing area named Gödene is planned in southwestern. *Selçuklu* is the latest constructed county of Konya where the high-storey buildings mostly exist in. The county contains two sub-districts in the center of Konya metropolitan area: Bosna Hersek and bus station sub-centers. The construction of the Selçuk University campus and large shopping centers caused the emergence of many subdivided lands in the city. Gated communities that use the land in a larger amount and which are not often added to the existing urban texture were observed in the continuation of this process. Ultimately, in the central-north direction urban voids were created due to the excess supply & underutilized residential areas & infrastructure. Bosna Hersek neighborhood has developed across the Selcuk University campus (east of Konya-Istanbul highway) exists in county boundaries at high-density. Beyhekim hospitals zone designed the north-western district of the city, urban bus station, stadium and shopping centers (such as Real, Kent Plaza, Novada Kulesite, Bera) are the upper scale planning decisions that attracts people to the area. Yazır neighborhood consists of prestige residences has the highest population density in Selçuklu county.

3.2. Descriptive statistics of participants

A total of 73 local authority experts participated in the survey. Questionnaires were performed with experts, such as archaeologist, environmental engineer, topographic engineer, economist, civil engineer, officer, architect, art historian and urban planner, working in local organizations. 84.9% of the participants were working in public sector, and 15.1% were working in non-governmental organizations (NGOs). Urban planners constituted the vast majority (46.6%) of experts.

Respondents mostly live in Selçuklu (45.2%), then respectively in Meram (38.4%) and Karatay (15.1%). Likewise, they mostly work in Selçuklu (47.9%), then respectively in Meram (38.4%) and Karatay (13.7%). The respondents generally prefer to live in the county of their workplaces (x^2=15,268, df=6, p=0, 018 ≤ 0,05).

69.9% of respondents have automobiles. Private car (54.8%), buses (12.3%) and pedestrian (11.0%) are predominate transportation modes of residential-workplace transportation. Minibus and two vehicle options are at the level of 8.2%. Use of two vehicles during residential-work transportation are in the form of: 'transportation via two minibuses', 'transportation via two buses', 'transportation via bus and minibus', 'transportation via private car and bus', 'transportation via tram and minibus', 'transportation via pedestrian+bus' and 'transportation via pedestrian+private car'. There are significant differences in variables such as 'automobile ownership and transportation type', additionally 'transportation time and satisfaction level' regarding residence-workplace travels. The majority of respondents, have private cars (78.43%), ensure their residence-workplace transportation by private car. Automobile ownership is at the level of 50.00% for the respondent experts who go to workplaces on foot.

The majority of respondents reach to their workplaces in 15 minutes (27.4%), 20 minutes (21.9%), 10 minutes (21.9%). However, 12.3 % respondents reach to their workplaces over a period of 30 minutes. The average residence-workplace trip duration is about

20 minutes. Due to high rate (54.8%) of 'access to the work by private car', the transportation time is low. There is a statistically significant relationship between 'residence-work transportation modes' and 'travel durations' (x^2 = 1.614, df = 66, p = 0.000 ≤ 0.05). Experts reach to their workplaces in 20 minutes on foot. They live in the residential areas which are 'far up to 30 minutes distances by private car', 'up to 45 minutes distances by bus' and 'up to 25 minutes distances by minibus'. The journey durations increase to 90 minutes when transportation is ensured via two vehicles.

3.3. Results of AHP based urban sprawl questionnaires

"The quality of urban life and health-*UQ&H*" (52%) is the most overrated urban sprawl effect factor groups by local authority experts. Additionally, significance of "Loss of environmental resources-*ER*" (17%) and "Natural, protected areas and rural environments" (17%) urban sprawl effect factor groups were emphasized at the second row (Table 4).

According to global prioritizations of local authority experts regarding the urban sprawl effect factors, the factor group of "The quality of urban life and health - *UQ&H*" has the most weights. In this group, *UQ&H-1:* Increase in air pollution is the most overrated urban sprawl effect factor. Furthermore they respectively supported the factors of; *ER-1*: Loss of land and soil, *UQ&H-3:* High noise level, *R-1:* Loss of natural habitats, *UQ&H-2:* Increase in respiratory problems (such as asthma), *UQ&H-5:* Residential areas, establishments and commercial centers being away from each other and separation with sharp borders, *UQ&H-8:* The absence of functional open spaces within the city, *UQ&H-9*: Increase in identical, unqualified, monotonous residential and *R-5:* More noise in rural areas (Figure 7, Table 4).

Table 4. *Evaluations of experts regarding urban sprawl effects.*

Impact Groups	Weights	Factors		Local Weight	Global Weight	Karatay	Meram	Selçuklu
Loss of environmental resources	0,172	ER-1	1	0,075	0,013	6	4	5
		ER-2	2	0,028	0,005	5	5	5
		ER-3	4	0,020	0,003	5	5	3
		ER-4	2	0,028	0,005	5	4	5
		ER-5	3	0,022	0,004	5	4	5
Efficiency of compact areas vs. sprawled areas	0,025	CUA-1	1	0,011	0,000	5	4	4
		CUA-2	2	0,003	0,000	5	5	5
		CUA-3	2	0,003	0,000	7	5	4
		CUA-4	2	0,003	0,000	6	5	5
		CUA-5	2	0,003	0,000	5	5	4
Natural, protected areas and rural environments	0,172	R-1	1	0,066	0,011	4	6	3
		R-2	5	0,018	0,003	6	6	3
		R-3	3	0,029	0,005	5	5	3
		R-4	4	0,019	0,003	5	5	3
		R-5	2	0,041	0,007	5	6	3
The quality of urban life and health	0,516	UQ&H-1	1	0,145	0,075	7	5	4
		UQ&H-2	3	0,058	0,030	6	6	4
		UQ&H-3	2	0,067	0,034	6	5	5
		UQ&H-4	6	0,038	0,020	6	5	5
		UQ&H-5	4	0,049	0,026	6	7	3
		UQ&H-6	8	0,029	0,015	6	6	5
		UQ&H-7	7	0,035	0,018	4	5	2
		UQ&H-8	5	0,047	0,024	4	4	3
		UQ&H-9	5	0,047	0,024	5	4	5
Social impacts	0,057	S-1	1	0,030	0,002	4	7	5
		S-2	2	0,012	0,001	5	7	5
		S-3	3	0,009	0,000	5	6	4
		S-4	4	0,007	0,000	7	6	2
Economic impacts	0,057	E1	1	0,021	0,001	6	5	4
		E-2	2	0,011	0,001	5	5	2
		E-3	3	0,009	0,001	5	4	4
		E-4	4	0,008	0,000	6	5	4
		E-5	4	0,008	0,000	6	5	4
					Total Weight:	0,365	0,344	0,291
					Normalized relative Importance (%):	36,5	34,4	29,1
					Ranking:	1	2	3

Degree of relationship	Number
Very low	1
Low	3
Medium	5
High	7
Very high	9

Global prioritizations of local authority experts regarding the urban sprawl effect factors show similar weight dispersions with local prioritizations (Figure 8, Table 4).

After global prioritizations, experts have evaluated 3 counties for each urban sprawl effect factor (Figure 9).

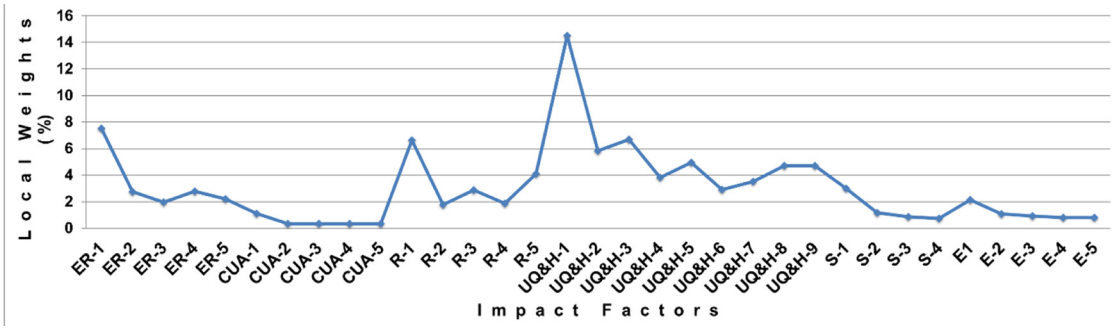


Figure 7. *Local prioritizations of local authority experts regarding the urban sprawl effect factors.*

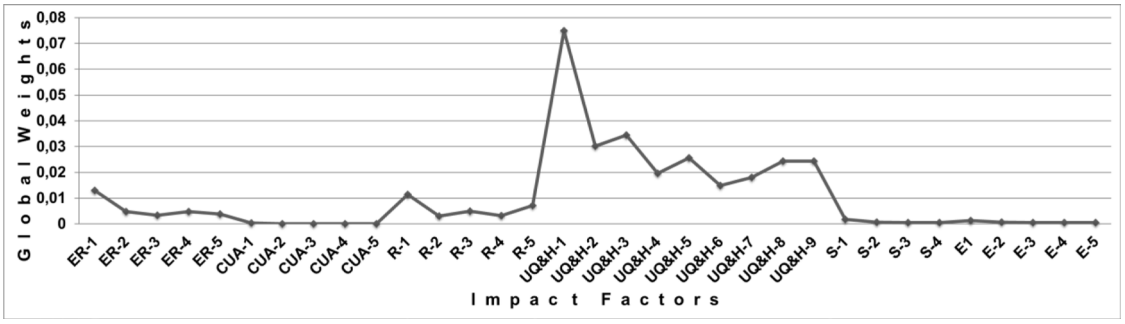


Figure 8. *Local prioritizations of local authority experts regarding the urban sprawl effect factors.*

In context of 'Loss of environmental resources'; Selçuklu was at the first row with the rates of 'Loss of land and soil' (3.56%), 'Loss of soil permeability' (1.47%) and 'Loss of soil bidiversity' (1.16 %). Karatay has high rates in 'Loss of land and soil' (2.77%), 'Loss of soil permeability' (0.82%) and 'Loss of soil bidiversity' (0.65%), too. Expert evaluations showed that Meram was in a better manner in context of 'Loss of environmental resources' (Figure 9).

In context of 'Efficiency of compact areas vs. sprawled areas'; Selçuklu was at the first row with the rates of 'Growing consumption of energy' (0.51%), 'Increase in travel related energy consumption' (0.16%), 'Distance to public servic' (0.14%) and 'Growing consumption of water' (0.14%). Karatay has high rate in 'Growth in CO^2 emissions' (0.15 %). While, Meram was in a better manner in context of 'Efficiency of compact areas vs. sprawled areas', Karatay and Meram have same rates in 'Increase in travel related energy consumption' (0.09%) and 'Growing consumption of water' (0.10%) (Figure 9).

In context of 'Natural, protected areas and rural environments'; Karatay, Selçuklu and Meram counties have equal share in the issues of 'Increase in the use of water and fertiliser in less productive areas' (0.95%) and 'Increase in water consumption in remote areas' (0.62%). The issue of 'Loss of best agricultural areas' was mostly observed in Karatay (0.65%), while the issues of 'More noise in rural areas' (1.69%) and 'Loss of natural habitats' (3.09%) were mostly observed in Meram county (Figure 9).

In context of 'The quality of urban life and health; Karatay has high rate in 'Increase in air pollution' (6.22%) problem. Selçuklu was at the first row with the urban sprawl issues of 'High noise level' (2.86%), 'Traffic congestion' (1.63%), 'Reduction of availability and becoming as a automobile-dependent settlement depending on the expanding urban areas (1.13%), 'The absence of functional open spaces within the city (2.15%) and 'Increase in identical, unqualified, monotonous residentials' (2.50%). Karatay, Meram and Selçuklu have same rate in 'Increase in respiratory problems (1.95%). The problems of 'Residential areas, establishments and commercial centers being away from each other and separation with sharp borders' (2.12%) and 'The lack of transportation options, inefficient public transport network' (1.59%) were mostly observed in Meram county (Figure 9).

In context of 'Social impacts'; Karatay has high rate in the issue of 'Concentration of poor quality neighbourhoods in the inner city' (0.35%). Although Meram and Selçuklu counties have high&equal rates in context of the issues of 'Exacerbation of social and economic division' (1.28%), 'Segregation of residential areas' (0.45%) and 'Less social interaction' (0.32%), Karatay has low rates in these problems due to its traditional structure (Figure 9).

In context of 'Economic impacts'; Karatay and Selçuklu have high&equal rates in context of the issues of 'Increase in household expenditure due to commute long distances from home to work' (0.79%), 'Additional costs of extension of urban infrastructures' (0.30%) and 'No savings in provision of water and sewage facilities (0.30%). Experts highly suffer from the 'Lack of a strong downtown' (0.41%) issue in Karatay and Meram. The issue of 'Cost of congestion for business in sprawled urban areas with inefficient transportation' (0.43%) was mostly observed in Selçuklu (Figure 9).

Through the two-paired comparisons of each urban sprawl effect factor group and urban sprawl effect factor, and also the evaluation of each county in the context of these urban sprawl effect factors, overall urban sprawl levels of Karatay (36.5%), Meram (34.4%) and Selçuklu (29.1%) counties (Table 4) were obtained. Expert evaluations indicated that Meram and Karatay counties have approximate sprawl levels. Selçuklu was accepted as the least sprawled county of Konya metropolitan area.

3.4. Expert views regarding urban sprawl problems

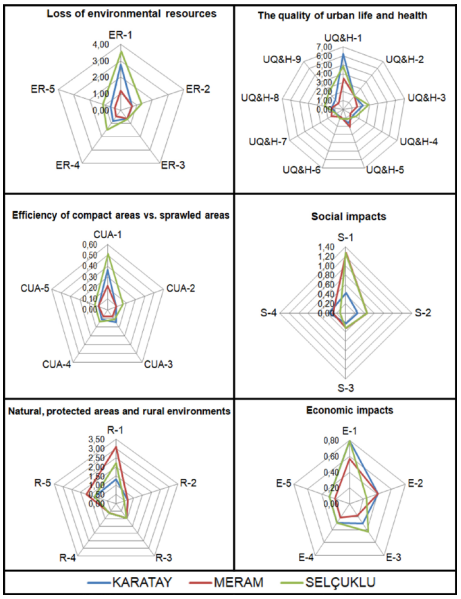


Figure 9. *Urban sprawl effect factor evaluations (%) of experts for 3 counties.*

56.2% of experts accept urban sprawl as a threat to Konya city. 39.7% of respondents have answered the question of "Is there an upper limit to control urban sprawl in Konya city center?" as "yes". They stated the existince of partial and insufficient limits (2.8%), control of sprawl via density decisions in zoning plans (1.4%) and protected areas (1.4%) as the limits to control urban sprawl in Konya. Research results show that acceptance of urban sprawl as a threat to Konya does not depend on variables such as 'being from Konya' or 'the duration of being in Konya'.

Experts pointed out macro-economic factors (30.87%) as the primary cause of urban sprawl phenomenon. Additionally, they accept that "regulatory approaches" (16.54%), "micro-economic factors" (14.24%) and "problems in the city center" (12.44 %) lead to urban sprawl. Hovewer experts have disregarded "residence preferences" (7.68%), "transportation policies (8.48%) and "demographic factors" (9.75%) as a sprawl causing factor.

Experts indicated that the most useful precaution for combating urban sprawl that could be taken by stakeholders (public, private and NGOs) is "Development of long-term integrated plans promoting sustainable development and the limitation of urban sprawl" (23.71%). As well as they have overrated the strategy of "Policies for the re-use of derelict brownfield sites and renovate of public spaces to assist in the creation of more compact urban forms" (19.81%). Experts have emphasized the importance of this strategy limits the excess sprawl of urban macroform in future due to presence of the factories remain in city centre. Participants also emphasized the importance of stakeholder participation in the planning and implementation stages via supporting the strategy of "Identification of the key partners including the private sector and community, as well as local, regional and national government and their mobilisation in the planning, implementation and evaluation of urban development" (16.51%).

The most significant precaution of local authorities and Ministry of Environment and Urbanization for combating urban sprawl has been pointed out as "to save agricultural lands" by the experts. They have also overrated the strategies of "more significant financial resources and regulations of the urban renewal policy" and "To control of illegal buildings".

4. Discussion and conclusion

Growing urban sprawl is a serious concern worldwide for a number of adverse environmental, spatial and socio-economic effects and is a major challenge on the way to sustainable land use (Jaeger and Schwick, 2014). Nowadays urban sprawl has become a common issue in Konya as a result of rapid population growth, too. The city has become a vehicle-dependent city with this growth&spread process

in urban areas. The applied questionnaire results reveal the drivers, effects and the dimensions of urban sprawl in Konya.

Most of the local authority experts (56.2%) were participated to the questionnaire, accepted urban sprawl as a threat to Konya. However, existence of an upper limit to control urban sprawl has been denied by majority (60.3%) of experts.

It is essential to understand the causes&catalysts of urban sprawl, which do not occur in the same way in all regions, for an efficient urban growth analysis in Konya. Determinations of experts regarding with the causes&catalysts of urban growth and sprawl in Konya are similar to the reviewed relevant literature in this study. Based on experts' views regarding the causes&catalysts of urban growth and sprawl "macro-economic factors", such as economic growth, are the primary (30.87%) important factors underlying urban sprawl phenomenon as argued by Bhatta (2010). Additionally, they accepted that "regulatory approaches" such as weak land use planning, poor enforcement of existing plans and lack of horizontal and vertical coordination and collaboration (16.54%); "micro-economic factors" such as rising living standards, price of land, availability of cheap agricultural land and competition between municipalities (14.24%); and "problems in the city center" (12.44%) lead to urban sprawl. However, experts have disregarded "residence preferences" as a driver of urban sprawl causing (7.68 %) on the contrary to Rezefar and Kramaz (2014).

Expert concerns regarding sprawl's adverse effects in Konya largely focus on environmental and socio-economic negative consequences for residents and the local environment in parallel with the reviewed literature. Experts have reached a consensus that urban sprawl's primary effecs are associated with quality of urban life and health (such as high noise level, increase in respiratory problems, residential areas, establishments and commercial centers being away from each other and separation with sharp borders, the absence of functional open spaces within the city, increase in identical, unqualified, monotonous residential, etc.) and the loss of environmental resources.

The analysis indicated that the most emphasized problems regarding urban sprawl in Konya city center by experts are;

- *In context of the quality of urban life and health: UQ&H-1:* Increase in air pollution in Karatay (6.22%), Selçuklu (4.84%) and Meram (3.46%); *UQ&H-3:* High noise level in Selçuklu (2.86%) and Karatay (2.23%); *UQ&H-9:* Increase in identical, unqualified, monotonous residentials in Selçuklu (2.50%); *UQ&H-8:* The absence of functional open spaces within the city in Selçuklu (2.15%); *UQ&H-5:* Residential areas, establishments and commercial centers being away from each other and separation with sharp borders in Meram (2.12%).
- *In context of loss of environmental resources: ER-1:* Loss of land and soil in Selçuklu (3.56%) ve Karatay (2.77%).
- *In context of in context of natural, protected areas and rural environments: R-1:* Loss of natural habitats in Meram (3.09%) and Selçuklu (2.21%).

Experts' overall urban sprawl evaluations via AHP (Table 4) highly differ from the data of constructed buildings (residential or non-residential) in last decade (Figure 5) and comparison of urban sprawl in three counties according to Google Earth data of 1994-2019 (Figure 6). According to the data of constructed buildings (residential or non-residential) in last decade the construction density was at the most in Selçuklu county than Meram and Karatay respectively in parallel with their populations (Table 1). According to the Google Earth data of 2009-2019 in terms of macroform expansion Selçuklu was the county where the most urban development observed than Karatay and Meram respectively.

However, AHP based comprehensive expert views regarding urban sprawl in Konya indicated that Karatay was the most sprawled county (36.5%) while Meram (34.4%) was secondly sprawled county and Selçuklu was the

least sprawled county (29.1%). AHP based comparative urban sprawl evaluation for three counties used in this study was enabled through the two-paired comparisons of each urban sprawl effect factor group and urban sprawl effect factor, and also the evaluation of each county in the context of these urban sprawl effect factors to *estimate a global urban sprawl value* for each central county. Thus, this difference is a natural consequence of the complexity of urban sprawl process (in terms of reasons and effects). AHP enables an effective multi criteria overall evaluation consisting many results, effects and priorities for this complex phenomenon.

Experts underlined the strategy of "development of long-term integrated plans promoting sustainable development and the limitation of urban sprawl" that could be taken by stakeholders against urban sprawl. Additionally, the strategy of "to save agricultural lands" was thought as the most significant precaution for combating urban sprawl that could be taken at the level of local authorities and Ministry of Environment and Urbanization. Therefore, definition of urban growth and services' distribution are crucial regarding the defined problems and potentials for each county in Konya. It is essential to incorporate all adverse effects of sprawl into policy making. However, in the light of findings, development and effective implementation of policies to eliminate the primary negative effects of urban sprawl on loss of environmental resources and the effects associated with quality of urban life and health have great of importance. This study provides evidence that urban policymakers should also direct their efforts to policies that conserve ecological resources, create a sustainable built-up environment and raise the liveability.

The integration of economic development, infrastructure and growth management should be ensured and natural assets should be protected by planning to keep away from urban sprawl's all kind of adverse consequences and ensure sustainable development. Agricultural fields which are significant for supplying of agricultural products to urban, sustaining rural life and also for creating open space should be used in a balance of protection and development. In this framework, it is essential to limit the growing urbanization toward to the efficient agricultural areas and prevent new constructions in these areas. Additionally, density zones should be re-edited in the city to limit the growing urbanization. New residential areas should be planned in the areas close to existing settlements to provide more contiguous development, while higher density should be preferred to prevent land losses. Local authorities should adopt planning policies like infill development which allow both residents and the local authorities to conserve existing urban assets by building on vacant, abandoned, or underutilized land within the existing city limits to create coordinated and compact urban growth strategies.

Green infrastructure systems, supporting enhanced efficiency of natural resources, health&well-being (air quality and noise regulation, raising accessibility, better health conditions) land&soil management, low-carbon transport, water management, mediate the impact of urban populations on the natural environment. Thus, green infrastructure systems should be universalized in Konya to mitigate adverse consequences of sprawl. It is essential to optimize the accessibility all-over the city and create walkable neighbourhoods. Less fragmented, better integrated transportation modes should be encouraged throughout the city.

Results of this study, were derived via a structured analytical hierarchy for Konya city to evaluate urban sprawl process in terms of reasons and effects based on AHP to estimate a global value for each central county, illustrate the drivers, environmental, spatial and socio-economic effects and dimensions of urban sprawl for Konya city. However, the results also represent guidelines for other cities to manage urban growth due to the fact that similar environmental, spatial and socio-economic problems have increasingly being experienced in a significant part of cities. Additionally, the study presents a comphrehensive&actual urban sprawl literature review. The findings

provide a favorable systematic for the key stakeholders of urban development to understand urban sprawl in terms of reasons and effects through exploring and identifying criteria, thereby to design effective policy solutions for combatting with urban sprawl and ultimately contributing sustainable development.

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Issues in the planning and design of university campuses in Turkey

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Abstract

Universities have crucial importance in producing and transmitting knowledge, and formulating an effective and critical public sphere that meets the public with the university population. Their spatial characteristics of universities also refer to an important position within the urban fabric: with dense students' and academicians' population, they occupy a considerable amount of spaces in cities. Their spatial formations change over time as new buildings are added and student numbers increased.

In that respect, this article seeks to explore how the spatial configurations of university campuses have evolved over time in Turkey. In order to explore the changes in spatial layout of university campuses, especially the organization of public spaces and their relations with the campus buildings, we have narrowed our focus through a chronological reading. Two methods of collecting data are used: First, we reviewed design articles about university campuses in architectural periodicals and online architecture databases. Second, the Five Year Development Plans of Turkish State Planning Organization (DPT 5 Yıllık Planları), have been examined to follow the governmental considerations. In addition, we made interviews with some of the architects who took part in the campus planning process of the cases that are selected for this article. In conclusion, analysis of the spatial configuration of campuses in Turkey reveals some unexpected insights about particular design approaches of universities. The analysis of specific campuses in chronological order shows that it is possible to trace specific campus design tendencies that are peculiar to specific periods.

Keywords
Campus design, Competitions, Youth, Public space, Turkey.

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1. Introduction

Universities play complex roles in defining the public realm: on the one hand, in their traditional role they provide specific environments for teaching, learning and research, while on the other hand housing a variety of spaces and cultural and social facilities for students, academicians, staff and the greater urban populations (Gumprecht, 2007). The dominance of young people in their populations cultivates a dynamic public environment in which fun and education intersect on the same ground as where the public realm is produced and shared. Furthermore, the spatial characteristics of universities differ from other districts in the city. Universities occupy a considerable amount of space in cities, hosting green areas with less noise and pollution, as well as slow traffic (Bender, 1998; Gumprecht, 1993). Their spatial formations change over time as new buildings are added and as student numbers increase, or they may spread to different spaces inside the city, expand beyond the original site be added to with new campuses. In this respect, the spatial organization of universities requires a chronological and critical reading in urban design studies.

In the development of universities and their physical imprints, only three countries matter: the United Kingdom, Germany and the United States (Muthesius 2000, 12). The number of studies considering the rest of the world, on the other hand, is rather limited. Starting in the 12th century these countries spearheaded major changes in the development of university profiles, becoming role models for the rest of the world. In the history of campus design, universities have been categorized into three types: city campuses, the American campus model and mega structures (Turner, 1987; Davis and Davis 1990; Hashimhony and Haina, 2006). The world's first universities, established in Bologna and Paris in the 12th century, were founded and firmly embedded in the urban context. They were city universities that were dispersed organically in different locations (Brockliss, 2000, 165). However, from the 19th century onwards, universities in the United States started to be established in green and natural surroundings, usually on the outskirts of cities. This reflected the changing understanding of the ideal educational institution as an inward-focused learning community with a distinct spatial organization that in time would come to be referred to as a campus. The word *"campus"* first started to be linked to universities in the 18th century, with its origins attributed first to Princeton's University campus, the main space of which was a sort of village green (Turner, 47). This kind of spatial organization was also seen in the University of Virginia, built in 1817 by Thomas Jefferson, where the idea was to create an academic village in which students and academicians could study and concentrate, far from the distractions of city life (Turner, 12). The campus layout was simple, featuring a wide, tree-lined central space surrounded by the professors' rooms and classrooms. The third model, which emerged after World War II, was the mega-structure, designed either as single large buildings, or as a group of interconnected buildings integrating the different functions within a continuous structure (Davis and Davis 1990, 43). Many of the universities established in the late 1960s, such as the Universities of Essex, Scarborough, Simon Fraser (Figure 7) and East Anglia, can be considered early examples of mega structures.

The university campus model is a relatively recent addition to the educational milieu when compared to other countries, and surprisingly, its history in Turkey has received little attention from an architectural history perspective. Although there have been several studies focusing on the institutional changes witnessed in higher education (Tekeli, 2010, Dölen, 2010, Hatiboglu, 1998), there have been very few addressing the physical and spatial development of campuses (Kortan, 1981; Türeyen, 2003). As such, this article explores the spatial principles behind campuses. Rather than presenting an analysis of the architectural styles of universities, the intention here is to take a narrower focus by examining the defining moments in different periods to explore the changes in spatial layout of university campuses. Previous studies (Hashimhony and Haina, 2006; Krushwitz, 2010; Larkham, 2000) discuss-

ing the spatial models of campuses in relation to some basic parameters are important in evaluating campuses as distinct urban forms, as Larkham states. Similar to Larkham, Kruschwitz defines three different forms describing the relationship between campuses and cities, being 1.) integrated urban settings 2.) affiliated urban settings and 3.) self-sufficient settings (Kruschwitz, 2010, 3-4), and then went on to define the spatial compositions of built and un-built environments as 1) compact; 2) spacious; and 3) laminar

In the present study, we make use of some spatial parameters in an evaluation of campus models and compare them with each other through a morphological analysis. The design approach of each campus will be evaluated according to:

1. The spatial compositions of the built and un-built environment
2. The functional zones
3. The formal character of the gathering spaces and their locations
4. The circulation networks

Universities in Turkey are increasing in quantity. *As of 2018*, the total number of public and foundation universities was 206, of which 119 were public institutions. Considering the relationship between universities and cities, Turkey has examples of all three campus models, although self-sufficient campuses have gradually come to dominate over the years. Universities, both new and old, prefer to move to public lands outside the city due to the lack of, or high price of land inside the city (Erkman, 1990). Today, 59 of the 119 state universities in Turkey are considered as single entities, and most of the new universities founded since 2000 have been established on single campuses. Uludağ University, the Izmir Institute of Technology (IYTE), Gaziosmanpaşa University and Karamanoğlu Mehmet Bey University are examples from different periods of universities designed from the outset as single campuses. While Ege University, KTÜ and METU were all originally designed as self-sufficient settings, over the years they have become merged into the surrounding districts, becoming affiliated campuses models within walking distance of the neighboring city districts.

In this article we focus on specific state universities for which archival data is available, with emphasis on the analysis of campus designs that resulted from competitive tenders. To clarify the various approaches to campus planning, we review planning and design articles relating to university campuses published in architectural periodicals and online architectural databases, including *Mimarlık*, *Arkitekt* and *Arrademento*, as significant resources in this respect, reflecting on the dynamics of the particular eras of campus planning. In addition, the 5-Year Development Plans of the Turkish State Planning Organization *(DPT 5 Yıllık Planları),* and the Report for Strategic Directions for Higher Education in 2007 are examined to identify the governmental decisions that influenced the spatial planning practices of universities. The identified campuses are examined in chronological order according to their dates of establishment, and an analysis is made of the planning principles applied at the time of the first universities.

2. Historical overview of universities in Turkey

The *"Darülfünun"* was the first higher education institution in the Ottoman Empire. Dating back to the 1850s, the *Darülfünun* was planned as a state-sponsored college where students both lived in and studied, and was housed in a gigantic building in the center of İstanbul (İhsanoğlu, 1993, 561). The advent of modern universities in Turkey coincided with the proclamation of Republic in 1923 (Gürüz, 2001). In parallel to the rise in national aspirations among the nation states, the creation of a young generation instilled with the ideologies of the new Republic became the main purpose of higher education (Demir, 2012, 91). *The Higher Education Law* entered into force in 1933, defining universities as places of research and teaching, with Istanbul University being the first university in modern Turkey to introduce the German research institution model.

After World War II, Turkey witnessed a rapid growth in population, and an inevitable increase in literacy rates. Following the arrival of the multi-party system, the Democratic Party came to

power and increased at Turkey's contacts with the West. Aiming to better satisfy the need for highly qualified technical personnel (Şimsek, p.1005), the new government founded four new universities: Ege University, Karadeniz Technical University (KTU), Ataturk University and Middle East Technical University (METU), where new fields of higher education were offered, such as urban planning, architecture and administrative sciences.

The student movements of the 1970s became a major force for change in the organizational and physical structures of Turkey's universities. Student activism increased in the form of occasional boycotts, sit-ins, conference attendance and regular political discussions on university campuses. Eventually, the 1971 military coup brought about a sudden end to political movements within universities, and the Council of Higher Education (Birinci YÖK) became the main coordinating body for the supervision of and intervention in the administration of universities. "Spreading universities to the different regions" to redress the established social and economic imbalance emerged as a theme at the beginning of the 1970s, having first been highlighted in the Higher Education Research Report of the DPT in 1968 *(Yükseköğretim Araştırması Raporu)*. The proximity of universities to developing areas in each region was an important criterion for the selection of locations,[1] and based on these considerations, the 10 new universities that were founded at the time were all in smaller cities.

The liberal policies in the 1980s focused particularly on the economy, transportation and higher education, with the aim being to change the face of the country (Şimsek, 966). The re-establishment of the Council of Higher Education was an important outcome of the new government's activities, although the most important change was the unification of the previously-established separate academies and vocational schools within the faculties of new universities.[2] The Fourth 5-Year Development Plan (19791983) set out a policy designed to increase academic collaboration and to reduce the differences in status of different institutions, as many universities were experiencing significant problems in creating an appropriate environment for learning, studying and living. Only Yüzüncü Yıl University was founded from scratch, free of the hindrance of preexisting faculties or institutions.

In 1992, a sudden increase was seen in the number of universities, with 21 public universities and two technology institutions opening on a single day – most in the west of Turkey. Unlike the universities of the 1980s, most of those that opened in the 1990s were founded in small or medium sized cities (Toprak, 2012, 12). Enhancing university-industry partnerships in professional research, and providing incentives to the private sector (Sixth 5-Year Development Plan, 1990) were defined as solutions contributing to the establishment of new universities. Furthermore, the Ninth 5-Year Development Plan suggested building techno parks inside or close to universities, which was presented as a way of developing the physical infrastructure of the universities. The opening of such technological institutions was clear evidence to the State's intention to boost industry-based research.

Between 2006 and 2008, 41 new universities were founded as part of the government policy to establish a university in every city, and the pledge that "There will be no city without a university" was reiterated in the 58th Government Plan (2002). According to the policy, universities should play a significant role in the economic development of cities, and so some universities became scientific and technological institutions.[3] However, those founded in the smaller cities came to experience serious problems in the creation of an appropriate physical environment, and it became a struggle to complete the physical infrastructure and faculty programs of most new universities. Furthermore, the built environment did not meet the social needs of the campus community. From 2010 to the present day, many universities have been founded in such economically and culturally developed cities as Istanbul, Ankara, Kayseri and Konya (Sargın, 2007). Opening new universities in cities with old and well-established universities has been linked to the policies of the current government

to promote "the construction of techno-cities" promoted in the 9th Higher Education Redevelopment Plan and the Law on Technology Development *(Teknoloji Geliştirme Yasası - 2001).*

Reviewing the cases, it is possible to assume that changes in the history of higher education in Turkey were mostly oriented by state policies. These policies furthermore, were developed in response to the occurrences at national level. The public universities still lack their own strategic governance since they are financially supervised by the government. It is surprising however, to realize that guidelines that would lead physical and environmental improvement in the universities are neither present in the plans. Once developed, such guidelines would open a way for reforms which can be adapted to a variety of situations at several campuses.

2.1. Early campuses between 1950 and 1970s

The first modern universities (İstanbul University, ITU and Ankara University) lacked campuses in their initial forms, having been founded in old buildings in the city centers, as was the case in several European city universities. However, the understanding of the spatial organization of universities changed in Turkey after World War II, similar to the changes seen around the world. In the 1950s, universities started to cover large expanses of land with the creation of self-contained campuses, with METU, Ege University and KTU in the 1950s being the first campus universities designed according to formal master plans. These institutions prioritized the movement of pedestrians, with campuses designed as self-sufficient settings, isolated from the city, where all the main functions needed by students and academicians in everyday life were located in a single and introverted location.

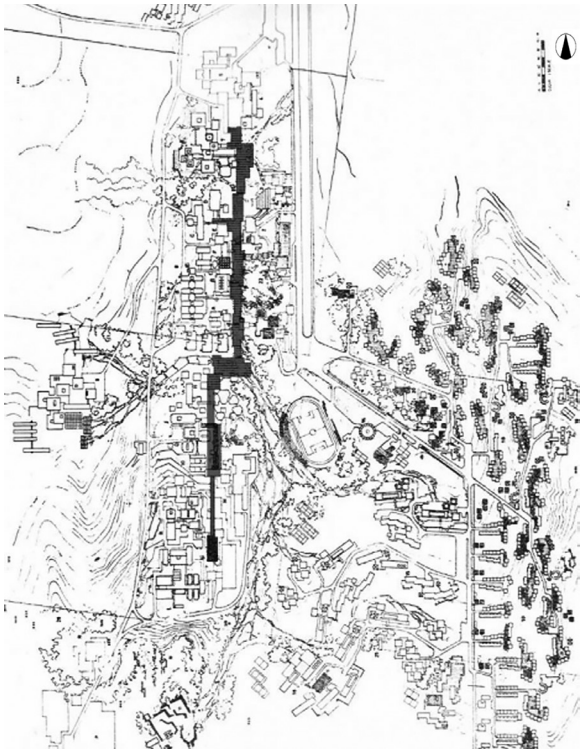

Figure 1. *Initial site plan of the METU campus; the alley is marked by grey (Source: Mimarlık Journal, vol 43).*

All of these three campus designs, among others, resulted from architectural design competitions. Altuğ and Behruz Çinici's design won first prize in the METU campus planning competition in 1959, while Ataturk University was created on the basis of a winning design (1956) by Enver Tokay, Hayati Tabanlıoğlu, Ayhan Tayman and Behruz Çinici. Perran Doğancı and her team won the first prize in the Ege University campus planning competition (1959), and Mustafa Polatoğlu and Nihat Güner won the KTU campus design competition (1962). Most campuses were built based on the main spatial designs of the winning projects. These architectural and planning competitions were publicly announced, and the winning projects and jury reports were extensively publicized in architectural journals such as *Mimarlık and Arkitekt.*

All of the above were conceived following the inward focused and self-sufficient settings seen in the campus models of the United States and Western European, with facilities gathered in a single location to create a space devoted not only to learning, but also to living and recreation. In Turkey, the METU campus is the most obvious example of this campus model from this period. The campus is located in the south-west of the city along the Eskişehir Road, five kilometers from the new parliament building. Built on formerly barren land, the site was cleared for landscaping and the construction of buildings (Sargın and Savaş, 2013, 97). In reference to the Kruschwitz definition, the academic zone was *compactly* arranged around

a central alley, and the whole configuration as arranged *spaciously*. The alley (pedestrian road) between the faculties was isolated from the vehicular access as a linear, pedestrian-friendly environment. All facilities, including the dorms and faculties, were within a 20-minute walk, and the alley was supported by a variety of landscape elements, such as small pools, lawns, and spaces for sitting and socializing. Open spaces of different sizes were well-defined, mostly around the academic buildings, serving as focal points for social and leisure activities (Figure 1). The main components of the campus were located within three main zones, for the faculties, residences and social amenities. The social amenities included a shopping center, cinema and small market (Çinici and Çinici, 1965). The jury report stated that the two most notable aspects of the project were the utilization of the site in accordance with main conceptual principles of the university committee, and the production of architectural unity (*Arkitekt*, 1965, V. 3).

The other three campuses were based on similar design principles, including the creation of open spaces close to the faculties, as the most obvious spatial characteristic of the winning projects of later campuses in the 1950s. For example, for the Ataturk University campus design (Figure 2),

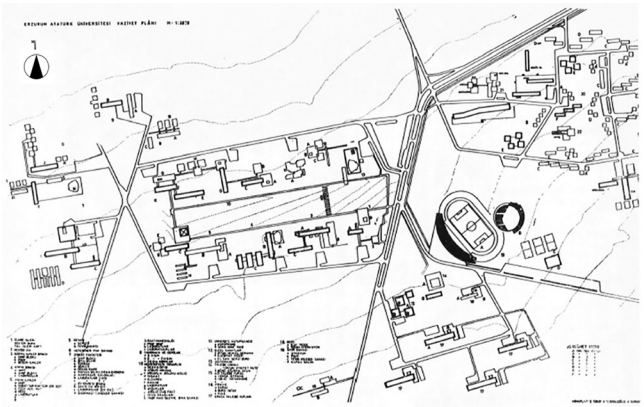

Figure 2. *Winning project for Atatürk University campus by Tabanlıoğlu Tayman and Çinici.*

mirroring that of METU, a pedestrian alley, free of traffic, was suggested as a linking spine, giving access to the surrounding buildings (Çinici and Çinici, 19). The project featured a monumental alley that was described as a key element in the production of a "the university aura". The intention was for social interactions in the community to be promoted as a result of informal interactions in the alley, while three different zones were defined, being academic, residential and social, while the main traffic road was structured to intensify the zoning of different functions. The campus has a spacious composition, with buildings located around the edge of the area and along a ring-road system. The physical relationship between the Ataturk Uni-

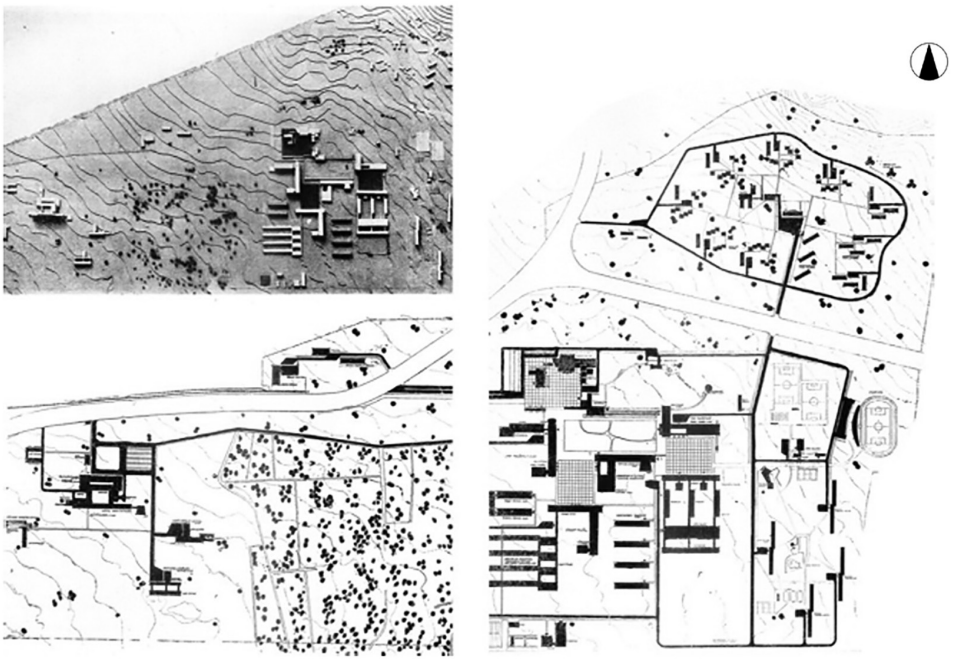

Figure 3. *Winning project for Ege University campus by Doğancı (Source: Arkitekt 3, 1959).*

versity campus and the city, however, was interpreted differently to the other three campuses, being located on a flat area within walking distance of the city center. The winning design showed the central vehicular traffic route extending to the historic city center, providing a "promenade for the city's residents." Unlike the other campuses, the intention was for Atatürk University to be integrated into the urban setting.

The Ege University campus is located just outside the Bornova district of İzmir, and was designed as two separate zones, with the hospital and medical faculty buildings in the west part isolated from the academic facilities and library building in the east part. The campus has a laminar arrangement, with buildings and open spaces located around a grid road system, intensified with secondary roads. The major educational precincts are arranged as enclaves, and are connected to each other by long pedestrian access routes and vehicular roads. Open spaces in the form of quadrangles and plazas were established close to the faculty buildings (*Arkitekt*, 1959, V.3, 109). As stated in the jury report, the plazas were kept to a human scale and the faculty buildings were directly connected to other important spaces, such as the dining area and library (Figure 3). The inner courts of faculty buildings reflected the social character of the design, prioritizing student interaction and communication in public spaces (Kayın and Özkaban, 2013, 241).

The campus of KTU has laminar composition, similar to that of the Ege campus. The KTU campus sits on two hillsides, with student dormitories arranged on one and the academic facilities on the other. Like the other three campuses, walking distances have been maintained, and the main circulation is based on a linear vehicular road that extends to main gate and connects to the sports hall and faculties (Figure 4). Open terraces built around the academic buildings are the main gathering points, as "public spaces that students can get around and hang out" (*Mimarlık*, 1965, 31-32). Unlike the alley in the METU campus, the terraces in KTU are intended to be visible and accessible from the vehicular access road and the main gate.

The current layouts of these four campuses (Figure 5) reveal that the main spatial principles of the initial plans, including the main zones, vehicular access roads and singular public spaces around the academic units have been maintained as originally planned, other than for the new additions. The educational buildings, residences and techno-cities in four

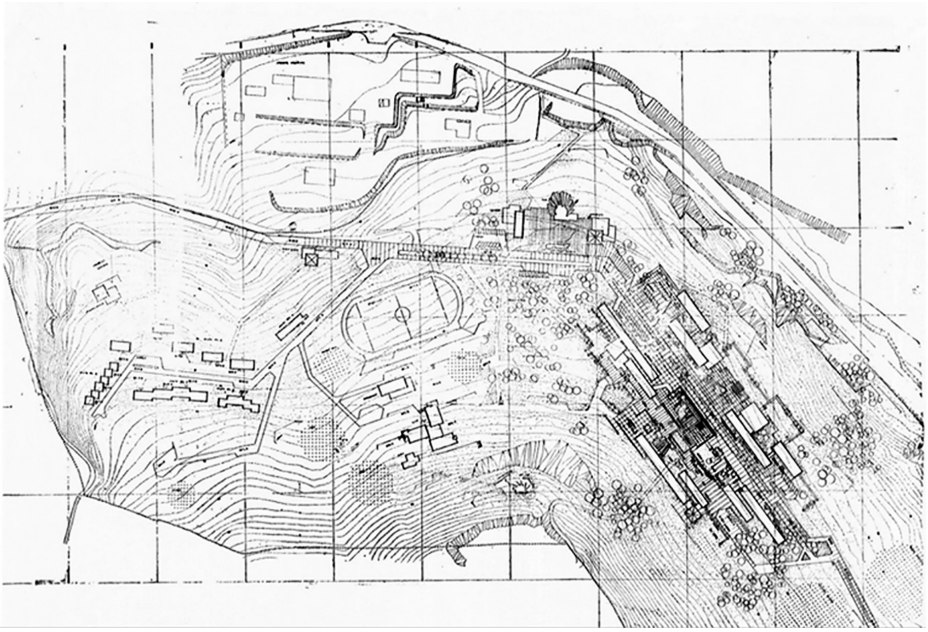

Figure 4. *Winning project for Karadeniz Teknik University campus by Güner and Polatoğlu (Source Mimarlık 1, 1971).*

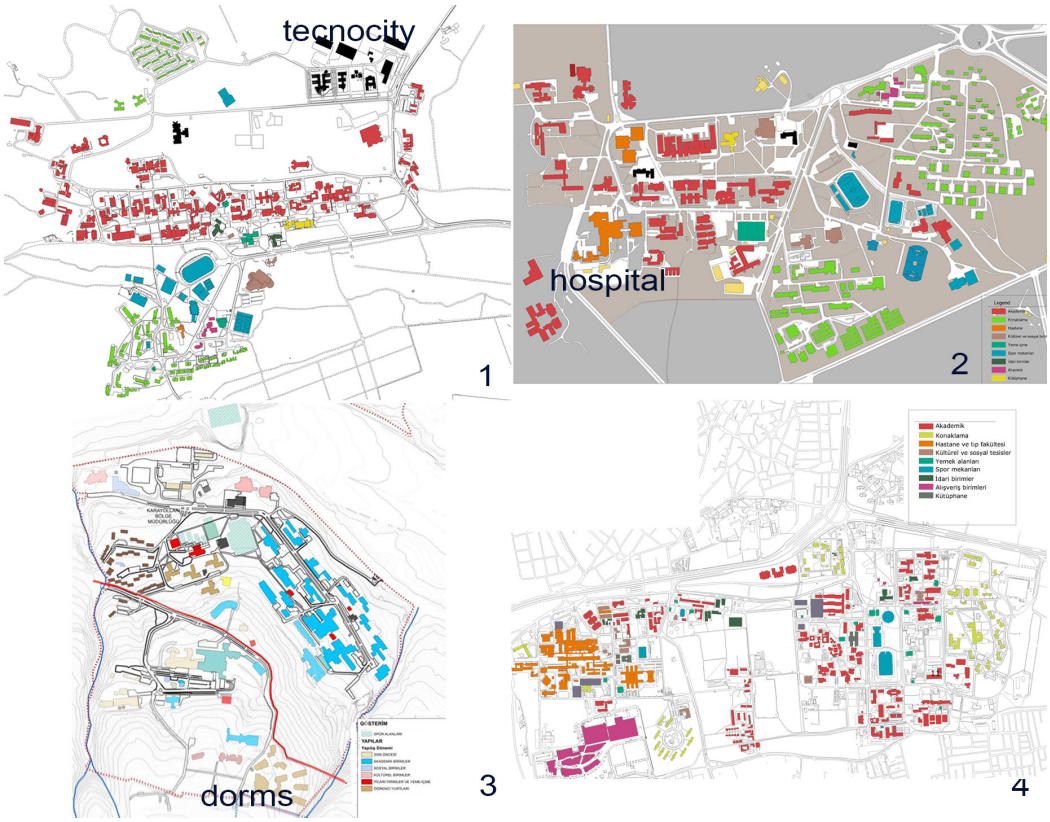

Figure 5. *The current layouts of these four campuses after new buildings added. These images are coloured by the author.*

campuses face inward, and while the academic units are fragmented and clustered around open spaces, the dormitories generally appear to be independent buildings. The techno-city in METU and the dormitory units in KTU have been located far from the main campus, and are somewhat isolated. Similar to the METU techno city, the hospital units in the southern part of the Ataturk University campus are isolated from the main campus, and are accessible via a second campus entrance. The other key change in the current design of these campuses is the dormitory access. In all of the universities other than METU, the dormitories are surrounded by fences with security points.

In the 1970s, the architectural competitions for the design of university campuses influenced the organization of the new campuses of already existing universities. The Ayazağa campus of ITU, the campus of Diyarbakır Ziya Gökalp University and Bursa University campus were all designed as grids in which different facilities were connected under one structure. Taking a similar approach to the new ITU campus, the campus of Diyarbakır Ziya Gökalp University was designed as mono-structure grid, in which all buildings were under one roof. Such a spatial layout resembles more those of post-war university campuses, such as Simon Fraser University in Canada. The main principle was production of inner courtyards between different facilities to promote the interactions between them.

The Diyarbakır University campus (Figure 6) is located 3 kilometers from central Diyarbakır on the Dicle Plain, and was planned as self-sufficient setting. According to Kruschwitz's defini-

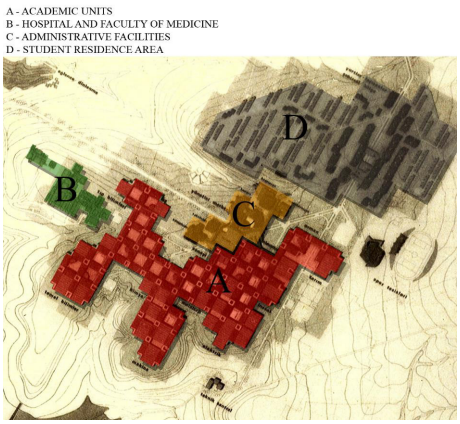

Figure 6. *Project for Diyarbakır Ziya Gökalp campus by Kemal Ahmet Aru; image is coloured by the author (Source: Arkitekt, 342).*

tion, the university features four zones (educational, administrative, residential and hospital), clustered in compact form. The gathering spaces take the form of inner courtyards, directly connected under one huge roof to promote connections across the university. The compact form encourages walking and reduces vehicle trips between essential functions, as one of the most practical aspects of the campus design, allowing students to move quickly between buildings in breaks between lectures.

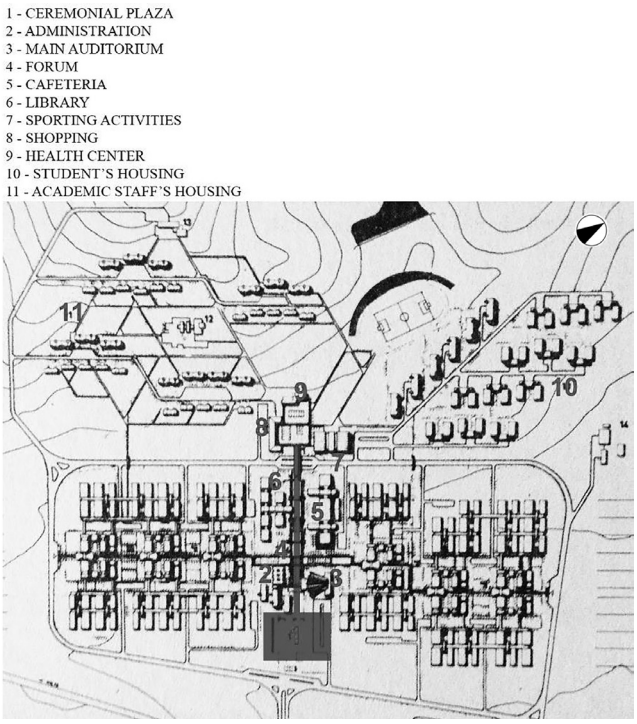

Figure 7. *Proposal of Enis Kortan for the master plan of Gaziantep University; the central main axis and the central plaza is marked by grey (Source: Kortan, 1981).*

Figure 8. *Current plan of Gaziantep University (Source: Gökcek, 2009).*

2.2. Campuses in the 1980s

During the 1980s, an extensive reorganization of higher education took place, with certain provisions resulting in changes to the physical and academic organization of the nation's universities. Surprisingly, very little has been published about the design of campuses in the 1980s (Bilgin, 2006; Erkovan, 2013), with one of the few exceptions being a study of Gaziantep University (Figure7), which was designed by a team of Enis Kortan and founded in 1982.

The campus, which lies 5 kilometers outside Gaziantep city center, was designed in a compact form. All buildings are located within a 1 km radius, with the vehicular access roads mark the edge of the area, with the aim being to ease pedestrian circulation. The campus is divided into three zones (Figure 9): the academic zone, the central zone and the residence zone (Bilgin, 2006, 103). The academic buildings are grouped around the central facilities, with sizes in proportion to the human scale at street level. The University's central buildings are aligned with the main pedestrian axis and divide the campus into two parts. In contrast to the layouts of previous campuses, the main gathering area is a plaza in a central location, designed to host such ceremonial events as semester openings and graduation marches. This differs from the design approaches of the previous period that prioritized the design of open spaces at different scales to encourage student interaction close to the academic facilities. Here, the centralized ceremonial square, surrounded entirely by administrative buildings, evokes a sense of control and authority in students.

It can be seen from the current campus plan of Gaziantep University that the organization of the architectural program suggested previously by Enis Kortan materialized, to a certain extent (Figure 8). The social and administrative functions are arranged in a central

area surrounded by the academic facilities; however, the main axis that concludes with a social center, which was designed with the purpose of stimulating social interaction, ended up being a weak and insignificant road. In short, the buildings are separated by a long axis, while the vast open areas in the design serve no social purpose at all.

In the 1990s, most of the new universities were constructed far away from the city centers. Pamukkale University, Mustafa Kemal University, Niğde University and IYTE were built on large, empty tracts of land outside the urban fabric. An analysis of the campus plans from the 1990s reveals an important factor in their spatial organization: in the 1980s it was common to construct a central square that was surrounded with administrative functions, and this would influence the campus model to such an extent that in 1992, most campuses built from scratch mimicked this centralized structure.[4] While some designs featured a centralized ceremonial plaza for the hosting of formal gatherings, others were designed with administrative functions at the core of the campus. In such spatial arrangements, the academic units and residences are pushed out to the campus periphery.

Mersin University's main campus in Çiftlikköy was designed in accordance with a centralized structure concept.[5] The priorities of the University administrators for the planning of the campus were typical, calling for harmony with the topography, separation of pedestrian roads from vehicular access roads, the arrangement of buildings in physical proximity to each other, and pedestrian walkways forming the spine of the campus. In the compact campus design, the faculties are linked by a curvilinear spine, while the administrative buildings are concentrated at a central location (Figure 9). Functions have been defined in three zones: academic, social/administrative and residential. Geometrically located at the very heart of the campus is a square that was intended to serve as a gathering space, featuring a variety of social facilities such as a cinema and a market, although it functions more as ceremonial space for formal gatherings, with the rectorate building. The university

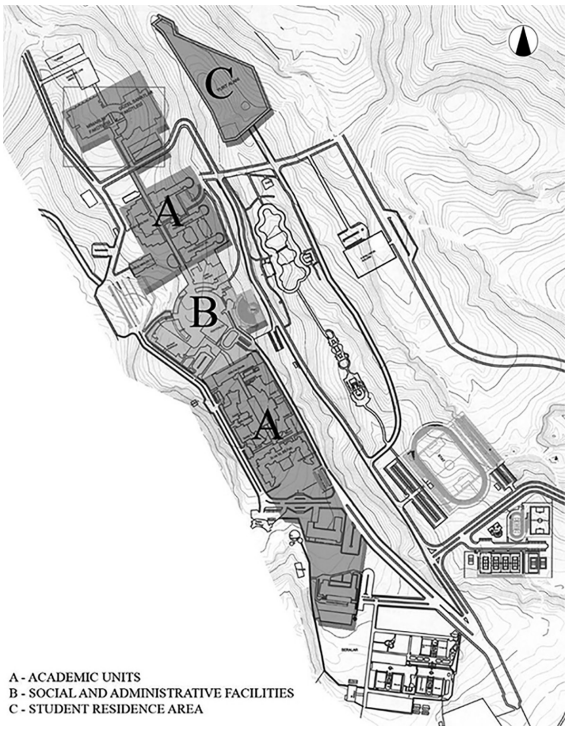

Figure 9. *The project for Mersin Çiftlikköy campus. The image is derived from Mersin University archive and modified by the author.*

has maintained Şahinbaş's main spatial principles and has adopted a holistic approach for the later additions. For example, in the original plan, Şahinbaş proposed a connection between the dormitory units and main axis through social units and a pool that would be constructed later.

2.3. Campuses in the 2000s

Around the world, identifying an overarching approach in campus planning after the turn of the millennium is challenging. The most prominent trend in campus design has been the construction of landmark individual buildings that transform campuses into architectural showpieces (Coulson et al., 2010, Deplazes, 2007). The campuses of such institutions as Princeton, Yale, the University of Cincinnati, MIT and the University of Chicago all sought out famous architects for the construction of landmark buildings. The Simmon Hall dormitory of Steven Holl at MIT, and the Educaatorium by Rem Koolhaas at Utrecht University stand as examples of such projects intending to support the identification of the university as a brand institution. With a vision in which campuses are viewed as outdoor museums of archi-

tecture, priority has been given to the symbolic meaning of buildings, while campus has transformed into a mere background that holds all the units together.

The current approach to campus planning in Turkey has witnessed a major departure from that of the 2000s. The production of campuses as integrated urban settlements to allow integration with the social and physical fabric of city has become an important aspect of campus design. The Adana Science and Technology University *(2011 - Adana Bilim ve Teknoloji Üniversitesi)* was planned as a city university. Despite these trends, there is still a tendency among some universities to construct their campuses as a single entity far from the center. For example, Muş Alpaslan University, Ardahan University, Yalova University, Yıldırım Beyazıt University (Ankara) and Türk-Alman University (İstanbul) all promote the concept of seclusion and isolation from the city. "From the university in the city to a campus university" has emerged as a popular slogan in the introductory pages of university promotional material. Some older universities have moved away from the inner city due to the inadequacies of the existing buildings and the growing student populations. For example, Marmara University, one of Turkey's most successful higher education institutions, planned to sell its land in the city of Istanbul and move into a new more peripheral unified site located outside the city.

Campus planning and design have gained importance in this period, with a group of architects committing themselves to the development of campus plans. Many plans and discussions related to such projects can be found in the Arkitera and Arkiv databases.

The campuses of Abdullah Gül University in Kayseri and Adana Science and Technology University in Adana were built following architectural competitions, having been designed as integrated city campuses, and these examples allow an understanding of how universities explore the idea of publicness in their spatial organization. In contrast to the previous periods, campuses are today idealized as spaces that bring the public together with the university population. It was considered as public spaces of the cities and some social and cultural activities were planned in the university campus programs.

For example, Abdullah Gül University was planned as two city campuses that would be integrated with public environments for the use of not only the students, but also the city residents. Founded in 2010, the young university is spread across two campuses – the Sümer Campus and the Mimar Sinan Campus – of which the former is settled on the former site of the Sümer Textile Factory Complex that was built in 1933.[6] The factory played a key role in the development of Kayseri and the Turkish national economy, and was built as an industrial setting that featured all necessary components for the workers' lives. When planning the campus, the old buildings and open spaces were retained, preserving the original spatial principles, with only the new educational functions redefined. The academic and administrative buildings are clustered in compact form around a central courtyard, while the residences of the workers in the original plan were defined as student dormitories in a separate area.

The Mimar Sinan Campus plan was designed by Alişan Çırakoğlu (Figure 10). Located at the periphery of the city the intention was to promote interaction between the university population and the city residents. The campus serves as "a bridge that connects two edges: nature and the city; science and life; technology and art" (Interview notes, 2014). The campus was originally conceived as being open to public and easily accessible. In addition to a planned public transportation network between the city and the campus, a variety of recreational, cultural and social facilities help create a sense of openness to the outside world. With its two campuses, the university was intended to serve as a public space for the city.

The Mimar Sinan Campus has laminar composition in an affiliated urban setting, with a layout formed through the juxtaposition of two zones. The first is the bridge that contains the cultural and social facilities – the library, science

center, rectorate, museum, convention center, main cafeteria and a mosque – while the second is a Z-shaped alley that connects to the academic units. The bridge, elevated over an artificial water source, is an open space designed for pedestrian circulation, while vehicular circulation is pushed out to the periphery of the campus to minimize interactions with the pedestrians. The campus is planned as an urban park, featuring extensive green areas where society and the campus community mingle. Another important aspect of the project is the design of multifunctional open spaces in the form of courtyards and quads, dispersed across different parts of the campus. When combined, these aspects both promote the social encounters and cultivate a campus life experience that is accompanied by nature. This reflects an architectural perception that idealizes the campus as a space of living, beyond the research and education.

By the 2000s, the design of landmark buildings on campuses had emerged as an alternative to the creation of long-term campus development plans. Most of the universities favored a single iconic building, designed and constructed by a famous architect, examples of which can be found in other parts of the world. These buildings are thought to contribute to attracting new students and providing recognition, rather than supporting the educational content. The library building of Uşak University, the main laboratory building of Namık Kemal University (Tekirdağ) and the hospital emergency building of Ege University are examples of this.

The library building of Uşak University (2006), designed by Ahmet Tercan, was nominated for a 2014 National Architecture Award, and has been the subject of various debates in the local press. Although there is no information about the spatial organization of the campus or its facilities on the university web page, the library building has generated headlines in the local press. Referring to its library, the university introduces itself with the pre-eminent campus design. The new Emergency Hospital building of Ege University may well be similarly evaluated. After the demolition of the old building, a new monumental structure was created with black translucent glass cladding to the façade. The building, close to the city, has a distinct and remarkable appearance with its bright massive form.

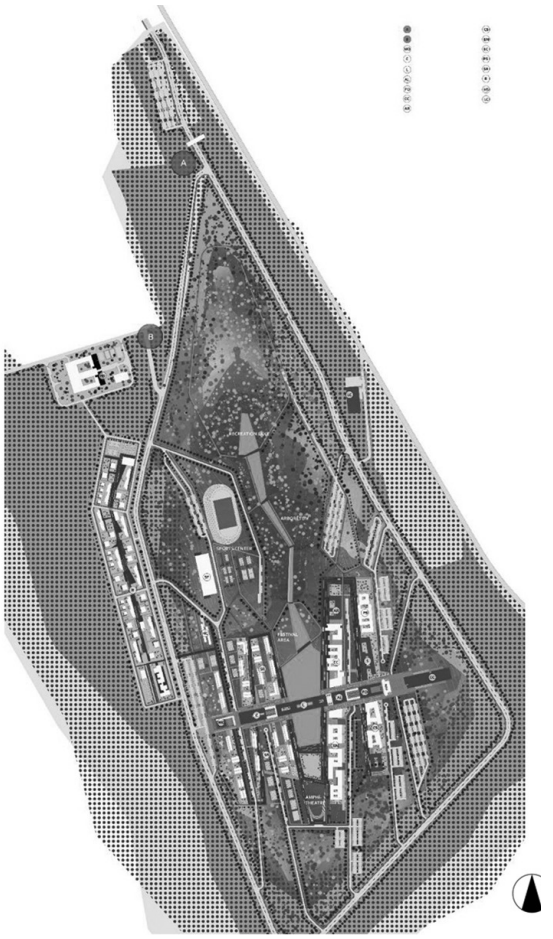

Figure 10. *The proposal of Alişan Çırakoğlu for Mimar Sinan campus of Abdullah Gül University.*

3. Conclusion

This article focuses on understanding of design and campus planning in Turkey with the purpose of exploration of spatial strategies of campuses that are built in different periods. This paper aims to evaluate the basic spatial principles of campus as a single entity and explore if there are changes in spatial layout of university campuses, the organization of built environment and their relations with the urban fabric through a chronological reading. In order to make a critical evaluation about different campus models, this paper uses some morphological parameters questioning 1.) spatial compositions of the built and un-built environment 2.) functional zones 3. Formal character of gathering spaces and their locations 4.) circulation networks.

Analysis of the spatial configuration of campuses in Turkey reveals some unexpected insights about particular planning approaches of universities: This provided unexpected information about campuses: the chronological evaluation gave some insights about spatial considerations of specific eras. It is observable that campuses reflect specific spatial understanding of their period. In that respect, we reviewed the campus projects in reference to three important periods in Turkey. For example, campuses that were built between 1950s and 1970s focus on design of public spaces to create social environments for university population. By 1980s, it is possible to observe a change in the spatial compositions of the campuses. Most of the campuses were evolved around the idea of centralized structure. In the 2000s, the change in the campus planning is related with the location of campuses in cities. With the purpose of involvement with social and physical fabric of city, universities have prioritized becoming public spaces of the cities. Additionally, specific physical approach of each period, that determines the relations between built environment and open spaces, is also mimicked by some other campuses in the same period.

Universities built within the period between 1950s and 1970s are important cases because they are first campus universities and they have self-contained campuses that all facilities locate in a single setting. The architects that design four campuses in this period give a special emphasis to the design of public spaces. Public spaces in the form of alley, court yard or green areas, where students could socialize and relax, are located near to academic facilities. Some are green, inciting people to sit or lie down while others are designed right next to classes with a purpose to increase students' chance to socialize via spontaneous encounters between classes. In addition, open spaces rather than buildings structured the spatial layout of the campuses. Especially, METU and Ege University campuses are examples of campus design that prioritize student interaction. Also, the campuses of 1950s are located at outside of cities to create an academic world where students and academicians study far from the distractions of city life. Only, Atatürk University campus is close enough to Erzurum to access the students' needs in city.

During 1970s, there was a change in spatial formation of campuses. The university campuses that were designed in this period had mono-functional and huge gridal forms. Ayazağa campus of ITU, campus of Diyarbakır Ziya Gökalp University and Bursa University campus were designed according to such design approaches. All buildings were joined under big structures to promote interaction across the university. Yet, the design of open spaces near to academic facilities was important in this period as seen in the campuses of 1950s. Specific physical approach of each period, that determines the relations between built environment and open spaces, is also mimicked by some other campuses in the later period.

However, we see that such kind of spatial understanding change into new spatial configuration in 1980s. The buildings in the campus were rather arranged in a centralized order. The governance of universities with a new central institution, HEI, reflected its imprints on the spatial organization of universities. The idea of previous period, prioritized allocation of public spaces in different parts of the campus totally disappeared. Instead of well-designed open spaces bonding the various facilities in different parts of the campus, locating one central monumental square next to administrative functions was the main design theme in this era. Gaziantep University and Mersin University campuses are examples to this. Changes in the spatial organization of open spaces in relation to built environment have left campuses with a different proposal for the public life inside the campus. And it is possible to claim that favoring a centralized structure can be taken as a reflection of changes in Turkish political system following the military coup of 1980.

During 2000s, universities that were discussed in this paper gave special emphasis to produce their campuses either as inner-city settlements or campuses in the peripheries of cities. The purpose was clear: to provide involve-

ment with social and physical fabric of city. For example, Mimar Sinan campus of Abdullah Gül University (Kayseri) and Adana Science and Technology University (Adana) were designed as urban parks that connect the campus community with the public. A variety of recreational, cultural and social facilities are designed in purpose of providing access from outside world into the university. Campus is designed not only for the campus community but also for the city population. Entrance controls are relatively vague; buildings are rather planned to incite people to access easily.

Despite the spatial varieties of different campuses, it is possible to explore some distinct features of the campus design in Turkey. The first is their distances from the urban fabric. Most of the campuses designed outside the cities aim to create self-contained and introverted environments. In other words, the idea is to produce knowledge "in the midst of the nature for a maximum quietness and concentration" (Christiaanse 2007, 46). Picturesque sceneries that unite the buildings along the green sites supported such kind of withdrawal from distractions of city life and concentration for studying. Such kind of isolation from city life required self-contained settings with all necessary functions for everyday practices. Another common feature of campus design is based on for the production of communities and their public spaces. As the space for academic community, campus reflected the embodiment of creating a total environment like a city. In that respect, creating a variety of public spaces in the campus was important to building an academic community, the early campuses of 1950s are examples of this understanding.

As a consequence, it is difficult to generalize these approaches as overarching concepts of those eras. The needs and expectations to shape the campus design process are not one; they are various and many. Deciding the campus location and its proximity to the city, the relation between the campus buildings and the organization of the overall pattern are driven by a complex interplay of interests, needs and expectations both of the state and the universities. However, it is important to consider how the change in the spatial organization in a campus setting influences the development of public life. Understanding the outcomes of design tendencies of campus projects that are peculiar to specific periods might help focusing on the production of lively student life in new campus projects.

Endnotes

[1] The specific criteria for the selection of sites are presented in the report: "being a focal point for service, student population, the adequate infrastructure for the development of a campus settlement and a supportive socio-cultural environment" (Sargin, 2007).

[2] Some higher education institutions were brought under the roof of nine new public universities. While the Mimar Sinan, Marmara, Yıldız Technical, Trakya and Akdeniz Universities were reconstituted through mergers of different schools and academies, Gazi University was converted from the Gazi Education Teacher Training Institute. Furthermore, many faculties of Ege University became affiliated to Dokuz Eylül University.

[3] The Bursa Technical University, Erzurum Technical University, Abdullah Gül Üniversitesi, Adana Science and Technology University and Turkish- German University were seen specifically as research institutions, where the intention was to promote collaborations with technology-based organizations (Toprak, 2012).

[4] During this period, 23 public universities were founded, although the campus plans of some universities are unavailable even on the university websites. An analysis of 11 campus maps (Dokuz Eylul University – Tınaztepe campus, Abant İzzet Baysal University, Adnan Menderes University, Afyon Kocatepe University, Dumlupınar University, Gaziosmanpaşa University – Çiftlikkoy campus, İztech, Sütçü İmam University, Kocaeli University – Umuttepe campus and Niğde University) reveals that they were designed around the idea of a centralized structure.

[5] The campus was launched after a project competition in the 1990s. A competition was held in which only

three invitees took part in 1995; Turgut Cansever, Kaya Arıkoğlu and Erkut Şahinbaş. The main principles of the conceptual project of Şahinbaş were adopted for the current campus project.

[6] The master plan was designed by Burak Asil İskender and Nilüfer Baturoğlu Yöney. A new building with administrative functions that was designed by Emre Arolat won the National Architectural Award in 2016.

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A review of LEED green building certification systems in Europe and Turkey

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Abstract

This study reviews LEED green building certification system which is used most widely in Turkey and in the world. A LEED green building certificate can be obtained by meeting different criteria of the review system and therefore each LEED certified building can have different features. This study reviewed all new buildings in Europe and Turkey, which have LEED Gold certificates. Additionally, the LEED green building certification system criteria which were met by more than 150 buildings to obtain the certification were listed and the percentages of the criteria that were met in Europe and in Turkey were determined. Based on these percentages, the criteria that were mostly preferred and those that were not generally avoided by certified buildings were shown. And by comparing these percentages the most important differences between in Turkey and Europe were identified and the reasons for these differences were investigated.

Based on the above, it was concluded that the performance of LEED certified buildings in Turkey were poorer than in Europe especially in energy. Although they have the same certification levels, green buildings in Europe are more energy efficient than those in Turkey. In areas such as brownfield redevelopment, light pollution caused by the building, use of certified wood, low VOC (volatile organic compounds) content in floorings and occupant line of sight, buildings in Turkey lag behind the buildings in Europe. In Turkey, regulations and the education level in the industry in these areas are not up to the standards of Europe.

Keywords
LEED, Green building certification system, Green buildings in Europe and Turkey.

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1. Introduction

Reflections of sustainable development in the construction industry have brought forward the concept of green buildings which are designed with social and environmental responsibilities in mind and remain eco-friendly and human-friendly through their life cycle. Along with green building projects, voluntary green building certification systems which allow eco-friendly features of these buildings to be documented, encouraged and promoted have been developed. Green building certification systems are supported by developed countries and seen as an effective tool for the real estate sector to have a sustainable transformation. Similar to what was happening in developed countries, the awareness in Turkey has also increased and many construction companies have started to use green building certification systems that are popular globally in their projects.

In Turkey, especially LEED (Leadership in Energy and Environmental Design) green building certification system is rather widely used. The reasons why LEED green building certification system has become more popular in Turkey are that it is the most widely used system in the world and preferred by multinational companies and the certification process are easier than other systems and the system has a high brand value. LEED green building certification system is expected to become more popular and be used more over time. Therefore LEED green building certification system is important for the real estate sector.

Although there are more LEED certified green buildings in Turkey, which is seen as a positive development for the sector, this also has brought many problems. Identifying and solving these problems will help to improve green buildings in Turkey. One of the most important problems relates to the fact that the energy performance of a certified green building has not been defined. There are ongoing discussions as to which criteria should be used to identify a building as a "green building"; how energy efficient a building with a green building certificate is and whether certification is granted based on objective reviews in Turkey. These ongoing discussions with no answers lead to a distrust for the sector. Given the fact that green building certificates are used as a marketing tool and increase the value of buildings, these uncertainties make people doubt about misinformation and unlawful gains and profits.

The objective of this study is to compare European countries which are more experienced in green building certification systems and Turkey where the history of these systems are relatively new to identify energy efficiency requirements met by certified green buildings; to show the energy performance which should be expected by the sector from certified green buildings; to contribute to the discussions on the performance and the validity of the certified green buildings and about the validity of LEED green building certification system in Turkey.

2. Green building certification systems

Green building certification systems are independent systems that review a building based on certain criteria to determine how "green" it is. The criteria used by these systems which are developed through collaborations of a wide range of government and non-government organizations, industry representatives and scientists provide guidelines about green building design and construction for the industry. Certificates are typically given by independent organizations or government bodies. Content of certificates and identified efficiency criteria develop in parallel to developing building technology and updated laws and regulations and the performance level required to get a certificate regularly goes higher.

Green building certification systems adopt a holistic approach for environmental impact of a building taking into account the building's life cycle. Energy and water consumption, use of resources, waste management, indoor air quality, natural life and ecology, operation and maintenance, innovation and for some certification systems economic and social impacts are the areas covered by green building certi-

fication systems. A project is reviewed based on criteria requirements met by the project and the project is granted a certificate with varying levels based on this review.

2.1. LEED green building certification system

There is a wide range of green building certification systems used in the world today. Many countries have developed their own green building certification systems to work better with local conditions. Systems that were developed in some countries including the USA, UK and Germany are used internationally. The popularity and brand value of such certification systems are higher than local/national ones and therefore mostly these certification systems are preferred. In this paper LEED Green Building Certification System which is the most widely used system in Europe and Turkey was reviewed.

LEED (Leadership in Energy and Environmental Design) was developed by USGBC (US Green Building Council) in 1998 and it is the most preferred green building review system in the world. Today, there are almost 50 thousand buildings certified by LEED in the world. The reason for the increase in the number of LEED certified buildings can be increased awareness and knowledge about green building concept and LEED around the world and incentives granted to LEED certified buildings in the USA. In Turkey, the number of LEED certified projects is 171 as of January 2017 and there are 306 projects that are registered but not yet certified. Given the fact that there are around 50 thousand projects registered to obtain LEED certification, it is possible to anticipate that there will be much more LEED certified buildings. Compared to other countries, certification levels in Turkey are mostly Gold and Platinum. There is less number of Certified and Silver level certificates. Turkey became the 9th country to have the highest number of LEED certificates in the world in 2015 (USGBC, 2015).

There are 353 LEED certified projects in Europe as of January 2017. LEED certification seems to be more popular in Germany and Sweden. Germany is the 6th country to have the highest number of LEED certificates in the world. Although these two countries have their own national certification systems, LEED system is preferred.

LEED offers a wide range of certification types that can cover design, construction and operation of all project types (new construction and major renovation, existing buildings, commercial interiors, residential buildings, homes, neighborhood development). Each certification type has requirements unique for that category. After certificate type suitable for the project is chosen, design and operation decisions are taken according to the credit category of the certificate type.

Each type of certificate consists of relevant categories and credits. Each category has specific prerequisites and a variety of credits that projects must satisfy. Total number of points in the category required by a specific type of certificate determines the certificate level. LEED evaluates a project over 110 points and certificate level of the project is determined based on the points earned. There are four certificate levels:

- LEED Certified : 40–49 points
- LEED Silver : 50-59 points
- LEED Gold : 60-79 points
- LEED Platinum : 80 points and above

Categories are as following:

Sustainable Sites: Sustainable Sites credit category encourages projects to be built in existing locations with an established structure, infrastructure, and resources available. The location preferred is intended to be close to various means of mass transportation. This category aims to prevent housing development on open/uninhabited areas; minimize a building's negative impact on eco-systems and waterways; encourage landscape that is in harmony with the natural features of the area and reward smart transport solutions and control rainwater runoff and reduce erosion; and reduce light pollution, thermal island effect and pollution from construction.

- Water Efficiency: The objective of this category is to ensure that water is used more efficiently and wisely

indoors and outdoors. Water efficiency is achieved by several options including choosing the right fittings and fixtures, landscape with reduced irrigation need, use of grey water.

- Energy and Atmosphere: This category rewards a wide variety of energy strategies including commissioning, control of energy use, efficient design and construction, efficient equipment, systems and lighting, renewable and clean energy and other innovative strategies.
- Materials and Resources: This credit category encourages selection of sustainable products and materials. This category supports minimization, recovery and recycling of waste and aims to improve indoor air quality.
- Indoor Environmental Quality: This category focuses on improving indoor air quality, having maximum access to natural sunlight and view, improving thermal control means and acoustics. The goal here is to ensure that occupants work more efficiently and health problems are prevented.
- Innovation: The objective of this category is to reward the use of innovative sustainable features and practices in buildings.

2.2. Previous studies on LEED green building certification system practicess

The literature on LEED green building certification systems both in Turkey and in the world is quite rich. Previous studies include comparative assessments of international and local green building certification systems and their implementations. Mao et al.'s study (Mao et al., 2009), "A Comparison Study of Mainstream Sustainable/ Green Building Rating Tools in the World" compares the international certification systems LEED, BREEAM, SBTool, CASBEE, BCA-GM and ESGB. Awadh (Awadh, 2017), "Sustainability and green building rating systems: LEED, BREEAM, GSAS and Estidama critical analysis" analyzes two internationally applied systems; LEED and BREEAM, and two particularly developed for the gulf region; Estidama and GSAS. Cole (Cole, 2013), "The importation of building environmental certification systems: international usages of BREEAM and LEED" provides a detailed analysis of the BREEAM and LEED implementation provided using data from six specific countries: Chile, Colombia, the Czech Republic, the Netherlands, Sweden, and the United Arab Emirates. The studies show that the LEED certification is the most used system in the world.

There are many academic studies on LEED green building certification systems both in Turkey and in the world. The following studies investigated the LEED certification process : Aksakal (Aksakal, 2009) "An Approach for the the Design Process in Green Building Projects: Leed V4 Certification Process", Ozcan and Temizbas (Ozcan et al., 2010) "Green Building" and Sumer (Sumer, 2013) "Green Building Management Processes and A Case Study on Project Management Processes in LEED and BREEAM Practices in Turkey". The study of Adiloglu et al. (Adiloglu et al., 2010), "ESER Green Building " reviews the requirements of LEED certification met and work done in the building, ESER which is the first building with LEED Platinum certificate in Turkey. Aktas's study (Aktas, 2013) " Converting Existing Buildings to Green Buildings: Implementations In Turkey " reviewed 8 existing buildings with LEED certification in Turkey and discussed the difficulties involved in the process of obtaining LEED certification. Ozturk's study (Ozturk, 2015) "Analysis of Green Building Certification Systems" compares LEED and other green building certification systems. In his book "Green Building Cost and Financial Benefits" which was the first comprehensive work on the cost of LEED certification Kats (Kats, 2003) made a cost analysis for 33 LEED certified buildings in the USA. Mapp et al.'s study (Mapp et al., 2011) "The Cost of LEED—An Analysis of the Construction Costs of LEED and Non-LEED Banks" and Nyikos et al.'s study (Nyikos et al., 2012), "To LEED or Not to LEED: Analysis of Cost Premiums Associated With Sustainable Facility Design" and Ugur and Leblebici's study (Ugur et al.,2015) "Review of

the Effects of Green Building Certification Systems on Construction Costs and Property Values" investigated the cost of LEED certification system. Diamond's study (Diamond, 2011) "Evaluating the energy performance of the first generation of LEED-certified commercial buildings" and Turner and Frankel's study (Turner et al., 2008) "Energy performance of LEED for New Construction Buildings" investigated LEED and energy efficiency. Potbhare and Korkmaz (Potbhare et al., 2009) in their study titled "Adaption of Green Building Guidelines in Developing Countries based on US and India experiences" investigated the development process of LEED certification system and how it is used in developing countries.

3. A review of LEED green building certification system implementation in Europe and Turkey

In this section, the method to review LEED Green Building Certification System Implementation in Europe and Turkey was explained and then implementation and principles in Europe and Turkey were compared and reviewed (Baştanoğlu, 2017).

3.1. Method

In this section of the study, the objective is to compare European countries which are more experienced in green building certification systems and Turkey where the history of these systems are relatively new to identify energy efficiency requirements met by certified green buildings; to show the energy performance which should be expected by the sector from certified green buildings; to contribute to the discussions on the performance and the validity of the certified green buildings and about the validity of LEED green building certification system in Turkey.

As discussed in section 2, LEED green building certification has prerequisites and optional credits for different categories. Each credit has a certain point. In order for a building to get credit points, it should meet the credit requirements described in detail in the LEED reference book. If most of the credit requirements are met, full points can be obtained and if not no point can be obtained. Some credits have percentages determined according to the level of performance of the building. A certain part of the credit point can be obtained according to the requirements met by the building. LEED reference book (USGBC, 2017) was used as the source for LEED categories and credits.

In order to make a sound comparison, all new buildings with LEED Gold and LEED NC (New Construction) certificates in all European countries and in Turkey until 2017 were included. Out of 158 buildings included in the review, 52 are in Turkey and 106 are in Europe. Information about the buildings included in the review was obtained from the American Green Buildings Council data base (USGBC, 2017). LEED credit points that these buildings earned to be LEED Gold certified were identified and achievement percentages of each credit in Europe and Turkey were calculated using weighed average as the number of buildings in Turkey and Europe is different and a comparison was made based on these percentages.

Based on these percentages, the requirements which should be expected to be met by new buildings with LEED Gold certification in Europe and Turkey were explained and differences between Europe and Turkey about how LEED credit points were gained were explained.

The steps of the methodology is shown on the Figure 1.

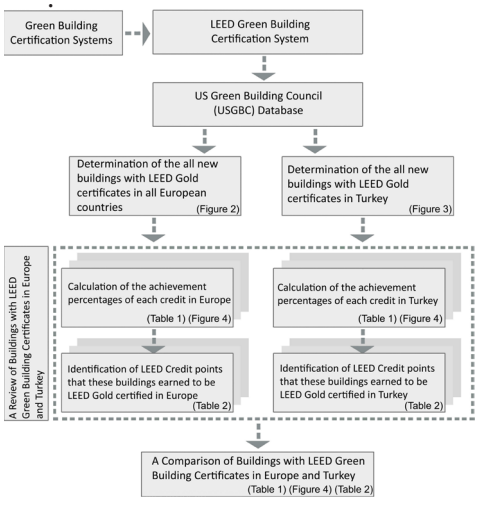

Figure 1. *The steps of the methodology.*

3.2. A review of buildings with LEED green building certificates in Europe and Turkey

106 LEED Gold certified new buildings in 18 European countries were reviewed in this study. Germany, Spain and Sweden have the highest numbers of LEED Gold certified new buildings. Poland and Finland come after these three countries. Serbia, Greece and Norway have only one LEED Gold certified new building each and most of these are office buildings.

In Turkey 52 LEED Gold certified new buildings in 10 cities were reviewed. Most of these buildings were office buildings and they are predominantly in Marmara Region, especially in Istanbul and Kocaeli.

Examples of LEED Gold Certified buildings in Turkey and Europe can be seen in Figure 2 and Figure 3.

Categories and credits in LEED certification system and achievement percentage of them in Europe and Turkey are shown in Table 1. Decrease in water consumption, optimum energy performance, on-site renewable energy and innovation in design were calculated on a scale therefore averages of these points were given.

3.3. A Comparison of buildings with LEED green building certificates in Europe and Turkey

In this study, all LEED Gold certified new buildings in European countries and Turkey were reviewed and as the

Figure 2. *Examples of LEED Gold Certified buildings in Europe (USGBC, 2017) (Photos: Url 1-8).*

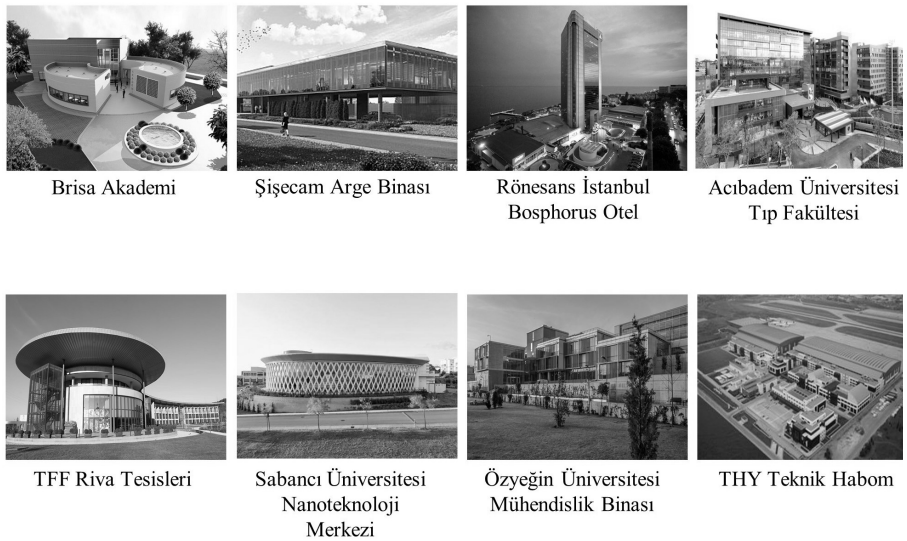

Figure 3. *Examples of LEED Gold Certified buildings in Turkey (USGBC, 2017) (Photos: Url 9-16).*

***Table 1**. LEED Credits and achievement percentages of buildings in Europe and Turkey (Baştanoğlu, 2017).*

Category/Credit Name (Points)		Percentage in Europe	Percentage in Turkey
SUSTAINABLE SITES (26p)		**%71**	**%73**
Prerequisite 1	Construction Activity Pollution Prevention		
Credit 1	Site Selection (1p)	%90	%88
Credit 2	Development Density and Community Connectivity (5p)	%69	%62
Credit 3	Brownfield Redevelopment (1p)	%35	%0
Credit 4.1	Alternative Transportation—Public Transportation Access (6p)	%91	%100
Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms (1p)	%88	%96
Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles (3p)	%92	%98
Credit 4.4	Alternative Transportation—Parking Capacity (2p)	%67	%73
Credit 5.1	Site Development—Protect or Restore Habitat (1p)	%35	%23
Credit 5.2	Site Development—Maximize Open Space (1p)	%68	%75
Credit 6.1	Stormwater Design—Quantity Control (1p)	%45	%62
Credit 6.2	Stormwater Design—Quality Control (1p)	%42	%44
Credit 7.1	Heat Island Effect—Non-roof (1p)	%70	%79
Credit 7.2	Heat Island Effect—Roof (1p)	%59	%71
Credit 8	Light Pollution Reduction (1p)	%26	%10
WATER EFFICIENCY (10p)		**%79**	**%80**
Prerequisite 1	Water Use Reduction—20% Reduction		
Credit 1	Water Efficient Landscaping (4p)	%92	%96
Credit 2	Innovative Wastewater Technologies (2p)	%62	%83
Credit 3	Water Use Reduction (4p)	3,1/4	3,3/4
ENERGY AND ATMOSPHERE (35p)		**%49**	**%41**
Prerequisite 1	Fundamental Commissioning of Building Energy Systems		
Prerequisite 2	Minimum Energy Performance		
Prerequisite 3	Fundamental Refrigerant Management		
Credit 1	Optimize Energy Performance (19p)	11,8/19	8,0/19
Credit 2	On-Site Renewable Energy (7p)	0,6/7	0,9/7
Credit 3	Enhanced Commissioning (2p)	%57	%44
Credit 4	Enhanced Refrigerant Management (2p)	%79	%90
Credit 5	Measurement and Verification (3p)	%66	%88
Credit 6	Green Power (2p)	%29	%17

Category/Credit Name (Points)		Percentage in Europe	Percentage in Turkey
MATERIALS AND RESOURCES (14p)		**%30**	**%39**
Prerequisite 1	Storage and Collection of Recyclables		
Credit 1	Building Reuse—Maintain Existing Walls, Floors, and Roof (3p)	%0	%0
Credit 2	Building Reuse—Maintain 50% of Interior Non-Structural Elements (1p)	%83	%85
Credit 3	Construction Waste Management (2p)	%1	%2
Credit 4	Recycled Content (2p)	%60	%98
Credit 5	Regional Materials (2p)	%79	%98
Credit 6	Rapidly Renewable Materials (1p)	%2	%10
Credit 7	Certified Wood (1p)	%19	%4
INDOOR ENVIRONMENTAL QUALITY (15p)		**%56**	**%52**
Prerequisite 1	Minimum Indoor Air Quality Performance		
Prerequisite 2	Environmental Tobacco Smoke (ETS) Control		
Credit 1	Outdoor Air Delivery Monitoring (1p)	%51	%37
Credit 2	Increased Ventilation (1p)	%73	%71
Credit 3.1	Construction IAQ Management Plan—During Construction (1p)	%88	%96
Credit 3.2	Construction IAQ Management Plan—Before Occupancy (1p)	%49	%50
Credit 4.1	Low-Emitting Materials—Adhesives and Sealants (1p)	%68	%77
Credit 4.2	Low-Emitting Materials—Paints and Coatings (1p)	%88	%94
Credit 4.3	Low-Emitting Materials—Flooring Systems (1p)	%43	%21
Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products (1p)	%15	%0
Credit 5	Indoor Chemical and Pollutant Source Control (1p)	%46	%60
Credit 6.1	Controllability of Systems—Lighting (1p)	%45	%52
Credit 6.2	Controllability of Systems—Thermal Comfort (1p)	%44	%42
Credit 7.1	Thermal Comfort—Design (1p)	%75	%87
Credit 7.2	Thermal Comfort—Verification (1p)	%58	%75
Credit 8.1	Daylight and Views—Daylight (1p)	%42	%35
Credit 8.2	Daylight and Views—Views (1p)	%62	%33
INNOVATION AND REGIONAL PRIORITY (10p)		**%78**	**%86**
Credit 1	Innovation in Design (5p)	3,3/5	3,9/5
Credit 2	LEED Accredited Professional (1p)	%98	%100
	Regional Priority (4p)	%96	%100

numbers of buildings reviewed in Europe and Turkey were different, weighted averages were used to calculate percentages of LEED credit requirements met and comparison was made accordingly. For each category, criteria requirements that were met by higher and lower number of buildings in Europe and those that were met by similar percentages of buildings in Europe and Turkey were determined.

The average achievement percentage of each credit and category of 158 buildings in Europe and Turkey are compared according to the Table 1 and Figure 4. Number of points achieved in category is compared according to the Table 2.

- Sustainable Sites category is an important category with 26 points in total; similar points were gained in Europe (18.5 points) and in Turkey (19 points). It is possible to conclude that achievement rate of points is higher in this category compared to others. No points were earned for Brownfield Redevelopment credit under this category in Turkey. The reason for this is that mostly well-developed lands are used.

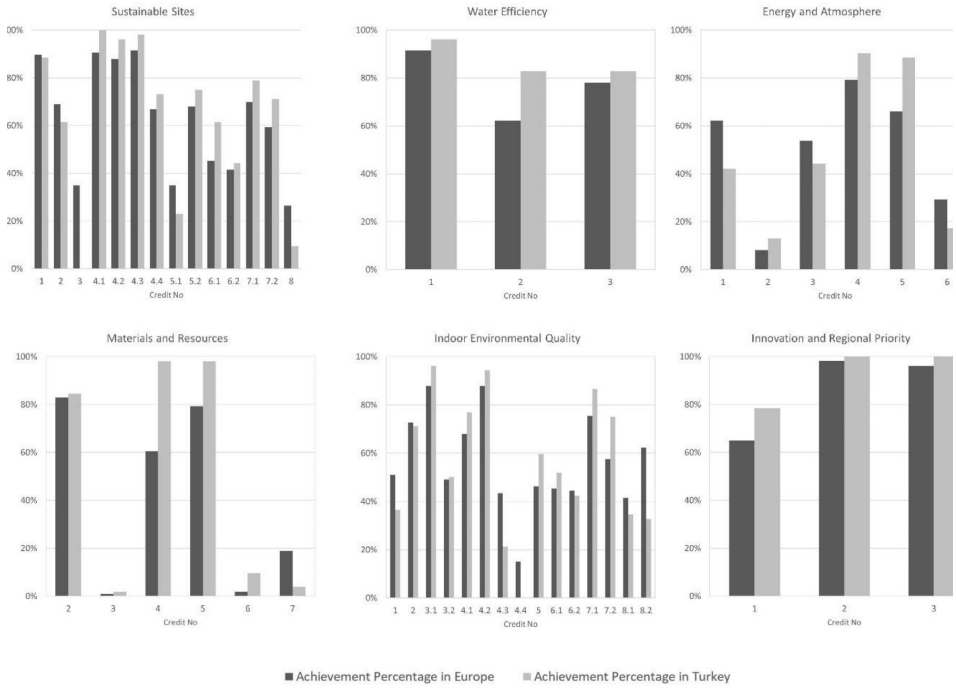

***Figure 4.** The credit achievement percentages of buildings in Europe and Turkey all categories in LEED certification system.*

- Water Efficiency category includes 10 points. Credit requirements in this category were met by 79-80% of the buildings in Europe and Turkey and therefore 7.9 points and 8.0 points respectively were earned. It is possible to conclude that achievement rate of points is higher in this category compared to others.
- Energy and Atmosphere category has the highest number of points (35 points) in all of the categories. Since this category both has the highest number of points and includes energy related requirements which have become increasingly important, this category has a major impact on LEED certification. The average in Europe is 17.3 points and in Turkey it is 14.6 points in this category. Based on the above information it can be concluded that LEED Gold certified new buildings in Europe have better performances in energy efficiency and relevant requirements. Additionally, points earned in this category are lower than the others. On-site renewable energy credit requirement is met at a very low percentage both in Europe and in Turkey. It is understood that there are difficulties in Renewable energy applications. Materials and Resources category includes 14 points. Credit requirements are met by 30% of the buildings in Europe and 39% of the buildings in Turkey. It is possible to conclude that achievement rate of points is significantly lower in this category compared to others. Almost no points have been earned from the credit requirements, Building Reuse and Material Reuse in this category. It is believed that these systems are newly developed and therefore harder to meet.
- Indoor Environmental Quality category includes 15 points. LEED Gold certified new buildings in Europe had average 8.5 points and in Turkey average 8.3 points. The credit requirement for Low emission materials-composite wood products in this category was met by a low percentage of buildings in Europe and no points were earned in this credit in Turkey.

***Table 2**. Number of points achieved category (Baştanoğlu, 2017).*

Category Name	Total Points	Points in Europe	Points in Turkey
SUSTAINABLE SITES	26p	18,5p	19p
WATER EFFICIENCY	10p	7,9p	8p
ENERGY AND ATMOSPHERE	35p	17,3p	14,6p
MATERIALS AND RESOURCES	14p	4,3p	5,6p
INDOOR ENVIRONMENTAL QUALITY	15p	8,5p	8,3p
INNOVATION AND REGIONAL PRIORITY	10p	7,8p	8,6p

- Innovation and Regional Priority category has 10 points. LEED Gold certified new buildings in Europe had average 7.8 points and in Turkey average 8.6 points. It is possible to conclude that achievement rate of points is high in this category.

Green building features were identified based on the comparison of every category and credit requirements met by the buildings reviewed in Europe and Turkey and the differences between the buildings in Europe and Turkey were determined. According to the findings of the study, some credit requirements were met by similar percentages of buildings in Europe and Turkey whereas others were met more either in Europe or Turkey.

The credit requirements that were met by a high percentage of buildings both in Europe and Turkey are those about location selection. Most of the LEED green certified buildings are at city centers and close to mass transportation access points. Based on the above findings, it can be concluded that LEED certified buildings are centrally located buildings with high values.

Credit requirements that do not entail high costs are met by high percentages of buildings both in Europe and in Turkey. Low cost credit requirements such as water efficient landscape design, waste management during construction were met by most of the buildings. Additionally, credit requirements such as outdoor bicycle racks, green car parks were met by a high percentage of buildings although they are not widely used. Credit requirements about chemical content of paints were also met by a high percentage of buildings and this indicates that paint manufacturers comply with LEED standards. As services of LEED consultant companies were used during construction of the buildings, these credit requirements were met by almost all buildings.

Some credit requirements were met by a very low percentage of buildings both in Europe and in Turkey. Most notable of these credit requirements are renewable energy production and purchase of green energy. Despite common belief, the likelihood of having a renewable energy system such as solar panels on a LEED certified green building is very low. Gurgun et al. (Gurgun et al., 2016) "Performance of LEED Energy Credit Requirements in European Countries" analyzes practices in European countries based on credit performances and it is shown that onsite renewable energy options were the least addressed energy efficiency solutions, probably because they are costly and not easy to find. This seems to be the biggest misperception about LEED green building certification systems in the real estate sector. This misperception causes problems during development and marketing of green buildings.

Users/occupants also assume that renewable energy systems are available on green buildings during marketing and promotion activities for these buildings. Furthermore, buildings with green building certification which do not use renewable energy lead to discussions about reliability of these certification systems. Credit requirements about material selection were met only by a very low percentage of LEED certified green buildings. It can be possible that the construction industry has difficulty in meeting the criteria about LEED certified wood products, renewable materials, composite wood products.

Turkey should focus on the criteria requirements that were met less in Turkey compared to European countries. LEED Gold certified new buildings in Turkey do not meet especially energy performance requirements as much as those in Europe. Although they have the same certification levels, green buildings in Europe are more energy efficient than those in Turkey. It can be concluded that Turkey somewhat lags behind Europe in designing energy efficient buildings. The main reason behind this problem is lack of enough regulation. Unless required by law, developers avoid meeting the criteria with high initial investment costs. It is also possible to say that passive energy efficiency strategies are less used in architectural designs in Turkey. As well as new laws and regulations about energy efficiency, awareness should be raised among industry stakeholders.

Turkey is also not up to the level of Europe in brownfield redevelopment credit. LEED certified green buildings developed on industrial areas after rehabilitation met the relevant criteria in Europe whereas none of the buildings in Turkey met these criteria. Assessment of land and underwater pollution, and relevant measures taken are not sufficient to meet LEED criteria. Relevant regulations should be developed, and the industry's awareness should be improved in Turkey.

The credit requirements for "Views" credit which is about occupant line of sight to outside was also met by a low percentage of buildings in Turkey compared to those in Europe. Given the fact that most of LEED certified green buildings are located at city centers, the reason for not meeting the requirement of line of sight can be lack of regulations on urban planning. In Turkey, there are more buildings which have living spaces in basement or buildings that are close to one other which significantly limits line of sight. It is recommended to develop regulations on urban planning to achieve more line of sight in buildings.

Turkey performs also poorer in criteria about chemical contents of floorings and wood products. It can be said that a lower percentage of materials in Turkey meet LEED certification standards when compared to Europe. It is expected that material manufacturers will develop more environmentally friendly products as the demand for such products increase. In addition to the above mentioned credits, the percentages in Turkey are not as high as those in Europe for measures against light pollution caused by buildings. It seems that developers ignore this green building feature in order to achieve the look they want for their buildings. This study found that some of the criteria requirements are met at a higher percentage in Turkey. Especially in water efficiency, grey water and water harvesting, more buildings in Turkey met the requirements

than in Europe. It can be concluded that awareness about water efficiency in Turkey is high and the industry can meet these criteria. Part of the criteria requirements which are met by a higher percentage of buildings in Turkey than in Europe were evaluated only based on declarations in LEED green building certification system. Credit requirements such as preparation of measurement and verification plan, conducting thermal comfort survey were evaluated based on declarations. As no on-site audit is used in LEED Green building certification system, these points can still be earned even if these credit requirements are not met. This can be considered as a problem in LEED green building certification system and it is recommended that there should be systems to check and verify that a building actually meets criteria requirements to prevent such arguments.

Overall, it is seen that the most important parameters in green building practices are the local regulations related to green building, education level of the project team and the construction costs of green building.

4. Conclusion and recommendations

In general, all green building certification systems have a similar review system. Each certificate has prerequisites and optional criteria about design, construction and operation. A building's certification level is determined based on the percentage of optional criteria met, and buildings can have green building certificates by meeting different criteria provided that they achieve a certain percentage. This system gives flexibility in certification process and allows that different type of buildings can have certificates based on different conditions. However, in this case since the same criteria are not valid for every project, every green building does not have the same features. For example, there is a minimum level for energy efficiency which certification systems require however this level is not very high and does not give a project significant benefits. A building with an energy efficiency that is not high can have the same certificate level with a building that have a high energy efficiency level but does not meet other criteria. A building that does not have a very high energy efficiency can be perceived as a high efficiency building just because it is certified. This causes confusion and uncertainties about the features that are expected in a certified building in the real estate sector. The consequences of such confusion and uncertainties which directly affect the real estate sector include false presumptions about the costs of development of green buildings which discourage developers from developing green buildings and misinformation provided to customers and unfair benefits while selling and renting green buildings. In order to avoid the above problems, features of a certified green building should be described, used and marketed correctly in the real estate sector. Furthermore, there have been some discussions about the validity of these certificates because of these uncertainties and a lack of trust has built up for certified green buildings in Turkey due to the reason that on-site audit is not done in these certification systems. These discussions and lack of trust prevent correct use of certificates and discourage green buildings. It is suggested that the benefit of LEED certification system would be enhanced if the minimum mandatory performance threshold of each criteria is increased above the industry standards. This will enforce the practitioners to implement all green building strategies instead of cutting corners to achieve the certification without having positive impact in all categories.

When differences in implementation of the certification system in Europe and Turkey were reviewed, regulations on energy efficiency, urban planning and brownfield redevelopment should be enacted. Additionally, construction of a green building requires multi-disciplinary work. Therefore, all disciplines involved in different stages of construction should be given training on green buildings. Inspection and control of the requirements declared to be met, development of evaluation criteria in line with urban planning principles and giving more importance to renewable energy systems can be among the recommendations to improve LEED green building certification system.

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Measuring effects of building orientation and vegetation on thermal comfort by ENVI-met (Case study: Maslak area, Istanbul)

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Abstract

Urban design and morphology are one of the most important factors affecting outdoor thermal comfort that should be given special attention. Optimal orientation would improve the quality of the building's thermal comfort as well as its urban area, considering the geography and climate of the area. Conversely, orientation and physical form of the buildings (particularly high-rise buildings) which are incompatible with climate could create a phenomenon called "urban heat island" and disrupt their thermal comfort. Moreover, vegetation as one of the outdoor affecting factors, through creating air movement and shading can help in enhancing the thermal comfort sensation. This paper, through a descriptive-analytical method, firstly explored the theoretical foundations around thermal comfort and the effects of morphology and vegetation on that. Secondly, a high-rise building complex located in Maslak district of Istanbul, a modern and developing region with the Mediterranean climate, was chosen as a case study. Three design alternatives, including the current design and two hypothetical design alternatives for building orientation and vegetation parameters, have been analyzed and the thermal comfort indicators, PMV and PPD have been calculated by Envi-met software. By evaluating and comparing the outputs, it can be concluded that controlling these two parameters (building orientation and vegetation) could have a positive impact on outdoor thermal comfort.

Keywords

Building orientation, Envi-met, High-rise buildings, Outdoor thermal comfort, Urban vegetation.

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1. Introduction

Achieving the human thermal comfort, in a recent high urban density, would be a challenge due to controlling the environments' micro-climate. Hasty and randomized urban design can lead to creating outdoor thermal discomfort between city blocks (Nouri, 2015).

Accordingly, urban design and morphology play an important role in providing thermal comfort, for instance, buildings form and orientation could create a phenomenon known as "urban heat islands" which could have negative impacts on urban areas like thermal discomfort. There are numerous design strategies to improve thermal comfort. In this study; two influential thermal comfort variables, building orientation and vegetation are investigated. First, with the descriptive method, definitions and theoretical foundations are presented. Then, related recent studies are presented in the form of a table to provide the theoretical framework for the analysis section of the case study.

2. Theoretical background

2.1. Thermal comfort

"Thermal comfort is defined as a state where no driving impulses exist so as to modify the environments by the behavior" (Hensen, 1991). The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) define thermal comfort as "the mental condition in which satisfaction with the thermal environment is expressed" (Ashrae, 2004).

Variety in variables and interactions can make thermal sensation to be more complicated. (Ogbonna & Harris, 2008). "To put it in another way, it is argued that thermal comfort has no absolute standard. Generally speaking, comfort takes place when body temperatures are within narrow ranges, the moisture of skin is low, and the physiological exertion of regulation is diminished. Comfort is also dependent on behavioral actions like changing clothing, changing activity, altering posture or position, changing the thermostat setting, complaining, opening a window, or leaving a space" (Djongyang et al, 2010). Thermal comfort can help sustainability through estimating energy usage of the building systems (Yao et al, 2009).

Table 1. *PMV ranges and physiological equivalent for different grades of thermal perception and physiological stress (Matzarakis, 1997) (Barakat et al, 2017).*

PMV	Thermal perception	Grade of physiological stress
<-3	Very cold	Extreme cold stress
-3	Cold	Strong cold stress
-2	Cool	Moderate cold stress
-1	Slightly cool	Slight cold stress
0	Comfortable	No thermal stress
1	Slightly warm	Slight heat stress
2	Warm	Moderate heat stress
3	Hot	Strong heat stress
>3	Very hot	Extreme heat stress

"Predicted mean vote (PMV) was developed for assessing thermal comfort. The PMV calculations consider four environmental parameters: air temperature, mean radiant temperature, wind speed and relative humidity; and two personal variables: clothing insulation and metabolic rate, as the inputs and predict thermal sensation. The Predicted Mean Vote (PMV) refers to a thermal scale that runs from Cold (-3) to Hot (+3)" as illustrated in Table 1 (Beizaee, 2012).

Despite showing the values in this table, PMV is not considering the acceptability of thermal comfort for most people and just expresses their opinion.

"Following these considerations, Fanger (1972) proposes an index for the evaluation of the conditions of

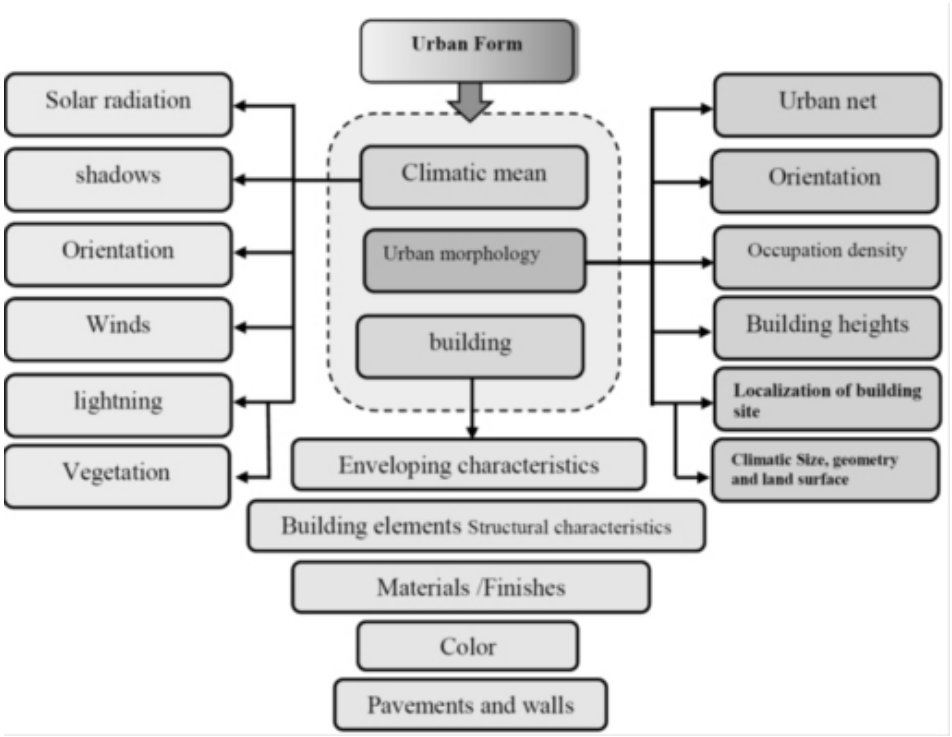

Figure 1. *Categories of constant intervening variables in outer space (Makvandi & Li, 2016).*

non-comfort (or discomfort) to an environment, expressed as a Predicted Percentage of Dissatisfied (PPD). The PPD index expresses the percentage of people in those conditions of metabolism, clothing and physical parameters of the environment, expressing, however, a negative judgment, in fact, complain; even when an environment is assessed by most people as neutral, it is believed that there are however 5 % of people who consider this condition as unsatisfactory" (Fabbri, k, 2015).

2.2. Outdoor thermal comfort variables

Mahvandi and Li (2016) classified outdoor thermal comfort variables into three categories. The first one included climatic characteristics like wind, humidity, temperature, solar radiation, vegetation and etc. The second category consists of morphological features, such as building geometry and orientation. The third one considers building elements, such as façade, finishes and materials. These variables must be simultaneously taken into account in a way that both climate and morphological features would be linked (Mahvandi & Li, 2016). Some of these thermal comfort variables also have been sorted in figure 1.

2.2.1. Building orientation

Building's angle can have a great impact on thermal comfort. Exposing building facades to the exterior environment, their form, orientation, and material properties could control the natural ventilation and solar radiation by evaporative cooling (Susie, 2011) (Iyendo et al, 2016).

Commonly, northern elevations are exposed to minimum solar rays versus southern elevations that are hit maximum amounts. Therefore, building orientation is one of the important factors that determine the received solar radiation of a building (Gupta & Ralegaonkar, 2004) (Omrany & Marsono, 2016).

2.2.2. Thermal comfort and vegetation in high-rise buildings

Being surrounded by vegetation is one of the key factors that help low-rise buildings mitigate uncomfortable climate conditions. In contrast, high-rise buildings are exposed to more solar radiation due to their larger surface area. Also, a high concentration of this type of building can cause environmental problems such as urban heat island (UHI), an effect that leads to thermal discomfort. As a result, providing thermal comfort requires

more consideration in high-rise buildings. (Chia Sok Ling et al. 2007) (Taib et al, 2010).

One of the methods for improving thermal comfort around high-rise buildings is introducing landscapes. This improvement is achieved through vegetation qualities such as evaporation, provided shade and air movement. Akbari (2002) found that "urban tree planting can account for a 25% reduction in net cooling and heating energy usage in an urban landscape". In addition to the outdoor thermal comfort benefits, the aesthetic of vegetation around the building blocks can have positive psychological effects (Iyendo et al, 2016) (Taib et al, 2010).

As mentioned above, the morphology of urban spaces and building form has a great impact on the micro-climates, and therefore on thermal comfort. Several studies have been conducted in recent decades and examined the impact of both variables on thermal comfort. Table 2 surveyed 14 of these studies from 2001 to 2017, which have been done in different locations and climates. In this table, the studies are classified according to the climate, and their dependent and independent variables are identified and categorized.

3. Case Study: Maslak area Istanbul

3.1. Research methodology

The method of research is descriptive-analytical. The theoretical framework has been developed using the literature review on the assessment of the various morphologies of urban high-rise buildings on thermal comfort. Therefore, one of the main administrative-commercial zones of Istanbul, Maslak area has been opted for quantitative and spatial estimation and evaluating the effects of high-rise buildings. This neighborhood is one of the main business districts in Istanbul, which is located in the European part of the city (Figure 2). Currently, one of the tallest buildings in this area is the 47-story spin tower, with a height of 202 meters. The other high-rise buildings in this area are the 53 and 54-tier towers that are between 261 to 270 meters high. Most of the towers built in this area are made of steel structures.

Table 2. *Key indicators regarding the "Urban Heat Island" (UHI) effect in the Adriatic settlements (Suau, C. et al, 2015).*

Climate	Research Title	Author(s)	Year	Dependent variables	Independent variables	Methods	Area of Study
Hot-dry	Numerical study on the effects of aspect ratio and orientation of an urban street canyon on outdoor thermal comfort in hot and dry climate	Ali-Toudert F. , Mayer H.	2006	Air temperature	Height to wide ratio (H/W), Orientation	Simulation (with ENVI-met)	Ghar-daia, Algeria
	Outdoor Thermal Comfort in the Hot Arid Climate	Aljawabral, F., Nikolopoulou M.	2009	Outdoor activities, Predicted Mean Vote (PMV)	Solar radiation	Survey	Marrakech in North Africa and Phoenix in North America.
	Impact of street design on urban microclimate for semi-arid climate (Constantine)	Bourbia F. , Boucheriba F.	2010	Physiological Equivalent Temperature (PET)	Sky view factors (SVF), wind speed	Quantitative	Cairo, Egypt
	Urban design in favor of human thermal comfort for hot arid climate using advanced simulation methods	Barakat A. et al.	2017	PMV,PET	Air temperature, relative humidity, MRT and PMV	Simulation (with ENVI-met)	New Borg El-Arab, Dubai, Emirate
Warm-humid	Urban shading (a design option for the tropics) A study in Colombo, Sri Lanka	Emmanuel R. et al.	2007	MRT, PET	Height to wide ratio (H/W)	Simulation (with ENVI-met)	Colombo, Sri Lanka
	Thermal perception, adaption and attendance in a public square in hot and humid regions	Lin T.	2009	PET, Thermal Sensation (Perception & attendance)	Air Temperatures, mean relative Humidity	Quantitative/ Survey	Taiwan
	Thermal Comfort Investigation in Three Hot-Humid Climate Theme Parks in Jakarta	Koerniawan M. D. and Gao W.	2015	PET	Solar radiation, Vegetation	Literature Review	Theme parks in Jakarta
	Effect of urban design on microclimate and thermal comfort outdoors in warm-humid Dar es Salaam, Tanzania	Yahia M.W. et al.	2017	Air temperature, wind speed, mean radiant temperature (MRT) //the physiologically equivalent temperature (PET)	Building Height, Vegetation// Wind speed, MRT	Simulation (with ENVI-met)	Dar es Salaam, Tanzania
Subtropical	Influence of Building Orientation on the Indoor Climate of Buildings	Januário M., Rodrigues A. L.	2012	Indoor temperature, Absorbed solar radiation	Orientation, Opened & closed windows	Simulation (with DEROB-LTH)	Maputo, Mozambique
	Thermal Comfort Zone for Outdoor Areas in Subtropical Climate	Moreno M. M. et al.	2008	Thermal Sensation	Air and globe temperatures, relative humidity, wind speed and temperature/ Vegetation	Survey	Campinas, Brazil
Temperate	Thermal Comfort and Outdoor Activity in Japanese Urban Public Places	Thorsson S. et al.	2007	Air temperature, globe temperature, surface temperature, relative humidity, wind speed, incoming short wave radiation, and incoming long-wave radiation// Thermal Sensation	Height// Stage of human Stress	Quantitative/ Survey	Matsudo, Japan
Cold	Climate and behavior in a Nordic city	Eliasson I. et al.	2007	Thermal Sensation (Human emotion, Attendance)	Height// Clearness index, Air temperature , Wind speed	Quantitative/ Survey	Gothenburg, Sweden
	Thermal Comfort in Outdoor Urban spaces: Understanding the human parameters	Nikolopoulo M. et al.	2001	Globe temperature	Number of people outdoors	Quantitative/ Survey	City-center of Cambridge, England
	Studies of Outdoor Thermal Comfort in Northern China	Lai D. et al.	2014	solar radiation, wind speed, and relative humidity //PMV, PET, UTCI	Air temperature	Quantitative/ Survey	Tianjin, China

Figure 2. *Maslak Mashattan area.*

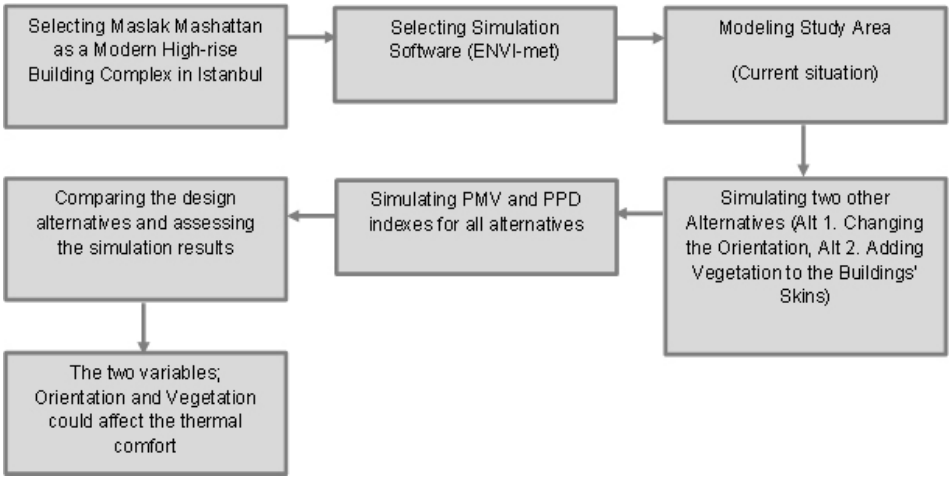

Figure 3. *Research process diagram.*

3.2. Research process

Maslak district due to having high-rise and modern buildings has been chosen for the study area and Mashattan Maslak building blocks for modeling and analyzing. After choosing the case study, the existing status of the neighborhood and building complex was simulated with the ENVI-met software (which has been identified as an appropriate tool for the simulation and evaluation of the thermal comfort indexes.). In order to measure the effects of vegetation and orientation on outdoor thermal comfort, two hypothetical alternative designs were proposed. Afterward, PMV and PPD variables as two thermal comfort indicators simulated with the software. Comparing the results, the effect of two variables (vegetation and orientation) on outdoor thermal comfort has been analyzed and demonstrated (Figure 3).

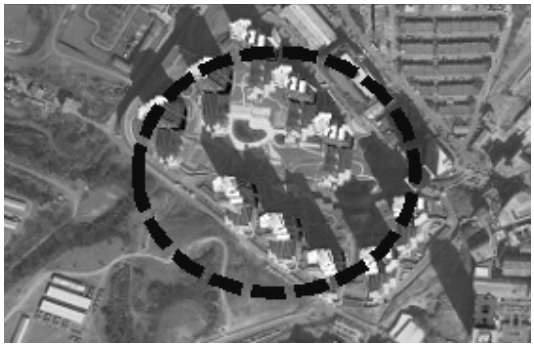

Figure 4. *Site location: Aerial photograph, 2018.*

3.3. Study area: Maslak area in Istanbul, Turkey

"The site is located between latitude 41°06' 26"N and 41°06'05"N, and longitude 29°01'45"E and 29°01'56"E. The area is bordered by the Bosphorus to the east, Belgrade Forest to the north and Kemerburgaz to the west. Densely populated residential areas, namely Levent and Etiler, are to the south. Moreover, an artificial lake and a stream (Kanlıkavak) are in the neighborhood. The altitude of the area ranges between 90 and 110 meters. Northern parts of both Asian and European sides of Istanbul are covered with Euro-Siberian flora that is deciduous forest vegetation. In the southern parts, which are under the Mediterranean effect, maquis vegetation dominates. The natural flora of the region has been changing for years because of the rapid increase in population and construction" (Çobanoglu, 2007) (Figure 4).

3.4. Simulation with ENVI-met

In this study, three alternatives have been evaluated using Envi-met 3D software. In several studies, this software has been used to simulate the microclimate factors in urban areas. This software is designed by Michael Bruse at the University of Mainz in Germany to simulate the interactions between surfaces, plants and urban environments (Bruse and Fleer, 1998). The effects of small-scale changes in urban design (construction patterns, vegetation, buildings morphology, etc.) could be analyzed through this software, as well as the micro-climate factors of the intermediate scale patterns in the urban environment (Tumini et al, 2014).

Physical components such as green spaces, watercourses, accesses, and the location of 6 blocks in modeling the design alternatives have been considered the same. Asphalt material has been used for paving the streets floor and soil and concrete for the courtyards, in accordance with the type of paving pattern. The space between these streets is filled with grass and building façade is a combination of glass and stone. The vegetation type inserted for alternative 3 is 4.5-meter trees. Also, the site is a rectangular shape, with 420 meters long and 240 meters wide, approximately. Figure 5 shows the input physical components of the simulation model for design alternatives.

The preliminary data for the modeling process has been entered at this stage. This data is based on geographic location (Istanbul), including latitude and longitude, air temperature, wind velocity and direction, relative and

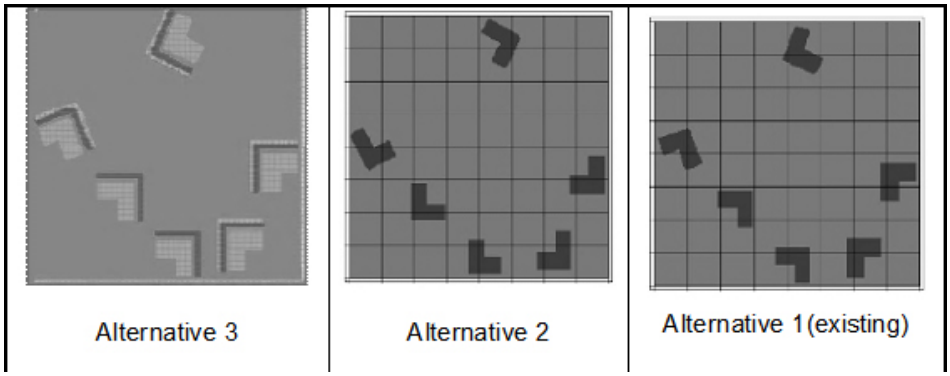

Figure 5. *Three options of modeling physical inputs (Authors, 2018).*

```
Total Simulation Time in Hours:                =00.25
Save Model State each ? min                    =15
Wind Speed in 10 m ab. Ground [m/s]            =3.52
Wind Direction (0:N..90:E..180:S..270:W..)     =45
Roughness Length z0 at Reference Point         =0.1
Initial Temperature Atmosphere [K]             =303
Specific Humidity in 2500 m [g Water/kg air]   =7
Relative Humidity in 2m [%]                    =50
Database Plants                                =[input]\Plants.dat

         ( -- End of Basic Data --)
         ( -- Following: Optional data. The order of sections is free. --)
         ( -- Missing Sections will keep default data. --)
         ( Use "Add Section" in ConfigEditor to add more sections )
         ( Only use "=" in front of the final value, not in the description)
         ( This file is created for ENVI-met V3.0 or better )
[PMV] ____________________________________Settings for PMV-Calculation
Walking Speed (m/s)                            =0.3
Energy-Exchange (Col. 2 M/A)                   =116
Mech. Factor                                   =0.0
Heattransfer resistance cloths                 =0.5

[SOURCES] ________________________________Type of emitted gas/particle
Name of component                               =PM10
Type of component                               =PM
Particle Diameter in [µm] (0 for gas)           =20
Particle Density [g/cm³]                        =1
Update interval for emission rate [s]           =600
```

Figure 6. *Basic microclimate input data for simulation software (Istanbul weather station, 2017).*

Table 3. *Reviewing 14 researches on urban microclimates and thermal comfort (2001-2017) (Authors).*

Metabolic Rate	Clothing	Building height
1.2 met	0.9 Clo	180 m

specific humidity, and the number of gaseous pollutants and suspended particles at a height of 2 meters. The calculation time for this simulation model is 3 pm on July 22nd, 2018. The atmospheric input data are extracted from the nearest airborne station in Maslak district. The basic data and initial inputs can be found in figure 6.

Also, Table 3 shows the clothing information, physiological and physical characteristics used to simulate in the software.

4. Analysis results

To assess the thermal comfort variations in different alternative morphologies, the indexes of Predicted Mean Vote (PMV) and Predicted Percentage of Dissatisfied (PPD) have been calculated, and the indexes have been simulated for all alternatives with the Envi-met. The first alternative simulation shows the existing situation and alternative 2 and 3 demonstrates the effects of orientation and vegetation, respectively. Figure 7 depicts the PMV index simulation for these three alternatives, moving from the darker shades to the lighter ones, the thermal comfort becomes closer to the ideal condition.

The results indicate that the minimum and maximum of the PMV in alternative 1 are -0.38 and 1.56, respectively. These values are also estimated for alternative 2; -0.36 and 1.59, and for alternative 3; -0.37 and 1.55, respectively. It is clear that the purpose of this study is to assess the changes in outdoor thermal comfort in the high-rise urban complexes. The criterion of assessments should be the rate of changes in the indexes for the outdoor condition of the site's center. As a result, according to the above outputs, the average PMV index for all three alternatives can be seen in Table 4.

The maximum value of PMV is 1.59 and belongs to Alternative 2, which is less favorable in terms of thermal comfort compared to other alternatives. Through examining the building

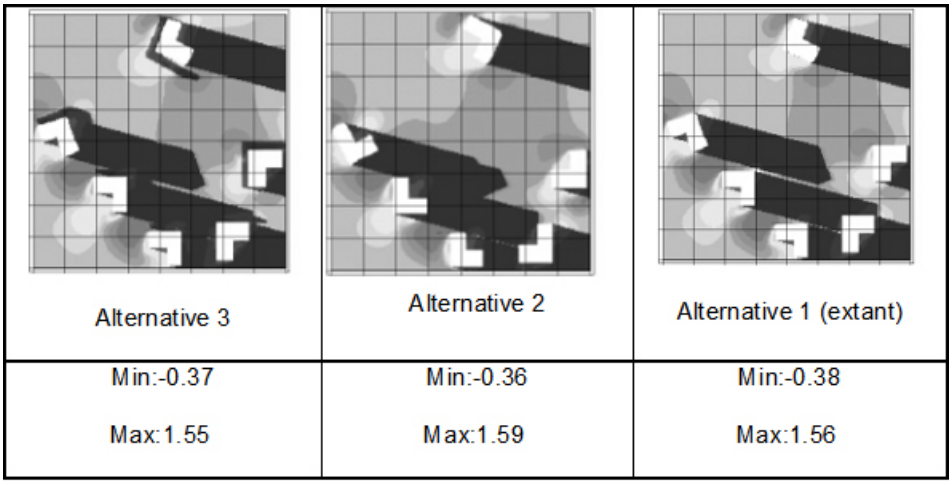

Figure 7. *The results of simulated Predicted Mean Vote (PMV) in the three research's alternatives.*

Table 4. *Basic information of input variables for simulation (Authors, 2018).*

Alternatives	Average PMV in the middle of the open spaces	PMV min	PMV max
Alternative 1 (extant)	-2.56	-0.38	1.56
Alternative 2	-2.51	-0.36	1.59
Alternative 3	-1.84	-0.37	1.55

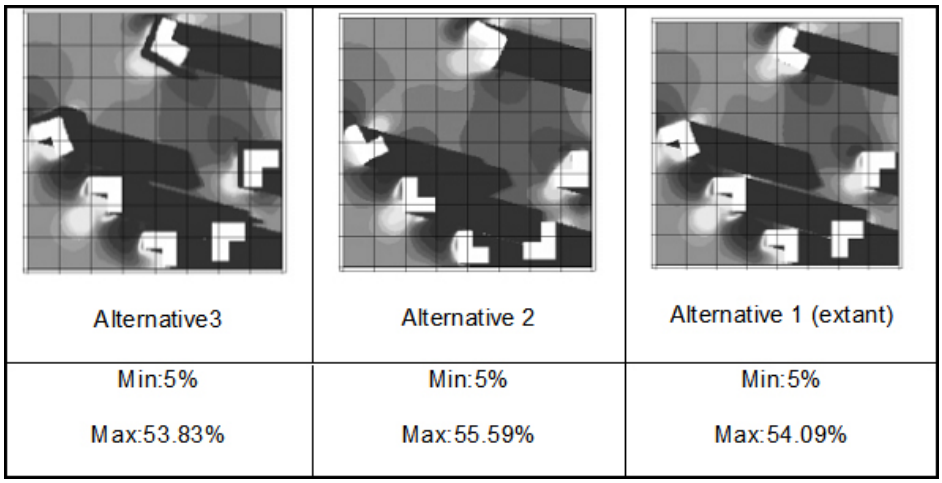

Figure 8. *Results of predicted percentage of dissatisfied (PPD) simulation in the three research's alternatives (Authors, 2018).*

Table 5. *The average PMV index for the three research's alternatives (Authors, 2018).*

Alternatives	Average PPD in the middle of the open spaces	PPD min	PPD max
Alternative 1 (extant)	83.1%	5%	54.09%
Alternative 2	81.7%	5%	55.59%
Alternative 3	72.4%	5%	53.83%

locations in the site for all three alternatives, it can be seen that the differences in buildings orientation in relation to each other result in having the lowest thermal comfort in Alternative 2. The lowest minimum is for the existing layout (-0.38). Having the highest average value in alternative 3 (-1.84) comparing to existing situation (alternative 1) proves the importance of vegetation in improving thermal comfort perception.

In Figure 8, the outputs of the PPD index simulation are shown for three design alternatives. Changing from the lighter shades to darker represents an increase in the amount of dissatisfaction predicted by the residents, consequently away from the ideal thermal comfort.

The simulation shows that the maximum of PPD index has been estimated at 54.09% for alternative 1, 55.59% for alternative 2, and 53.83% for alternative 3. The maximum PPD value for alternative two is more than the other alternatives that predict the highest percentage of thermal dissatisfaction for this alternative. Therefore, by simulating both indicators for all alternatives, it can be found that alternative 2 has the lowest degree of thermal comfort. In contrast, alternative 3 with vegetation on the building complex has the lowest percentage, which demonstrates the better thermal comfort in PPD index simulation (Table 5).

Simulating PMV and PPD indexes, the closer the PMV value to zero, and the lower the PPD percentage, the better thermal comfort. Therefore, by comparing the PPD and PMV values in all three alternatives, it can be deduced that the third alternative is the most optimal proposal among the other study alternatives, with the average PMV and the average PPD, -1.84 and 72.4%, respectively. Conversely, in alternative 2, the highest percentage of PPD and the least value of PMV results in not being the optimal design alternative compared to others. As can be seen from the analysis, the differences between outputs are not very remarkable. However, on the larger scale of an urban area, it can show a significant result, eventually. Therefore, it is critical to consider building orientation in plans before construction in order to provide better outdoor thermal comfort in urban complexes.

Obviously, relocating the building projects that have been already implemented is impracticable; nonetheless, for the future designs, the optimal building location should be identified and put into practice. Moreover, for the current built projects, other solutions such as adding vegetation to the building facades could affect the thermal comfort positively.

5. Conclusion

3D simulation of the PMV and PPD indexes in alternative 3 shows that this alternative provides the most optimal condition in terms of thermal comfort than other alternatives. Moreover, alternative 2 (changing the blocks' orientation) has the lowest thermal comfort compared to the others. Clearly, in addition to these alternatives, there are various types of design options, yet the purpose of this study is to prove that the way of placing the buildings in the site without relocating and merely by rotating them, would affect the thermal comfort. Furthermore, it proves the effect of vegetation on improving thermal comfort.

The data analysis shows that the PMV / PPD space model can predict the thermal comfort in different urban design patterns. In some ways, it can be admitted that the values of PMV / PPD indexes change by the morphology of urban buildings. Changes in building morphology, especially high-rises, alter the sky view factor, and also the microclimate parameters, which will eventually affect the outdoor thermal comfort. On the other hand, rapid population growth, urbanization, and industrialization of the cities have a significant changing role in some meteorological quantities. Since there is a strong relationship between urban morphology and sky view factor, variations in sky view factor will change the air temperature inside the city. As a result, changing the urban buildings form and urban morphology will alter the parameters affecting thermal comfort and other environmental factors, as well as the formation of the urban heat islands.

Consequently, the plan, shape, and morphology of the urban buildings, should be considered in development plans, based on different climate conditions. As well as considering the building regulations' clause of urban development projects, such as a detailed urban plan, with emphasis on improving the human thermal comfort. In order to achieve sustainable development, designers, architects, and urban planners should contemplate the above considerations.

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LEED certified mixed-use residential buildings in Istanbul: A study on category-based performances

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Abstract

The building industry has a significant negative effect on climate change and increases other environmental problems at the global scale. LEED, which is one of the most globally used environmental assessment tool, provides the certification of projects according to the evaluation criteria of green buildings under certain categories. On the other hand, an emerging form of architecture, the mixed-use residential high-rise building (MRB), appears in larger numbers especially in the metropolitans of developing countries, such as Istanbul. This building typology displays a positive approach in the context of sustainability. Since they are high-budget projects addressing to high-income groups, it is inherently expected that they have a green approach as a social responsibility. The objective of this study is to analyze LEED certified MRBs in Istanbul by focusing on their prioritization of evaluation categories. LEED's database revealed a total of twenty-one certified projects under the New Constructions (v.3) scheme. Based on the gained points by these projects, mean rank values of the evaluation categories were calculated, which indicated the priorities given by this sample group. Furthermore, the conducted Kruskal-Wallis test showed there was highly significant difference among the rankings of the categories for these projects. Based on these rank order tests, obtained category priority order of MRBs was compared to the one implied by LEED's assigned category weights. It was found that Energy and Atmosphere category gained much lower attention than required. Taking the results of the study into account, certain conclusions were drawn for this building type in Istanbul.

Keywords

Green building rating systems, LEED, Assessment category, Mixed-use, Residential buildings.

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1. Introduction

Today, it is a well-known fact that the building industry is largely responsible of the global environmental impact as well as a considerable part of health related problems. Around 40% of the total global energy demand and material use is due to construction activities (Erlandsson & Borg, 2003). Buildings consume 12% of potable water and 55% of wood products, while they account for 30% of greenhouse gas (GHG) emissions and generate around 55% of the waste sent to landfills (Castro-Lacouture, Sefair, Flórez, & Medaglia, 2009). Moreover, indoor environments which do not comply with green building practices may cause severe effects on human health, known as the Sick Building Syndrome (Castro-Lacouture et al., 2009). However, it also is a field where significant improvement on the issue has been and is continuing to be accomplished (Zabalza Bribián, Aranda Usón, & Scarpellini, 2009).

There have been continuous efforts to find solutions for mitigating these problems through green building practices and technologies (Cole, 1999, 2005; Crawley & Aho, 1999; Ding, 2008). Green building principles help conduct resource efficient design and construction, improve performance throughout operation and reclaim wastes at the end of life phases of buildings (Greer et al., 2019). Therefore, one of the most important tools to tackle these mentioned problems is the Green Building Rating Systems (GBRS).

On the other hand, as a solution to overpopulation and housing shortage in urban areas, MRB projects have been increasing in numbers especially in cities of developing countries with high population densities. Istanbul is one example to these cities where such high-rise developments arise significantly owing to its recent advancements in the real estate sector and growing financial centres. Having the highest population of over 15 million, Istanbul has always been a metropolitan with the highest demand and sales numbers for housing in Turkey (TUIK, 2019). It should also be noted that there is a considerable and increasing demand for green building certification in this city. As of 14 July 2019, there are a total of 245 LEED, BREEAM and EDGE certified projects in Istanbul, of which 210 are LEED certified (CEDBIK, 2019). Hence, this paper analyses LEED certified MRB projects in Istanbul, regarding their prioritization of green building assessment categories.

1.1. Aim and scope of the study

The main aim of this study is to find out to what extend above mentioned LEED certified green projects in Istanbul comply with the priority order of evaluation categories set forth by LEED authorities. Therefore, the study presents the assessment of these projects based on their performances in LEED evaluation categories and provides insights for this building typology in Istanbul, by comparing the category priority order revealed by the project performances to the order adopted by the LEED system.

As to the version of LEED, although the latest version of the system is version 4 (v.4), version 3 (v.3) was chosen for the analysis in the study due to the lack of certified MRB projects in version 4 and the abundance of them in version 3 in Istanbul.

The issue of 'Mixed-use Residential Buildings' has often been examined as to its economical aspects in studies particularly in the field of real-estate; and as to its social and environmental aspects in the fields of urban planning, architecture and interior architecture. In the literature, the mentioned topic has been dealt with from various points of view, such as economic efficiency,contributing factors (Rabianski and Clements, 2007; Rabianski et al., 2009), public welfare (Akgün, 2010), human health and social well-being (Barros et al., 2019), the relationship between architectural design approach and user behaviour (Goodman, 2008; Zengel and Deneri, 2007) and architectural language (Aslankan, 2019). However, as it was mentioned in a comprehensive literature study conducted on the topic (DeLisle and Grissom, 2013), this issue was examined mostly from the aspects of scale, usage of site, urban form and finance. It

is seen that studies which analyze the issue from the aspects of sustainability and green architecture are rather less and the existing examples have dealt with it mostly from energy perspective. Moreover, in research involving case studies it is seen that the green features of buildings have been reported (Şahin and Hocaoğlu, 2015), or parameters such as location, spatial analysis, relationship with environment, function ratios (Sarı, 2006) and urban design (Hocaoğlu, 2014) have been evaluated. In this context, the present study has an original contribution to the literature since it provides the analysis of MRBs with a holistic approach based on their performances in green building assessment categories of LEED and the evaluation of findings based on the conditions of Istanbul.

Moreover, although publications on green building rating systems, particularly on LEED have appeared in the literature often, none of them solely examine the performances of certified MRB projects in Istanbul based on assessment categories and present an in-depth analysis on the underlying reasons of poor category performances. Hence, the scope of this study can be summarized as;

i) Finding out mixed-use residential high-rise buildings in Istanbul which have completed LEED NC v.3 certifications and listing their certification details

ii) Gathering achieved points by these projects under each category from LEED's database

iii) Finding out category scores and calculating mean rank values by the conducted rank order tests

iv) By the conducted Kruskal-Wallis test, revealing that there was highly significant difference among the rankings of the categories

v) Establishing a priority order among the categories based on the conducted rank order test

vi) Comparing the priority order of categories derived from the projects' performances with the order set forth by LEED authorities

vii) Based on the findings, drawing certain conclusions for this building typology in Istanbul

Therefore, this analysis serves as a guide for those researchers interested and professionals involved in green building rating systems, as well as authorities associated to the construction industry particularly in Turkey.

2. Mixed-use residential high-rise buildings

Residential environment, which is an essential component of the urban fabric, constitutes the highest percentage of urban settlements (Oktay, 2001; Skalicky & Čerpes, 2019a). Since residential environments have a central position in an individual's life by being a fundamental aspect of daily routine and providing comfort and security, the psychological and social importance of housing is undeniable. In these environments, the relationships between the user, the building and the society are so crucial that when the compatibility between these elements gets weaker, physiological and psychological problems, as well as social disorders may arise (Oktay, 2001; Vliet, 1999).

The continuously growing migration from rural to urban areas, leads to the increase of urbanization globally. It is estimated that by 2050, 70% of the world population would be living in urban areas (Skalicky & Čerpes, 2019b). In the light of this projection and the awareness of the environmental impact of urban sprawl, also as to the fact that land becoming scarce and expensive in urban areas, there is a tendency towards compact, high-rise developments (Ahmad, Aibinu, & Thaheem, 2017; Barros et al., 2019; Wener & Carmalt, 2006). A significant number of researchers and policy makers suggest higher-density tall urban developments as a means of sustainability, since they optimize land use while leaving more ground surfaces for green areas and other amenities (Yuen, 2005; Zengel & Deneri, 2007). However, since high-rise developments are massive structures designed to serve large populations, these buildings are often associated with high levels of resource consumption. They entail large amounts of material consumption during construction, exhaust water and energy resources during operation, and produce significant amounts of waste at their end of life

phases (Ahmad et al., 2017; Wener & Carmalt, 2006). However, the insight of assuming high-rise buildings as less sustainable might be overstated since studies to verify this hypothesis which analyses the issue in a holistic context hardly exists in literature (Ahmad et al., 2017). It should be acknowledged that this issue comprises many parameters which may also have positive effects on sustainability. In fact, a study focusing on the spatial distribution of population has found that when population and income levels were kept constant, carbon emissions were lower in urban areas when compared to rural areas, where there are lower population densities (Ahmad et al., 2017; Glaeser & Kahn, 2010).

On the other hand, in numerous studies it is stated that high-density mixed-use developments affect social wellbeing positively by providing socially cohesive environments and lessen energy consumption by promoting walking, cycling and public transportation (Bentley, Alcock, Murrain, McGlynn, & Smith, 1985; Jacobs, 1961; Mouratidis, 2018; Murrain, 1996). Therefore, in the field of planning, the recent trend has shifted from 'massive and repetitive housing blocks… towards a rich variety of…mixed-use developments' (Oktay, 2001).

Together with these arguments and increasing globalization, a new hybrid form of building typology, namely, mixed-use residential high-rise building (MRB) has emerged for users who wish to keep up with the fast urban life. It should be noted that there is no internationally accepted definition of a high-rise building (Al-Kodmany, 2018). In this study, MRB is defined as a multi-storey building including various facilities, with its primary use being residential. Therefore, MRBs consist of not only dwellings, but also some other public services, such as; fitness centres, shopping malls, cafes and restaurants. As these buildings accommodate various facilities in a single entity, they also act as semi-public spaces (Zengel & Deneri, 2007). Moreover, since the residents have the opportunity to access a variety of amenities within their residential buildings, MRB projects help to reduce the extra carbons to be emitted for transportation. In this context, this building typology can be deemed sustainable, since it embraces an inclusive design approach within the society, sets a good example for local self-sufficiency and help lessen environmental impacts.

According to Sev, mixed-use developments should be supported as users have the opportunity to meet various needs close to their place of habitation (Sev, 2009). By integrating a number of uses in a single location, this typology also provides flexibility to adapt buildings according to changing demands, thus increasing its long term life-cycle. It is also stated that MRBs would help improve social relations and enhance social values. Moreover, they would yield to full-time occupancy of spaces and therefore provide more security for their users (Sev, 2009). However, from another point of view, MRBs have negative effects on the transportation in their area, as these complexes easily become a place of attraction for citizens (Zengel & Deneri, 2007).

Karakus states that, in the past, the guiding principles for the production of high quality housing were mostly shaped by functionality and aesthetics. Yet today, the guidelines for designing urban housing which require high density solutions are based on promoting sustainable communities (Karakuş, 2009). Within this framework, this high-cost building typology is expected to have a green design approach as a social responsibility. Therefore, this study has been carried out considering the importance of assessing the performances of MRBs regarding green building rating systems.

3. Green building rating systems

Since green buildings provide energy, water and material conservation, economic savings, as well as, healthy and high-quality spaces; they have gained considerable public support and have become the major pioneering field in sustainable development (Ali & Al Nsairat, 2009). There are numerous environmental building assessment tools used worldwide. Most of these tools are developed national-

ly and used internationally across the globe. However, only some are subjected to customization for international use, according to changing local conditions (Süzer, 2015).

3.1. LEED

The US-originated Leadership in Energy and Environmental Design (LEED) is considered to be one of the two most prominent and widely used environmental assessment tools at the global scale (Wu, Mao, Wang, Song, & Wang, 2016). Since it was developed in 2000 by the US Green Building Council (USGBC), it gained tremendous popularity and became a credible guide to implement and assess green building practices beyond its country of origin (Süzer, 2015). As of 3 July 2019, there are 103052 LEED certified projects worldwide (USGBC, 2019a).

LEED offers the assessment and certification of various project types under its different schemes. Each scheme contains certain evaluation categories and under these categories there are credits to be fulfilled with assigned points. Projects are evaluated based on their performances and awarded simply according to their total gained points. If the project receives a score between 40-49 points it is awarded as Certified, if it gets points between 50-59 it is certified as Silver, if it gets points between 60-79 it is granted Gold, and finally if it receives a score higher than 80 it gets Platinum award (Horvat & Fazio, 2005; Süzer, 2015; USGBC, 2009, 2019b).

Since the day LEED was first launched as its pilot version v1.0, it has been continuously updated to address current needs and building technologies accurately and upgraded regarding its assessment methods and used standards, under the names v2.0, v2.2, v.3 (also known as version 2009) and v.4, successively. The currently used version v.4 was launched on 11 January 2019 (USGBC, 2019b) and lately a Beta version which is v.4.1 was launched in April 2020. The categories and credit weights included in each scheme and version differ partly as the system goes under such revisions (USGBC, 2020).

4. Methodology

As to the analysis of the study, for gathering data on projects, LEED's online project database was used (USGBC, 2019a). The various schemes offered by LEED and their field of use are as follows (USGBC, 2019b):

- BD+C: Building Design and Construction, including New Construction (NC), (for New Constructions and Major Renovations),
- ID+C: Interior Design and Construction, for complete interior fit-out projects
- O+M: Building Operations and Maintenance, for existing buildings
- ND: Neighbourhood Development, for new land development projects
- Homes: For single family, low and mid-rise multi-family homes (up to six stories)
- Cities and Communities: For entire cities and sub-sections of a city
- LEED Recertification: For projects previously achieved LEED certification
- LEED Zero: For projects with net zero goals in carbon and/or resources

For the analysis, as to the LEED scheme, New Constructions and Major Renovations (NC) was chosen. The reason for selecting the NC scheme is due to the fact that this scheme covers the building typology which is the main subject of the paper and offers a more extensive field of use when compared to other schemes, therefore gives higher certification numbers when MRB projects are considered (USGBC, 2019a).

Moreover, as to the version of LEED, version 3 (v.3) was chosen for the analysis in the study. Although the latest version of the system is version 4 (v.4), LEED's database revealed that, out of a total of 42 projects registered for certification under the NC v.4 scheme in Istanbul, only 5 of them have a completed certification and neither one can be classified as an MRB project. On the other hand, its previous version, v.3 was launched in 2009, however, it has a significant number of registered projects in Istanbul, some of which are still under the certification process (USGBC, 2019a).

From the search on LEED's project directory, by using the search filters of; v.3 as the version, New Constructions as the scheme and Istanbul as the city, the database gave the results of a total of 210 projects. It was seen that, out of these 210 registered projects, only 66 of them had a completed certification. After careful screening of these results, it was seen that, out of 66, 21 projects could be identified as MRBs (USGBC, 2019a). It is important to underline that more than one-thirds of the LEED NC (v.3) certified projects in Istanbul is composed of MRBs.

The certification scores of these 21 projects were used for the analysis of this study. Moreover, it was noticed that out of the 21 projects, 5 of them had received separate certifications for their building blocks which yielded to the increase of the sample size to 35 for the conducted statistical analysis. The details of the mentioned projects and their code numbers are presented in Table 1.

LEED NC v.3 scheme is composed of five main categories which are; (i) Energy and Atmosphere (EA), (ii) Sustainable Sites (SS), (iii) Indoor Environmental Quality (IEQ), (iv) Materials and Resources (MR) and (v) Water Efficiency (WE). The total points assigned to the credits presented under each category make up a total of 100 base points. The additional two categories of evaluation are Innovation and Regional Priority, which add extra 10 bonus points (USGBC, 2009). The certification process simply involves the summation of achieved points for each credit, under each category. The point allocation system for the credits found under each category is based on scientific studies and the consensus of LEED authorities. These credit points entail an implicit weighting system among the categories of evaluation, as they display a certain weight within the total 100 base points and thus imply a priority among these categories (Horvat & Fazio, 2005; Süzer, 2015).

Table 1. *Details of LEED NC (v.3) certified MRB projects in Istanbul (USGBC, 2019a).*

#	Project Code	Name of Project	Overall Score (Out of 110)	Certification Level	Year of Certification	Reference
1	1a	Agaoglu Maslak 1453 A Blok	60	Gold	2017	
2	1b	Agaoglu Maslak 1453 B Blok	63	Gold	2018	(Ağaoğlu, 2019a)
3	1c	Agaoglu Maslak 1453 C Blok	61	Gold	2017	
4	2	And Pastel Turuncu	66	Gold	2018	(Anadolu Grubu, 2019)
5	3	Andromeda Gold Residence	61	Gold	2013	(Ağaoğlu, 2019b)
6	4	Cinar Apartmani	63	Gold	2018	(BB Yapı, 2019)
7	5	Daire Kartal	62	Gold	2018	(Kale, 2019)
8	6	Dumankaya Flex Kurtkoy	50	Silver	2014	(Dumankaya, 2019)
9	7	Istanbloom	63	Gold	2015	(Esin Yapı, 2019)
10	8	Maltepe Piazza Residence	62	Gold	2019	(Rönesans Gayrimenkul, 2019)
11	9a	Metropol Istanbul A Block	60	Gold	2017	
12	9b	Metropol Istanbul B Block	62	Gold	2017	("Metropol İstanbul", 2019)
13	9c	Metropol Istanbul C1 Block	62	Gold	2017	
14	10a	Narlife A Block	60	Gold	2016	
15	10b	Narlife B Block	60	Gold	2016	(Tepe İnşaat, 2019)
16	10c	Narlife C Block	61	Gold	2015	
17	11	Nidapark Seyrantepe	63	Gold	2018	(Tahincioğlu, 2019)
18	12	Rings Office Suites	60	Gold	2017	(Çevredostu, 2019)
19	13	Selenium Retro	60	Gold	2018	(Aşçıoğlu, 2019)
20	14a	Soyak Konforia Block A	51	Silver	2018	
21	14b	Soyak Konforia Block B	51	Silver	2018	("Soyak Konforia", 2019)
22	14c	Soyak Konforia Block C	51	Silver	2018	
23	15	Soyak Soho	63	Gold	2014	(Soyak Yapı, 2019)
24	16	Sunsetpark Caddebostan	45	Certified	2017	(Kentpark Yapı, 2019)
25	17	Tekfen Bomonti Apartments	63	Gold	2012	(Tekfen Realestate, 2019a)
26	18a	Tekfen Hep Istanbul B2	54	Silver	2018	
27	18b	Tekfen Hep Istanbul B3	55	Silver	2018	
28	18c	Tekfen Hep Istanbul B4	56	Silver	2018	
29	18d	Tekfen Hep Istanbul B5	55	Silver	2018	(Tekfen Realestate, 2019b)
30	18e	Tekfen Hep Istanbul B8	55	Silver	2018	
31	18f	Tekfen Hep Istanbul B10	54	Silver	2017	
32	18g	Tekfen Hep Istanbul B11	52	Silver	2017	
33	19	The House Residence	66	Gold	2017	(Yenigün, 2019)
34	20	Yildiz 45	64	Gold	2018	(Yıldız Yapı Grubu, 2019)
35	21	42 Maslak Tower A	55	Gold	2015	(Yeşil Bina Dergisi, 2016)

Table 2. *LEED NC v.3 main category weights and priority order.*

Category	Weighting		Priority Order
Energy and Atmosphere	35 points	35%	1
Sustainable Sites	26 points	26%	2
Indoor Environmental Quality	15 points	15%	3
Materials and Resources	14 points	14%	4
Water Efficiency	10 points	10%	5
Total	100 base points		

The weighting system of LEED NC, v.3 for its categories and hence their priority order are given in Table 2 (USGBC, 2009).

In the current study, as to the method of analysis firstly the score details of LEED certified MRB projects in Istanbul were collected from LEED's project database (USGBC, 2019a). To find out the Category Scores (CS) of the projects, the Achieved Points (AP) by the projects under each category were divided by the Total Available Points (TAP) allocated to the categories by LEED (Table 2). The calculated CS values ($\bar{R}$) are given in Table 3.

Secondly, by using these CS values, rank-order tests were conducted to assess the priority order among these groups of data. The CS values were sorted in ascending order, so that each value was assigned a rank that indicated where in the order it appeared (Argyrous, 2011). After that, the mean rank values were calculated for each category. Higher the mean rank value meant higher success, thus higher priority given to that category. It was found that, the mean rank ($\bar{R}$) value of the Energy and Atmosphere category

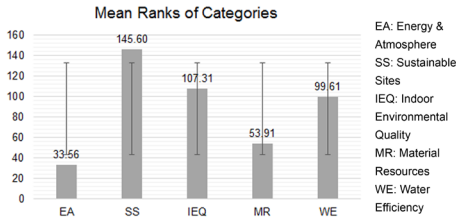

Figure 1. *Mean rank values of assessment categories of MRB projects.*

Table 3. *Calculated Category Score (CS) values of MRB projects.*[1,2]

Project Code	EA			SS			IEQ			MR			WE		
	AP	TAP	CS	AP	TAP	CS	AP	TAP	CS	AP	TAP	CS	AP	TAP	CS
1a	15	35	0.43	16	26	0.62	9	15	0.60	6	14	0.43	6	10	0.60
1b	15	35	0.43	18	26	0.69	9	15	0.60	6	14	0.43	6	10	0.60
1c	12	35	0.34	17	26	0.65	9	15	0.60	6	14	0.43	8	10	0.80
2	15	35	0.43	23	26	0.88	8	15	0.53	5	14	0.36	8	10	0.80
3	11	35	0.31	22	26	0.85	8	15	0.53	6	14	0.43	4	10	0.40
4	8	35	0.23	23	26	0.88	10	15	0.67	6	14	0.43	8	10	0.80
5	10	35	0.29	23	26	0.88	9	15	0.60	6	14	0.43	6	10	0.60
6	11	35	0.31	14	26	0.54	7	15	0.47	4	14	0.29	6	10	0.60
7	13	35	0.37	23	26	0.88	7	15	0.47	4	14	0.29	8	10	0.80
8	9	35	0.26	22	26	0.85	9	15	0.60	5	14	0.36	10	10	1.00
9a	8	35	0.23	21	26	0.81	11	15	0.73	6	14	0.43	6	10	0.60
9b	9	35	0.26	21	26	0.81	12	15	0.80	6	14	0.43	6	10	0.60
9c	9	35	0.26	20	26	0.77	11	15	0.73	6	14	0.43	7	10	0.70
10a	14	35	0.40	16	26	0.62	7	15	0.47	6	14	0.43	7	10	0.70
10b	13	35	0.37	16	26	0.62	9	15	0.60	6	14	0.43	7	10	0.70
10c	15	35	0.43	16	26	0.62	8	15	0.53	6	14	0.43	7	10	0.70
11	14	35	0.40	21	26	0.81	9	15	0.60	5	14	0.36	6	10	0.60
12	9	35	0.26	22	26	0.85	7	15	0.47	6	14	0.43	6	10	0.60
13	18	35	0.51	16	26	0.62	7	15	0.47	7	14	0.50	4	10	0.40
14a	9	35	0.26	15	26	0.58	10	15	0.67	6	14	0.43	4	10	0.40
14b	10	35	0.29	14	26	0.54	10	15	0.67	6	14	0.43	4	10	0.40
14c	10	35	0.29	14	26	0.54	10	15	0.67	6	14	0.43	4	10	0.40
15	14	35	0.40	21	26	0.81	6	15	0.40	5	14	0.36	8	10	0.80
16	10	35	0.29	19	26	0.73	7	15	0.47	2	14	0.14	2	10	0.20
17	11	35	0.31	23	26	0.88	7	15	0.47	6	14	0.43	6	10	0.60
18a	11	35	0.31	20	26	0.77	8	15	0.53	5	14	0.36	2	10	0.20
18b	10	35	0.29	20	26	0.77	8	15	0.53	5	14	0.36	4	10	0.40
18c	11	35	0.31	20	26	0.77	8	15	0.53	5	14	0.36	4	10	0.40
18d	10	35	0.29	20	26	0.77	8	15	0.53	5	14	0.36	4	10	0.40
18e	11	35	0.31	20	26	0.77	8	15	0.53	5	14	0.36	4	10	0.40
18f	9	35	0.26	20	26	0.77	8	15	0.53	5	14	0.36	4	10	0.40
18g	9	35	0.26	20	26	0.77	8	15	0.53	4	14	0.29	4	10	0.40
19	12	35	0.34	22	26	0.85	10	15	0.67	3	14	0.21	10	10	1.00
20	11	35	0.31	20	26	0.77	9	15	0.60	8	14	0.57	6	10	0.60
21	22	35	0.63	15	26	0.58	8	15	0.53	6	14	0.43	4	10	0.40

Category Scores (CS) = Achieved Points (AP) / Total Available Points (TAP)

[1]*Project code numbers 1, 9, 10, 14 and 18 have separate certifications for their different building blocks, noted here as a, b, c, etc.*

[2]*EA: Energy and Atmosphere, SS: Sustainable Sites, IEQ: Indoor Environmental Quality, MR: Materials and Resources, WE: Water Efficiency, AP: Achieved Points, TAP: Total Available Points, CS: Category Score*

was 33.56, Sustainable Sites was 145.60, Indoor Environmental Quality was 107.31, Materials and Resources was 53.91 and finally, Water Efficiency was 99.61 (see Fig. 1).

To see statistically, if some categories received much more attention than others, or if there was a rather more uniform distribution of rankings throughout the groups, a Kruskal-Wallis (KW) test was conducted (Table 4). According to the KW test, it was seen that there is highly significant difference among the rankings of the categories ($p < 0.001$).

Table 4. *Kruskal-Wallis test conducted on CS values of MRB projects.*

	EA	SS	IEQ	MR	WE	
median	0.31	0.77	0.53	0.43	0.60	
rank sum	1174.5	5096	3756	1887	3486.5	
count	35	35	35	35	35	175
r^2/n	39413	741978	403072	101736	347305	1633504
H-stat						108.43
H-ties						108.96
df						4
p-value						1.E-22
alpha						0.05
sig						yes

Hence, based on the results of the Kruskal-Wallis test, it was concluded that it is possible to establish a hierarchy order among the category performances of the projects. As mentioned before, mean rank values for the category scores found by the conducted rank order test revealed the priority order of the categories regarding the performances of MRBs. Due to the fact that category scores were sorted in ascending order; higher mean rank values indicated higher success, thus higher priority. Hence, the category order for the projects was determined as; first Sustainable Sites, second Indoor Environmental Quality, third Water Efficiency, fourth Materials and Resources and finally fifth, Energy and Atmosphere (Fig. 2). Consequently, the priority order established by these projects was compared with the order set forth by LEED, using its implicit category weightings (Fig. 2, Table 2). Based on this comparison, by detecting which categories gained higher importance and which ones were overlooked (or found fewer opportunities for application), discussions were made and certain conclusions were derived for this building typology.

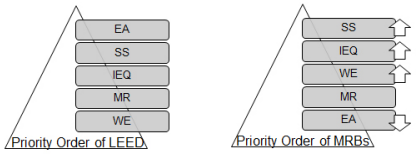

Figure 2. *Comparison of the priority order of categories according to LEED weightings (left) and MRB projects results (right).*

5. Findings and discussion

As mentioned above, the hierarchal order of categories in LEED, which is implied by their weights, is based on the consensus regarding the severity of the global environmental problems. Hence, the most important assessment category in LEED and other widely used green building rating systems across the world is associated with energy due to the issue of climate change (Sallam & Abdelaal, 2016). It is a well-known fact that today the most alarming environmental problem the world is facing is global warming stemming from the excessive emission of harmful gases because of the increased usage of fossil fuels instead of renewable resources. However, the findings of this study show that the category with the lowest mean rank value, which is 33.56, is Energy and Atmosphere for these projects, in stark contrast to LEED's proposal. EA lies at the bottom of the hierarchy pyramid as the last environmental concern for these projects while it stands as the first category for the LEED system (Fig. 2). This implies that EA category has not achieved enough emphasis as required and displayed the weakest performance in the applications of MRB projects.

The reason for this finding is believed to be mostly related to economic concerns. In their study, Wu et al. underlined that credits of EA, such as; '…optimized energy performance through energy modelling (EAc1), on-site renewable energy (EAc2) and enhanced commissioning (EAc3) are believed to be the biggest added expenses for LEED projects' (Wu et al., 2016). Furthermore, in another study it is stated that, LEED does not accredit passive design applications and therefore achieving a high score in EA category is not possible unless mechanical systems are used (Santos, Samani, & de

Oliveira Fernandes, 2018). Hence it is believed that new credits accrediting passive design strategies could be integrated into the system so that decision makers would be encouraged to foster energy efficiency and achieve higher scores under this category through these strategies without the necessity of high cost mechanical systems.

In parallel to LEED's order, due to the current problems of Istanbul, such as; extreme population density, irregular urbanization, squatter settlements, urban sprawl, lack of green areas, as well as, heavy traffic because of the insufficient and inefficient public transportation services (Süzer, 2012), SS can be rightfully considered as the second most important category. Since this category is found to be in the first place regarding projects' performances, it can be understood that the required emphasis was given to this category and a satisfactory result was achieved.

Since the category of IEQ, located at the third place in LEED's order is found at the second place for the MRB projects, it can be derived that needed emphasis was given to this issue. However, considering the LEED evaluation criteria under this category, related to the selection of indoor finishing materials regarding Volatile Organic Compound (VOC) emissions, it can be stated that there is still a lack of availability of suitable certified materials in the local market in Turkey (Süzer, 2012). Moreover, as imported certified materials would increase emissions of GHGs for transportation, it would serve against the principal of using local materials. Yet, in the future, it is expected that recently increasing awareness can promote the production of such materials locally.

When the MR category is examined, it is seen that in both of the hierarchal pyramids its position is stable, as the fourth category. Furthermore, other studies in literature have also indicated that MR and EA categories, which are also the categories with the two lowest performances in the present study, are the most difficult ones to obtain credits in the evaluation process (Moussa & Farag, 2017; Wu et al., 2016). This issue is believed to be related to certain applicability problems such as, difficulties in reaching certified building materials and products, and lack of availability of the market for green technologies, as mentioned above (Moussa & Farag, 2017).

Yet, it is important to note that, the Turkish construction materials industry is a net exporter sector ("Turkiye IMSAD", 2017), therefore, the abundance of local construction materials for the projects constitute a positive aspect considering this category. On the other hand, regarding the waste management approach in the city, it is seen that landfill is the most widely practiced method ("IBB Kati", 2010). However, according to the EU, it is the least preferred option in the waste management hierarchy ("Being wise", 2010). Furthermore, LEED does not audit the waste management policies of localities. Hence, even though projects might include amenities for the separation of wastes, the lack of effective recycling programs of municipalities or private establishments would make these applications useless.

Finally, it is seen that WE, the last important category in LEED's order takes place in the third row in MRB pyramid and indicates that sufficient performance was achieved. Yet, it should be noted that together with the newly supplied water resources in Istanbul, the municipality can hardly meet the current demand of the city's population (ISKI, 2019). Another problem is that there is a significant amount of generated waste water and a very high portion of it is discharged into receiving environments ("ISKI Stratejik Plani", n.d.). Therefore, since it is often pointed out that the emerging global crisis will be related to the scarcity of water resources (Jury & Vaux, 2007), considering the increasing population density in the city, this issue may constitute a severe problem in the future.

6. Conclusion

This paper analyzes LEED certified MRBs in Istanbul as to their performances in environmental assessment categories, with the aim of finding out if they comply with the priority order of categories asserted by LEED authorities. By using the category-based

scores of these projects, the conducted rank order tests, namely; calculating the mean rank values and performing a Kruskal-Wallis test on them revealed that the level of compatibility between the results derived from the projects and LEED's proposal are quite low.

Green building industry is considered as the flagship of sustainable development today and its most important environmental issue is based on minimizing energy consumptions, providing energy conservation and using renewable resources in these buildings. Yet, the findings of this study show that energy issue has turned out to be the last concern for the analysed LEED certified MRB projects in Istanbul. This finding reveals the fact that energy is the most critical issue for this building typology and Turkey needs to take action particularly as it has always been a country dependent on foreign energy resources (Sen, Günay, & Tunç, 2019). When the import figures are examined, it is seen that the greatest current deficit is always related to the energy expenditures (Munir, 2012).

In fact, Istanbul and overall Turkey have an advantageous location, as to benefitting from renewable energy resources (Erbil, 2011). Due to factors such as, being close to the equator and taking sun rays perpendicularly, as well as having long hours of insolation throughout the year, Turkey has a high potential for the use of solar energy (Erbil, 2011). Furthermore, regarding geothermal energy resources, Turkey is the seventh richest country in the world, and the first in Europe (Akpınar, Kömürcü, Önsoy, & Kaygusuz, 2008). As to wind energy, Turkey is considered to have a high potential as well. Istanbul, located at the coastal region of Black Sea and Marmara Sea, represent one of the most promising areas in Turkey with its wind densities (Ilkiliç & Aydin, 2015). Beside these advantages, the city can also benefit from tidal energy, since it is located at the Bosporus, where there are strong marine currents (Yazicioglu, Tunc, Ozbek, & Kara, 2016). It is stated that even though Turkey is a new actor in the renewable energy sector, it has been on the fast track in the past decade. Since Turkey is a net fossil-fuel importer, in order to decrease its dependence on such energy imports and improve its security, decision makers have been giving increasing emphasis on the issue. These efforts have also drawn the attention of the private sector companies in the country (Sen et al., 2019).

Yet, the problem of having EA category as the least priority for this building typology in Istanbul may be due to administrative difficulties and economic barriers in implementing effective green initiatives in Turkey. The initial investment costs of green systems and products are still very high in the country. To promote green initiatives, governmental tax incentives should be increased as in countries like Japan, UK or USA (KPMG-International, 2015). Furthermore, it should be pinpointed that green investments redeem their initial costs in the long term by providing energy savings. Thus, long term cost efficiency should be embraced as the project goal. Apart from the purpose of serving for public welfare, when evaluated from the commercial aspect, it should be noticed that energy related categories offer the possibility of providing the highest points in green building assessments.

As mentioned above, since MRB projects include various facilities and have high population densities, they consume significant amounts of energy. Therefore, in this building typology, using renewable and clean resources, providing energy efficiency and complete self-sufficiency are much more important compared to some other building types.

Together with certain improvements in Turkey and particularly in Istanbul, such as legislative regulations, the availability of the market for products or services increasing energy efficiency and the use of renewable energy resources, these rapidly multiplying high budget projects must be encouraged for displaying a higher performance in this fundamental category. Furthermore, to attain results more in-line with LEED priorities and to obtain more sustainable living environments, the awareness of decision makers, designers and investors on the issue should be increased.

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Exploring the 'R's and constructing the big picture of 'recycling' in architecture and construction industry

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Abstract

In the current scenario, the three 'R's 'reduce, reuse and recycle' have been extended to fourteen 'R's due to the increasing awareness to the impacts generated by the extraction of natural resources, manufacturing of goods as well the disposal of the post consumer goods. Even though the meanings associated with 'R's have been increasing, studies have revealed a gap in distinguishing the various degrees of recycling. It is in this context, thematic analysis has been adopted to construct an overall picture of recycling with a thrust on architecture and construction industry. This paper has attempted to explore the 'R's, the definitions and classification of recycling by authors in diverse domains and have been consolidated and synthesized. Findings reveal that 'upcycling' and 'upgrading' are the subsets of recycling. Six degrees of upcycling have been recognized in architecture and the construction sector that revolve around existing building stocks, salvaged building components and building materials with recycled content. In addition, this paper reinstates the need for a 'pre-process' phase specific to developing engineered building materials with recycled content especially with secondary resources from domains other than the construction domain.

Keywords
Architecture, Construction industry, Recycle, Thematic analysis, Upcycle.

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1. Introduction

Archaeological studies have traced the origins of 'reuse and recycle' to the Palaeolithic era. 'Reuse and recycle' that were once deeply intertwined with the values of the people belonging to the lower Palaeolithic era witnessed numerous paradigm shifts as centuries of years rolled. At one point of time, the essences of 'reuse and recycle' began to fade among the people. The diversification and indifference towards recycling was predominantly due to people's attitude towards the conservation of resources, observed to be highly specific to place and time.

Initially, natural resources were predominantly used for meeting the day to day needs and activities. However with the advent of industrial revolution in the 18th century, goods with numerous manufactured materials became part played of the day to day life activities of the people. Along with the plethora of new materials came the problems and threats that had impacts on diverse realms of our planet that include the lithosphere, atmosphere, hydrosphere, biosphere and the technosphere. Mankind began to grapple with the threats posed in the environment due to improper management and disposal of the used goods. With an intention to find solutions, age old practices of reuse and recycle that were once deeply rooted in the cultural values of the people were revived in the modern context. The 1970s witnessed the revival of the three 'R's, 'reduce, reuse and recycle'. From then onwards, 'R's have been gaining momentum.

The term 'recycle' has been often associated with 'upcycling,' 'recirculation,' 'upgrading,' 'downcycling,' 'downgrading,' 'cascading' etc. Further, 'recycling' has been classified as 'open loop recycling,' 'closed loop recycling' and also as 'cradle to cradle' approach. Van Ewjik and Stageman (2016) have posited that there has been a gap in distinguishing the degrees of 'recycling'.

The goal of this paper is to construct the big picture of 'recycling' focusing on architecture and construction sector. With an intention to meet the formulated goal, objectives such as tracing the origins of recycle in history, understanding the diverse R's, exploring the approaches to recycling in architecture, coding the degrees of upcycling are framed. Hence, there is an utmost need to explore, synthesize and construct the big picture of 'recycling' in a wider spectrum from diverse perspectives with a thrust on architecture and the construction domain. For meeting the aforementioned objectives, 'thematic analysis' is adopted as the methodology in this paper.

2. Methodology

Thematic analysis is reported as a method for 'identifying, analysing and reporting patterns within data' (Braun & Clarke, 2006). It is recognized as a flexible method that facilitates to analyze and interpret the data from diverse perspectives (Braun & Clarke, 2012). It is effective to analyze interpretative studies that seek to discover something new that involves data collection, deductive and inductive approaches, and analyse two different phased data, followed by coding and categorizing (Alhojailan, 2012). The selection, collection and analysis of data need to be transparent in thematic analysis (Joffe, 2012). Hence, this section elaborates on the data collection and analysis phase.

2.1. Data collection

This study revolved around the tracing of 'reuse' and 'recycle' in history, followed by the various 'R's to construct the big picture. Articles were sourced from the secondary resources with search engines like 'Google Scholar', 'Academia', 'Scribd' and 'Research Gate' from 14th March 2019 to 31st May 2019. The search for the handbooks, research articles including undergraduate, postgraduate and doctoral research reports were done at three levels.

Firstly, phrases like 'material recirculation', 'do it yourself', 'waste prevention', 'waste minimization', 'urban mining', 'found resources', 'wealth from waste', 'waste management', 'cradle to cradle approach', 'material and product centric recycling', 'recycling and eco-products and eco-effectiveness' were used to understand the essence of 'recycling' broadly. Secondly, terms such as 'reduce', 'reuse' and 'recycle', 'upcycle', 're-contextualization', 'downcycle' and 'cascade' were used to identify the ap-

propriate research articles. Thirdly, the search was narrowed down to explore 'recycling in architecture' and hence phrases such as 'adaptive reuse', 'junk as a building material', 'building materials with recycled content', 'material re-contextualization in architecture' were used. Besides, postulates, theories, logics and approaches posited in architecture and construction domain were also searched for. The contents were consolidated, synthesized to construct the 'big picture' of 'recycling', which in turn facilitated the positioning of 'upcycling' within the boundaries of 'recycling', interpreting the meaning and the degrees of 'upcyling' in architecture and construction domain.

Around one hundred and twenty six papers addressing 'recycling' and 'upcycling' broadly from the historical period to the current scenario and specific to architecture and construction sector were identified. The titles were grouped under various heads such as 'waste management', 'wealth from waste,' 'creativity and wastes,' 'sustainability and innovation,' 'circular economy,' 'urban mining,' 'R's and 'upcycling,' 'recycling and architecture.'

2.2. Data analysis

The number of research articles published under various heads as discussed in the section 2.1 display the ways through which 'recycling' has been explored in diverse directions. The various definitions of 'recycling', classification and the process facilitated the construction of knowledge inductively. The meanings and practices were consolidated, synthesized and interpreted adopting the principles of the thematic analysis inductively.

The theories, postulates and approaches addressing 'recycling' in architecture and construction sector served as the base for the deductive analysis. The findings of both the inductive and deductive analysis are synthesized to understand the concept of 'recycling' holistically, interpret the meaning as well as the degrees of 'upcycling', specifically to construct the big picture of recycling in architecture and construction domain.

3. Findings

Around 11.9% of articles were observed to fall under 'waste management' category. The number of papers classified as 'wealth from waste' accounted 5.7%. Nearly 22.2 % of articles were grouped under 'creativity and wastes.' 'Sustainability and innovation,' 'postulates and theories in architecture,' 'urban mining' accounted 4.7% each. The articles classified as 'circular economy,' 'R's and 'upcycling' accounted 8.7% and 7.9% respectively. Nearly 29.5% of articles were identified under the 'recycling and architecture.'

3.1. Tracing the roots of 'reuse' and 'recycle' in history

In ancient civilizations, people identified several methods towards the managing of wastes. People followed the principles of 'reuse', 'repurpose', and 'recycle' as strategies for two reasons. Firstly, it reduced the time and efforts spent in the extraction of natural resources. Secondly, it prevented the entry of goods beyond repair into the landfills.

In history, 'recycling' was referred as 'scavenging' (Downs & Medina, 2000). People observed 'recycling' as a fundamental value (Rathje & Murphy, 2001). However, the reasons for recycling varied with respect to people, place and time. Studies on archaeological excavations in different sites around the world display that people adopted the principles of 'reuse' and 'recycle' right from the 10th century onwards. Right from the prehistoric era, humans have been sensitive to the extraction of natural resources (Cohen & Yosef, 2015). It has been posited that under certain circumstances, homohabilis addressed wastes as resources (Havlicek, 2015). For instance, lithic reclamation emerged in the Lower Paleolithic era (Lemorini at al., 2015) and Middle Paleolithic era (Amick, 2015).

With respect to time, the reasons for reuse and recycle varied amongst the people. Romans practiced 'recycling,' with the perspective of effectively managing both the financial resources as well as the virgin materials (Gilchrist, 2015). The economic

growth in the Roman period developed a sense of disinterest towards 'recycling' amongst the people (Claridge et al., 2010). However, it has been posited that Romans adopted 'reuse and recycle' with a focus to conserve financial resources.

In archaeology, 'reuse addressed a change in the use, user or form of an artefact after serving a specific function in a particular activity' (Schiffer, 2016). Four kinds of reuses, such as 'conservatory process,' 'lateral cycling,' 'secondary use,' and 'recycling,' were identified. In the conservatory process, lateral cycling and secondary use by retaining the true forms were adopted. During that time, recycling was considered as a kind of 'reuse', where the structure of the object was modified.

From the 1930s and the 1940s, 'recycling' was practiced in the army camps during the world war when resources were scarcely available (Benjamin, 2011). Comprehending the issues generated by diverse man-made materials, the spirit of 'recycling' was revived during the 1970s. With an intention to understand 'recycling' from a wider perspective, the following section discusses the various terms associated with 'R's.

3.2. An overview of 'R's after the 1970s

People realized the threats posed by the generation, types, improper handling and management of wastes. This complexity witnessed the emergence of reusing and recycling of the discarded goods for the same or different purposes. During the early 1970s, the origin of three R's, 'reduce, reuse and recycle' was advocated by Ontario's Pollution Probe (Hoornweg & Tata, 2012). As years rolled by, the meanings associated with 'R's have been interpreted in diverse directions. As a result, the three fundamental 'R's, namely, 'reduce, reuse and recycle' began to increase gradually with a deeper thinking focusing on diverse strategies to address the wastes as resources that prevent or reduce their entry into the landfills.

Currently, ways to handle wastes fall under the diversion and the disposal categories (Hoornweg & Tata, 2012). The four R's, 'reduce', 'reuse', 'recycle', and 'recover' have been included under the category 'diversion'. The 'disposal' category has comprised the landfills, incineration, and the controlled dump. Besides, the fourth 'R' represented 'rethink' or 'recover' or 'rebuy' (Davidson, 2011). The three 'R's during the 1970s have been extended to many 'R's in the present context. The other 'R's have been associated with 'replenish,' 'rethink,' 'respect,' 'responsibility,' 'replant,' 'rot' and 'restore'. 'Reduce, reuse and recycle' has marked the origin of the 'R's which has been extended to 14 'R's in today's context are summarized in Table 1.

Table 1. *From three to fourteen 'R's.*

From the 1970s onwards	Three to ten 'R's		
Ontario's Pollution Probe in the 1970s (O'Connor, 2015)	Reduce, Reuse, Recycle		
Environment Protection Act 1970– Waste framework directive	Avoidance, Reuse, Recycling, Recovery, Treatment, Containment, Disposal		
Resource Conservation and Recovery Act (1976)	Reduce, Reuse, Recycle		
European commission Directive 2008/98 – Waste management hierarchy	Prevention, Preparation for reuse, Recycling, Recovery, Disposal		
Sustainable development institute (2008)	Reduce, Reuse, Recycle and Recovery		
Davidson (2011)	Prevention, Reuse, Recycling, Rethink or Recovery or Re-buy , Disposal		
Waste management hierarchy (Hoornweg and Tata, 2012)	Waste diversion – Reduce, Reuse, Recycle, Recover; and Waste disposal- Landfill, Incineration and Controlled dump		
Dickey (2008)	4 'R's	Reduce, Reuse, Recycle, Recover	
CRRA (2009)	5 'R's	Reduce, Reuse, Recycle, Recover, Rethink	
Greenlane diary (nd)	6 'R's	Reduce, Reuse, Recycle, Respect, Replenish and Refuse	
Alatervo (2013)		Rethink/ Reinvent, Refuse, Reduce, Reuse/Repair, Recycle, Replace/Re-buy	
Swafford (2015)	7 'R's	Reuse, Repurpose, rot, repair, return, refill and refuse	
Abella (2013)	8 'R's	Reduce, Replace, Reuse, Recycle, Recover, Refuse and Reject, Rethink	
Earth Month org (2014)	10 'R's	Respect, Refuse, Reduce, Reuse, Renew , Recycle , Responsibility , Rethink, Replant, Restore	
Ten 'R's (Reike et al., 2018)	Resource retention loops	Shortest loop	Refuse (R_0), Reduce (R_1), Resell/ Reuse (R_2), Repair (R_3)
		Medium loop	Refurbish (R_4), Remanufacture (R_5), Repurpose (R_6)
		Long loop	Recycle (R_7),Recover (R_8) and Re-mine (R_9)
		Reservitisation (R_{10}) highly interrelated with reuse and so not listed as a separate R	
Lisa (2014)	14 'R's	Reduce, Reuse, Recycle, Respect, Refuse, Replenish, Rethink, Repair, Reinvent, Recover, Responsibility, Replant, Restore, Rot	

Ten 'R's to retain the resources in the supply chain that fall under the short, the medium, and the long loop have been recognized (Reike et al., 2018). Refuse (R_0), Reduce (R_1), Resell or Reuse (R_2), Repair (R_3) have been included in the short loop. Medium loop addressed Refurbish (R_4), Remanufacture (R_5), and Repurpose (R_6). Recycle (R_7), Recover (R_8) and Re-mine (R_9) have been categorized as the long loop resource retention option. Reservitisation (R_{10}) has been

observed to be intertwined with Recycle (R_6). Hence, R_{10} has not been listed as a separate 'R.'

When materials from the discarded products serve as the resources for developing a new product, it has been addressed as 'design from recycling' (Ragaert, 2016). Materials extracted from the discarded or post consumer goods or materials sourced through demolition of building stocks have been recognized as 'freely available' or 'secondary resources.'

Four 'R's (Dickey, 2008); five 'R's (CRRA, 2009); six 'R's (Greenlane diary, nd; Alatervo, 2013), seven 'R's (Swafford, 2015); eight 'R's (Abella, 2013), ten 'R's (Earth Month org, 2014) and fourteen 'R's (Lisa, 2014) have been identified from various blogs. According to Lisa (2014), fourteen 'R's revolving around 'reduce', 'reuse', 'recycle', 'respect', 'refuse', 'replenish', 'rethink', 'repair', 'reinvent', 'recover', 'responsibility', 'replant', 'restore' and 'rot' (Lisa, 2014) have been identified.

3.2.1. 'R's and the waste management

Understanding the problems generated by the disposal of commodities and other related goods, the waste management hierarchy was framed during the1970s (Lazarevic et al., 2010). 'Avoidance', 'reuse', 'recycle', 'recover', 'treatment', 'containment' and 'disposal' have been the various ways to manage wastes generated (Environment Protection Act, 1970). According to the Directive 2008/98/EC, 'prevention', 'reuse', 'recycle', 'energy recovery' and 'disposal' have been prioritized hierarchically to deal with wastes. 'Prevention' thus focused on the measures to be taken so as not to generate any wastes, which always has been considered as an ideal situation. 'Reuse' addressed the repurposing of discarded objects by valuing the material used, the intention of the form as well as the structure itself.

Gertsakis and Lewis (2003) outlined a simple description of environmental attributes that include 'reduce', 'reuse', 'recycle', 'treatment' and 'disposal'. 'Reduce' has been the most desirable outcome whereas disposal has been the least desirable option. The goal to 'recycle' has been considered to be predominantly 'ameliorative' and 'partly preventive'. The recycled outcomes fall in between the most and the least desirable categories. However, waste management hierarchy has been criticized as 'disposal' based waste management by the environmentalists.

3.2.2. 'Recycling' after the 1990s

According to Merriam Webster dictionary, the term 'recycle' is listed as a 'hypernym.' It is observed to be both a noun and a verb. 'To pass through a series of changes or treatments' is the expression of the noun, whereas 'to adapt to new use,' and the 'process' refer to a verb. The hyponyms of 'recycle' are 'downcycle' and 'upcycle,' expressing narrower or more specific meanings.

Reprocessing of extracted materials from products at the end of life to return them into the supply chain to create new products has been 'recycling' (Worrel & Reuter, 2014). 'Recycling' has addressed the integration of collection schemes supported with the value-based conception of waste (Van Ewijk & Stagemann, 2016). Oyenuga and Bhamidimarri (2017) have recognized 'recycling' as a comprehensive way to manage the wastes effectively. Recovery and disposal have been the last two strategies in the hierarchy. 'Recovery' has been associated with the retrieval of energy from waste. The entry of wastes into the landfills has been associated with dumping.

3.2.2.1. Classification of 'recycling'

'Recycling' has been a strategy to retain the materials extracted from the discarded goods as resources. Connelly and Koshland (1997) have identified 'recirculation,' 'upgrading,' and 'cascading' as the three levels of recycling. 'Recirculation' has addressed the use of secondary resources without any change in the inner material. When the original structure has been partly retained, it has been referred as 'partial recycling.' The reuse of material or the product in the degraded form of material quality while compared with the pre-consumed state has been recognized as 'cascading'.

Direct reuse, non-destructive, and conventional recycling based on the level of structural and material de-

formation have been associated with 'recycling' (Allwood et al., 2011). A product in the original form or with a superficial change in the surface for a different purpose has been classified as of 'direct reuse.' Non-destructive recycling has been sub-classified as 'deformative,' 'subtractive,' and 'additive.' Physical modification of the product has been observed to fall under the 'deformative' category. Materials extracted from the original products have been recognized as a 'subtractive' approach. When products have been joined or connected, it has been recognized as an additive version of non-destructive recycling. When the material has been completely broken down as a feedstock, it has been known as conventional recycling.

Recycling has addressed the reprocessing of the secondary materials into the same product or materials or substances for the same or a different purpose (Goorhius & Bartl, 2011). Product recycling, material recycling, feedstock recycling, and downcycling have been recognized as the categories of recycling. Product recycling has addressed the repurposing of the product in its true form for various other applications. The modification of the physical form without changing the chemical composition has been termed as product recycling. Reprocessing of the physical and chemical constitution into the original constituents has been feedstock recycling. Downcycling has been denoted as any recycling process that resulted in a product with lower quality.

'Recycling' has been interpreted as 'functional,' 'upcycling' and 'downcycling' (Niinimaki, 2013; MacArthur, 2013). The process of recovering materials for the original or different purposes, excluding energy recovery, has been termed as 'functional recycling'. The method of converting materials for lesser quality and reduced functionality has been 'downcycling.' When the focus has been on higher quality and increased 'functionality,' it has been recognized as 'upcycling.'

The reintroduction of discarded materials back into industrial production, returning them into the supply chain has been addressed as 'recycling' (Hung et. al, 2012). Szaky (2014) posited the significant role played by the confluence of material composition, kind, and intention of the discarded goods in determining the purpose during the second life.

Repurposing of secondary resources from the material perspective has been also addressed as recycling. Closed-loop production has addressed reuse, recovery, and remanufacture, where the products have been collected from the manufacturing of the original product (Rashid at al., 2014).

Worrel and Reuter (2014) posited 'recycling' to be 'product and material centric.' Material centric has been a subset of the product-centric approach. It has been a channel to achieve resource efficiency. Broadly, primary, secondary, tertiary and quaternary have been identified as the four types of recycling. The re-extrusion of pre-consumer scrap has been recognized as primary recycling. The mechanical treatment of the secondary resources has been known as secondary or physical recycling, modification of the chemical properties has been tertiary and quaternary treatment has focused on energy recovery (Ignatyev et al., 2014).

According to Elkersh and Haggar (2015) upcycling, recycling, and downcycling have been the three types of recycling that correspond to the development of products with a higher, equal, or lower value. However, upcycling and recycling addressed the manufacturing of goods with higher or equal value when compared to the original application.

3.2.2.2. Interpreting the classifications of 'recycling'

Authors have classified 'recycling' in many ways. As discussed in the previous section, the nomenclature developed by authors like Conelly and Koshland (1997); Allwood et al. (2011); Goorhius and Bartl (2011); Niinimaki (2013); MacArthur (2013); Ignatyev et al. (2014), Elkersh and Hagger (2014) are summarized in Table 2.

It is observed that the various definitions are grouped, regrouped and interpreted to fall under 'material

Table 2. *Interpreting the classifications of 'recycling'.*

Authors	Classification		Description		Interpretation
Connelly and Koshland (1997)	Upgrading		Addition of energy to bring back the original structure to a pre-consumed state		Material centric
	Cascading		Use of material or product in degraded form		Product centric
	Recirculation		Repurpose in true form		Re-contextualization
Allwood et al., (2011)	Non destructive recycling	Deformative	Physical modification		Re-contextualization
		Additive	Goods are joined or connected		
		Subtractive	Extraction of materials from original goods		Material centric
	Conventional		Materials completely broken down as feed stocks		
Goorhius & Bartl (2011)	Product recycling		Physical and chemical constitution is retained		Re-contextualization
	Material recycling		Only chemical constitution is retained		Material centric
	Feedstock recycling		Chemical constitution of material	Reprocessed in to original constituents	
	Downcycling			Degraded	
Niinimaki (2013); MacArthur (2013)	Functional		Process of recovering materials for the original or different purposes		Product centric
	Upcycling		Converting materials for better quality and functionality		
	Downcycling		Converting materials for lesser quality and reduced functionality		
Ignatyev et al. (2014)	Primary		Re-extrusion of pre-consumer scrap		Material centric
	Secondary		Mechanical treatment of the secondary resources		
	Tertiary		Modification of the chemical properties		
	Quaternary		Recovery of energy		
Elkersh & Hagger (2015)	Downcycling		Products	Lower value	Product centric
	Upcycling			Higher value	
	Recycling			Original value	

Table 3. *From 're-contextualization' to 'upgrading'.*

Authors	Classification		Description		Interpretation
Connelly and Koshland (1997)	Upgrading		Addition of energy to bring back the original structure to a pre-consumed state		Material centric
	Cascading		Use of material or product in degraded form		Product centric
	Recirculation		Repurpose in true form		Re-contextualization
Allwood et al., (2011)	Non destructive recycling	Deformative	Physical modification		Re-contextualization
		Additive	Goods are joined or connected		
		Subtractive	Extraction of materials from original goods		Material centric
	Conventional		Materials completely broken down as feed stocks		
Goorhius & Bartl (2011)	Product recycling		Physical and chemical constitution is retained		Re-contextualization
	Material recycling		Only chemical constitution is retained		Material centric
	Feedstock recycling		Chemical constitution of material	Reprocessed in to original constituents	
	Downcycling			Degraded	
Niinimaki (2013); MacArthur (2013)	Functional		Process of recovering materials for the original or different purposes		Product centric
	Upcycling		Converting materials for better quality and functionality		
	Downcycling		Converting materials for lesser quality and reduced functionality		
Ignatyev et al. (2014)	Primary		Re-extrusion of pre-consumer scrap		Material centric
	Secondary		Mechanical treatment of the secondary resources		
	Tertiary		Modification of the chemical properties		
	Quaternary		Recovery of energy		
Elkersh & Hagger (2015)	Downcycling		Products	Lower value	Product centric
	Upcycling			Higher value	
	Recycling			Original value	

centric,' 'product centric' as well as 're-contextualization.' However, the definitions of 'upcyling' and 'upgrading' are observed to be varying. With an intention to understand the definitions and meanings, this paper has attempted to explore 'upcycling' and 'upgrading' in detail.

3.3. Interpreting the definition of 'upcycling' and 'upgrading'

Nearly twenty one definitions were identified that are classified as 're-contextualization' and 'upgrading for high end applications.' Around one-third are identified to be falling under 're-contextualization.' Two-thirds are observed to be revolving around the 'product and material centric.' The latter was around 41.66% to be 'material centric' and 58.44% to be both 'material and product centric' as in Table 3. From the definitions, it has been observed that the essence of upcycling has been adopting the principles starting from 're-contextualization' to 'upgrading' and 'upcycling,' representing the lowest and the highest levels respectively.

3.4. From 're-contextualization' to 'upgrading'

The Merriam-Webster dictionary decodes the term 're-contextualize' as a transitive verb that means to place something in a different context. 'Re-contextualization' has been addressed as the repurposing of discarded items in different contexts (Pennycook, 2007). Re-contextualization has included the transformation of discarded goods for different purposes with or without modifying the original form facilitated with or without energy.

A German engineer, Reiner Pilz coined the term 'upcycle' (Kay, 1994). It addressed the process of converting waste materials into new materials or products of better quality as well as environmental values (Nyaguthii, 2013; Mansouri & Seyedeh, 2014). Upcycling has generated positive impacts on the environment (Ebbert et al., 2017). It has been established that designers need to be creative, critical, and think out of the box to develop innovative and inventive upcyled outcomes (Ali et al., 2013). Upcycling focused on maintaining or upgrading resource quality and productivity through many cycles of use (Braungart, 2007). Glaveanu (2016) reported 'upgrading' as a direction to add value to the secondary

resources while developing high end applications. The definitions of 'upcyling' including 'upgrading' have been consolidated in Table 3.

From the classification of definitions, it is observed that Conelly and Koshland (1997) have used the term 'upgrading', whereas Niinimaki (2013), MacArthur (2013) and Elkersh & Hagger (2015) have used the term 'upcycling'. According to Conelly and Koshland (1997), 'upgrading' has been a process where the original structure of the material has been retained. Glaveanu (2016) has used both the terms 'upgrading' and 'upcycling' with the thrust on perfect mix while developing high end products. From the various definitions, the authors have observed that 'upcycling' has been predominantly associated with developing high end applications.

In this context, the authors have interpreted 'upgrading' as process of developing materials extracted from secondary resources by enhancing the properties so as to manufacture high end applications. Hence, 'upgrading' is identified as a subset of 'upcycling.'

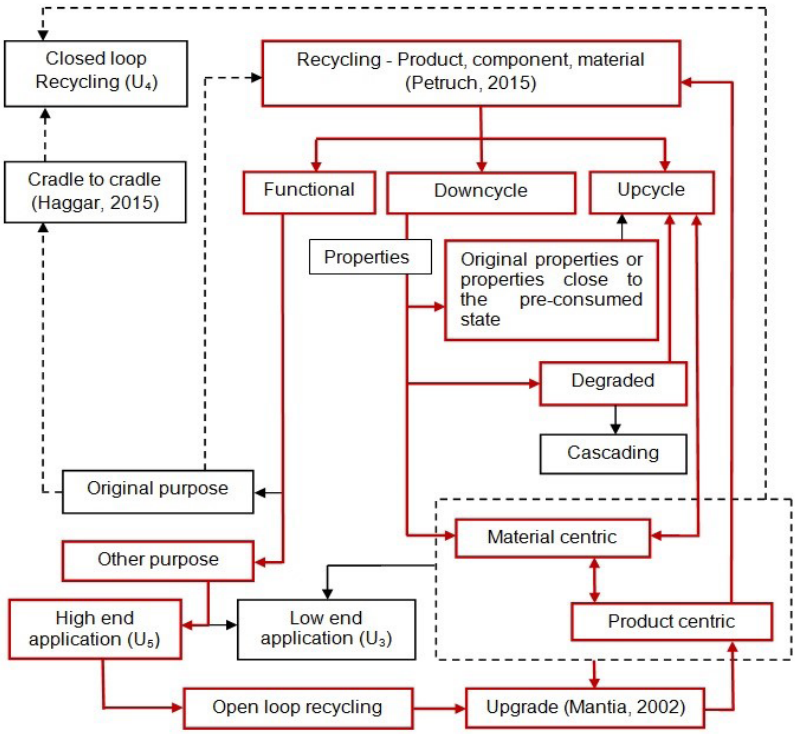

Figure 1. *An insight into 'recycling'.*

3.4.1. Relationship between 'recycling', 'upcycling' and 'upgrading'

The relationship between 'upcycling,' 'downcycling,' 'upgrading,' 'product and material centric,' 'closed loop and open ended recycling' has been integrated and mapped in Figure 1. Irrespective of open or closed loop recycling, materials and products play important roles. When the properties of the secondary resources have been degraded for developing low end applications, it has been observed as 'cascading' and hence excluded in identifying the degrees of upcycling.

According to Petruch (2015), 'recycle' is observed at the material, component and product level. 'Recycle' is classified as 'downcycle', 'upcycle' and 'functional'. As shown in Figure 1, 'downcycle' and 'upcycle' are found to be predominantly material centric. When the focus is to recycle the 'function' for the same or different purpose, it is identified as closed and open ended. When the focus is on developing 'high end applications,' 'upgrading' of secondary resources is identified as a pre-requisite. This is 'product centric', whereas investigating the properties of the secondary resources serves as the subset, where 'upcycling' comes in to the picture. But, when only the properties of secondary materials is the focus, it is predominantly material centric.

3.4.2. Degrees of 'upcycling'

The six degrees of upcycling include re-contextualization of the discarded goods in their true forms (U_0); re-contextualization of the discarded goods through physical modification, without energy (U_1) and with energy (U_2); downcycling for low end applications in other domains without degrading the materials or with properties that do not fully correspond to the pre-consumed state (U_3), recycling materials for the original application (U_4) and upgrading secondary resources for developing high end applications (U_5) as in Table 4.

The first three degrees of upcycling include U_0, U_1 and U_2 that fall under Repurpose (R_6). Recycle (R_7) includes U_3, U_4 and U_5. U_3 and U_4 constitute the long and the longer resource retention loops. U_3 is also known as partial recycling, where secondary materials

Table 4. *Degrees of 'upcycling'.*

<table>
<tr><td>Resource retention</td><td colspan="2">Degree</td><td colspan="4">Upcycling</td></tr>
<tr><td rowspan="3">Repurpose (R_6)</td><td colspan="2">U_0</td><td rowspan="3">Re-contextualization (medium loop)</td><td rowspan="3"></td><td>Discarded goods in their true form</td><td rowspan="3">Functional recycling</td><td rowspan="3">With or without modifying the true forms</td></tr>
<tr><td colspan="2">U_1</td><td>Physical modification of discarded goods without energy</td></tr>
<tr><td colspan="2">U_2</td><td>Physical modification of discarded goods with energy</td></tr>
<tr><td rowspan="3">Recycle (R_7) (Materials are extracted from the secondary resources)</td><td>Long</td><td>U_3</td><td rowspan="3">Retain the original properties of the materials or properties that do not fully correspond to the pre-consumed state</td><td rowspan="3">Material and product centric</td><td>Low end applications</td><td>Open loop</td></tr>
<tr><td>Longer</td><td>U_4</td><td>Recycling - original application</td><td>Closed loop</td></tr>
<tr><td>Longest</td><td>U_5</td><td>Upcycling and upgrading of secondary resources in the same or a different domain (longest resource retention loop)</td><td>Open loop</td></tr>
</table>

with original are properties close to the pre-consumed state are considered. Upgrading of secondary materials for high end applications is the highest degree of upcycling (La Mantia, 2002) as shown in Figure 1. Upgrading constitutes the longest resource retention loop. While developing high end applications, investigating the potentials of the secondary materials have been playing a crucial role. However, due to the lack of adequate knowledge on secondary resources, upcycling and upgrading has been less popular amongst the design community (Xu & Gu, 2015).

3.5. Recycling in architecture

During the Roman era, building materials from the existing building stocks were recycled. 'Recycling' surfaced as a strategy primarily to manage the fiscal as well as the mineral resources effectively (Gilchrist, 2015). Existing building stocks, salvaged components and building materials with recycled content have been the three directions to 'recycling' in architecture. The following sections discuss the different strategies adopted for adaptive reuse of the existing building stocks, utilization of salvaged components and developing building material with recycled content.

3.5.1. Adaptive reuse

The reuse of heritage buildings has been a direction to sustainability (Bullen & Love, 2011). The reuse of buildings or sites for an application utterly different from the original function has been addressed as 'adaptive reuse' (Moshaver, 2011). 'Typological,' 'technical,' and 'strategic' have been the three approaches adopted in the adaptive reuse. The typological approach addressed the usage of a building for a different use when compared to the original function. The integration of services or improving the conditions has been identified as the technical approach. The strategic approach has been the process and strategies used for adapting the built structures. However, Plevoets and Cleempoel (2013) acknowledged a poetic understanding of the adaptive reuse has been recognized as another direction to the strategic approach.

According to Pleevoets and Cleempoel (2014), adaptive reuse has been challenging. Renaissance concepts addressing 'following,' 'translation,' 'imitation' and 'empathy' evolved concerning the adaptive reuse of the interior spaces. Under the class 'following,' critical attitude was excluded. 'Translation' included both critical and creative stances. 'Imitation' was applied in projects

liberally to evolve a relation between the original and the created version. Capturing the original elegance of the interiors has been very empathetic. Whatever the approach be, cost has played a crucial role in adaptive reuse of existing buildings stocks by restoring the interiors for different occupancy, (Bullen & Love, 2011).

3.5.2. Salvaged building components

According to Chan (2007), 'salvaging' has been addressed as the reuse of whole elements retrieved during the demolition of old buildings. According to Daketi (2013), three ways to address recycled building materials have been identified. 'Conventional reuse' has focused on the application of salvaged materials from older structures. 'Repurposing' of salvaged material for different applications has been addressed as 'adaptive reuse.' Recycled content reuse has included the conversion processes of recovered materials into new building material. Ponnada and Kameshwari (2015) have used the term 'architectural salvage' where timber-based components have been disassembled and refurbished.

3.5.3. Building materials with recycled content

Reprocessing of reclaimed materials as new materials or use has been 'recycling' (Dolan et al., 1999). 'Recycling' has implied newness, a result of processing or extracting material and reconfiguring them. The emergent outcomes have been predominantly elemental and experimental expressions (Chan, 2007); expressive and experimental (Carpenter, 2009).

Manufacturing of building materials with recycled content has been termed as 'opportunistic architecture' (Simitch & Warke, 2014). Recycling of materials from the demolition of buildings has been observed to cap the mining of virgin materials (Oyenuga & Bhamidimarri, 2017). The term 'super use' has referred to the applications of secondary resources in the construction sector based on the potentials of discarded materials (Altamura & Baiani, 2019).

'Re-material oriented design' has been addressed as reusing or repurposing or upcycling of secondary resources in an architectural or interior setting (De Castro Pereira, 2017). Re-material oriented design represented as ROD has been an unpredicted non-linear activity that includes intuitive, reflective, skilful, and conscious approaches. Practice has played a significant role in intuitive ROD. The experience of the individuals in the respective fields has been identified as reflective ROD. Directions unravelled adopted through routine practice has been addressed as skilful ROD. Conscious ROD has incorporated continuous modelling of variables to develop appropriate outcomes to be successful. Based on the available or known parameters, individuals interested in upcycling have been observed to fall under the categories I, II, III, and IV as in Table 5.

Table 5. *Interpreting the ROD.*

Parameters	Category I	Category II	Category III	Category IV
Goal	Known	Known	Known	Yet to be defined
Materials			Yet to be defined	Known
Process				Yet to be defined
Skills and tools	Available	Unavailable		
Framed setting	Favorable	Challenging	Unfavorable / highly challenging	
Interpretation	Well defined or stated problem	Moderately defined	Ill defined or wicked problem	
	The 'ill defined or wicked problem' need to be transformed in to a 'well defined or stated problem'			
	The 'yet to be defined, unfavorable/ highly challenging parameters falling under Category III and IV need to be 'well defined'			

The lack of knowledge and confidence in using recycled building materials prevent the utilization of secondary resources in the construction sector (Munn & Soebarto, 2004). When upcycling has been the goal with little or no knowledge of materials, processes, skills, and tools, the framed setting has been observed to be a challenging task. In such situations, there has been a need to bring the 'ill defined' parameters into a 'well defined state.'

In this context, it has been essential to explore the approaches adopted to recycle and repurpose secondary resources sourced from construction and demolition wastes as well as from domains other than the construction industry and architecture. The following section discusses the approaches, logics, and postulates adopted for repurposing secondary resources in the construction sector. Besides this, the various postulates have been consolidated, synthesized and interpreted in the later section 3.5.4.1.

3.5.4. Postulates, logics and secondary resources

Concerning the utilization of discarded materials in architecture and the construction sector, ideologies posited by archaeologists and architects are interrelated and interpreted to construct the 'big picture' in architecture. Roman's reuse principles; the competing logics of sustainable architecture, rethinking architecture based on 'form follows materials,' and the sustainable approaches are the various theories, postulates and ideals recognized in architecture.

The repurposing of post consumer packaging waste in the construction sector was been traced from the Hellenistic age. After investigating the potentials of 'amphorae,' Romans came up with ideas to reuse and repurpose them in architecture and construction sector (Will, 1997). While doing so, the true forms of the pots with pointed bases were either modified or unmodified. Romans classified 'reuse' as 'A,' 'B,' and 'C' (Pena, 2007). The utilization of amphorae for the same purpose is reuse 'A.' Reuse 'B,' and 'C' denoted the applications in other fields without and with modifications in true forms respectively.

Eco-technical, eco-aesthetic, eco-cultural, eco-medical, eco-social, and eco-centric have been identified as the six competing logics of sustainable architecture (Guy & Farmer, 2001). The first five logics have addressed the technical approaches, fluid forms, culture in context, health of the occupants, and the social aspects respectively right from the generation of ideas, identification of approaches, and concepts. Design, form, materials, construction techniques, building materials, the volume of spaces, operation, and maintenance have been identifies as significant aspects reflect the sustainable values. Among the six competing logics, 'eco-centric' has addressed the diverse ways of repurposing secondary resources in the construction domain.

Gang (2010) has postulated three approaches, namely the cooks', the prospectors' and the nomads.' The three approaches have been formulated based on 'form follows materials.' The cook's paradigm has been about incorporating the leftover products in the building industry for diverse construction purposes. Curiosity, persistence to locate the used materials, evaluate the potential of the identified materials with an intention to give new life in architecture have been recognized as the prospective architects' role. Nomad's approach has been the design of lightweight structures with the potential to be dry assembled at the site.

Architect Pandya (2012) has evolved sustainable approaches like 'A,' 'B,' 'C,' 'D' and 'E.' Approaches like 'A,' 'B,' 'D' and 'E' have addressed the participatory design for traditional wisdom, interpreting the traditional wisdom in a contemporary way , sustainability through design and exploration for eco friendly interiors and exteriors respectively. Approach 'C' has addressed the utilization of recycled wastes as secondary resources in the construction industry.

3.5.4.1. The interpretation

The approaches relating to the applications of secondary wastes in architecture has been interpreted to be a synthesized version of Romans' Reuse 'C'; Guy and Farmer's 'eco-centric' ideal; Gang's nomads' and prospectors' approaches and Pandya's approach 'C' (Ramaraj & Nagammal, 2017). Adaptive reuse and the utilisation of salvaged building components has been observed to fall under 'repurposing' that has been categorized as Romans 'Reuse A' and Gang's Prospector's approach. Developing building materials with recycled content has been interpreted as 'downcycling, recycling and upcycling' integrating the Romans reuse 'B' and 'C' Approach 'C', Gang's Prospector's and nomad's approach. Besides, 're-material oriented design' addressed as ROD is also manifested while developing recycled building materials with construction and demolition waste (De Castro Pereira, 2017). The outcomes of such approaches have led to the emergence of elemental and experimental expressions (Chan, 2007) incorporating both 'repurpose' and 'recycle' falling under R6 and R7 respectively as shown in Figure 2.

4. Conclusion and discussion

The primary goal of this article is to explore 'recycle' from a wider perspective so as to construct the big picture. An in depth knowledge about the origins of recycle in history, understanding the diverse R's, recycling in architecture, coding the degrees of upcycling are explored, consolidated, synthesized and interpreted by adopting 'thematic analysis.'

Firstly, with respect to 'tracing the origins of recycle', research articles from archaeology were identified and explored. It has been observed that our great ancestors have been acquainted with the spirit of 'reuse'. Numerous strategies to reuse as well as repurpose the used goods have been adopted effectively and also creatively.

Secondly, the essences of 'R's after the 1970s is explored. 'Reduce, reuse and recycle' are the three predominant three 'R's that originated initially. As decades passed by, the 'R's have been extended from three to fourteen meanings. However, Reike et al. (2018) have identified ten 'R's such as Refuse (R0), Reduce (R_1), Resell or Reuse (R_2), Repair (R_3) Refurbish (R_4), Remanufacture (R_5), Repurpose (R_6), Recycle (R_7), Recover (R_8), Re-mine (R_9). The tenth 'R', Reservitisation (R_{10}) is not explicitly stated as it is identified as a sub strand of Recycle (R_6).

Literature studies reveal that 'recycle' is classified in many ways. Six types of classifications of 'recycle' are explored and interpreted to understanding the meanings of 'upcycle.' From the various definitions and classifications, it is observed that 'upcycle' is a subset of 'recycle. The explanations of 'upcycle' predominantly focus on the development of high end applications. In this context, it is crucial to mention Glaveanu's definition of 'recycling' stated as 'perfect mix of upcycling and upgrading.' With this definition, the authors have interpreted 'upgrading' as the subset of 'upcycling' where the properties of the secondary resources are enhanced.

Thirdly, adaptive reuse of existing buildings including salvaged building components and building materials with recycled content have been recognized as the three directions for recycling in architecture and the construction sector. Adaptive reuse of existing buildings stocks and the utilisation of salvaged building components for the original purpose have adopted the essences of reuse 'A' and 'eco-centric' ideal. The application of salvaged building components for a different purpose in the construction industry without modification has been classified as reuse 'B' and Gang's prospectors' approach.

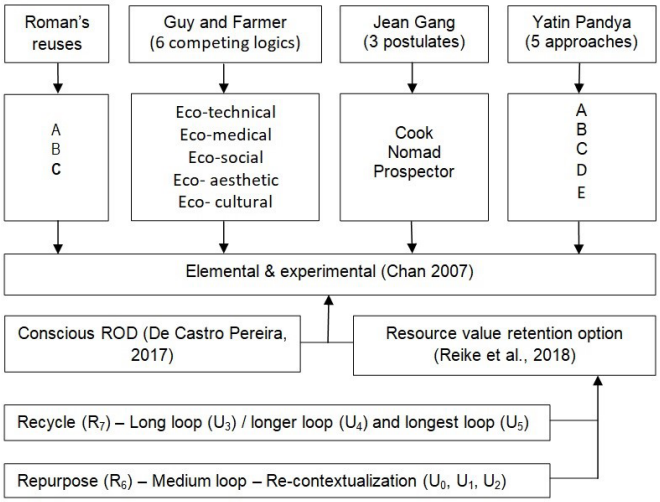

Figure 2. *Amalgamation of theories, logics, approaches and postulates in architecture and the utilization of secondary resources.*

With an intention to meet the fourth objective, the diverse meanings of 'recycle' is integrated with the postulates, logics and approaches observed in architecture. Direct reuse of secondary resources for developing applications in architecture from diverse domains other than the building and construction industry has been observed to be a fusion of 'zero or physical recycling'; 'direct reuse or non-destructive recycling falling under open loop recycling.' Further, direct reuse is recognized as an integrated expression of Gang's cook's and prospector's approaches as well as Roman's reuse 'B' falling under the first three degrees of upcycling U_0, U_1 and U_2. Development of new applications falls under U_5 and includes reuse 'C' and Gang's prospector's approach. When lightweight materials that are portable and dry assembled site is the outcome of integrating reuse 'C', Gang's prospector's and nomad's approaches. U_5 involves tertiary recycling where the properties are modified according to the intended application as shown in Figure 3.

Table 6. *The big picture of 'recycling' in architecture and the construction industry.*

<table>
<tr><td colspan="5" rowspan="2">Downcycling / Recycling /Upcycling
(Product and material centric)</td><td colspan="3">Logics, theories and postulates</td></tr>
<tr><td colspan="3">Eco-centric logic and Approach C</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Reuse B/C</td><td>Gang's postulates</td><td>ROD / resource retention</td></tr>
<tr><td rowspan="3">Tertiary recycling</td><td rowspan="3">Conventional / destructive recycling (feedstock)</td><td colspan="2">Modification of chemical properties (open loop recycling)</td><td rowspan="6">Opportunistic architecture / Developing building materials or applications with recycled content / ROD</td><td rowspan="3">C</td><td rowspan="5">Nomad's and Prospector's approach</td><td>New applications through upgrading (U_5)</td></tr>
<tr><td rowspan="2">Original properties as well as with properties that does not fully correspond to the pre-consumed state</td><td rowspan="2">Closed loop recycling</td><td rowspan="2">Original application (U_4)</td></tr>
<tr><td rowspan="3">Open loop recycling</td><td>Low end application (U_3)</td></tr>
<tr><td rowspan="2">Secondary or physical or mechanical recycling</td><td colspan="2">non-destructive recycling (Deformative / Subtractive/ Additive)</td><td>B</td><td rowspan="3">Functional recycling</td><td rowspan="3">Recontextualization (U_0, U_1, U_2)</td></tr>
<tr><td colspan="2">Conventional / destructive recycling (Feedstock)</td><td>C</td></tr>
<tr><td>Zero recycling /secondary or physical or mechanical recycling</td><td colspan="2">Direct reuse (or) Non-destructive recycling (Deformative/ Subtractive/ Additive)</td><td>B</td><td>Cook's approach
Prospector's approach</td></tr>
</table>

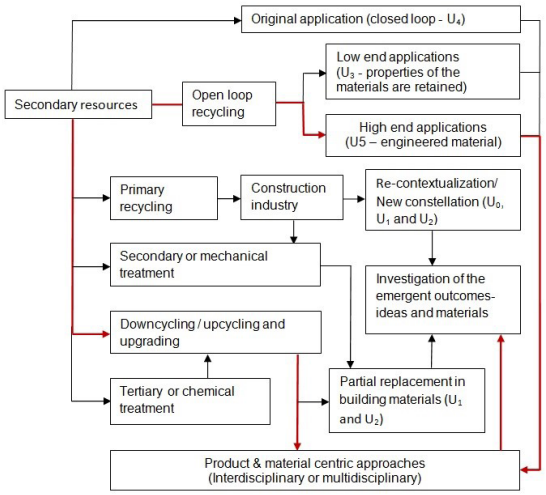

Figure 3. *An Interpretation on 'recycling' in architecture and construction industry.*

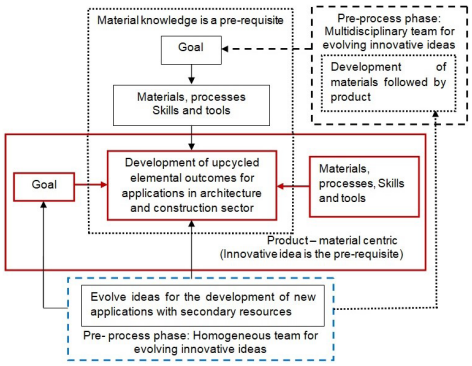

Figure 4. *The relationship between ROD, product and material centric approaches.*

Downcycling has been identified as a subset of upcycling and also addressed as downgrading. 'Cascading' or 'downgrading' have been the reuse of materials in a degraded form when compared to the pre-consumed state and used for applications lower than the original purpose. This paper has argued that when materials extracted from secondary resources especially from various domains other than the construction sector retain properties that do not fully correspond to the pre-consumed state but used for developing low end applications in construction fall under U_3.

The relationships between recycling, upcycling and upgrading have been interpreted, interrelated with the postulates, logics and approaches framed in architectural domain as in Table 6. Functional recycling or re-contextualization that include U_0, U_1 and U_2 fall under cook's and prospector's approaches and categorized as zero or secondary or physical or mechanical recycling, adopting the ideals of open loop recycling. Tertiary recycling that involve the modification of chemical properties that does not fully correspond to the pre-consumed state for the original or a different purpose in an altogether different domain has been recognized as closed and open loop recycling respectively.

The utilization of secondary building materials or resources from domains other than the construction industry requires either interdisciplinary or multidisciplinary efforts adopting the principles of opportunistic architecture and ROD. However, in today's context, there is an ultimate need to utilize secondary resources from domains other than the construction sector. With this as the focus, this article has mapped a direction to utilise such secondary resources in architecture and construction sector as shown in Figure 4.

In Figure 4, 'material centric' and 'product centric' approaches are mapped. When the approaches are 'material centric' and 'product centric', the investigation begins with

the materials and ideas respectively. It is observed that when upcycling the material is the focus, multidisciplinary team is needed for developing ideas. However, a homogeneous team is needed to evolve innovative ideas initially followed by the multidisciplinary team while investigating the secondary resources comes later.

This article has contributed to the existing knowledge in two directions. As already discussed, six degrees of upcycling have been deciphered falling under the classes Repurpose (R_6) and Recycle (R_7). Secondly, this paper has reinstated the need for 'pre-process phase' in both the 'material and product centric' approaches. Further, diverse ways of exploring the 'pre – process phase' to evolve and develop unique ideas and outcomes with secondary resources from domains other than construction sector shall be investigated with homogeneous and heterogeneous teams depending upon the priority.

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The experimental works conducted on modern heritage and mixed system buildings with the purpose of the conservation and restoration

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Abstract

Within the 20th century, the National Architectural Period in Turkey began and the structures which had mixed systems with reinforced concrete (RC) and masonry was seen commonly. This period is also called "Modernization" and the buildings were considered as Modern Architectural Heritage structures. Since most of these buildings are used today, conservation and restoration attempts have become more essential to maintain safety conditions for users with the cultural heritage value of the buildings. Some parameters should be taken into account like the material properties, environmental conditions and human activities that are more effective in the degradation of the structures. However, the conservation and restoration of mixed structures are less investigated in literature because these structures have complex construction techniques and there are not definite rules in the related regulations. So, these kinds of articles that present the studies can be seen invaluable for the structures which has similar problems and solutions. This paper presents in-situ examination and laboratory analyses on the building materials used in Istanbul University Buildings accepted as a cultural heritage masonry infilled RC structure. First of all, in-situ examination was done according to the observations on the exterior and interior walls, Secondly, representative material samples taken from different locations of the buildings both masonry and the RC sections. For the determination of the properties and deteriorations of the materials, the chemical analyses and the physical and mechanical tests were conducted. According to the results, the conservation and restoration applications were recommended for the case study buildings.

Keywords

Modern architectural heritage, RC structures, Experimental works, Restoration, Conservation.

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1. Introduction

As described in the literature of Architecture History, the period of 1920-1950 years is known Early Republican Period Architecture in Turkey. The Early Republican Period refers to a process where work on "modernization" is accelerated. Modernization is considered as a Republican project and the official policy of the giants. Many public spaces were born from the needs of modern life in that time (Işık, 2010). Until 1930, the construction activities were seen intensively. In particular, public buildings primarily related to education built in this period; reflect architectural style called the First Natural Architecture in which the features of Ottoman Neo Classical style were interpreted with their daily needs (Parlak & Yıldız, 2017) During 1910-1927 period is known as I. National Architecture Period in Turkey, As a result of the effort in creating national consciousness by combining the National Architecture movement, ideological thoughts and architectural elements, it was shaped by using an eclectic understanding by taking the scheme and forms of the past (Seljuk and Ottoman) religious and educational institutions (arch, column, erasure, fringe, etc.) and by taking the plan scheme of the west. Until the 1930s, the mixed structures with reinforced concrete and masonry were used in Turkey. However, the number of these mixed structures are limited. In Modern times, mostly reinforced concrete buildings were preferably constructed. In the mixed structures, the walls were constructed by rubble stone in the basement and brick on the upper floors. The slabs were reinforced concrete and the roof was wooden. In this period, reinforced concrete column and steel beam applications with mixed beams are among the common construction systems (Özbakan, 2007).

During 1940-1950 period is known as II. National Architecture Period which is an approach that outweighs the emotional and / or traditional aspect. The monumental structures that are heavy, stone-covered, massive and sitting on the ground with their entire body, which attach great importance to window details and eaves, embody the traditional direction, the use of the Turkish House's traditional features, the use of regional construction and material embody the emotional aspect (Alsaç, 1976; Kortan, 2000). Kortan (2000) stated that generally static-stationary expressions, central plans, symmetrical systems were used in the buildings. He points out that the structure is not expressed on the facades and that the structure is shown as a masonry structure even if it was built in a reinforced concrete framework (Alsaç, 1976).

In the late 19th century, the reinforced concrete was occurred with the industrial revolution. The structures with RC frame had been supported with steel, wooden and masonry structures because their construction time was shorter and they were more economical (Ersoy & Özcebe 2017),

Throughout the twentieth century, a wide range of architectural and engineering structures were built using concrete as a practical and cost-effective choice and concrete also became valued for its aesthetic qualities (Gaudette & Slaton, 2007). Even though reinforced concrete (RC) and prestressed concrete (PSC) are perceived as "modern" or "new" materials from the standpoint heritage conservation, several buildings and infrastructural facilities built in concrete are progressively being listed as architectural heritage (Menon, 2010).

At the beginning of the 20th century, reinforced concrete was seen favorable construction material. The buildings which had a mixed construction system with masonry and reinforced concrete were started to be built. In later times (1950), only RC structures were commonly used. This material was perceived as having favorable characteristics relating to resistance, durability and plasticity. Further, it was quicker to manufacture, easier to control and resulted in reduced costs. These other factors made it fashionable. Therefore, there were many reasons for its widespread use; not only social or historical factors but also, mainly, economic and technical ones (Esponda, 2010).

Apart from its aesthetic value and strength, the advantage of reinforced concrete lies in its plastic stiffness and capacity of being molded into any spa-

tial form. There was also a time when reinforced concrete was considered to be more durable than traditional construction materials such as stone. The system offered the advantage that much greater spans could be achieved economically, thus facilitating much greater flexibility in architectural design. Also, compared to stone or brick, RC allowed the walls and general support structure to be reduced in thickness (Calderini, 2008).

The repair and restoration of reinforced concrete, which is the main building material of the 20th century and which enables great developments in the history of architecture, has been brought to the agenda as a field that needs to be discussed and developed because of the fact that various structures and many buildings are in danger of disappearing. Certain methods are used today for repairing or strengthening concrete / reinforced concrete. Firstly, the correct detection of damage is of great importance for the repair of a reinforced concrete structure. Applications such as repair and reinforcement without proper diagnosis will be useless, and may damage the structure (Özbakan, 2007).

The restoration theories of the early nineteenth century, emphasizing the concept of conservation and recognize of interventions, provided theoretical legitimacy for the new material, concrete. Concrete deterioration occurs primarily because of corrosion of the embedded steel, degradation of the concrete itself, use of improper techniques or materials in construction, or structural problems. The causes of concrete deterioration must be understood in order to select an appropriate repair and protection system (Özbakan, 2007, Gaudette & Slaton,2007). While reinforcing steel has an important role in expanding the applications of concrete in twentieth century architecture, corrosion of this steel has also caused deterioration in many historic structures (Erlemann, 1999). Another problem is seen related to the poor consolidation of the concrete during its placement in forms, or in molds in the case of casting. This problem especially occurs in highly ornamental units. In early twentieth century, the production techniques of the concrete were similar to techniques used in forming cast stone. Poorly consolidated concrete often contains voids and water easily enters into these voids. If this water reaches the reinforcing bars, the corrosion occurs. Because of the corrosion, at first the deformation (volume increase) of the reinforcing bars form and then demolish the protective concrete cover over the embedded reinforcing bars. This situation can decrease the concrete strength. Proper settlement and chemical admixtures are also used today to eliminate this problem (Gaudette, 2000).

Among the environmental or atmospheric factors such as exposure to wind, rain, snow, and salt water or spray are highly effective on the deterioration of the materials. In addition, high-pressure water when used for cleaning can also erode the concrete surface like the rain and snow. The deterioration morphology may differ according to the properties of the materials. With the exposure of these factors on concrete, weathering appears as erosion of the cement paste and because of being a composite material, the phases of binder and aggregate are started to disintegration due to the freezing-thawing. As water within the concrete freezes, it expands and exerts forces on the adjacent concrete. Repeated freezing and thawing can cause a damage which appears as surface degradation, including severe scaling and micro-cracking that extends into the concrete. In the second half of the twentieth century, air entrainer is used in the concrete to provide enhanced protection against damage due to cyclic freezing-thawing of saturated concrete (Gaudette & Slaton,2007).

Like the other masonry materials, the characteristic signs of problems in concrete include cracking, spalling, and staining. Cracking occurs in most concrete but will vary in depth, width, direction, pattern, and location. Spalling, the loss of surface material, is often associated with freezing-thawing as well as cracking and delamination of the concrete cover over embedded reinforcing steel. Spalling deflects the concrete for both strength and physical properties. Staining of the concrete surface can be related to soiling from

atmospheric pollutants or other contaminants, dirt accumulation, salt efflorescence and the presence of organic growth and etc. as a result of water migration (Gaudette & Slaton,2007). In general, both concrete and the other masonry materials like stones, clay-based materials, mortar and plasters are influenced from similar affecting factors mentioned above. Before assessment of the characteristics of the materials, the causes of deterioration should be determined.

"Apart from conservation and restoration of monumental structures as works of art and historical documents, it should be ensured that their conservation is permanent and sustainable. In addition, the basic approach underlying restoration decisions is providing maximum conservation and restoration with minimum costs as well as minimal intervention in the authentic structure, strengthening of the structure considering the damages and thus passing it down to next generations" (ICOMOS, 2001).

Since the purpose of repairing such structures is to conserve the aesthetic and historic value of the monument, the conservation works are based on original materials and reliable documents. Three primary approaches are usually considered for historic concrete structures: maintenance, repair, or replacement. Maintenance and repair best achieve the preservation goal of minimal intervention and the greatest retention of existing historic building. However, where elements of the building are severely deteriorated or where inherent problems with the material lead to ongoing failures, replacement may be necessary (Macdonald, 2003).

A condition assessment of a historical building should begin with a review of all available documents related to original construction and prior repairs. While plans and specifications for older buildings are not always available, they can be an invaluable resource and every attempt should be made to find them. Archival photographs can also provide a valuable source of information about original construction.

In order to assessment of the condition of the building materials, there are mainly two methods that are called as destructive testing and non-destructive testing methods. The non-destructive testing methods can be used in the field to evaluate concealed conditions by using the basic and some sophisticated techniques (U.S. Department of Transportation Federal Highway Administration, 1997). To further evaluate the condition of the concrete and the other masonry samples may be taken for laboratory study to determine material components and composition, and causes of deterioration. This is called destructive testing method. The laboratory studies provide a general identification of the original materials' properties and deterioration morphology. Information gathered through laboratory studies can also be used to help choosing the most appropriate materials for the conservation and restoration works.

This study is about the conservation and restoration of the education buildings in Istanbul University which were constructed as the mixed structures of reinforced concrete framework and masonry n the 1940s, maintaining their original form and cultural heritage value.

The buildings of the Faculties of Science, Letters and Aquatic Sciences at Istanbul University were examined. These buildings are located in the historical peninsula of Istanbul, which is included in the UNESCO's world heritage list, more specifically in plot 20-113, building block 2707, Balabanağa neighborhood in the district of Fatih, Istanbul (Ahunbay, 2004), The view of the structure from the southeast facade is given in Fig. 1. This structure has been registered as cultural heritage by Istanbul Heritage Board.

Constituting the largest structure block in the historical peninsula of Istanbul, these buildings are located around three courtyards. 21 building blocks are separated from each other by dilatations, with each block being an individual building considering their load-bearing systems. This complex structure is surrounded by monumental structures, such as Pertevniyal Valide Sultan Mosque to the west, Şehzade Mosque to the northwest, Bayezid II Bathhouse, Seyyid Hasan Paşa Madrasah, Bayezid II Madrasah and Bayezid

II Mosque to the east, Süleymaniye Mosque, Kuyucu Murad Paşa Social Complex and Kalenderhane Mosque, which was originally a church in the Byzantine period, to the north (Fig. 1).

The faculty buildings were designed by Architects Sedat Hakkı Eldem and Emin Onat, started to be constructed in 1943. A part of the buildings was completed in 1946, while the remaining part was completed in 1952 after which educational activities started to be carried out.

Architects Sedat Hakkı Eldem and Emin Onat were at the top of the architect's representative of the period which is described as II. National Architectural Period in Turkey (1940-1950). One of the most important buildings they built together is said to be the structure of the Faculty of Science and Letters of Istanbul University (Batur,1994).

It is the most important work of the architects designed monumental indoors and outdoors. The capacity to include the two faculties with all their units was also realized. On the one hand, it reflects the giant, massive mass solutions and the understanding of interior design of the German Nazi architecture of that period, on the other hand, it includes elements such as window layouts and eaves formations of traditional Ottoman residential architecture. There are rectangular and square courtyards surrounded by monumental regular and stone-faced buildings. With this aspect, the structure reflects a monumental-academic tendency (Sağgöz, Sarı, Şen & Al, 2014).

Today, this structure complex includes the Faculty of Science, the Faculty of Letters and the Faculty of Aquatic Science. Today, from the blocks where the Faculty of Science, Engineering and Literature is located, in the section where the Faculty of Letters is located, the traditional madrasahs, which are both traditional faculties, are taken as example in the facade and details and in the plan design (Tekeli, 2006)

Figure 1. *Aerial photo and layout plan of the examined structure.*

These structures were chosen as a case study not only for having historic value but also having mixed construction system with masonry and reinforced concrete.

2. Research methods

This study, which started with the research on the historical process of the mentioned structures, consists of: (i) in situ examination, (ii) identification of the characteristic properties of the materials by chemical analyses, physical and mechanical tests on the representative samples taken from different points of the structures and (iii) recommendations for conservation and restoration of the structures based on the data analysis. All the tests and analyses were conducted according to the related standards and knowledge in the related literature (Arıoğlu & Acun, 2006; TS EN 196-2, 2014; TS 10088 EN 932-3/A1, 2006; TS EN 933-10, 2015; TS 699, 2016; TS EN 12504-1,2019; TS EN 772-4, 2000).

In situ examination and laboratory studies conducted on the building materials taken from the structures were considered as the research methods. In situ examination was conducted by visual inspection and documenting the conditions shown in the following.

The aims of in situ examination studies are;

- to document the original construction technique and materials,
- to document the environmental pollution affects,
- to document the damages in building elements,
- to document the deteriorations occurred on the material surfaces,
- to document the sampling locations.

After in situ examination, building material samples were taken from each structure mentioned below. As these buildings have both masonry part and RC part, representative samples were taken from each construction materi-

als as much as possible.

The characterization analysis was conducted on the samples taken from masonry parts; stone, brick, mortar and plaster, for documentation and proposals for restoration works. As the characterization tests acid loss, ignition loss (calcination), sieve analyses and physical property tests were conducted on mortar and plaster samples, the visual analyses and physical property tests were conducted brick and stone samples. As a result of these analyses and tests, the mixture ratios and ingredients of the mortar and plasters were determined, and also, the type of bricks and stones were identified.

Secondly, the mechanical property tests were conducted on the samples taken from RC parts: concrete samples, for determination of the strength for documentation and restoration works. These tests were given in the following;

- Non-destructive tests: Schmidt hammer test (to determine the hardness of the concrete surface), Profometer analysis (to determine the steel reinforcement)
- Destructive tests: Coring concrete samples (to determine the compression strength)

3. The results and discussion

In this section, the results of all analysis and tests were given respectively. The results of in situ examination is also as important as the results of laboratory studies. By the results of all the studies, the recommendations could be given for conservation and restoration of the structures. The results were given in the following.

3.1. The results of in situ examinations

In situ examinations were conducted in order to detect and document the effects of environment and any other parameters on the building materials of the structures. Among all the factors, air pollution was seen the most affective factor on the surfaces of the materials. For example, surface contamination due to air pollution was observed on the eastern facade of the structure facing towards the Vezneciler Street and Kimyager Derviş Paşa dead-end Street (Fig. 2). The façades of the structure other than those that were

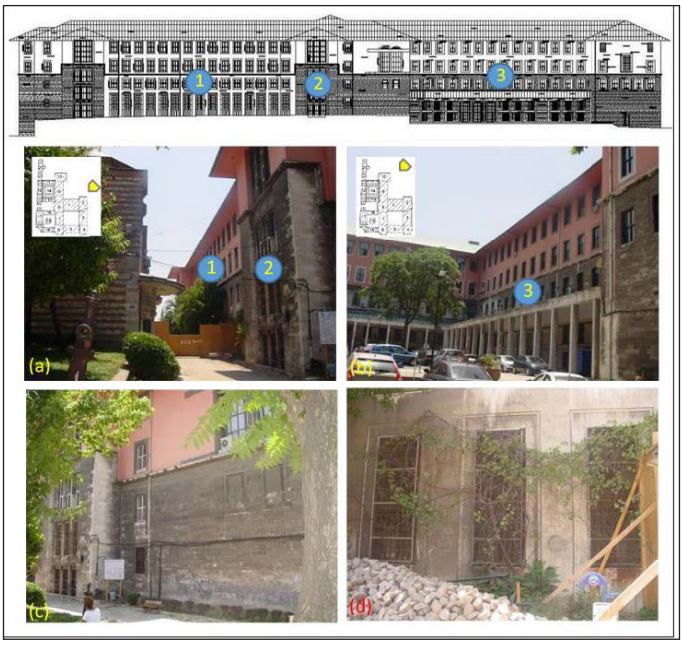

Figure 2. *Eastern facade: (a) Faculty of Letters, (b) Faculty of Science (c, d) Contamination in facade and window jamb.*

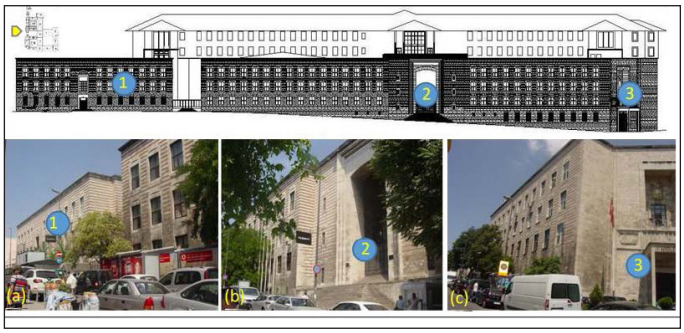

Figure 3. *Western facade: (a) Physics Department, (b) Faculty of Science, (c) Faculty of Aquatic Sciences.*

Figure 4. *Faculty of Aquatic Sciences: (a, b) Inner court, (c) Facade contamination, (d) Corrosion effect in reinforcement.*

stone-pitched and coated with Edelputz plaster which was favorite in that time.

In the facades of the Faculty of Science, the top of the green eaves covering the top of the arcaded section and the inner parts of all window jambs were contaminated. Besides, the structures of the colored mortar between the jamb and the lintels became empty because of the surface abrasion.

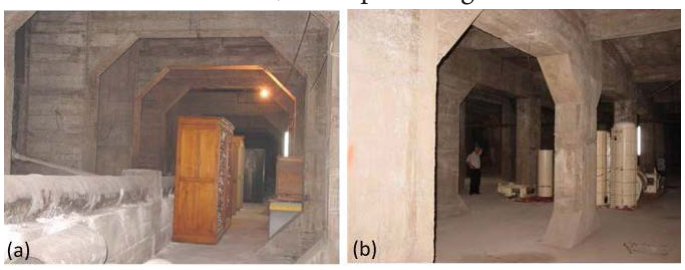

Figure 5. *Load-bearing members in basement storey for Faculty of Science building (a, b).*

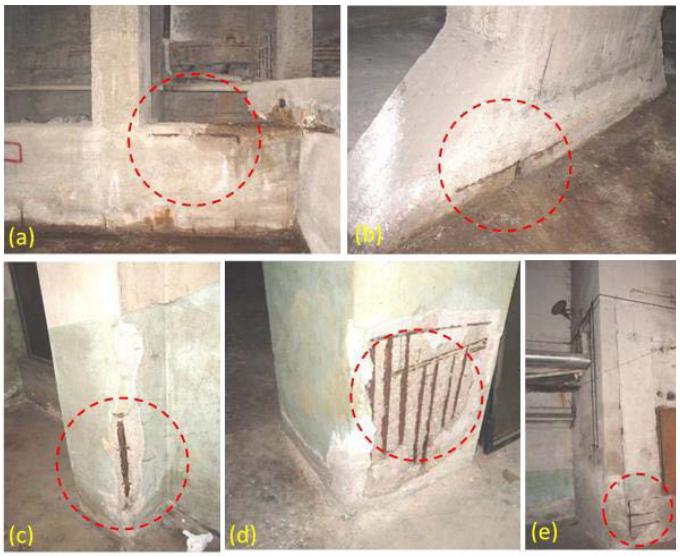

Figure 6. *RC columns and foundations subject to corrosion effect in Faculty of Science building (a-e).*

Figure 7. *RC foundations subject to corrosion effect in Faculty of Letters (a, b).*

Figure 8. *Corrosion effects in Faculty of Aquatic Sciences.*

Contamination was observed on the eastern facade and side facades of the Department of Physics building (Building 21) in the Faculty of Science. Furthermore, surface abrasion was apparent on the facade containing the entrance door and on the natural stones of the jambs. Corrosion was observed on the iron guards inside the windows in the ground story. The window guards in the Department of Physics building were extremely corroded, and the rust stains had flown onto the natural stone coating, resulting in contamination.

Although the western facade of the structure facing towards the Büyük Reşit Paşa Street was cleaner than the other facades, surface abrasion was observed on the limestone laid in alternating order with bricks (Fig. 3).

Heavy contamination was observed on the northern facade of the structure that faces the Vezneciler Street and on the inner sections of all window and door jambs, whereas a small amount of surface abrasion can be seen on natural stones. Also, a little bit efflorescence forms on the surface of the natural stone coverings and deforms the aesthetic vision.

While surface abrasion could be observed on the southern facade of the structure facing Ordu Street, extreme contamination was apparent on all-natural stones facing the inner courtyard at the Faculty of Letters. Contamination could be observed on the façades of the buildings facing the courtyard in the Faculty of Aquatic Sciences. Moreover, the load-bearing system elements of the buildings were damaged to a great extent (Fig. 4).

In the visual examination made on the buildings of the Faculty of Science and Faculty of Letters, the reinforcements had suffered from the loss of cross-sectional area due to corrosion. The linking water settled at the dilatation which was full of rubble between the binding beams and this situation deforms the structural system. (Figs. 5-7).

In the Faculty of Aquatic Sciences, at the basement due to excessive moisture, the material degradations formed. Due to low concrete cover and non-evacuation of moisture, the excessive corrosion of the reinforcements occurred (Fig 8).

3.2. The results of laboratory analyses and tests

The laboratory analyses and tests were conducted to representative building material samples taken from Faculty of Science, Faculty of Aquatic Sciences and Faculty of Letters buildings. The samples were taken from various locations of the structures for laboratory tests in the present research. Chemical analyses, physical and mechanical tests were conducted on the material samples taken from the structure in accordance with relevant standards [21-26]. In this scope, (i) visual analysis, loss on acid and calcination analyses were conducted to determine the types and ratios of binding aggregates in the mortar and plaster samples, and sieve analyses and physical property tests were conducted on the aggregated that remained from the loss on acid test; (ii) calcination analysis and physical property tests were conducted on the stone and brick samples and (iii) compressive tests were carried out on the concrete samples. The results of all analyses and tests were given in the following respectively.

3.2.1. Sampling and visual examination

After a detailed investigation carried out to take representative samples, determining unique locations for the construction period of the examined structures are determined, 15 samples were taken. The codes, positions and descriptions of the samples, as well as the locations from which they were taken are given in Fig. 9 and Table 1, respectively.

In the visual analysis, the condition of the mortar and plaster samples before the loss in the acid test and the aggregates that remained after the loss in the acid test were examined under a stereo microscope, whereas the stone and brick samples were examined by eye and under a stereo microscope.

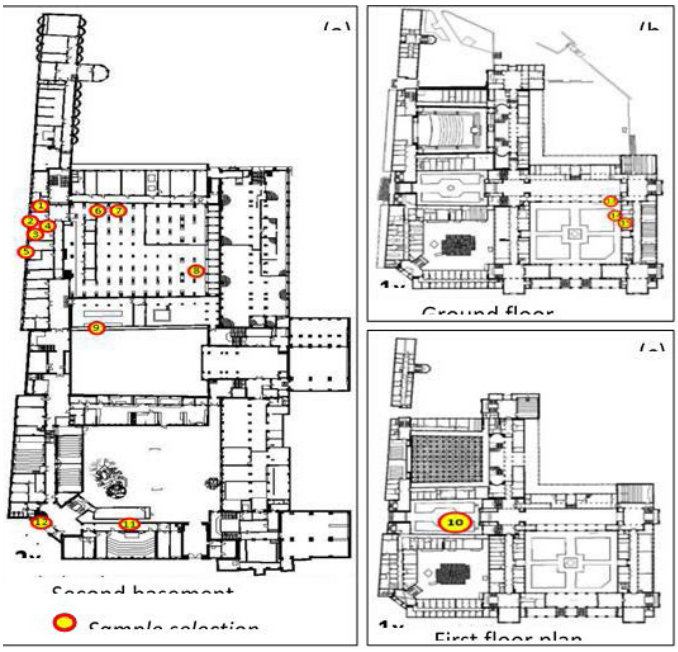

Figure 9. *Sample selection locations in plan view of the structure (a-c).*

Table 1. *The locations of the samples.*

Sample	Definition	Storey	Location
1	Interior plaster	First basement	Wall
2	Interior plaster		Office room
3	Pointing mortar		Office room
4	Brick		Office room
5	Interior plaster		Office room
6	Pointing mortar		Wall
7	Solid brick		Wall
8	Hollow brick		Wall
9	Interior plaster		Wall
10	Paving stone	First	Window side in facade
11	Interior plaster	Second basement	Wall
12	Interior plaster		RC beam
13	Paving stone	-	Facade in inner court
14a	External plaster-white mosaic		Facade in inner court
14b	Roughcast		Facade in inner court
15	Window jamb		Facade in inner court

Samples 1-10: Faculty of Science, Samples 11 and 12: Faculty of Aquatic Sciences, Samples 13-15: Faculty of Letters

Table 2. *The results of ignition loss and acid loss analyses.*

Sample*	Retained fine material (%)	Undersize grain (%)	Loss on acid (%)	$CaCO_3$ (%)	** CO_2 / H_2O ratio (%)	Binder/Aggregate ratio by weight (%)
1	9	64	27	16	2.9	1/3
2	13	62	25	15	3.7	1/3
3	12	74	14	16	1.5	1/3
5	18	68	14	19	3.1	1/2
6	11	78	11	12	1.8	1/3
9	6	78	16	17	4.0	1/3
11	10	76	14	11	1.4	1/2
12	8	66	26	27	3.0	1/2
14a	3	5	92	66	4.8	1/3
14b	14	65	21	23	3.1	1/2
15	60	-	40	82	3.8	1/3

*In Samples 14a and 15, the carbonate quantity ratio was determined to be high ratio because of the presence of too much limestone ballasts as aggregate. **If the ratio is less than 10, it is foreseen that the mortar has a hydraulic property.

3.2.2. The results of chemical analysis

To determine the chemical properties of the mortar and aggregate morphology in the samples taken from fifteen different points in the examined structures, loss in acid analysis was

Table 3. *The results of sieve analyses.*

Sample*	Material		Sieved aggregate (%)					
			8 mm	4 mm	2 mm	1 mm	0.5 mm	0.25 mm
1	Interior plaster		100	98	92	76	49	3
2	Interior plaster		100	97	87	65	32	2
3	Pointing mortar		100	95	82	58	36	2
5	Interior plaster		100	100	97	91	56	1
6	Pointing mortar		100	96	89	65	22	2
9	Interior plaster		100	97	88	60	31	2
11	Interior plaster		100	94	80	57	29	5
12	Interior plaster		100	100	96	84	63	11
14a	External plaster-white mosaic		-	-	-	-	-	-
14b	Roughcast		100	100	91	69	30	5
15	Window jamb		-	-	-	-	-	-

*Samples 4, 7, 10 and 13 contain no aggregates.

Table 4. *The results of physical property tests.*

Sample	Material	Water absorption percentage by weight (%)	Water absorption percentage by volume (%)	Unit volume of mass (g/cm³)	Density (g/cm³)	Porosity (%)
1	Internal plaster	15.5	26	1.70	2.61	35
2	Internal plaster	18.0	29	1.61	2.58	38
3	Pointing mortar	6.0	12	1.95	2.58	24
4	Brick	14.0	21	1.54	2.51	39
5	Internal plaster	15.0	26	1.71	2.56	33
6	Pointing mortar	14.0	23	1.64	2.61	37
7	Solid brick	18.0	31	1.71	2.65	35
8	Hollow brick	17.0	29	1.70	2.51	32
9	Internal plaster	19.0	30	1.60	2.56	38
10	Paving stone	5.0	12	2.32	2.53	8
11	Internal plaster	11.0	21	1.91	2.55	25
12	Internal plaster	9.0	18	1.97	2.58	24
13	Paving stone	8.0	15	1.84	2.67	31
14a	External plaster-white mosaic	7.0	14	2.02	2.50	19
14b	Roughcast	6.0	12	1.96	2.57	24
15	Window jamb	5.0	9	2.00	-	-

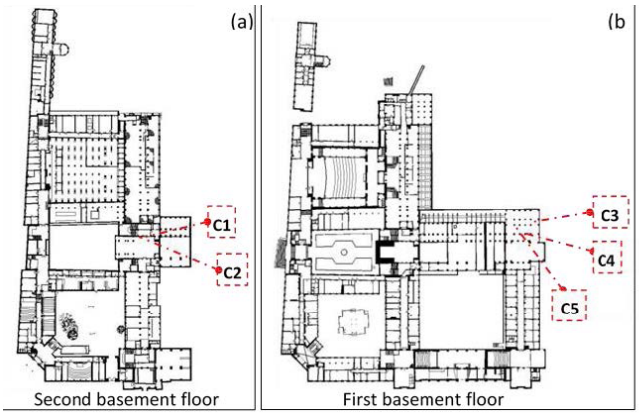

Figure 10. *The locations of core samples taken in the structure (a, b).*

Table 5. *The results of mechanical property tests.*

Sample	Material	Compression Strength (MPa)
RC Building Elements of Faculty of Science		
1	2.Basement-C1	21
2	2.Basement-C1	22
3	2.Basement-C2	18
4	2.Basement-C2	21
Average		21
RC Building Elements of Faculty of Letters		
1	1.Basement-C3	12
2	1.Basement-C3	15
3	1.Basement-C4	9.0
4	1.Basement-C4	17
5	1.Basement-C5	9.0
6	1.Basement-C5	10
Average		12

conducted, and subsequently, sieve analysis and ignition loss analysis were carried out on the aggregates that remained following the loss in acid analysis. Loss in acid analysis was conducted using 10-20% HCl acid. Calcination analysis was carried out by keeping the powdered samples in a muffle furnace for certain periods of time at 550°C and 1050°C, respectively. The results are given in Table 2.

3.2.3. The results of sieve analysis

Sieve analyses were conducted to find out the sizes of the aggregates remaining from the loss on acid test. The granulometry analysis results is given in Table 3.

3.2.4. The results of physical property tests

In an attempt to determine the physical properties of the mortar, plaster, stone and brick samples; water absorption, unit volume weight and specific weight tests were conducted under atmospheric pressure in accordance with the related standards (Table 4).

3.2.5. The results of mechanical property tests

To determine the quality of the concrete in the load-bearing elements of the structures, five core samples taken from columns at different locations were subjected to a compressive test in accordance with TS EN 12504-1 standard. Locations of the core samples are shown in Fig. 10. The compressive strengths of the cores are measured and the results are given in Table 5.

3.3. The conservation and restoration roposals

The examined buildings consisted of ashlar (organic limestone), artificial stone and marble. Ashlar stones were used as finishing material on the exterior façades of the buildings. Artificial stones were used on the façades of the Faculty of Letters facing the inner courtyard, and marbles were used on the load-bearing columns in the arcaded section on the eastern/northern facades of the Faculty of Letters. Although these stones are resistant to external atmospheric conditions, degradation in the form of crumbling

and dusting may occur on the surfaces when exposed to humidity for a long time and due to the impact of air pollution. The depth of surface abrasion observed on these stones varies, with the highest surface abrasion being observed on the Department of Physics building (Building 21) at a depth of 2-4 cm.

Contamination observed on a facade of a structure usually occurs as a result of the transformation of calcite, the main mineral of limestone, to gypsum by reacting with sulfur dioxide, trioxide and sulfurous acid in an environment of air pollution. As gypsum is somewhat water-soluble, it grazes the surface in the form of a solution and penetrates the porosity on the surfaces washed with rainwater. In the drying phase, it absorbs the particulate contaminants suspended in the air and crystallizes. In the sheltered locations which rainwater cannot reach, gypsum fills the porosity through dry accumulation and is stored on the surface in the form of incrustation. Soot, fly ash, unburnt hydrocarbons, dirt, heavy metals, and carbon pollution from the exhaust gases of diesel vehicles are added to the crust layer of gypsum, resulting in blackening of the crust's surface. Facade cleaning was recommended for eliminating the black dirt layers that have accumulated on the stone surfaces of all facades under examination due to dust, air pollution, smut, flying ashes and degradation.

As such, it was recommended to brush the black layers on the stone surfaces using water, non-ionic detergent or steam. For persistent stains, the use of soft aggregates, such as calcite or dolomitic smaller than 125 μ and micro sanding technique under low pressure (1-1.5 a), was recommended. In applying this technique, a small section of the facade should be tested to determine the appropriate pressure, and then, the technique should be applied to all surfaces. Cleaning applications should not be carried out in very cold or very hot conditions. Spring months are suitable to apply this technique attention should be paid to ensure that the stone surfaces to which water has been sprayed dry soon, as the water that remains on the surface for extended periods may lead to additional problems.

The theoretical mixture ratios to be used for conservation and repair throughout the structure based on the characteristic properties of the samples derived from the visual examination, loss on acid analysis, sieve analysis, calcination analysis and physical property tests on the authentic mortar and plaster samples are given in Table 6. The recommended mixtures may require adjustment of the amount of water, depending on its consistency, or partial adjustments depending on the material performance.

4. Conclusions

It is the most significant criteria in the application of protection and repair techniques that the original materials used in the construction of historical buildings should be conserved in-situ. This study, conducted relying on this principle, consists of the efforts to determine the content and strength of the original materials used in the buildings, which was constructed as an RC frame on a land of Istanbul University in 1940s as well as recommendations for application as a result of such efforts. In the first phase that consists of the field examination on the structure under examination, general contamination and surface abrasion were observed on the facade surfaces, corrosion and loss of cross-sectional area were observed on the reinforcements and other structural elements. In the second phase, chemical and physical tests were conducted on the first group of samples (mortar, stone, plaster) tak-

Table 6. *The mixture ratios of proposed mortar and plaster.*

	Samples					
	1, 2, 9 (Hybrid plaster)	3, 6 (Compo)	5, 11, 12 (Hybrid plaster)	14a (External plaster)	14b (Hybrid plaster)	15 (Artificial stone plaster)
Binder / Aggregate	1/3	1/3	1/2	1/3	1/2	1/3
Binders (Lime: L, Cement: C)	L and C (20%)	L and C (30%)	L and C (20%)	-	-	-
Normal Portland cement	75 kg	100 kg	75 kg	-	400 kg	-
White cement	-	-	-	500 kg	-	450 kg
Slaked lime	400 kg (0.3 m^3)	350 kg (0.25 m^3)	400 kg (0.3 m^3)	-	-	-
Aggregate	[a] 1 m^3 (1700 kg)	[b] 1 m^3 (1700 kg)	[c] 1 m^3 (1700 kg)	[d] 0.8 m^3 (1400 kg)	[e] 1 m^3 (1600 kg)	[f] 0.85 m^3 (1500 kg)

[a] bank sand (4 mm undersize), [b] aggregate (between 2-6 mm: 20% and 2 mm undersize: 80%), [c] fine silica sand (0.5 mm undersize), [d] lime stone ballast (6 mm undersize) [e] stream sand (4 mm undersize), [f] lime stone ballast (10 mm undersize)

en from the buildings to determine the original content of the material, and the strength of the structural element was ascertained through mechanical tests on the second group of concrete samples. Based on the results of the chemical and physical tests, mixture ratios were determined for the elements exposed to surface abrasion, which require integration. Furthermore, as a first response to the degraded quality of the structure's concrete reduced to C10 as revealed by the strength tests as well as to the corrosion of reinforcements and loss of cross-sectional area on the reinforcements. The corrosion on the exposed reinforcement should be cleaned and protective paint should be applied. Considering the service life of the structure over 70 years and the low quality of its concrete, it is recommended that the structure should be strengthened against seismic impacts following the completion of the conservation and restoration applications.

In conclusion, this paper presents a systematic study which can be used for the buildings having the mixed construction techniques and can be seen as a guide. This is only a case study which consist of a detailed research method. Similar research methods can be applied for the other cases. Each study is an experience which should be taken into account before the restoration attempts of these kinds of buildings.

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Şile and its castle: Historical topography and medieval architectural history

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Abstract

Being a district of Istanbul, Şile is located towards the east of the northern end of the Bosporus. This small city lies next to the Black Sea and it forms the northeastern section of the provincial borders of Istanbul. Şile Castle is popularly known as "Genoese Castle" but some other sources date it to the Late Byzantine period, as a typical watchtower. Following a long period of neglect, it most recently came into prominence with a restoration in 2015, which fully brought it back to the supposed original appearance. Although some assumptions were formerly made in order to describe the origins of Şile Castle, it was seen that its medieval architectural history was not elaborated despite the relevant information that were scattered around some significant primary sources as well as a number of secondary sources. Those works were not put together with the aim of exclusive objectives for Şile and its castle that the modern studies were also unaware of about which extant monument they mention of. Thus, a critical reading was done between relevant primary and secondary sources with a topographical and architectural point of view for Şile. The obtained information were chronologically considered for the topographical depiction, first construction, and usage of the castle for centuries. Major findings displayed that the origins of Şile Castle not only predate formerly supposed times but also differ than a simple watchtower in terms of initial function. Nearby castles also set an example regarding the usage of Şile Castle in later times.

Keywords
Architectural history, Bithynia, Historical topography, Medieval castle, Şile.

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1. Introduction

Modern Şile is located in the northwest of Turkey. It is a metropolitan district of Istanbul, which falls roughly 50 kilometers northeast of the city and 40 kilometers east of the Bosporus. While the district population is approximately 40.000 inhabitants, around 15.000 of them reside in the center (TÜİK, 2019).

Lying next to the Black Sea with a large and modern harbor, the settlement center of Şile has some distinctive geographical features. It is situated above a wide and sharp-pointed cape with impassable cliffs and stony bays along its rough coastline, before a small group of rocky islands that protect the harbor.

According to archaeological surveys, surroundings of Şile were inhabited during the Epipaleolithic period, which falls roughly 20.000 – 10.000 years before present time. In this regard, around the northwestern Domalı (Sahilköy) and Doğancılı villages of Şile, the ridge of Mürselli Baba, the hill of Tekmezar and the sands of Akçalı were significant discovery sites, where various examples of small drills, retouched stone tools with geometric shapes (mainly scrapes and blades), leftover flakes, and a few obsidian glass were documented (Özdoğan, 1985; Gatsov and Özdoğan, 1994).

Speaking for Şile town center, small ceramic findings from its eastern part and the nearby Ocaklı Island have displayed that the area saw continuous inhabiting starting from the Hellenistic period (Fıratlı, 1952). A cistern was also discovered in the west of Şile town center, which supposedly remained from the Byzantine period (Bakalakis, 1978).

The renowned Şile Castle is located on Ocaklı Island in the north. The castle as well as harbor of Şile are often named after the island as "Ocaklı Castle" and "Ocaklı Harbor". Moreover, Şile Castle is popularly known as "Genoese Castle" and some anonymous sources also attribute the old harbor of Şile to Genoese, a former Italian maritime republic (Cura and Eyüpgiller, 2019).

There were very limited researches on the architectural history of Şile Castle within the context of its medieval origins, as modern studies mostly focused on structural surveys and later periods. Hence, through an interdisciplinary research methodology, this study aims to handle a rather ambiguous period of Şile Castle in depth, which was previously not elaborated in the light of primary sources and relevant comparisons to some nearby Bithynian examples.

2. Şile Castle: An architectural literature review

The castle is located on the rocky and arid Ocaklı Island in the north of Şile coastline that the rectangular main structure is situated above its highest point (Fig. 1). Moreover, the whole upper perimeter of the island is encircled with a line of relatively low ramparts, which connect to the aforementioned keep at one corner point (Fig. 2). This fortification system is built of roughly shaped and average sized rubble masonry with very limited brick usage. The main building of the castle, actually resembling a rectangular tower has approximate floor dimensions of 10 x 12 meters and a supposed height of 15 meters. It had three floors that were separated by barrel vaults but all of them were collapsed. The top section has regular battlements. There is a cistern in the southeastern part of the island, which has dimensions of 6 x 10 meters and a depth of around 4 meters (Fıratlı, 1952).

The irregular wall circuit that surround the small island has abundant spolia, such as ancient bricks, various handles, and pointed bottoms of amphorae, which must belong to the same locality. Further ancient fragments were documented inside the walled area on the island (Bakalakis, 1978).

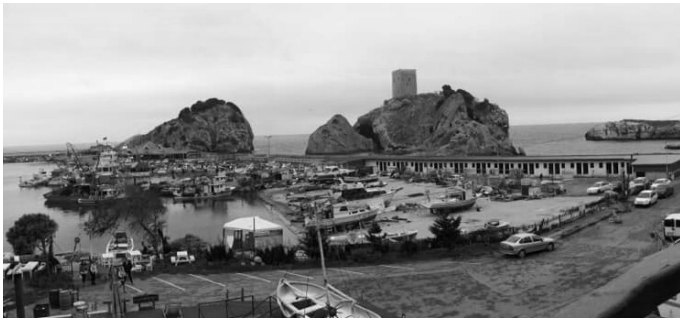

Figure 1. *A view of Şile coastline from the south that Ocaklı Island with Şile Castle is located in the center (Sağlam, 2018).*

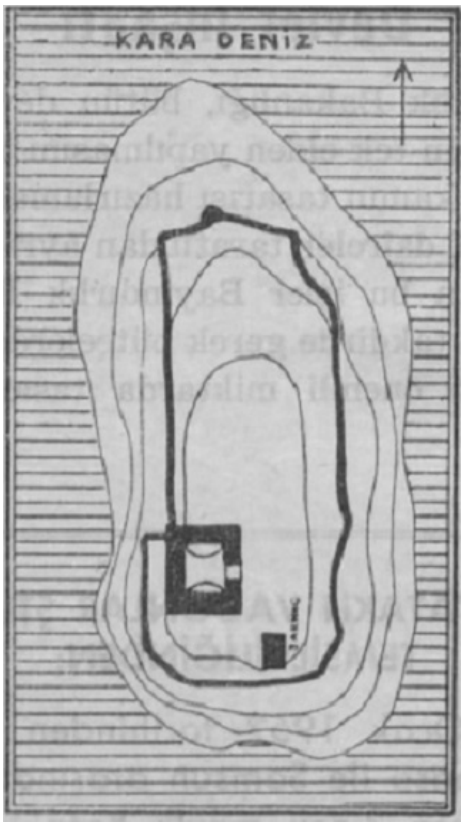

Figure 2. *A plan of Şile Castle on Ocaklı Island, where the main tower building, surrounding lower walls, and the cistern in the south are shown (Fıratlı, 1952).*

On the northern façade of the main building, there used to be a balcony with supportive consoles. It was apparently for observation due to the orientation towards the open sea. Upper floors of the tower were accessed by a vertical ladder system, which was collapsed in a later time (Eyüpgiller, Dönmez & Çobanoğlu, 2013).

The tower of Şile Castle has a number of arched openings that resemble wide observation windows instead of arrow slits. The main entrance of the tower is on the southern façade. It also has a cellar below the ground level. Şile Castle was designated as a listed building on 10.07.1981 (Envanter, 2019).

After similar examples from elsewhere in the world, it has been said that Şile Castle most probably had a wooden roof on top of its battlement level with a pyramidal or hipped form, which no longer exists (Eyüpgiller, 2019). Similar examples to Şile Castle were mentioned as Güvercinada Castle in Kuşadası, Izmir and Kız Kulesi in Pazar, Rize (Eyüpgiller, Dönmez & Çobanoğlu, 2013; Eyüpgiller, 2019).

Şile Castle was described as a "fortress" by Fıratlı (1952), where Eyüpgiller (2019) defined the central building as a typical "watchtower" that such common vertical structures were reportedly erected for observation and defense purposes on islands, peninsulas and other coastal areas for detecting enemy troops approaching from the seaside, according to the same scholar. Yet, ramparts completed the layout to a castle. In addition, Bakalakis (1978) argued that it is impossible that there would have been a proper settlement within Şile Castle, as the walled area was relatively small.

There are some brief hypotheses about the origins of Şile Castle that scattered around a group of modern secondary sources, which actually have different research scopes instead of the castle itself. Those arguments are simply based on rather narrative anonymous sources of information, backed by brief first impressions, which eventually failed to elaborate the medieval period of Şile Castle. This insufficient literature was most recently quoted by later modern studies mentioned below.

Correspondingly, on one hand, some modern researchers argued that Şile Castle is a Byzantine monument from the 13th century; yet some sources on the other hand claim that it was built by the Genoese (Cura and Eyüpgiller, 2019), who were active in the Black Sea mostly during the 14th-15th centuries. Yet, there is absolutely no primary source about a Genoese presence in Şile (Sağlam, 2018). It has also been briefly questioned by further researchers that Şile Castle was actually built by an anonymous Byzantine emperor called Andronikos but then used by the Ottomans (Eyüpgiller, 2019). Another argument dates the castle to 2000 years before present time (Eyüpgiller, Dönmez & Çobanoğlu, 2013). Finally, Bakalakis (1978) misinterpreted the comment of Fıratlı (1952) about the nearby Heciz Castle at Kalealtı village and argued that Şile Castle was built by the Ottomans during their earlier domination in the area around the late 14th century. Belke (2020) superficially attributes the castle to the Ottomans as well.

The castle supposedly had repairs by the Byzantines and Ottomans; but due to its poor state prior to the restoration of 2015, any distinctive construction phase or trace of repair was not recorded especially on the tower (Eyüpgiller, 2019). Thus, it can be argued that its previous state overall displayed a single construction phase. The tower of Şile Castle eventually had a full restoration that has caused worldwide attention as well as controversy due to the final appearance (Fig. 3; Fig. 4).

Figure 3. *A southwestern view of Şile Castle before its major restoration (Sağlam, 2007).*

Figure 4. *A southeastern view of Şile Castle before its major restoration (Sağlam, 2007).*

3. Methodology

With the aim of displaying the medieval origins of Şile Castle and its probable changes during that period, a historical research methodology was preferred in coordination with an architectural point of view. In the meantime, a topographical perspective was considered for the wider environment to ensure the accuracy of this research, as localization has always been a challenging issue for historical settlements and buildings. In this respect, it has been intended to reach all primary sources about Şile. In fact, many of them were separately quoted by certain modern studies to some extent. However, almost all of them were unaware of each other; also which historical settlement and its extant monument they spoke of. Hence, a thorough chronological research was carried out, which was followed by the assessment of archeological evidences. In the meantime, nearby Byzantine castles were considered for some topographical and architectural comparisons that especially Yoros, Seyrek and also Eskihisar showed similarity in some cases.

4. Historical topography of North Bithynia in ancient times

Primary sources about North Bithynia during Hellenistic and Roman periods provide information with various levels of detail that some toponyms may also have slightly different versions inside those sources, which should be carefully noticed from now on. Due to the precise scope of this research within the context of historical topography, the related primary sources were quoted without any interpretation in the beginning and a detailed discussion was provided afterwards.

For instance, the anonymous Periplus of Pseudo-Scylax from the 4th century BC briefly mentions the rivers of Sagarios (Σαγάριος), Artanes (Ἀρτάνης), Rivas (Ῥήβας), and the island of Thynias (Θυνιὰς) along the Bithynian coastline (Müller, 1855).

In his "Periplus of the Euxine Sea" (Chapter 17) from the 2nd century CE, historian Arrian of Nicomedia first mentions the river of Rivas (Ῥήβας), then the cape of Melaina (Μέλαινα ἄκρα = Black Cape), and following that the river of Artanes (Ἀρτάνης), where a bay for small boats and a nearby temple dedicated to Aphrodite were located. The next place was the river of Psilis (Ψίλις) that small boats could shelter under a projecting rock near its mouth. The distances between those four places were 150 stadia each (1 stadion = ~185 meters). The harbor of Kalpe (Κάλπη) was located with a distance of 210 stadia from the last spot. It was followed by a harbor for small boats called Rhoe (Ῥόη), the small island of Apollonia (Ἀπολλωνία) with a harbor, and the coastal locality of Chelai (Χηλὴ) that the distances in between were 20 stadia for each of them. Finally, 180 stadia away from the latter place,

the river of Sangarios (Σαγγάριος) was located (Arrian, 1842).

According to the "Geography" (Book 5, Chapter 1) of Ptolemy, which is also from the 2nd century CE, places along the northern coasts of Bithynia were listed with their approximate coordinates as the village of Artake (Αρτάκη χωρίον) and the rivers of Psyllidos (Ψυλλίδος), Riva (Ῥήβα), Kalpa (Κάλπα) and Sangarios (Σαγγαρίος), respectively (Ptolemy, 1845). Late Medieval copies in Latin of the same source regularly mention one of those places slightly different, as "Artace castellum" (castle).

Marcian of Heraclea as a local geographer provides further details by the 4th century that 150 stadia away from the river of Riva (Ῥήβα), the cape of Melaina (Μέλαιναν ἄκραν) was located. After another 150 stadia, the river and village of Artane (Ἀρτάνην ποταμόν καί χωρίον) came. It also had a harbor for small boats, which was protected by an island in front of it. The river and castle of Psillion (Ψίλλιον) was located 140 stadia away from them. Then, the harbor and river of Kalpa (Κάλπα), the island of Thynias (Θυνιάς), and the river of Sangarios (Σαγγάρίος) were mentioned, respectively (Müller, 1855).

Finally, on Tabula Peutingeriana, which is a Late Roman itinerary, a linear course formed by the river of Herbas -> 16 miles -> Melena -> 19 miles -> Artane -> 19 miles -> Philium -> 27 miles -> Chelas -> 20 miles -> the river of Sagari appeared along the North Bithynian coast and from west to east, respectively (1 Roman mile = ~1481 meters) (Talbert, 2010).

5. A topographical discussion: Artane and the two Chelai

After a detailed and rational consideration of all the primary sources in the previous section, Miller (1916) and Talbert (2000) have argued that Artane(s) actually falls to modern Şile by position. Riva(s) / Herbas = namesake Riva; Melaina akra / Melena = namesake Karaburun; Psilis / Psillion / Philium = Ağva; Kalpe = namesake Kerpe; Rhoe = somewhere near Kefken; Apollonia / Thynias = Kefken Island; Chelai = somewhere near Cebeci / Çelikkaya Cape; and Sangarios / Sagari = namesake Sakarya River were the remaining ancient places and their modern locations that were proposed by the aforementioned scholars (Fig. 5).

In this case, it can be concluded that during the Roman period, Artane was a small, probably fortified settlement with a namesake river (modern Türknil), which was mentioned even during the Hellenistic period. There were also a temple dedicated to Aphrodite / Venus and a harbor for small boats. This harbor was protected by an island in front of the settlement. These details well match with the current geography of modern Şile.

While the ancient settlement where modern Şile is located was called Artane / Artana, its river was accordingly called Artanes / Artanas due to the grammar of Ancient Greek. It was supposedly derived from "Arta", meaning "river" in Luwi language, therefore the name of that ancient settlement actually meant "country of the river" (Umar, 1993).

However, it should be noted that during the antiquity, a phonetically similar place to modern Şile, namely Chelai was located nearby. The ancient Chelai in Bithynia was seemingly located 20 stadia east of Kefken Island and 180 stadia west of Sakarya River. Interestingly enough, this name certainly replaced Artane during much later centuries, as discussed in following sections, and the fate of that ancient Chelai remained unknown. Though Şile was called Chele / Chelai starting from the Middle Byzantine period, this shift apparently confused some modern scholars. According to Ramsay (1890) and Umar (1993), the place mentioned as "Chele" by later Byzantine sources of Anna Komnena and George Pachymeres supposedly indicated the ancient Bithynian locality between Kefken Island and Sakarya River in the east, but it is absolutely certain that both historians indicated the place now called Şile.

For a more accurate positioning, the ancient Chelai neither falls to somewhere near Cebeci nor Pazarbaşı Cape, as proposed by Talbert (2000) and Umar (1993), respectively. Both places are located in the immediate south of Kefken Island but the well defined loca-

tion of the ancient Chelai certainly corresponds somewhere towards the east, therefore falls around Harmankaya Cape of Babalı in Kandıra, as proposed by Miller (1916) and Bakalakis (1978). Moreover, the latter scholar also argued that the locality of Delikkaya / Çelikkaya / Çalıkaya at Harmankaya Cape should be the exact position of the ancient Chelai, as an etymological similarity between those names also testifies. However, the renowned Dikili Cape, Dikili Rocks and Dikili Beach in the same area could also be shown as examples to this issue, instead of those rather lesser known local names (Fig. 5).

Various Late Hellenistic and Early Roman small findings, an ancient quarry with in situ massive blocks and further archaeological remnants from Roman and Early Byzantine periods were documented both at Dikili Cape and Harmankaya Cape. The only epigraphic evidence concerning Chelai appeared on a typical Hellenistic / Roman altar with a bucranium bas-relief (Bakalakis, 1978). Its inscription was initially attributed to modern Şile despite the apparent earlier date of the artifact (Miliopoulou, 1907). Hence, Bakalakis (1978) attributed that altar to the ancient Chelai in the east.

According to Umar (1993), the name Chelai probably originated from "Kala" in Luwi language, which means "coast" or "pier". Then, Casacuberta (2018) said that the Ancient Greek term "χηλή" (chele) originally referred to the pincers of a crab but later defined a sea basin enclosed by two projecting pieces of land or artificial moles, like a bay. Moreover, a "chele" actually forms a shape similar to a hoof that the word also has this meaning. With regard to the famous Byzantine encyclopedia of Souda, the word "χηλή" (chele) kept those meanings by the mid-10th century (Gaisford, 1834). Such distinctive coastal features are still present in modern Şile as well as the region around Dikili Cape and Harmankaya Cape in the east, where the ancient Chelai supposedly located.

The exact period in which Artane (modern Şile) became Chelai / Chele is unclear together with the reason behind this change of name. With respect to the oral tradition by the 19th century, elderly inhabitants of modern Şile spoke of their ancestors as immigrants from another settlement in the east that the ancient Chelai was proposed as this place (Bakalakis, 1978). After a very limited group of ancient and Late Medieval cartographic sources that omitted almost a millennium, Bakalakis (1978) then argued that the aforementioned change of name might be happened following the Fall of Constantinople in 1453. This assumption, which did not consider the Byzantine literature review for Şile by Miliopoulou (1907) and Bănescu (1928; 1932) is apparently inaccurate with regard to the sources discussed in the next section. This literature was most recently compiled by Belke (2020). In the end, sometime between the 8th and 11th centuries came forward.

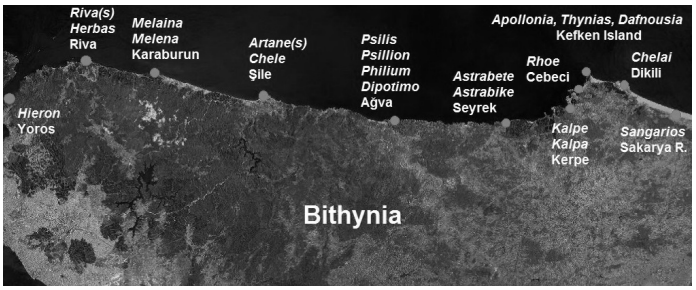

Figure 5. *Ancient and modern names of some North Bithynian places that were frequently mentioned within the context of Şile and its castle (Sağlam, 2020, after Yandex Maps).*

6. Şile in Byzantine times: A new name and a purposeful fortification

It appears that the settlement of Artane was still present during the Early Byzantine period, as the Ravenna Cosmography from the 7th - 8th centuries lists the places of Erba, Melena, Artane / Artamen, Filium, Chel(l)as and Sagari / Saccar along the northern coastline of Bithynia, respectively (Pinder and Parthey, 1860). Their modern correspondences were listed in the previous section.

In the meantime, according to Nicephorus I of Constantinople and Theophanes the Confessor, Constantine V (r. 741-775) resettled 208.000 Slavs in 762-763 to Artana and around the river Artanas, who emigrated from the First Bulgarian Empire due to the harsh policy of Telets (r. 762-765): "... καί πρός τόν ποταμόν Αρτάνας καλείται

αύτοί κατοικίζονται" (Nicephorus I, 1837); "... έπί τόν Άρτάναν πρός τόν ποταμόν, ός Άρτάνας καλείται" (Theophanes, 1839; 1841; 1982). Artana / Artane then disappears in later sources. In the end, the original toponym of Artana / Artane was replaced by a rather generic geographical definition, which was very common in ancient times, especially for coastal places (Umar, 1993). In this case, the aforementioned demographical change might be a reason but it is uncertain. The successor toponym, being "Χηλή " (Chele) in Greek was used until 1922 for Şile.

It is worth noting that a second topographical debate emerged after some Byzantine primary sources that a certain toponym was interpreted as either modern Şile (Turkey) or Chilia (Romania). However, Bănescu (1928; 1932) concluded that certainly the former settlement and its castle were referred with regard to distinctive topographical details, whose detailed literature review for the Byzantine period of Şile guided the research in this section.

Thereafter, as the inner parts of Asia Minor were under constant devastation by Turkish raiders following the Battle of Manzikert (1071), Anna Komnene mentions on the eve of the First Crusade (1096-1099) that a large piece of protruding land that was delimited by Nicomedia, the coastline continuing towards the north, the village of Chile (χωριου Χιλής) and the river of Sangarius was well secured through a long and deep ditch by Alexios I Komnenos (r. 1081-1118) (Komnene, 1878; 2000).

When speaking of the fight for the throne during the time of Andronikos I Komnenos (r. 1183-1185), Niketas Choniates indicates that the emperor ordered his son-in-law Alexios Komnenos to be enchained, as the opponents intended to depose Andronikos I and replace him with Alexios. Then, he was banished to the small village / fortress (πολίχνιον) of Chele (Χηλή) next to the coast at the mouth of the Pontus, where a tower (πυργίον) was constructed for his imprisonment (Choniates, 1835; 1984). Soon afterwards, when Andronikos I was deposed in 1185, he first took shelter in Chele with the hope of escaping to Crimea. While the inhabitants of Chele were indifferent to him at that moment, it was impossible to sail due to the strong headwind, therefore he washed ashore several times and was eventually arrested (Choniates, 1835; 1984).

George Pachymeres recalls several anecdotes concerning the Late Byzantine period of Chele. First of all, following the recapture of Constantinople from the Latins in 1261, Michael VIII Palaiologos (r. 1258-1282) blinded John IV Laskaris later that year, who was a heir to the throne. John IV was first imprisoned in Chele (Χηλή). Then, he was sent to the castle of Niketiaton in Dakibyze (modern Eskihisar, Gebze) (Failler, 1979; Pachymeres, 1835) that were previously recovered from the Latins by John III Vatatzes in 1241 (Akropolites, 1837; Macrides, 1978).

When Patriarch Joseph I had dissented against Michael VIII about the reunion of the Catholic and Orthodox churches in the Second Council of Lyon (1272-1274), he resigned in 1275 and retreated into the castle of Chele on an islet next to the Euxine (Black Sea): "Χηλή (φρούριων δ' αύτη επινησίδιον πρός ταίς άκροις τής Εύξείνου θαλάσσης)." He spent one winter in Chele but then requested another place from Michael VIII due to harsh conditions there, which was fulfilled and the abdicated patriarch moved to the Monastery of Kosmidion (Le Beau, 1835; Pachymeres, 1835).

There was another conflict during the same period, which occurred due to contradicting acts of two patriarchs. When the predecessor Arsenios Autoreianos excommunicated Michael VIII due to blinding the legitimate heir John IV, it resulted with a forced deposition of the patriarch. Then, the successor Joseph I officially pardoned Michael VIII but a religious conflict grew among the opposing fractions. General John Tarchaneiotes was a leading figure of the deposed Arsenios' followers, therefore he was sentenced and banished to the castle of Chele (Χηλής φρουριῳ) in 1289 (Leontiades, 1998; Pachymeres, 1835).

Later on, when Andronikos II Palaiologos (r. 1282-1328) intended to campaign through Asia Minor against the Turks, he departed from Constantinople in 1296. After three days, he

arrived at the castle of Chele that was surrounded by the sea: "Χηλήν τό άμφιθαλασσίδιον φρούριον". However, he needed to retreat due to a devastating earthquake happened at that moment (Downey, 1955; Laiou, 1993; Pachymeres, 1835).

The Battle of Bapheus in 1302 was resulted with an Ottoman victory against the Byzantine Empire and they started to expand into Bithynian territories. According to George Pachymeres once again, Ottoman raids started to reach not only Chele and Astrabete (Ἀστραβητή) but also the castle of Hieron (modern Yoros Castle) by 1304 (Pachymeres, 1835; Korobeinikov, 2014).

The reign of Andronikos II Palaiologos included several political, economical and military crises. Insufficient imperial administration and continuous Ottoman raids caused the revolt of some army commanders. Accordingly, when General Kassianos was sent to Mesothynia (Kocaeli Peninsula) in 1306 to take over the lost control that was mentioned above, he decided to revolt against the emperor. Along with the battalion under his command, Chele was seized and Kassianos thought that he was in safe. However, some citizens from the town of Chele secretly allied with Andronikos II and laid a plot against Kassianos, who was eventually captured by chasing imperial troops (Pachymeres, 1835; Kyriakidis, 2014).

When the Russian pilgrim Ignatius of Smolensk had a sea journey to Constantinople in 1389, he visited all the main coastal cities of North Bithynia. After passing Dafnusiyu (Дафнусию) and Karfiyu (Карфию), he then arrived at the city of Astraviyu (Астравию), which was already under the Turkish control. He stayed there one night and passed Fili (Фили) and Rivu (Риву) the next day, respectively (Majeska, 1984; Khitrowo, 1889).

Ottoman historian Âşıkpaşazâde (1400-1484) indicates that Bayezid I (r. 1389-1402) formed a large army and intended to attack Constantinople. For this reason, he departed from Koca-ili (Nicomedia) and arrived at Yoras (Yoros Castle) around 1391. Meanwhile, he sent Yahşi Beg to Şili hisarı (Şile Castle), who peacefully seized it with the promise of remittance (Âşıkpaşazâde, 2003). The same narration about Şile Castle was also mentioned by Neşrî (1949) in the early 16th century.

7. Supplementary accounts about Şile until the early modern period

When the Castilian ambassador Ruy González de Clavijo had departed from Constantinople for Trebizond by late 1403, his ship first reached the Black Sea through the Bosporus. Then, it arrived at the small castle of Sequello, which remained inside Turkish lands and situated above a rock that was almost entirely surrounded by the sea except for a small entrance. Afterwards, he continued to Finogia (Kefken), which was a small island under Genoese control (Clavijo, 1782).

Şile was regularly mentioned as a coastal reference point by portolan charts from the 14th-18th centuries that were used by European sailors for navigation. They have slightly different variations but Silli / Sili is the most common one, which first appeared on the chart of the Genoese mapmaker Pietro Vesconte dated 1311. Later cartographic works not only mention Şile by name but also indicate some of its geographical features like cape (capo), bay (cauo, golfo) and river (rio).

Portolan texts also mention Şile starting from "Lo compasso da navigare" dated 1296 (Gordeev, 2015). For instance, Rizo portolan as an Italian source from 1490 indicates that the distance between Yoros (Giro) and Şile (Sile) was 30 miles towards the east; and the distance between Şile and Ağva (Dipotimo) was 15 miles towards the same direction (Kretschmer, 1909). On the other hand, in its 113th chapter, the Greek portolan of Demetrius Tagias dated 1559 also locates Şile (σόλα) between Riva (ρύβα) and Ağva (πότιμο) as a landmark along the coastline after Kerpe (κάρπι), towards the west (Tagias, 1641; Delatte, 1947).

According to Evliya Çelebi by 1640, there was a janissary garrison under a general (pasha) in Şile (Evliya Çelebi, 1971). Russian diplomat Pyotr Andreyevich Tolstoy (1645-1729) describes Şile as a large town with an insuffi-

cient harbor for the ships of that time (Gordeev, 2015).

Ottoman archival documents and archaeological remnants show that starting from the late 18th century, Şile became a strategic position for the defense of the Bosporus and three coastal redoubts with numerous muzzle loaded cannons were deployed against the Russians, which were abandoned in the 20th century (Eyüpgiller, 2019).

8. Contemporary castles from Bithynia

While some of its major settlements like Nicaea and Nicomedia were surrounded by city walls since antiquity, an intense defensive construction phase began in Bithynia during the Komnenian period, which was carried out by Alexios I, John II and Manuel I, respectively. This building program intended to secure the region and halt the rapid Turkish advance into Asia Minor following the catastrophic Battle of Manzikert (1071).

For this reason, in addition to renewal of the aforementioned ancient fortifications, new castles were built at strategically important positions (Belke, 2013; Deluigi, 2015). Furthermore, Paşalar Castle (Metabole) as an Early Byzantine regional encampment was significantly strengthened, while Çoban Castle (Boğazkesen) was constructed at a very strategic mountain pass in the north of modern Geyve (Bahar, 2013; Yıldırım, 2003). Similarly, the supposedly Early Byzantine castle of Kefken Island was fortified with semicircular towers in the 11th-12th centuries and a castle with a similar masonry technique was built on top of a coastal rock at nearby Kerpe by the Black Sea (Fıratlı, 1952). In addition, Bayramoğlu (Philokrene), Darıca (Ritzion), Aydos (Aetios) and Çobankale (Xerigordos) in the inner parts of Bithynia appeared as probable Komnenian castles with later additions, which secured crucial land and sea routes before Constantinople (Bahar, 2013). A similar Komnenian defensive construction program was carried out also on Aegean territories through new rural castles called "Neokastra" (Deluigi, 2015).

In the meantime, a certain portion of Asia Minor was recovered with the help of the First Crusade (1096-1099) and the Turks were gradually pushed back from Bithynia into the central Asia Minor. Consequently, the Byzantines were able to fortify Bithynia during a relatively stagnant and peaceful period along the Anatolian frontier.

Generally speaking, Komnenian castles have mixed masonry that is consisted of quarried stone blocks and regular brick courses. Spolia and elaborate brickworks were often preferred in the masonry. Semicircular towers are a common feature on the layout. Moreover, there is a noteworthy difference of workmanship between visible and hidden parts of masonries (Foss and Winfield, 1986; Yıldırım, 2003).

Following the Fourth Crusade (1202-1204), the Empire of Nicaea under the Laskaris dynasty was able to maintain the Komnenian gain with minor additions. However, during the reign of Michael VIII Palaiologos (1259-1282), there were new Turkish campaigns into the western territories of Asia Minor. Hence, the aforesaid emperor carried out another defensive construction program through the end of his reign. His aim was an even better fortified eastern frontier against the Turks with a series of castles along the western banks of Sangarius (Sakarya River), such as Büyükkale (Adliye), Harmantepe and Seyfiler (Belke, 2013). Bağlarbaşı, Mekece and Mağara can be listed among further Palaiologan castles along Sakarya River (Yıldırım, 2003).

In addition, on a strategic crossroad next to the Gulf of Nicomedia, the castle of Eskihisar (Niketiaton) has an exceptional architectural feature in its central part, which is a fortified tower house with a probable Komnenian / Laskarid origin that was converted into a proper fortress through some extensive late 13th century defensive additions (Fig. 6) (Bahar, 2013; Eyice, 2001; Niewöhner, 2017a). As another exceptional case, the castle of Hereke (Charax) was dated to the Latin period in the early 13th century but it eventually became a part of the later defensive system of Bithynia (Bahar, 2013).

Palaiologan castles had a significant role in terms of territorial defense and the protection of inhabitants during the 13th-14th centuries. The use of quarried stone masonry with irregularly arranged and coarsely cut small blocks is a common practice on them, mostly without the use of bricks. Facades are usually plain and there is a lack of wide external ornaments (Belke, 2013; Foss and Winfield, 1986; Yıldırım, 2003). Nevertheless, distinctive traces of the Palaiologan civil architecture that are characterized by rich decorative brickworks can still be seen to a limited extent on some examples (Bahar, 2013).

Figure 6. *An aerial view of Eskihisar Castle (Niketiaton) in Gebze, Kocaeli (Yandex Maps).*

It was argued by Niewöhner (2017b) that Late Byzantine castles often do not correspond to ancient settlement sites and they appeared due to an urgent need of security. Yet, as they did not have an administrative unity, rural societies of those rather deurbanized lands acted separately within their castles and failed to establish a defense in coordination, likewise the successful one against the Arabs during previous centuries. According to the study of İnalcık (2012), while the Bithynian mainland was under constant Ottoman threats starting from the same period, the Byzantines could only took shelter in their peripheral strongholds, which fell apart and eventually conquered. Bakalakis (1966) argued that the sparse Christian population of Astrabete and other nearby Greek posts within Mesothynia probably needed to squeeze in Chele during the 14th century, as it was a well protected spot.

Among close settlements to Chele that were mentioned by Pachymeres and Ignatius by the 14th century, Astrabete / Astraviyu appears as the cape of Astrabike (Ἀστραβίκη) inside a Greek portolan dated 1553, which was placed 38 miles after "Chile" (Χιλή), 14 miles after Dipotamon (Διπόταμον) and 5 miles before "Karbe" (Κάρμπε) on the Black Sea coastline (Delatte, 1958; Majeska, 1984; Atanasiu-Croitoru and Cristea, 2009). Accordingly, Belke (2007) accurately localized it as Seyrek between the aforesaid Şile, Ağva and Kerpe, which now belongs to Çalköy, Kandıra as a coastal neighborhood. Though this Late Byzantine town appears under Turkish control by 1389, a patriarchal document dated October 1393 about Konstantinos Rhamatas mentions a Greek vineyard in Astrabiki (Αστραβίκι), which testifies the later Byzantine legacy there (Miklosich and Müller, 1862; Ariantzi, 2017). This settlement was also mentioned in church lists of later centuries (Diovouniotios, 1958; Bakalakis, 1978).

Seyrek Castle is located on a rocky peninsula in the north of the district, which formerly protected the small port. It has an irregular layout along the rough topography. The castle seemingly had a long and single wall course with few rectangular towers in corner positions (Fig. 7). Though anonymously dated to the Byzantine period (Kocaeli İl Yıllığı, 1973), its architectural characteristics correspond to the reign of Michael VIII Palaiologos, as the masonry of curtain walls and towers have quite roughly hewn, uniform quarry stone with the usage of gray mortar and very few bricks, which are similar to the previously mentioned late 13th century examples around Sangarius (Fig. 8) (Belke, 2013).

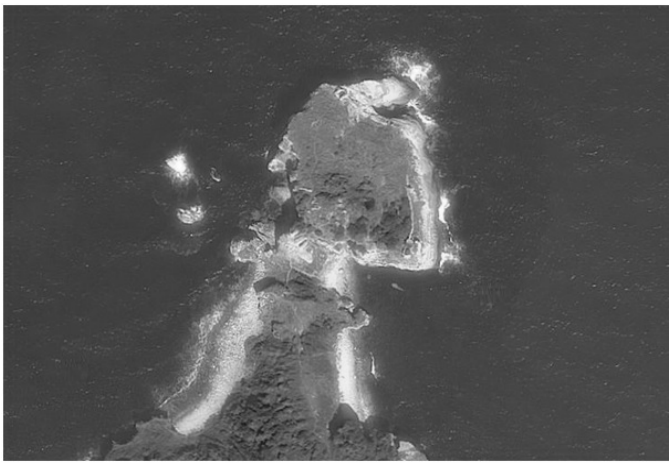

Figure 7. *An aerial view of Seyrek Castle, the former Astrabete / Astrabike, now in Kandıra, Kocaeli (Yandex Maps).*

Figure 8. *The view of Seyrek Castle from the south (Şaban Ağır, 2017).*

Yoros (Hieron) as another castle near Şile and on the western end of Bithynia is located at modern Anadolu Kavağı, Beykoz. It was built on a site that was constantly inhabited since ancient times. Its irregular and longitudinal layout extends from a dominant hilltop until the Bosporus, which has two main parts that were separated in a later time by a distinctive partition wall with four towers. The first part of the castle is on the top, which has semicircular twin towers with abundant marble spolia and a main gate in between (Fig. 9). The second part continues until the coast, which has few, irregularly arranged towers and long wall courses with rubble masonry but one certain section with rear casemates clearly resembles the first part on the top. After epigraphic evidence and certain stylistic features, the castle was dated to the 13th-14th centuries by Eyice (1976). This assumption was also strengthened by the technical study of Tekin and Kurugöl (2012). However, Foss and Winfield (1986) dated the top section and main body walls of Yoros Castle to the last decades of the Komnenian period with regard to the regular mixed masonry and a direct comparison to the walls of Blachernae in Constantinople, which were built by Manuel I Komnenos. Then, it has been argued that the partition wall as a later addition created an inner castle on the hilltop. That wall was attributed to the Palaiologan period due to its own, rather inferior masonry style with a distinctive brickwork ornament, which has a long, two-line inscription in Greek (Foss and Winfield, 1986; Yıldırım, 2003). A slab with an inscription in Latin also indicated that the repair of the castle and its extension until the sea were financed by a Genoese nobleman called Vincenzo Lercari, most probably around the 14th-15th centuries (Eyice, 1976).

Figure 9. *The hilltop section of Yoros Castle from the east (Sağlam, 2018).*

Mural slabs of Yoros Castle can be mentioned as its most characteristic details that an interpretation for one of them supposedly revealed the exact construction period. Two pairs of slabs are located on the twin towers that the first group has the abbreviation of IC XC NH KA = Ἰησούς Χριστός νικά (Jesus Christ conquers) around Greek crosses. The second group has the abbreviations of ΦC XC ΦE ΠI and ΦC XY ΦE ΠC around more elaborate crosses, which are most probably variations of "Φώς Χριστού φαίνει πάσιν" (The light of Christ enlightens all) (Eyice, 1976). The last slab originally stood above the rear of the main gate, which is now in Istanbul Archaeological Museum (Fig. 10). It has a large Greek cross with the abbreviation of A Π M Ϛ that the first letter might also be Δ. It was interpreted as Δ Π M Ϛ by Eyice (1976) and the improvised deciphering of "Δεσπότην Μιχαήλ Παλαιολόγον Σώσον" [(O cross), save Despot Michael Palaiologos] was proposed, which was then considered by the same scholar as an indication of the construction period as 1261-1282, the reign of the supposed Michael VIII. However, it is probably not the case, because "Ἀρχὴ Πίστεως Μυστηρίου Σταυρός" (The principle of belief, the mystery of the cross) for the abbreviation of A Π M Ϛ was already mentioned after certain paleographic evidence (Rhoby, 2018; Wal-

ter, 1997). This meaning seems more harmonious to previous slabs in terms of the content.

From an architectural point of view, Yoros can be considered as a Middle Byzantine castle that was significantly altered during the Late Byzantine period, likewise some other Bithynian fortresses. Yoros was mentioned together with Chele (Şile) and Astrabete (Seyrek) within the context of Turkish raids by 1304, which points a geographical relation of those three castles along a coastal route in North Bithynia.

Figure 10. *The slab of Yoros Castle, which was once located above the rear facade of its main entrance but now kept in Istanbul Archaeological Museum (Sağlam, 2018).*

To sum up, it can be argued that the functional change of Eskihisar Castle from residential to military shows similarity to Şile Castle that the emergence of nearby Seyrek Castle and the later layout of Yoros Castle well resemble its next function as a shelter with geographical advantages against the Ottomans, as discussed below.

9. Conclusion

Earlier accounts define the ancient settlement at modern Şile as a small and probably lightly fortified town with a harbor and a temple. Its name was apparently changed from Artane to Chele between the 8th and 11th centuries for some reason. The most remarkable incident of this period was a demographic shift that more than 200.000 Slavs were reportedly resettled in Artane. Characteristic geographical features of Şile were repeatedly mentioned by primary sources from almost all historical periods.

A structural survey of Şile Castle before the major restoration of 2015 has displayed that its architecture did not present any distinctive construction phases. Any Ottoman alteration was also not recorded. Thus, with regard to precise topographical and architectural details that were mentioned by a certain group of primary sources, what is known as Şile Castle today was first constructed by Andronikos I Komnenos around 1183-1185 as an isolated detention post; actually a lightly fortified residential tower. It was used for this purpose from the late 12th century until the late 13th century that Alexios Komnenos, John IV Laskaris, Joseph I of Constantinople and John Tarchaneiotes were its renowned occupiers, respectively. Andronikos I himself also decided to take shelter in Chele while fleeing in 1185. His decision was probably related to the supposed initial function of the building. Though contemporary accounts mention Chele and Niketiation as "castle", the imprisonment of the deposed John IV in both places around 1261 would not be a mere coincidence, because Eskihisar (Niketiation) in fact also had the appearance of a fortified imperial residence at that time, which was yet to be converted into a proper fortress later that century. Similarly, Joseph I was transferred from Chele to Kosmidion Monastery in Constantinople, which was a slightly equivalent spot in terms of the retirement function. Both accounts additionally imply that Chele was probably not a very pleasant place to reside in for a long time.

By the late 12th century, Şile Castle emerged as a lightly fortified residential tower or a kind of an elite prison on a geographically isolated position. Its defensive strength was considerably different and weak from typical Komnenian fortresses that some of them were built in Bithynia until Manuel I. Şile Castle initially had a special purpose and it was certainly not a part of the original Komnenian fortification program in Bithynia. In fact, it can be said that the Komnenian restoration perhaps enabled Andronikos I as the last emperor of that period to erect such a specific complex under relatively peaceful conditions in Bithynia, which well secured the region through some new castles following the short Turkish occupation after 1071.

Furthermore, as Şile Castle was formerly supposed as a watchtower by origin simply after its position and archi-

tectural appearance, it would probably not make sense by the late 12th century, because the eastern flank of the mouth of the Bosporus from the Black Sea was absolutely not a potential enemy route for the Byzantine Empire at that time. Arched windows, balcony and the battlement level of Şile Castle must have been used for local observation but it can be argued that an operative coastal watchtower function was especially adapted by the Ottomans in later centuries to safeguard the Bosporus against Russian fleets.

Starting from the 14th century, Şile Castle became a proper military target for the Ottomans rather than a simple prison complex. They needed to besiege and properly conquer it with the help of a small army, as initial raids remained inconclusive. Although it was formerly questioned that Şile Castle was too small to include a proper settlement, it can be argued that the inhabitants of Chele (former Artane) almost certainly took shelter in it, as a last resort in front of the Ottoman threat.

Under these circumstances, Şile Castle was possibly deployed as a proper fortress in the 14th century against landward attacks in spite of its limited defensive capability. This could also be the reason why General Kassianos chose Şile Castle during his revolt, as he initially considered it as a safe spot against the emperor. Its isolated position surely provided a strategic advantage on top of an impassable rocky island with some ramparts. The sea surrounded the island except for a small entrance, as recalled by contemporary witnesses. As the site now appears as an island, its former entrance was highly likely eroded by the sea over five centuries.

Seyrek Castle, the former Astrabete / Astrabike supposedly emerged during the Late Byzantine period with regard to primary sources. It was built perchance with a parallel concern to the later function of Şile Castle, that is to say providing shelter to nearby inhabitants against Ottoman raids. On top of a geographically similar position to Şile Castle, it was easy to defend but difficult to conquer it in case of a landward siege. The nearby Kerpe Castle lacked such a military advantage that Seyrek Castle apparently sought. However, it was seemingly conquered sometime before 1389.

The later layout of Yoros Castle (Hieron) can also be mentioned as an example to the supposed new function of Şile Castle and the construction of Seyrek Castle during the same period. Yoros Castle did not have a clear geographical advantage like them, which actually enclosed a huge ancient settlement site. Then, its landward and relatively strong hilltop section towards the east was separated through a fortified partition wall and was designated as a smaller enclosure. This work isolated the hilltop part from the larger enceinte and made it easier to defend against oncoming Ottoman attacks. Significant epigraphic evidences were documented exclusively on this part of Yoros Castle, including elaborate marble slabs and a long, brickwork inscription on the partition wall. In this case, it can also be said that through such pious messages that were placed towards the potential threat, the residents of Yoros did not only rely on their strong castle but also sought a divine protection during a distressful period, which also affected Şile and Seyrek.

To conclude, the general appearance of the castles of Şile, Yoros and Seyrek well stress the declining political state of the Byzantine Empire against the Ottomans in North Bithynia. Şile Castle was an isolated Middle Byzantine prison tower but it then had an urgent functional change, likewise the castle of Eskihisar. It started to be considered as a proper fortress by the Late Byzantine period, which also triggered Ottoman attacks. Following the conquest of Şile Castle, as the site was no longer a potential battlefield, its tower probably had another duty as a coastal watchtower that Şile was the base of a janissary garrison by the 17th century. Finally, a defensive firepower was needed at Şile against the Russians during the early modern period but the new role of the castle is uncertain within this modern military concept. Şile Castle is currently closed to public visit despite the restoration of 2015 and Ocaklı Island is also inaccessible.

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Biography of a monument: Historical and morphological survey of the Tower of Justice (Adalet Kulesi)

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Abstract

The Tower of Justice (*Adalet Kulesi*) in the Topkapı Palace is the most striking and visible feature of the imperial complex, defining the renowned silhouette of the Seraglio. This imperial tower, known as *Kasr-ı Adl* or *Kasr-ı Padişahi*, was a reflection of the Ottoman visual ideologies and believed to represent the power and glory of the ruler, as an embodiment of his omniscient eye, watching over his subjects to distribute justice. This paper is an attempt to document the architectural and symbolic evolution of this significant monument and scrutinize the changing meanings attributed to it from the 15th century until the 19th century. The date of construction and the patron of the latest Tower of Justice –as we see it today– is not yet documented. Under the light of visual sources and morphological analysis, this research sheds light on the period, in which the latest neo-classical pavilion surmounting the tower was built. Archival documents from the Ottoman State Archives and Topkapı Palace Museum Archives, together with inscriptions, engravings, paintings, and photographs are used in this research to demonstrate the transformation and continuous renovation of the Tower of Justice throughout the Ottoman era.

Keywords
Tower-kiosk, Bursa, Edirne, Istanbul, Topkapı Palace, Tower of Justice.

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1. Introduction

The Tower of Justice in the Topkapı Palace is one of the major landmarks of Istanbul, defining the celebrated skyline of the Seraglio with its elevated height and assertive morphology. The royal pavilion surmounting the tower, crowned with a pointed lead cap, emphasizes the imperial significance attributed to the structure and amplifies its height and significance. The Tower of Justice is perceived as an iconic architectural representation of the palace and the Historic Peninsula. Yet, the history of the tower, its physical transformations, and symbolism in the Ottoman context have not been studied in detail.

This paper will scrutinize the history and the evolution of the idea of the tower-kiosk, starting from the Seljukid period, and explores the Ottoman ideology behind this architectural typology. The aim is to shed light on different phases of the Tower of Justice in the Topkapı Palace based on visual, textual, and archival documents. This monumental structure, as an architectural embodiment of imperial power and justice, went through various alterations since it was first constructed by Mehmed II during the second half of the 15th century. The tower, and the belvedere pavilion on top, took on various meanings and functions throughout the centuries, and when it finally took its current neoclassical form, it stood as an emblem of the modernizing reforms of the late Ottoman era.

2. Tower-kiosk typology

Vertically elongated edifices—whether military, religious, or royal in purpose—are often strong symbols of power, prosperity, and grandeur and can be found in many architectural styles across many time periods. Tower-like structures not only confirm the visibility and audibility of power but also were used for watching over enemies, fires, and potential threats. Throughout history these towers sometimes functioned as treasures or prisons and were also utilized for defensive purposes, as they could be difficult to penetrate.

In the Turkic context, in addition to bastions for military purposes and minarets for religious buildings, tower-like structures were also included in royal palaces. Palatial structures, as the center of the government and the house of the ruler, represented the concept of the state and the government as institutions and were emphasized architecturally with elevated structures surrounded by walls (Gülsün, Öner and Yılmaz, 1995). This formula, adopted by the Seljukids for the Alaaddin Palace of Konya, which included a masonry royal kiosk surmounting a strong, square-based tower. The concept of elevated royal pavilions was later developed by the Ottomans and an architectural typology, defined as "tower-kiosk" *(kule-köşk)* emerged (Tanyeli, 1988, 188). This Ottoman typology included an imperial kiosk surmounting the tower, which was an architectural representation of the power and authority of the ruler and a statement of his virtual existence. For Nebahat Avcıoğlu, the kiosk, in the Ottoman context not only symbolized the royal presence of the rulers, but also emphasized the relationship of the palace with the city by synthesizing "several formal features of Ottoman palatial architecture into an ideal signifier" and "to disseminate it within the constantly evolving urban fabric" of the city (Avcıoğlu, 2008, 196).

Even though not much is known about the early Ottoman palaces or imperial residences, Ottoman sources confirm the existence of palace-like structures since the 14th century (Sözen, 1990). After the conquest of the Byzantine city of Prousa in 1326, the Ottomans declared the city as their capital and renamed it Bursa. The Byzantine Tekfur Palace, located on the acropolis of Mount Olympus (Uludağ), became the palace of the Ottoman rulers and was referred to as *Bey Sarayı* (Kuban, 1996, 144; Çağaptay, 2020). Although not much is known about its original form, the palace was gradually expanded during the reigns of different Ottoman sultans. The inner citadel, with "fourteen round towers on three sides and three square towers on the remaining (north) side," sitting on a sheer cliff, served as the Ottoman palace (Çağaptay, 2020), and some additions were made during the times of Murad I (r.1362–1389) and Bayezid I (r.1389–1402) (Ayverdi, 1976, 117;

Çağaptay, 2011; Yenal, 1996). Evliya Çelebi described the Palace of Bursa as a sumptuous structure at an elevated location surrounded with walls *(Cümleden mükellef sarây-ı azîm ve âlî yukaru iç kal'ada pâdişâhlara mahsûs sarây-ı kebîrdir)* (Çelebi, 1998, 11). The elevated location of the citadel at the promontory of the mountain and the visible position of the palace from the lower-city are emphasized by Pancaroğlu, who states that the Bey Palace offered vistas of newly conquered and prospective Ottoman lands as a "vantage point" (Pancaroglu, 1995, 43).

The palace, apart from holding the rich treasures of the Ottomans, carried a ceremonial role as well (Gabriel, 2010, 28; Keskin, 2014). For instance, the weddings of Orhan Gazi and Bayezid I, the circumcision of princes, and the enthronement of Mehmed I and Murad II were conducted within the Bursa Palace (Sözen, 1990). During the time of Bayezid I, in particular, ostentatious feasts and celebrations were hosted in Bursa Palace; it was also stated that Bayezid I climbed up to a high dungeon *(ali-burç)* every day to listen to his subjects and their petitions (Keskin, 2014, 893). This concept of high-tower as a symbol of sovereignty, justice, and the sultan's gaze over his subjects would become a common architectural typology in succeeding Ottoman palaces.

After the conquest of Edirne in 1365 by Murad I, a palace, known as *Saray-ı Atik* (Old Palace), was erected in the inner city in 1417 (Atasoy, 2005); in the meantime both Bursa and Edirne were used as capital cities (Sözen, 1990). The similarity of the Bursa and Edirne palaces, in terms of their urban placement, central locations, and walled configurations, is emphasized by Aptullah Kuran (1996). The Old Palace of Edirne was abandoned during the reign of Murad II (r. 1421–1444, 1446–1451), who commissioned the construction of the New Palace *(Saray-ı Cedid)* outside the city, [1]which would later be completed by his son Mehmed II, who established its main architectural configuration (r.1444–1446, 1451–1581).

The New Palace of Edirne was a manifestation of an emerging imperial order and a more established and hierarchical state organization (Ayverdi, 1976; Osman, 1989; Eren, 1995; Özer, 2014).[2] Saray-ı Cedid was composed of three successive courtyards, which had different functions, ranging from ceremonial to residential. The Second Court of the palace, located between the publicly accessible *Alay Meydanı* and the secluded living quarters of the sultan, known as the *Kum Meydanı*, was dedicated for state affairs (Osman, 1989). At the center of this court stood the most significant and notable structure of the palatial complex, the *Cihannüma Köşkü* (Belvedere Kiosk). Even though the inscription of the edifice (1451–1452) dates it to the reign of Mehmed II, it is believed that the initial kiosk built by Murad II had a tower-like form as well (Arel, 1996, 103; Özer, 2014, 30). A similar tower-kiosk existed at the Manisa Palace of Murad II; it functioned as the private library and reading room of the sultan (Tanyeli, 1988, 193; Kontolaimos, 2016).

The Cihannüma Kiosk of the Edirne Palace, which was also known as *Kasr-ı Padişahi, Fatih Kasr-ı Ali, Hane-i Hassa, Taht-ı Hümayun Kasrı, and Mabeyn-i Hümayun,* was composed of seven stories and reached up to thirty meters after consecutive additions (Ünver, 1953; Özer, 2014). The enormous height of the tower dominated the architectural layout of the palace and made itself visible both for the European envoys approaching Edirne and for the ones visiting the palace proper (Kontolaimos, 2016). According to Ayda Arel (1996, 103), these tower structures, namely "dungeon-kiosks," in addition to providing a secure space for keeping the treasury and valuable items of the sultan, also carried a symbolic function, manifesting the sovereignty of the ruler and his supremacy.

Having several rooms at each floor and carrying multiple functions, the tower was surmounted with a privy kiosk for the sultan's private use. The word *"cihannüma",* which means pinnacle or world-exhibiting, communicated the function and peculiarity of the structure. The throne room of the Cihannüma Kiosk was placed above the square-based tower and had an octagonal plan, with windows opening to each direction. Paved with marble flooring and embellished with a central

pool, the privy kiosk was decorated with *çini* tiles and rich engravings emphasizing its royal significance (Eldem, 1969, 21–57; Ayverdi, 1973, 235; Akçıl, 2009, 126–128; Özer, 2014, 27). The conical lead cap of the imperial kiosk emphasized the visibility and monumentality of the edifice. Cihannüma Kiosk, as the treasury, library, and privy chamber of the ruler, represented his physical and symbolic existence and sovereignty. The tower, according to Kontolaimos, placed at the center of the palace grounds, symbolized the Ottoman social and cosmic order, as the "world's balcony," which "allowed the Ottoman ruler to see the world and perceive it as a reflection of its own mental and cognitive understanding of things" (Kontolaimos, 2016, 26).

Another tower-kiosk at the Edirne Palace was built, a century later, by Süleyman I (1520–1566) in 1561 and was known as the Tower of Justice *(Adalet Kulesi)* (Ayverdi, 1973, 235)(Figure 1). This three-story structure, located by the bridge that connected the city to the main entrance of the palace (Kontolaimos, 2016, 24), was composed of a sherbet house *(şerbethane)* on the first floor, the Council Hall *(Divanhane)* on the second, and a privy chamber of the ruler *(Hass Oda)* at the top floor. The imperial chamber, surmounting the tower, included a centrally positioned pool and was capped with a pyramidal roof that accentuated its height and visibility (Ayverdi, 1973, 235; Akçıl, 2009, 126–128). The architects of this tower must have taken the Tower of Justice *(Adalet Kulesi)* at the Topkapı Palace in Istanbul as a model—it was also built during the reign of Süleyman I, during the early 16th century. In fact, towers became an imperial leitmotif of the Ottoman capital during the 16th century, as similar edifices were erected at sultan's summer palace in Kavak and at his grand-vizier Ibrahim Pasha's palace at the Hippodrome as well (Arel, 1996, 105: Tanyeli, 1988, 199).

Figure 1. *Tower of Justice (Adalet Kasrı) and Belvedere Kiosk (Cihannüma Kasrı) in Edirne Palace, late 19th century (Vieux Sérail d'Andrinople, İstanbul Üniversitesi Nadir Eserler Kütüphanesi, Yıldız Albümleri).*

3. The New Palace of Istanbul *(Saray-ı Cedid-i Amire)*

After the conquest of Constantinople, Mehmed II inaugurated a grand reconstruction campaign to rebuild his new capital (Kafescioğlu, 1998). His first palace, built over the Forum of Theodosius and known as the Old Palace *(Saray-ı Atik)*, was also believed to include a tower structure (Tanyeli, 1988, 199). Mehmed II then commissioned a New Palace *(Saray-ı Cedid)* at the tip of the Seraglio, on the Byzantine acropolis. This New Palace established the core of the Ottoman ruling system and was an architectural embodiment of Mehmed II's Code of Law *(Fatih Kanunnamesi)* (Necipoğlu, 1991). Similar to that of the Edirne Palace, the New Palace in Istanbul was composed of successive courtyards that opened into each other through monumental gates. The First Court *(Alay Meydanı)* was partially accessible to public and composed of service structures such as ateliers, depots, imperial mints, hospital, and bakeries. The Second Court, accessed through a monumental gate flanked by two towers *(Bab-üs Selam)*, is known as *Divan Meydanı*. This administrative court, where the state ceremonies were held, opened up to the Enderun Court of the palace, where the sultan lived with his male and female servants, who resided within segregated sections known as the *Enderun-i Hümayun* and the *Harem-i Hümayun*.

The Second Court of the palace, namely the Divan Court, was the administrative center of the Ottoman Empire and included buildings in which state affairs were held. The architectural composition of the Second Court, which was set during the time of Mehmed II, was monumentalized and remodeled during the time of

Süleyman I, between 1525 and 1529 (Necipoğlu, 1991, 53). In addition to the External Treasury *(Dış Hazine)*, Imperial Kitchens *(Matbah-i Amire)*, and Royal Stables *(Has Ahırlar)*, the centerpiece of the Divan Court was the Council Hall *(Divanhane-i Hümayun)*, with the Tower of Justice *(Adalet Kulesi)* attached to it. The Council Hall, known as *Kubbealtı* or *Divan*, is located at the North side of the Second Court and is composed of two domed chambers surrounded by an L-shaped portico.

The Council Hall, in which the council of the grand vizier met four or five times per week to discuss state affairs and issue laws and decrees, functioned as the high court of justice. The concept of justice was one of the pillars of the Ottoman state; therefore the Council Hall was referred as "iwan of the council of justice" *(iwan-i divan-i adl)*, "the arena of justice" *(saha-i adalet)*, and "the arena of the great house of justice" *(saha-i darül-adale-i muazzama)* in 16th-century texts (Necipoğlu, 1991, 58). In this respect, the Tower of Justice *(Kasr-ı Adl)*, adjacent to the Council Hall, was a monumental manifestation of the idea of justice as proclaimed by the sultan and his courtiers.

The Council Hall featured a latticed window overlooking the Divan, behind which the sultan could watch and listen the council meetings without being seen. This window opened into a small chamber that was located within the Tower of Justice; it represented the omnipresence of the ruler, who ceased to attend the council meetings starting from the reign of Mehmed II. The latticed-window epitomized the ruler's sovereignty and his ability to govern his domains through his invisible gaze. Necipoğlu describes this effect: "the Council Hall's curtained royal window and the tower paradoxically signified the absent sultan's omnipresence in the administration of justice" (Necipoğlu, 1991, 59). This latticed window has been defined as a "panopticon," through which the sultan could "see without being seen" (Thys-Şenocak, 2008).[3] In a number of 16th-century miniatures, the sultan was depicted inside this imperial chamber within the tower, observing the council meetings, which demonstrates the significance of the tower in Ottoman court decorum.

4. The Tower of Justice *(Adalet Kulesi)*: A monument of power

The Tower of Justice in the Topkapı Palace not only dominates the spatial configuration of the Divan Court but also marks the physical and symbolic adobe of the royal compound. The tower, which was used as a treasury during the time of Mehmed II, was constructed of brick and masonry sitting on a square plan (Eldem and Akozan, 1982, 71). It is not known whether the building was crowned with a royal pavilion in the 15th century. The edifice underwent major renovations during Süleyman I's extensive remodeling of the Divan Court, between 1527 and 1529 (Necipoğlu, 1991, 85). With the construction of a new Council Hall and a new External Treasury, the function of the tower as the state treasury came to a halt. Located next to the Council Hall, the Tower of Justice held a more symbolic role in court rituals and decorum by the 16th century. Strategically located at the intersection of the Divan Court and the Harem quarters of the palace, the tower was positioned as a vertical threshold between the two royal domains: public and private, outer and inner, male and female, the ruler and his subjects.

During the 16th-century renovations, a royal belvedere pavilion was added to the tower, augmenting its visibility and monumentality. The timber privy chamber, surmounting the masonry tower, was a continuation of the tower-kiosk architectural tradition, representing the virtual existence and the sovereignty of the ruler. With its pyramidal cap and amplified height, the Tower of Justice could be seen from all around Istanbul, Pera, and Scutari, as depicted in Melchior Lorichs's panorama of Istanbul, dated 1559 (Westbrook, Rainsbury Dark, and Meeuwen, 2010). The latticed window shutters of this privy chamber, overlooking the capital, represented the all-encompassing gaze of the ruler over his subjects, confirming

and legitimizing his rule and omnipotence. The new and amplified Tower of Justice of Süleyman I dominated the skyline of the Seraglio and confirmed his epithet: the Lawgiver *(Kanuni)*.

Hans de Jode's 1659 painting, *View of the Tip of the Seraglio with Topkapı Palace,* clearly depicts the red belvedere kiosk of Süleyman, with its pyramidal cap (Figure2). It is known that the Tower of Justice went through restorations in 1667–1668, during the time of Mehmed IV (r. 1648–1687), as part of the extensive renovation of the palace after the Harem fire of 1665 (Necipoğlu, 1991). The hadith inscription at the Harem entrance to the Tower of Justice at Şadırvanlı Sofa served as a reminder of the sultan's justice (Kocaaslan, 2010, 134).[4] Apart from decorative remodeling, it appears that the architectural configuration of the tower remained unchanged from the 17th to the 18th century (Figure 3).

Figure 2. *The Tower of Justice with the red Belvedere Kiosk during the 17th century (detail from View of the Tip of the Seraglio with Topkapı Palace, Hans de Jode, 1659, Kunsthistorisches Museum Wien).*

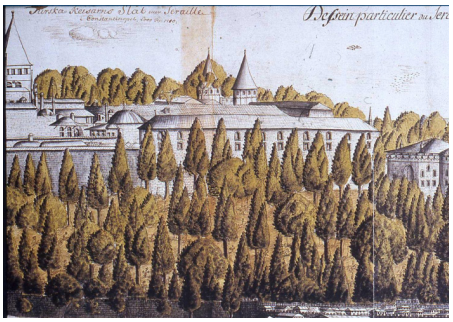

Figure 3. *Detail from Cornelius Loos panorama of Seraglio, showing the Tower of Justice at the top left, 1712 (Cornelius Loos i det osmanska riket – teckningar för Karl XII 1710–1711, Stockholm Nationalmuseum).*

4.1. The tower during the 18th century

During the second half of the 17th century, the Ottoman Empire faced several military and economic hardships, and for almost fifty years the sultans of this period preferred to reside in the Edirne Palace, leaving the capital neglected and dilapidated. With the return of Ahmed III (r.1703–1730) to Istanbul, a rejuvenation campaign was inaugurated to rebuilt the capital and restore its former glory. Strengthened with a new visual ideology that promoted the visibility of the ruler, Ahmed III and his grand vizier, Ibrahim Pasha, adorned the city with numerous monuments, fountains, pleasure gardens, kiosks, and waterfront palaces and encouraged the Ottoman elites to do so as well. Architecture and landscaping was used as a tool for representing the presence of the sultan and celebrating his return to the capital (Hamadeh, 2008). As a reflection of this emerging visual ideology, Ahmed III renewed the Topkapı Palace as well. The works he commissioned within the palace grounds, such as the Library of Ahmed III in the Enderun Court or the reading room known as *Yemiş Odası* (Fruit Room), reflected the new artistic vocabulary of the era. The construction of a monumental freestanding fountain across the Imperial Gate *(Bab-ı Hümayun)* and the building a new waterfront palace at the Seraglio Point by the Topkapusu Gate signified the sultan's intent to proclaim his presence beyond the walls of the palace and to make himself visible to the public eye (Uğurlu, 2012, 12; Ünver, 2019).

The Council Hall was also remodeled during the time of Ahmed III as a part of the comprehensive renovation of the Topkapı Palace. Unfortunately no decorative details remained from this artistically significant era, except for an inscription and two tughras (calligraphic monogram of the ruler) bearing the name of Ahmed III on the wall of the Divan hall. The inscription of the Proclamation of Unity *(Kelime-i Tevhid)* and one of the tughras were inscribed by the sultan himself (Database for Ottoman Inscriptions), which indicates the importance attributed to the renovation of the Council Hall.[5]

While the inscriptions do not mention the renewal of the Tower of Justice during this period, an archival document from 1715 (h.1127) indicates that the privy chamber within the

Tower of Justice and the chamber of the grand vizier were renovated (BOA MAD.d.4274). According to this register, written in *siyakat* script, the renovation took ninety-eight days, between December 22, 1714 and March 8, 1715, while the sultan was on a campaign for the Ottoman-Venetian war. The Tower of Justice, the columned portico of the Imperial Chamber, the chamber of the grand vizier, and the chamber of the deputy governor were all redecorated *(berây-ı nakş-kerde-i Kasr-ı 'Adalet ve sütunha-i Daire-i Hümayun ve Dâire-i Hazret-i Sadr-i Ali ve Hazret-i Vezir-i Mükerrem Kâim-makam Paşa)*. According to the detailed cost of each item, frescoes *(Kasr-ı Adalet nakş)* and columns of the Tower of Justice and the portico of the Council Hall were remodeled; the total cost of the construction was 92,912 qurush. Another document from the Topkapı Palace Museum Archives (TSMA.d.3126) mentions the renovation of the Tower of Divan *(Divan Kulesi)* in 1780 (h. 29.12.1194), during the time of Abdülhamid I. According to this document, the lead roof of the tower and the Council Hall were replaced at the cost of 10,302 and 5,916 qurush, respectively.

Another major renovation took place during the reign of Selim III (r.1789–1808) in the end of the 18th century. This sultan is known for his reforms that aimed at establishing military and sociocultural associations with the West that are known as *Nizam-ı Cedid* (New Order). The inscription placed at the entrance portico of the Council Hall and composed of forty-two verses, confirms that the Council Hall was restored in h.1207 (1792–1793) and praised the New Order introduced by the ruler (Ayık, 2012, 42).[6] The architectural program of Selim III was a reflection of his New Order *(Nizam-ı Cedid)*, and the inclusion of Baroque and Rococo elements in the decorative program of the Council Hall manifested his plan to build a "new, powerful and modern empire" that shared an architectural vocabulary with its European competitors (Uğurlu, 2012, 315). The diplomatic role of the Council Hall, where the foreign ambassadors were hosted before they were received by the sultan in the Audience Hall, supports this argument.

According to Necipoğlu (1991, 85–86), the renovation of the Tower of Justice took place during this period as well. The inscription of Selim III does not make any reference to the tower, and the renovation register from 1792–1793 (h.1207) does not mention the renovation of the Tower of Justice (TS.MA.d_3127).[7] Still, under the light of archival and visual sources, one can conclude that the Tower of Justice went through a modification (or series of modifications) during the course of the 18th century. Antoine Ignace Melling's

Figure 4. *The Tower of Justice during the early-eighteenth century (Vue de la Seconde Cour Interieur du Sérail, Melling, Voyage Pittoresque de Constantinople, 1819).*

engraving from the late 18th century depicting the Seraglio and the Second Court of the Topkapı Palace portrays the renewed Tower of Justice, with an enlarged and more visible belvedere pavilion and larger windows on either side (Melling, 1819) (Figure 4). Ottoman sultans of the 18th century, while embellishing their capital with numerous fountains, pavilions, palaces, gardens, barracks, and religious monuments, also enhanced their main imperial residence, the Topkapı Palace, marking their presence and prominence in the heart of their capital via vertical monumentality of the tower.

4.2. The amplified tower of Mahmud II

By the early 19th century, the Council Hall and the Tower of Justice went through another comprehensive renovation, this time during the reign of Mahmud II (r.1808–1839). A reformist ruler, he utilized architecture significantly to manifest his authority and also to legitimize his groundbreaking reforms. As demonstrated by Darin Stephanov (2018), Mahmud II employed his physical and symbolic visibility in the public sphere as a political tool to reinforce his popular belonging. After his enthronement, Mahmud II commissioned large-scale renewal programs for both his palace and the capital. It is not an exaggeration to state that Mahmud II transformed the cityscape of Istanbul by renovating significant monuments and erecting new ones; in particular, after he abolished the Janissaries in 1826, he wanted to glorify and commemorate this "pious event." Some of the most significant edifices include the Beşiktaş and Çırağan waterfront palaces, the Sublime Porte *(Bab-ı Ali)*, military headquarters *(Seraskeriyat)* in Beyazıt, the Nusretiye Mosque, Hayratiye Bridge (crossing the Golden Horn), and the Kuleli, Tophane, Davudpaşa, and Rami barracks (Özgüven, 2009; Yılmaz, 2010).

The remodeling of the Topkapı Palace was completed during the early years of his reign, between 1808 and 1826.[8] A total of twenty-four tughras and inscriptions belonging to Mahmud II, adorning the major halls, gates, and spaces of the Topkapı Palace, attest to the scope of his renovations, which included the Imperial Gate *(Bab-ı Hümayun)* of the palace, the Middle Gate *(Bab-ı Selam)*, the Gate of Felicity *(Bab-üs Saade)*, imperial mints *(Daprhane-i Amire)*, the Privy Chamber *(Hass Oda)*, the Kiosk of Osman III, the Apartments of the White Eunuchs *(Babüssaade Ağaları Koğuşu)*, the Chamber of the Chief Black Eunuch *(Darüssade Ağası Dairesi)*, the Alay Kiosk, the Topkapusu waterfront palace, and many rooms and chambers in and around the Harem (Özlü, 2018; Özlü, 2020). In addition to remodeling the entire palace, Mahmud II reformulated the traditional institutional mechanisms of the Enderun as well (Ata Bey and Arslan, 2010; Uzunçarşılı, 1945). Therefore, this reformist ruler thoroughly reconfigured both the physical and institutional character of the palace, ushering in a new era in the Ottoman realm.

As a part of his renovation program of the palace, the Council Hall and the Tower of Justice were also remodeled and reconstructed in 1819–1820 (h.1235), as is verified by a forty-four-line inscription located at entrance portico of the Council Hall (Şimşirgil, 2005; Ayık, 2012, 38).[9] The inscription emphasizes the importance of justice and positions the sultan and his council as the sole protectors of justice. The tower is believed to symbolize the justice of the unseen ruler, and its extended height and elaborated architecture emphasized the virtual presence of the sovereign (Necipoğlu, 1986, 305). Mahmud II, who took the epithet "the just" *(adli)* after his name, used architecture to advertise his judicature (Necipoğlu, 1991, 84). The inscription confirms this connection and declares Mahmud II's fairness and his protection over his domains by associating the tower *(vâlâ kuleyi bünyad idüb)* with justice and the mythical Mount Qaf *(kule-i kâf-ı adalet)* and defining it as an imperial locus of justice *(adaletgah-ı hakani)* (Ayık, 2012, 39).

While some sources date the current neoclassical tower to the reign of Mahmud II, under the light of recent visual evidence, this argument proves to be invalid. The Tower of Justice, as reconstructed by Mahmud II in 1819–1820, included a timber belve-

dere pavilion that does not exist today. The photographs of James Robertson and Claude-Marie Ferrier, which were taken during the 1850s, clearly portray Mahmud II's remodeling of the tower (Figure 5). A new masonry level was also added to the brick infrastructure of the tower, augmenting its height. While Necipoğlu dates this masonry extension of the tower to the 16th century, (Necipoğlu, 1991), Sedad Hakkı Eldem suggests that the addition of the sandstone level took place during the 18th century (Eldem and Akozan, 1982, 70–71). Yet, based on visual sources, one can suggest that this notable amplification of the tower, with the addition of a new masonry level, was executed during the extensive and ambitious renovations of Mahmud II, during the early 19th century. Mahmud II displayed his inclination towards vertical monuments by decorating the city with these visible emblems of his rule (Özgüven, 2009). The Beyazıd fire tower, the Kuleli Barrack, the slender minarets of Nusretiye Mosque, the addition of corner towers to the Selimiye Barracks, various memorial stones *(dikilitaş)* and the renovation of the Galata Tower and the Maiden Tower are among the most well-known examples of Mahmud II's emphasis on verticality.

The ostentatious timber belvedere pavilion that surmounted the Tower of Justice and its amplified dimensions created a monumental impact. The new tower visually and spatially dominated the Divan Court, as well as the skyline of the Seraglio, thanks to its increased elevation, conical lead cap, and imposing morphology. Three large, arched windows on four sides of the royal kiosk had latticed shutters up to a certain level. This configuration, while providing substantial panoramic vistas of the city, concealed the spectator and communicated the omnipresence of the ruler. The tower is an embodiment of Mahmud II's visual ideology that promoted the visibility of the ruler to legitimize his rule and his reforms in the eyes of his subjects. Not much physical evidence is left of Mahmud II's grandiose tower, which was demolished then reconstructed a few decades later, by the second half of the 19th century.

5. The neoclassical tower

The Tower of Justice, as seen today, is the product of the mid-19th century (Figure 6). Although it is one of the most significant and emblematic structures of the Topkapı Palace, neither its construction date nor its patron or architect have been documented so far. Additionally, the characteristic architectural morphology of the tower has not yet been explored in depth. The last section of this article is an attempt to answer some of these questions, if not all, and to contextualize the tower in the Ottoman architectural tradition.

Figure 5. *The Tower of Justice of Mahmud II seen in a photograph by Claude-Marie Ferrier, 1857 (Léopold, Voyage à Constantinople, 141).*

Figure 6. *The new Tower of Justice with its neo-classical tower (Abdullah Fréres, late 19th century).*

As mentioned above, some scholars attributed the current Tower of Justice to the era of Mahmud II, largely due to the 1819–1820 inscription located at the entrance portico of the Council Hall. It is also true that the neoclassical features of the tower reflected the dominant imperial style of Mahmud II's era. However, a closer investigation of the architectural morphology of the pavilion connects it to a later period. Furthermore, the aforementioned visual sources prove that Mahmud II's timber belvedere kiosk had been replaced with the neoclassical one during the course of the 19th century. Yet, no archival records, inscriptions, or construction documents could be found so far regarding the demolition of Mahmud II's timber pavilion and the construction of the masonry kiosk.

Given the lack of archival evidence, a careful investigation of visual sources can provide clues about this significant modification. Photographs from the period that show Mahmud II's timber kiosk can help shed some light on the date of its demolition. Major sources, in this respect, are the James Robertson's panorama of Constantinople, dated 1855, and Claude-Marie Ferrier's photograph of the tower, published in 1857. Famous French photographer Claude-Marie Ferrier (1811–1889) visited Istanbul during 1850s and documented the major monuments and the modernizing face of the city with series of photographs. Robertson also came to Istanbul in 1851, at the request of Abdülmecid, to serve as the chief engraver of the Ottoman Imperial Mint; early in his forty-year career at the mint (around 1853), he developed a passion for photography and began to take photographs of Istanbul—panoramas in particular (Figure 7). Most of his photographic works date to the reign of Abdülmecid, and they were exhibited around Europe between 1853 and 1860 (Öztuncay, 2003). Both photographers documented the recently newly constructed Dolmabahçe Palace of Abdülmecid, together with other monuments of the city, which prove that Mahmud II's tower remained intact up until the mid-19th century.

A view of the Dolmabahçe Palace mosque, taken from the north, provides us with an unexpected snapshot of the Seraglio. A closer investigation of this photograph shows that the Tower of Justice had been remodeled and took its neoclassical form at that time. The presence of the Topkapusu Waterfront Palace *(Topkapusu Sahil Sarayı)* at the tip of the Seraglio proves that the photograph was taken before the Seraglio fire of 1863. Sedad Hakkı Eldem credits James Robertson for this photograph in *Reminiscences of Istanbul* (Eldem, 1979, 4). Additionally, Pascal Sébah's Seraglio panorama of 1862 clearly depicts the new tower together with the Topkapusu Waterfront Palace (Öztuncay, 2003) (Figure 8). Under the light of this visual evidence, it could be stated that Mahmud II's timber belvedere pavilion crowning the Tower of Justice was demolished, and a new structure built, sometime

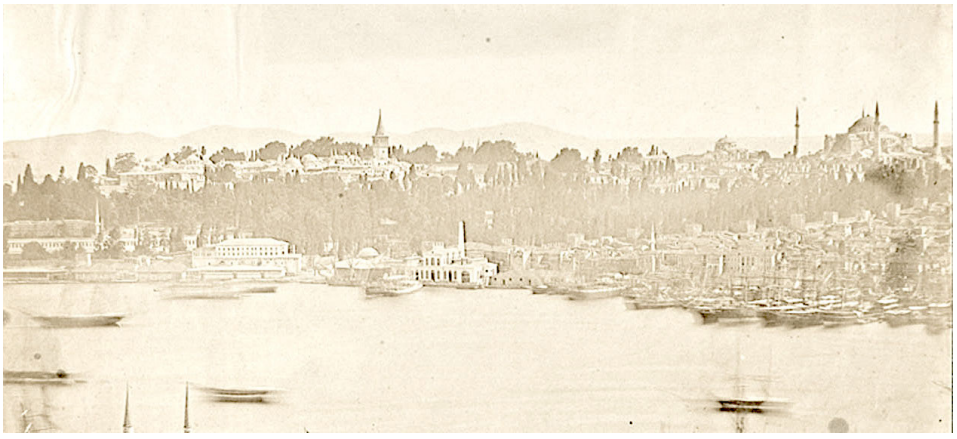

Figure 7. *Detail from the Robertson Panorama of Constantinople (James Robertson, 1855, Suna İnan Kıraç Vakfı Arşivi, FKA_001827).*

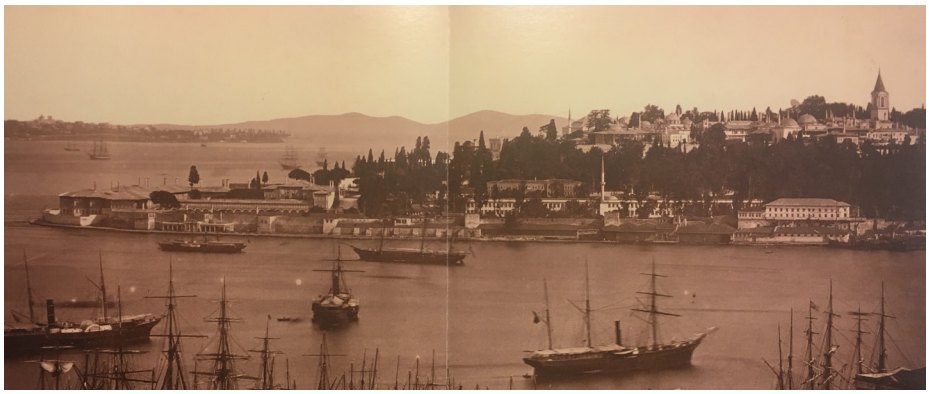

Figure 8. *1862 Panorama of Constantinople by Pascal Sébah (Bahattin Öztuncay, 2003).*

between 1855 and 1862. These dates correspond to the last years of the reign of Abdülmecid (r.1839–1861) and the first years of Abdülaziz's rule (r.1861–1876). Sedad Hakkı Eldem attributes the construction of the new tower to Abdülaziz, stating that the project was led by the architect Balyan during the 1860s, without offering solid evidence (Eldem and Akozan, 1982). On the contrary, Ekrem Hakkı Ayverdi notes that the latest modification to the tower took place during the time of Abdülmecid (Ayverdi, 1973b, 682).

Although no archival evidence could be found documenting the construction date of the new tower, it can be suggested that the renovation of the tower took place during the era of Abdülmecid. Abdülmecid moved his residence to the new Dolmabahçe Palace in 1856 (*Ceride-i Havadis 791*, 7 L 1272), but he commissioned an extensive renovation of the Topkapı Palace after his relocation. After the fire in the Enderun Court in 1856, the Third Court of the palace went through extensive remodeling, which included

Figure 9. *The Mecidiye Kiosk within the context of Abdülmecid's renovation of the fourth court (Author's Archive).*

the restoration of the Audience Hall *(Arz Odası),* the Seferli and Kilerli Wards, and demolition of the Doğancı Apartments.

Renovation registers from the Ottoman archives dating to 1856 (h.1272) provide important clues about the nature of the renovations conducted in the Enderun Court and in the Fourth Court of the palace. The first part of the document (BOA TS.MA.d.4613), dated h. 21 Ca 1272 (29.1.1856), states that the rooms around the Chamber of Sacred Relics, the first chamber of the Imperial Treasury, the apartments of the Privy Chamber corps *(Has Oda Koğuşu)*, and the Enderun Mosque next to it were renovated. The second part of the aforementioned document (BOA TS.MA.d.4613), dated h. 10 Z 1272 (12.8.1856), mentions the works done in the Fourth Court of the palace, which included the demolition of the Çadır Kiosk, the Sofa Mosque, and the Sofalı Apartments. The document also mentions that the apartment of the Chief of the Enderun *(Ağa Dairesi)*, previously known as the apartments of the Kilerli Corps, was also renovated within the scope of this project.

The Üçüncüyeri section of the palace gardens in the Fourth Court of the Topkapı Palace also underwent large-scale construction and landscaping. This quite prominent and visible site, where the hanging gardens and pleasure kiosks of the sultans were located, was reconfigured in line with the new imperial architectural language of the reforming sultan. Within this framework, in 1858, Abdülmecid ordered the reconstruction of Mahmud II's Sofa Mosque and the building of a

new imperial pavilion right next to it. The Çadır Kiosk and the Üçüncüyeri Kiosk, located in the Fourth Court, were demolished, and the New Kiosk *(Kasr-ı Cedid)*, known as the Mecidiye Pavilion, was built in their place (Özlü, 2020) (Figure 9). This specific location, overlooking the Sea of Marmara, the Bosphorus, and the Asian shores of the city, constitutes one of the most visible and prominent spots of the royal complex. According to Pars Tuğlacı, the Mecidiye Kiosk, built in Empire style, was designed by Serkis Balyan (Tuğlacı, 1990).

Within the precincts of the old palace, the area and gardens around the Mecidiye Kiosk were also reconfigured to reflect the architectural style of the Dolmabahçe Palace. Üçüncüyeri Gate, which provided access from the Fourth Court to the Gülhane Gardens, was also remodeled, and two noticeable guardrooms on either side of the gate, known as the Kule Kiosks, were constructed. The morphological similarity between this gate and the imperial gate of the Dolmabahçe Palace communicated the new imperial architectural language and symbolic mark of the ruler.

Based on the aforementioned evidence, it could be suggested that the Tower of Justice in the Second Court of the palace was reconstructed as a part of the comprehensive rejuvenation of the Topkapı Palace in 1856. The new kiosk, replacing the timber belvedere of Mahmud II, was constructed with masonry and was characterized by its neoclassical style, standing as an emblem of modernization during the Tanzimat period. Three small pillars with Corinthian capitals were placed at the corners of the pavilion, supporting the horizontal frieze overarched with shallow arches, which gave a characteristic appearance to the roof. The previous conic cap of the tower was also replaced with an angled octagonal form. Large windows, with round arches covering the entire façade, define the elongated body of the tower and give it a transparent appearance. These architectural features and transparency of the kiosk indicate that the new neoclassical addition was not built as a privy chamber for the sultan's personal use, but as a symbolic structure, representing his virtual existence, even after Abdülmecid's "abandonment" of the palace of his ancestors. The shrinking plan area and elongated height of the kiosk also confirm its emblematic role rather than actual use.

The neoclassical architectural language of the new tower was also in line with the architectural style of Abdülmecid's era—rather than the orientalist and neo-Gothic forms used during the reign of Abdülaziz (Ersoy, 2015). A closer look at the similar tower-like structures from the reign of Abdülmecid, such as the Tophane clock tower and guard towers of Dolmabahçe Palace, confirms the shared architectural vocabulary of the period. Windows with round arches, multiple columns at the corners, and shallow arches framing the windows could be observed on all these edifices, including the Tower of Justice (Figure 10). The simplified neoclassical form of the Tower of Justice, stripped from the heavy rococo decorative elements, can be interpreted as a conscious attempt by the architect to link the structure with the historical context of the Divan Court.

Figure 10. *Details from the Tower of Justice, Dolmabahçe Guard Rooms, Tophane Clock Tower, and Üçüncüyeri Tower in the Topkapı Palace showing their shared architectural morphology (Author, 2016-2017).*

In sum, considering the absence of archival material or written evidence, an evaluation of the visual sources and a morphological analysis both lead to the conclusion that the last modification of the Tower of Justice, as it is seen today, took place during the reign of Abdülmecid. The large-scale renovation of the royal precincts after the sultan's relocation to the Dolmabahçe Palace, which include the reconfiguration of the Enderun Court and the erection of the Mecidiye Pavilion, together with changes to the immediate landscape, communicated Abdülmecid's symbolic presence in the Topkapı Palace. In other words, to compensate for his absence from the traditional core of the Ottoman ruling system, the ruler embedded his imperial mark at the most visible and significant parts of the Topkapı Palace and confirmed his virtual existence via architectural modifications. These architectural edifices, including the Tower of Justice, with its amplified height and distinctive morphology, represented the seeing eye of the sultan, one who grants justice to his subjects.

6. Conclusion

Tower-like structures crowned with imperial kiosks had been an integral element of imperial architectural vocabulary since the early Ottoman times, functioning as strong symbols of political and military power. The towers, due to their robust structure, were also used as treasuries for keeping relics and other valuable items. The elevated morphology of the tower-kiosk not only provided far-reaching vistas for the sultan to monitor his lands and his subjects but also reinforced the towers themselves as markers of sovereignty. In the New Palace of Edirne, the amplified height of the Cihannüma Kiosk dominated the landscape and pronounced the Ottoman's presence in these newly conquered domains, expanding towards the "lands of Rum." Following the conquest of Constantinople, Mehmed II included tower-like structures in both of his palaces *(Saray-ı Atik and Saray-ı Cedid)*, manifesting the Ottoman rule in his new capital. The 16th century witnessed an escalation both in the number and height of the tower-like imperial structures. The Tower of Justice in the Topkapı Palace was monumentalized with the addition of a timber imperial pavilion, and it reflected the grandeur and prosperity of the state and Süleyman I's fairness. The vertical morphology of the tower-kiosk dominated the skyline of the Seraglio and stood as a manifestation of the omnipresence of the ruler and his all-encompassing gaze over his subjects.

The Tower of Justice's function as a treasury came to an end during the course of the 16th century, especially with the addition of the privy chamber surmounting the masonry tower, it adopted a symbolic role. This timber pavilion, built by Süleyman I, was a manifestation of his absolute power and infinite justice. The pavilion not only provided visual access to the cityscape through latticed windows on all four sides but also provided the sultan an opportunity to monitor his viziers and ministers through an encurtained window overlooking the Council Hall. Therefore, the tower, offering direct physical access to various sections of the Topkapı Palace, also provided auditory and visual paths for the ruler to supervise his subjects and courtiers without being seen.

During the 18th century, the visibility of the tower was magnified once again, this time to reinforce the legitimacy and authority of the sultans, who were struggling with internal and external difficulties. It is known that Ahmed III, after his return to the capital, and Selim III, during his modernizing reforms, both renovated the Tower of Justice as an emblem of their sovereignties and to manifest control over the civil and military components of the empire. In a similar manner, Mahmud II amplified both the height of the masonry substructure and constructed a majestic privy chamber on top during the early 19th century. His timber imperial kiosk, in addition to his numerous other assertive architectural projects, was a bold declaration of the centralizing institutional and military reforms yet to come.

The last phase of the Tower of Justice, as we see it today, was shaped during the reign of Abdülmecid. After his relocation to the Dolmabahçe Palace, the

modernist ruler initiated an extensive renovation project in the Third and Fourth Courts of the Topkapı Palace, remodeling the palace grounds and adding a new sultanic pavilion on a visible spot overlooking the Sea of Marmara. Visual sources prove that the Tower of Justice was remodeled during this period, being given an elongated and more elegant form. The transparency of the tower kiosk eliminated its function as a privy chamber and declared the new role of the Topkapı Palace in the context of the Tanzimat. After Abdülmecid made the Dolmabahçe Palace the main residence of the Ottoman sultans, the Topkapı Palace was repositioned as a symbolic and ceremonial venue rather than the seat of the empire. The Tower of Justice, with its neoclassical morphology, became the representation of the modernizing reforms of Abdülmecid and the Tanzimat ideology that aimed at reordering the old regime and building a new order over the traditional system. These final renovations to the Tower of Justice were an attempt by the sultan to simultaneously incorporate and project a dual nature for the tower, and, therefore, the empire—old and new, continuity and change, and tradition and modernity.

Endnotes

[1] The first Edirne Palace was abandoned during the reign of Murad II, and a new palace was constructed outside the city, next to Tunca River. No solid information is available to explain the reason of this abandonment; however, it has been suggested that the location of the old palace did not allow for the palace to expand and that the new palace had a more favorable climate. Later, some additions were made to the Old Palace of Edirne during the reign of Süleyman I, and it was transformed into an educational facility for 6,000 pages. Not much remains of this palace as of today, as it was demolished by Selim II for the construction of Selimiye Complex in the late 16th century.

[2] Edirne Palace was actively used until the 18th century and served as military quarters and a recreational hunting ground for several sultans. In particular, during the reign of Süleyman I, Edirne Palace was used extensively, as recorded in the Mühimme Defteri of 1567–1569 (7 Numaralı Mühimme Defteri, No:1122). The palace was, however, abandoned after the 18th century: it had been damaged by the earthquake of 1758 and the fire of 1776 and then suffered more damage by the first invasion of the Russian army in 1826. The imperial complex was restored by Mahmud II in 1828, but unfortunately it was blown up by Ottoman officials during the second Russian invasion in 1877. After its destruction, valuable pieces of tiles were taken to the UK by the British and are currently displayed in the Victoria and Albert Museum.

[3] Lucienne Thys-Şenocak interpretes the Tower of Justice and the gilded window (kafes-i müşebbek) overlooking to the Divan Hall as a panopticon — epitomizing the seeing eye of the sultan without being seen.

[4] The insciption on the entrance gate to the Tower of Justice reads "One hour of justice is more auspicious than seventy years of worship."

[5] It is also important to note that, these inscriptions were originally located in the first chamber (Divan-ı Hümayun) of the Council Hall, but all the decorative details were transferred to the second chamber (Defterhane) during the Republican-era restorations.

[6] The incsription of Selim III at the entrance of the Council Hall (Ayık, 2012, 42):

"Selīm Ḫān-ı keremver kām-yāb etdikde devrānı

Cihānıŋ intiẓāma tutdu yüz ḥāl-i perīşānı

Müceddid olduğu dünyā vü dīne gūnden eẓherdir

Odur ṣāḥib-ḳırān-ı nev-ẓuhūr-ı nesl-i ʿOs̱mānī

Cihānı yapdırıp maʿmūre-i emn ü amān eyler

Yıḳar aʿdā-yı dīniŋ başına dünyā-yı vīrānı

Niẓām-ı nev verip tecdīd eder bünyān-ı iḳbāli

Bunu ilḥāḥ eder daʿīm oŋa tevfiḳ-i Yezdānī

Keremde pehlivāndır ḥamlesinde şīr-i ġarrāndır

Sözünde ḳahramāndır vaṣf olunmaz şevket ü şānı

Bilir tertīb-i devlet resmini baḫt-ı hümāyūnu

Mülük-i sālife ṣan bundan öğrenmiş cihānbānī
Ḳılıp taʿyīn-i ḫiḍmet farḳ ü temyīz eyledi bir bir
Gürūh-ı ʿaskeri ve zümre-i aʿyān u erkānı
Bu divāngāh-ı ʿālīyi bu resme eylemek taʿmīr
Meger lāzım değil miydi açarsaŋ çeşm-i imʿānı
ʿAceb ṭarz-ı bülende ḳoydu el-ḥak eyleyip tekmīl
Niẓām-ı dīni resm-i devleti nāmus-ı şāhānı
Muʿallā ḳubbe-i eflāki gūyā indirip ḫāke
Ḥarīminde nümūdār eyledi ṣaf ṣaf sürūşānı
Temāşāsında maḥşergāh-ı dehşet ʿaks eder cāna
Der ü dīvārı nüẓẓāra olup mirʿāt-ı ḫayrānī
Ḥużūra yüz süren erkān-ı devlet çarḫ-ı rıfʿatden
En evvel seyr ederler ḫāk-būs-ı mihr-i tābānı
Bu resm-i nev-ẓuhūr enmūzec olsun çeşm-i aʿdāya
Cihād esbābını hem böyle tanẓīm eyler ʿirfānı
O bir şāh-ı cihān-ı rüşd ü himmetdir ki el-ḥāṣıl
Bulunmaz lāciverdī ḳubbeniŋ altında aḳrānı
Çıḳıp ḳānūn-ı devlet perdeden olmuşdı bī-āheng
Şifā-sāz oldu iḥyā eyledi Sulṭān Süleymān'ı
Sükūn-ı pür-temekkündir ʿalāmet ḥamle-i şīre
Bu ārām etdirir aʿdā-yı dīne teng meydānı
Tesettür ḳılsa ṭopun sīnesinde gülle aldanma
Eğer gürlerse gürler raʿd u berḳ-i ḳahr-ı Sübḥānī
Ne dem endīşesi tedbīr ile başlarsa teshīre
Alır iḳlīm-i ġayb-ı lā-mekānı mülk-i imkānī
Hemīşe ẕātına iḳbāl ü şevketle murādınca
Mübārek ede Mevlā yapdığı āsār u ʿümranı
Edip teʾyīd reʾyin muʿcizāt-ı seyyidü'l-kevneyn
Kerāmāt-ı bülend-i evliyā olsun nigehbānı

Füyūż-ı sırr-ı ilhāmiyle Ġālib geldi bir tārīḫ
Selīm Ḫān yapdı hem-ṭāḳ-ı felek bu cāy-ı dīvānı
1207"

[7] TS.MA.d_3127 (h. Rebiulahir 1207/ December 1792). This renovation register mentions the renovation of "the Topkapı and towers," yet, these towers, whose lead roofs were damaged due to heavy winds, must be the ones located next to the Topkapusu Sea Gate of the palace.

[8] After the abolishment of the Janissaries, which he viewed as a serious threat, Mahmud II spent less time behind the secluded walls of the Topkapı Palace and made himself visible in the cityscape. He virtually abandoned the palace and preferred to reside in his newly built palaces, Çırağan and Beylerbeyi, by the Europeand and Asian shores of the Bosphorus.

[9] The incsription of Mahmud II at the entrance of the Council Hall (Ayık, 2012, 38):

"Şehinşāh-ı cihān Maḥmūd Ḫān-ı maʿdelet-pīrā
Muʿallā cāy-ı dīvānı mücedded eyledi iḥyā
Müşebbek revzeni zencīr-i ʿadliŋ bir ʿadīlidir
Bilā-taḥrīk eder Ḥaḳ şāḥibin ol ḫusreve īmā
Selīm Ḫān-ı cinān-menzil edip ancaḳ zemīnin ṭarḫ
Müzeyyen etdi ʿadl ü dād ile şāh-ı zamān ḥālā
Felekler bu muʿallā Ḳubbealtı'ndan ʿibāretdir
ʿAdālet olmasa olmaz sipihr-i köhne pā-ber-cā
Vekīl-i salṭanat ṣadreyn ü defderdār ve tevḳīʿī
Olur dīvān günü bu asūmāna encūm-i zehrā
Sipihr-i şevketiŋ aḥkāmını seyr etmege gāhī
Ṭulūʿ eyler verā-yı zer-ḳafesden ol meh-i ġarrā
Ḥużūr-ı ḥażret-i Ḥaḳḳ'a ḳalır zīrā müzevverdir
ʿAdāletgāh-ı ḫākānīde fayṣal bulmayan daʿvā
Bu nev-cāyıŋ verāsı ḳulle-i Ḳāf-ı ʿadāletdir
Ayağı altına düşse nola dünyā vü mā-fīhā

Sipirh-i kīne-cūyı mehcesiyle dāġdār etdi
ʿAlem-efrāz olunca ḳulle-i nev āiftāb-āsā
ʿIyān etdi o vālā ḳulleyi bünyād edip żımnen
Nigehbān olduğun āfāḳa ol ḫāḳān-ı mülk-ārā
O rütbe mülke teʿs̱īr etdi ol şehden mehābet-kim
Murād etse künām-ı şīri eyler āhüvān yaġmā
Dilerse mīşezārı mehd eder bir peççe rūbāha
Dilerse şīr-i nerri ṭıfl-ı āhūya eder lālā
Ferīdūnlar o şāha ʿarż-ı ḥācet eylesün gelsin
Penāh-ı pādişāhān eyledi dergāhını Mevlā
İki zerrīn taṣa salṭanat tācın verirlerdi
Rikābında gelüp peyk olmuş olsa Sencer ü Dārā
Sıṭablında eger Pervīz olaydı bir at oğlanı
Aŋar mıydı cihānda edhem-i Şebdīz'ini ḥāṣā
Nüvid-i feṯḥ için tatar olaydı böyle ḫāḳāna
Eder miydi Hülagü ʿömrünü ılġar ile ifnā
Açıŋ dest-i niyāzı dāʿīm olsun dāver-i ġāzī
Sözüm ger ḥaḳ ise ey sākinān-ı ʿālem-i bālā
O ḫāḳān sıdḳ ile ḳıldı cenāb-ı Aḥmed'e ḫıdmet
Kitābullāhıŋ etdi seyf ile aḥkāmını inbā
Yine çıḳdım ṣadedden ḳaldı bu cāyıŋ biraz vaṣfı
Alışmış medh-i ḫāḳāna zebān-ı hāme-i imlā
Ṣaded bir yana dursun şevḳ u şādīden gider ʿaḳlım
O şāhı yād ederken mālik olmam kendime ḳaṭʿā
Bulaydım bāri bir mışrāʿ-ı raʾnā cāy-ı zībāya
Ḳuṣurum olsa da ʿavf eyler ol şāh-ı kerem-fermā
Gören ser-dāde-i inṣāf olur ʿİzzet bu tārīḫe
Mücedded eyledi dīvān yerin Maḥmūd Ḫān vālā
1235"

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Qubba of the Ksour Mountains, between material and immaterial

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Abstract

The study of architectural shapes of funeral monuments such as the Qubbas requires a particular attention owing to their diversities and symbolic.

Describing and examining the shapes of Qubbas, looking for explanations about their differences and their locations are the objectives. Each time, the "How" will help us understand the "Why".

The analysis is typological, anthropological and axiological. We installed a duality, by putting the different criteria of analysis together within an architectural rationale to clear the types and the typologies inherent in these buildings and explain the causes of differentiations between these types.

Three typologies of Qubbas were revealed. Their variability lies in the dimensional aspect, the commonly used columns, the technique of connecting the square base to the dome and finally the type of dome. This variability is due essentially to the religious characters they live in.

It seems pertinent today to cease to see the architecture of Qubba in terms of spontaneous architecture. These little funerary and sacred monuments, that we see, as the product of spontaneity are in reality the product of a rigorous reflection, more complex than the current reflections, in the sense that what is taken into account is not only the material but more and in particular the immaterial.

Keywords
Immaterial, Ksour-Mountains, Material, Qubba, Typologies.

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1. Introduction

Production of architectural forms comes with lengthy and a complex process wich leads to formal modeling. Amos Rapoport showed that the explanations based on climate, materials, technology, location, economy are insufficient to explain the form. Other parameters of a cultural and spiritual nature intervene (Rapoport, 1972).

The study of the architectural forms of the Qubbas requires a special attention, because of their formal and symbolic diversity. The objectives are to study and describe the forms of the Qubbas, in the Ksour Mounts.

The method of analysis used is a hybridization of three approaches: typological, anthropological and axiological.

The Qubbas are in three typologies. They have different external appearances. As for the causes of these differentiations, they are to be found in the immaterial, through the rank of the Walï (Saint), his genealogy and the degree of his veneration.

According to the axiological survey, the *Qubba* is a totem. It is not only the symbol of the sacred, it is, even its substance. It is a memorial. The *Qubba* is a hybrid of cult and cultural functions. Its architecture expresses the funerary and the religious. Consequently, it is, and must be considered as a national heritage.

2. Problems

Up till now, few architectural comments have been made about the death's space. Death forms a network of places, objects with their allegories and symbols, their signs and their landmarks, forming a specific path (Martin, 2006). If death has found its historians, philosophers, psychologists, sociologists and semiotician, it has been rarely tackled from an architectural angle.

2.1. Why this subject?

The choice of subject was the aftermath of an emotional stage in my childhood. A scene which is appropriate to introduce the subject. My uncle, a young man in his twenties, supervised by my father, under the watchful eye of the Mokqadem of the Qubba from Sîd Hadj el Hafid, deposed his packet of cigarettes on the tomb of the Saint. So a Saint buried would be able to intercede in favor of a living smoker to free him from a dependence on tobacco. I grow up, and after attending the *wa'da*[1] of the Ûlad (descendants) Sîd 'Ali B. Yahyia at Mechria Sguira (Little) in El Bayadh, *ksar* of my ancestors, I noticed a certain behavior of the inhabitants towards these buildings, which aroused curiosity and interest in me.

2.2. Why this subject is important

At first sight, the visitor has the impression that the Qubbas are similar. The outer appearances and the colors attract the attention of the visitor and hide the differences between the Qubbas.

We might ask our self, why studying the shape of the Qubbas. The premise of any historical approach it is because the past is instructive.

The restoration work on the *ksour* has been launched. Sacred spaces are also affected by these restorations. We were led to note with bitterness how these works called "restorations" are carried out without ties with the spiritual and symbolic factors which inspire the very logic of these buildings (Hall, 1978).

2.3. Why the Ksour Mounts?

From the map of the major state, we notice that on the Algerian territory, the partition of the *Qubbas* is denser in the west than in the east. This quantitative difference has largely contributed to direct our choice to the study zone in the Southern west of Algeria.

2.4. Hypothesis and objective

Do the *Qubba* have specificities? If so, what are these specificities? How can they be explained? Our hypothesis states that if there is specificity, it is not just a matter of material concerns. It is necessary to consider that these specificities are rooted in an immaterial experience. Among the immaterial causes, we consider the holiness of the character, which is honored, the degree of veneration that is shown to him.

Describing the *Qubba*'s forms, looking for the causes to their differences, their localizations are the objectives. Each time, the How will serve to make us grab the Why.

3. Definition of the concept

The title: "*Qubba* of the *Ksour Mountains*, between *material* and *immaterial* ", draws up the inventory of the concept-keys. The signifier: dome as being the equivalent of the *Qubba* is not suitable to give meaning and the representation that are transmitted by the *Qubba*. It is not a geometric shape as it appears in the dome. We retain for the signifier *"Qubba"*: (plural: *Qubbas*, gender: feminine) does not only refer to a funeral building, but also to the notion of a marker of personality landmark and of the genesis of the individual and of its social group. It is raised to signify the landmark provider of the protective spiritual strength, of the solidity of lineage and the virtue that is expected for belonging to an ethnic group or a chain of solidarity. It is this reference feature that leads builders to reserve the most visible brands everywhere and for everyone (Deffontaines, 1948).

By the *material,* we are referring to "all the goods belonging to a community". In *material aspect*, we distinguish the elements that encompass the *materials* and the use made of them.

The *immaterial,* we refer to all that is of the order of the mind and soul. It is the symbolic network woven through intersection of customs, traditions and religious values within a community. The *immaterial* is conveyed by the *Walï.*

4. Synopis of Islamic funerary monuments

The first mausoleum in Islam is the dome of the Christian in Samarra (Marçais, 1962). The mausoleums appeared since the 10th century in the Persian environment. The same phenomenon developed in other regions of Islam, with the Turbe Turks, the *Adriha* of the Sultans of Egypt and the *Qubbas* of the *Awliya* in the Maghreb (Burlot, 1990).

The funerary architecture in India is very steeped in the Persian realizations. The dome and the vault constituted the main roofing system. The Iranian arch dominates as the layout of the pierced façades and entrances, but certain features of the Hindu influence are visible (Morelle, 2015). The most famous of the mausoleum is that of Taj Mahal, considered one of the masterpieces of funerary architecture in India.

In Egypt, under the Fatimid reign, a new form of funerary mosque appeared, it is the mosque of El-Gûyûshi. It's a Mashhed. The term is used to designate a catafalque. In this religious building, elements are to be remembered: the minaret, where two square towers are superimposed and an octagonal tower capped with a dome. Its pointed shape will become characteristic of Egyptian funerary monuments (Burckhardt, 1976).

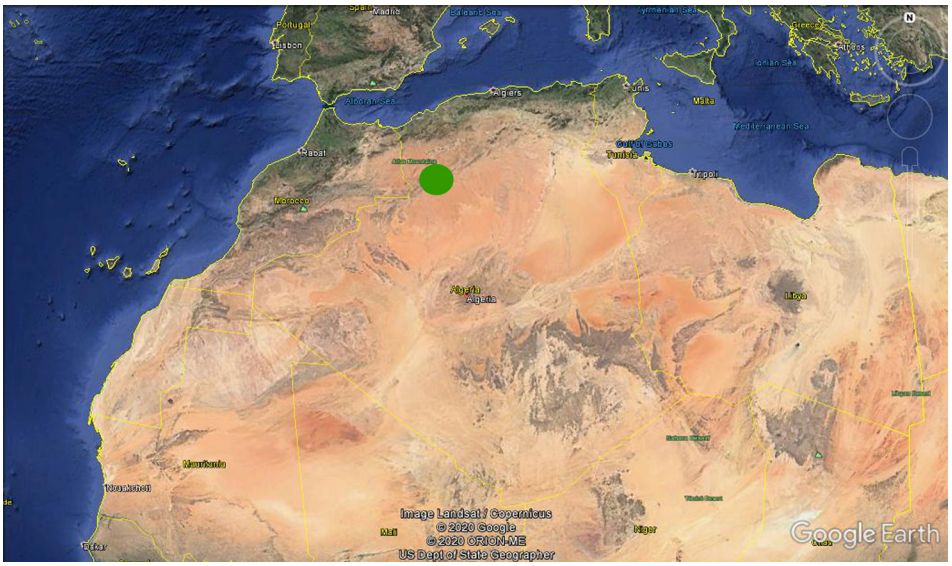
Funeral buildings in the Maghreb are not reserved for princes and warriors. They are raised in homage to the holy characters (Ravereau, 1981). Addition to the *Qubbas*, these are the *Zawiyas* which were funerary buildings dedicated to the Saints (Bellil, 2003).

5. Presentation of the studied space

This part is devoted to the presentation of the studied space. The Saharian Atlas is a mountainous territory which is linear, stretching from the Moroccan boundaries in the west to extend to the massifs of Aures in the east. It is made of five mounts:

1. The Mounts of Ksour in the west;
2. The Mounts Amour;
3. The Mounts of Ould Nail;
4. The Mounts of Zab;
5. The Massifs of Aures (Figure 1)

We are in the area of the *Ksour Mounts.* Where ever you go, the traditional settlement is a *ksar*. In Berber, it's a Aghram[2] (De Foucauld, 1940). The size of the *ksar* and the importance of its built space depend on the feeding capacities of the region. When the *ksar* loses its feeding capacities, it is abandoned. But when the region is capable of developing, another Agham comes to juxtapose to the first and it continues this way until the limits of the possibilities of the region (Basset, 1937). Among the principle characteristics of *ksour* are the fortifications. These walls can come from a collective mentality where the order is symbolized by the materialized limit (Eliade, 1994).



Studied space

Figure 1. *Situation of studied space (Source: image Landsat / Copernicus 2020 Google Earth).*

6. Methodology

The method of analysis used is a hybridization of three approaches: typological, anthropological and axiological.

This work could see light thanks to the kindness of people who welcomed, helped, advised and guided us through the vast territory which they knew. They patiently supported our visits, our insurmountable curiosity.

To locate the human settings, we had to divide the zone of investigation into perimeters, in relationship with the amenities of the trip and the availability of contacts.

The fieldwork was undertaken into three phases:

1. Phase of observation and collection of information. It also served for to familiarize with sites and people, to have the local population;

2. The second phase is the organization of the collected information and its confrontations with the theoretical basis;

3. The third phase consists in coming back on the ground for a second reading overtaking the stage of observation to devote in the investigation.

6.1. Delimitation of the studied space

The investigation space is delimited according to two criteria:

1. The administrative division

2. The homogeneity of the physical milieu (the mountainous system)

Concerning the administrative division, the choice fell on the department of El-Bayadh, given the important number of the *ksour* (*24 Ksar*).

A second pre-selection oriented on the mountainous system. The *ksour* located in the Wilaya of El Bayadh are in two mountainous entities: the Mounts of *ksour* and the Djebel Amour. We only take into account the *ksour* located in the first mountainous entity.

6.2. The determination of the sample of the Qubbas

We started by an exhaustive inventory of the Qubbas, then we displayed the properties which distinguish them and we established the criteria (Perec, 1992). We inventoried 46 *Qubbas* (Table 1).

The criteria are:

1. The function of the *Qubbas;*

2. And their *position* in the *cemetery.*

For the function, it is a question of seeing, if the Saint is buried or simply that the building was dedicated to him. In the first case, it is a *Qubba*, and in the second case, it is an *Mqam.* Out of the (46) cases, (39) are *Qubbas* and (7) are *Mqams.*

As to the topology, it permits to characterize the relationships of positioning between the Qubba and the cemetery. We have detected two groups:

1. Distance/Remoteness: It concerns all the *Qubbas* which are detached from the cemetery;

Table 1. *Exhaustive inventory of Qubba in studied space.*

Ksar	Cemetery	Denomination	Code
Boussemghoun	Sîd H'med Tidjani	Sîd H'med Tidjani	Q01
		Sîd Hafiyan	Q02
		Sîd Mûlay Hashmi	Q03
		Sîd Bûnakhil	Q04
		Sîd Bû-smrûn	Q05
Stiten	Sîd 'Ali Khlifa	Sîd 'Ali Khlifa	Q06
	Ûlād H'med	Sîd H'med B 'Uda	Q07
	Ûlād Mûmen et Shnayaf	Sîd B Mukhtar	Q08
		Sîd B 'Uthman	Q09
		Sîd Sghir	Q10
	N'khakhta	Sîd Lak'hal	Q11
		Sîd B Sh'ayb	Q12
	Ĥwarin	Sîd 'Abd-l-Hadi	Q13
		Sîd 'Abd-l-Qader-l-Djilani	Q14
Arba Foukani	Sîd M'amar	Sîd M'amar	Q15
		Sîd Brahim	Q16
Arba Tahtani	Sîd 'Isa	Sîd Bû-Dkhil	Q17
		Sîd 'Isa	Q18
		Sîd Hmed Tidjani	Q19
Ghassoul	Sîd 'Ali B.Sa'id	Sîd 'Ali B.Sa'id	Q20
Chellala Dahrania	Lalla 'Aysha	Lalla 'Aysha	Q21
	Sîd Muhamed B Slayman	Sîd Muhamed B Slayman	Q22
		Sîd Hmed Barayan	Q23
		Sîd Slayman Bû-Smaha	Q24
	Sîd 'Abd-l-Qader-l-Djilani	Sîd 'Abd-l-Qader-l-Djilani	Q25
Sidi El Hadj Ben Ameur	Sîd Hadj B 'Amer	Sîd Hadj B 'Amer	Q26
		Sîd Hmed Bel Hadj	Q27
		Sîd 'Abd-l-Qader-l-Djilani	Q28
Ksar Shargui	Sîd Shaykh	Sîd Shaykh	Q29
	Sîd Hadj Bahûş B Shaykh	Sîd Hadj Bahûş B Shaykh	Q30
		Sîd Hadj B Ddin B Hadj Ddin	Q31
		Sîd Muhamed 'Abd-l-Lah B Shaykh	Q32
		Sîd Hadj 'Abd-l-Hakem B Shaykh	Q33
	Sîd 'Abd-Er-Rahman B Shaykh	Sîd 'Abd-Er-Rahman B Shaykh	Q34
Ksar Gharbi	Sîd Hadj B Shaykh	Sîd Hadj Mkhayti B Shaykh	Q35
		Sîd Hadj B Shaykh	Q36
	Sîd Bahûş B Hadj 'Abd-l-Hakem	Sîd Bahûş B Hadj 'Abd-l-Hakem	Q37
	Sîd Brahim B Muhamed	Sîd Brahim B Muhamed	Q38
		Sîd Muhamed B Shaykh	Q39
Mécheria Sghira	Rwaqa	Sîd Hadj El Hafid'	Q40
		Sîd Hmed B Yûsef	Q41
		Sîd El Bashir	Q42
	'badal	Sîd Lakhdar	Q43
		Sîd Brahim B Sa'id	Q44
		Sîd Muhamed B Hmed	Q45
		Sîd Muhamed Mûl Khalwa	Q46

2. Inclusion: It concerns all the *Qubbas* which are located inside the cemetery. We identify two types of establishment:

- *Qubbas grouped within the same cemetery;*
- I*solated Qubba (only one building in the cemetery).*

The constitution of families is done by crossing the *functional data* to the *topological* one. We had four families (Table 2).

- F1: *Mqam*, implanted within the cemetery
- F2: *Qubba*, implanted within the cemetery
- F3: *Qubba*, implanted outside the cemetery
- F4: *Mqam*, implanted outside the cemetery

F2 is the corpus, which will be the subject of analysis.

6.3. Analysis approaches

For the material aspect, we used the *typological analysis,* while, for the *immaterial* aspects, it is through the *stories of life*. For collect public opinions about the *Qubbas*, a *sociological survey* was conducted using a *questionnaire.*

6.3.1. Typological approach

Epistemologically, "type" comes from the Greek "tupos". As for the typology, it is a science of the elaboration of types facilitating the classification (Pinson & Thomann, 2002). We retain that the type is not the object or the figure to imitate, but the concret means of reproduction (Panerai et al,

2009). For Durand, a type is an abstract object, built up by the analysis, which gathers the categories of objects (Durand, 1825). Carlo Aymonino considers typology as a means of classifying artistic phenomena (Aymonono, 1966).

6.3.2. Anthropological approach

We have interrogated the collective memory to grab the latent factors related to the *Qubbas* and those who live there (Herkovits, 1967). This approach with a human face revalues beings and life and refuses to consider social facts as things (Bertaux, 1980). Fanch Elegoët uses a biographical approach to understand the social practices of the Breton peasantry. This approach allows the internal logics to emerge through the practices and representations of (its) actors (Elegoët, 1978).

The hagiography allows access to the reality by giving a voice to the silent ones of history. The *Hagiography* is characterized by a predominance of place accuracies over time accuracies (Dupront, 1990). The stories related to the *Qubbas* and those who live there are collected from people of a certain age who have respectability and credibility in their community, which gives them the function of guardians of the *collective memory.*

The use of the tape recorder made it possible to record the story of the silencers of anthropology. Oscar Lewis has noted that thanks to the tape recorder, non-specialized, uncultured, even illiterate individuals can talk about themselves and recount their experiences and observations (Lewis, 1963). The volume of hagiographic recordings is nine hours. To move from oral to written words, we had recourse to the transliteration of the Arabic alphabet into Latin letters, proposed by The Encyclopedia of Islam (Marting et al, 2010).

6.3.3. Sociological approach

An *axiological,* survey was conducted. This survey saw the participation of the public and experts. Its aim is to highlight the value of *Qubbas*, through judgments and opinions (Heinich, 2017). According to a fourfold functionality:

Table 2. *Constitution of families of Qubbas.*
F1. Mqam, implanted within the cemetery.
F2. Qubba, implanted within the cemetery.
F3. Qubba, implanted outside the cemetery.
F4. Mqam, implanted outside the cemetery.

Code	Function		Topology		Families
	Qubba	*Mqām*	Inclusion	Distance	
Q01	0	X	X	0	F1
Q02	X	0	X	0	F2
Q03	X	0	X	0	F2
Q04	X	0	X	0	F2
Q05	X	0	0	X	F3
Q06	X	0	X	0	F2
Q07	X	0	X	0	F2
Q08	X	0	X	0	F2
Q09	X	0	X	0	F2
Q10	X	0	X	0	F2
Q11	X	0	X	0	F2
Q12	X	0	X	0	F2
Q13	X	0	X	0	F2
Q14	0	X	0	X	F4
Q15	X	0	X	0	F2
Q16	X	0	X	0	F2
Q17	0	X	X	0	F1
Q18	X	0	X	0	F2
Q19	0	X	X	0	F1
Q20	X	0	X	0	F2
Q21	X	0	X	0	F2
Q22	X	0	X	0	F2
Q23	X	0	0	X	F3
Q24	0	X	0	X	F4
Q25	0	X	0	X	F4
Q26	X	0	X	0	F2
Q27	X	0	0	X	F3
Q28	0	X	0	X	F4
Q29	X	0	X	0	F2
Q30	X	0	X	0	F2
Q31	X	0	X	0	F2
Q32	X	0	X	0	F2
Q33	X	0	X	0	F2
Q34	X	0	X	0	F2
Q35	X	0	X	0	F2
Q36	X	0	X	0	F2
Q37	X	0	X	0	F2
Q38	X	0	X	0	F2
Q39	X	0	X	0	F2
Q40	X	0	X	0	F2
Q41	X	0	X	0	F2
Q42	X	0	X	0	F2
Q43	X	0	X	0	F2
Q44	X	0	X	0	F2
Q45	X	0	X	0	F2
Q46	X	0	X	0	F2
Total	39	7	39	7	

1: 03 cases (06.52%)
2: 37 cases (80.43%)
3: 02 cases (04.35%)
4: 04 cases (08.70%)

1. The normalization.
2. The formalization.
3. The distinction.
4. The identity.

For the result obtained to be valid, one must rigorously respect, on the one hand the principles which govern the development of the questionnaires, and on the other hand the administration of the latter, as well as the con-

stitution of the sample of respondents (Beaud & Weber, 2003). The questions asked must be relevant and accessible to the interviewee (Berthier, 1998).

The questionnaire is divided into two sections. The first concerns the personal data of the respondent. The second suggests twelve questions divided into four functions (Mendras, 1975). We have *(171)* respondents. The questionnaire was developed in Arab, French and English[3].

We used different social networks (Instagram, Viber, and messenger) to make the questionnaire available to the people to be surveyed. For this, we used Google-forms as a digital medium.

The sample was selected according to culture, region and socio-professional affiliation. Regarding the age of the respondents, the majority of the target group was young people.

Ages between:

- (18-20) = *(10%)*
- (21-35) = *(54%)*
- (36-50) = *(22%)*
- (51-65) = *(08%)*
- (66 and over) = *(06%)*

The gender criterion is random. No intention commanded the choice of respondents by gender.

- Man = *(56%)*
- Woman = *(44%)*

To reach people from different cultures, we opted for a two-scale strategy:

- At the national level: Algeria is a huge country of fairly heterogeneous social groups, of interdependent but fairly distinct cultures.
- On an international scale: Using our contact networks, we were able to reach surveys of thirteen different nationalities. Distributed as follows:

  1. American = *(2)*
  2. Belgian = *(3)*
  3. Canadian = *(1)*
  4. Egyptian = *(4)*
  5. Emirati = *(2)*
  6. French = *(13)*
  7. Jordanian = *(1)*
  8. Kuwaiti = *(1)*
  9. Saudi = *(1)*
  10. Senegalese = *(1)*
  11. Sudanese = *(1)*
  12. Syrian = *(1)*
  13. Turkish = *(1)*

  Coming back to the national respondents, they are distributed, administratively, over Twenty five Wilayas. Distributed as follows:

Regarding professional status, most of the respondents are civil servants in the service sector *(44%)*. Students represent *(29%)*. The experts are nineteen *(11%)*, thirteen national and six international. They are research professors, specialists in vernacular architecture.

7. Results and discussion

The analysis is centered on the material data. We then became interested in immaterial data with the aim of finding the causes of the differences in the forms of Qubbas. Then, using an axiological approach, we measured the value of the object investigated, through the judgments and opinions of the public.

7.1. Material data

We analyze three types of data:

- Implantation in cemetery and dimensional criteria.
- Constructive system.
- Type of roof (Aesthetics).

7.1.1. Implantations and dimensions

Out of *(36) Qubbas* inside the *cemetery, (26)* are grouped together in the same cemetery. These are reserved for saints belonging to the same family tree, either mystical or Adamic (Dermenghem, 1982). (10) are isolated. These are the *Qubbas* implanted alone in the *cemetery*. These are buildings for the holy founders of lineage or a human settlement.

Of *(36) Qubbas*, we notice two *Qubbas* vary in height from (H 8 - 10m). They have a right-of-way between (S = 64 - 100m²), this category is named *D1*. Of the *(19) Qubbas*, (H 5 - 8m), their surface area varies between (S = 25 - 64m²), this category is named *D2*. And finally, *(15) Qubbas* have a height that varies between (H 3 - 5m) and a surface area between (S = 9 - 25m²), this category is named *D3*.

The analysis of the heights of the *Qubbas* has revealed to us a fundamental fact that is directly related to the religious figure concerned. We can therefore argue that the more the religious figure is revered, the greater the volume and the influence of his

cenotaph. By crossing the dimensional data with those of the occupation, we obtained four types of *Qubbas* (see Table.3).

7.1.2. Constructive system

In Islam, the sculpture and the representation of living forms are abolished. This means that a credible typological study is only undertaken with the constructive elements (Bourouiba, 1981). These elements are:

1. The arcade system;
2. The columns;
3. And the technique of linking between the circular form of the roofing, generally a square dome.

7.1.2.1. The arcade system

The arcade occupies an important place in the Muslim architectural vocabulary. Thirty five Qubbas are equipped with an overhanging full arch.

7.1.2.2. The columns

In the Maghreb, the columns are often cylindrical or polygonal. Every column is composed of three parts: the base, the shaft and the capital. Eight types of columns (Sariya) were surveyed *(Bachminski & Grandet, 1985)*.

(20) Qubbas have smooth circular polished columns, *(15)* are octagonal in shape. One Qubba has no columns. Of the *(15) Qubbas* with octagonal columns, (14) belong to the lineage of Ûlād Sîd Shaykh. The *Qubba* of Sîd Hadj B ʿAmer is an exception. The hagiography has revealed that Sîd Hadj B ʿAmer was the first master of Sîd Shaykh and undoubtedly to honor this master the descendants of Sîd Shaykh built the dome with columns reserved for their descendants (Du Jonchay, 1940).

7.1.2.3. Technique of connection

The passage from the square plan to the dome is a very delicate technique. This problem had been solved through three techniques.

1. Panelled cupola: the principle consists of a diagonal arc of reinforcement, banded under a dome to facilitate its construction and increase its resistance (R.A);

2. Cupola on pendant: A concave spherical triangle, formed between the large arches that support the dome and allow it to move from a square to a circular plane (R.B).

3. Cupola on trunk: consists of the construction of a small vault in an angle that allows a change of square plan to circular or octagonal (R.C) (Cominardi, 1994).

7.1.2.4. Summary of the construction system

The constructive system revealed that the used arcature is of the overhanging full arch type. The columns that criss-cross the square shape are of two types: Smooth columns and octagonal columns. There are three types of connecting techniques for the transition from the square plan to the cupola: the pans cupolas, the cupolas on pendentives and the cupolas on trunks. By crossing the three constructive criteria, four types are obtained (see Table.3).

7.1.3. Aesthetics of the Qubbas

We identified three types of roofing (see Table.3):

- T1: *Qubbas* with ogival or conical dome *(28%)*.
- T2: *Qubbas* with thin drum *(69%)*.
- T3: *Qubbas* with flat terrace *(3%)*. This model is the most ancient (Grandet, 1992). This type is employed by the sedentary Berber highlanders to honor their saints. They built *Qubbas* for them similar to their own habitations (Berbrugger, 1864). Only, the *Qubba* of Lalla ʿAycha has flat roofing.

7.1.4. Summary of the material data

Height typologies are retained. The *Qubba* of Lalla ʿAysha is not classified because it is unique and does not belong to any family. The most dominating typologies are A, E and F (Table 3, Figure 2, Figure 3, Figure 4).

7.2. Immaterial data

We are sketching a typology of *Awliya* to cross it with that of the *Qubbas*. We will look at the Saints who inhabit the three most representative types of *Qubbas* (A.E.F), As well as the *Qubbas* (G) of the the Ghaûth. The sample is of *(28) Qubbas*.

Table 3. *Typologies of Qubbas.*
T.S.O.C. Typology of the Qubbas according to the size and occupation in the cemetery.
1. Qubbas, whose height varies between 3m and 5m, and with an area between 9m² and 25 m². They are grouped in cemetery;
2. Qubbas, whose height varies between 5m and 8m, and with an area between 25m² and 64 m². They are isolated in cemetery;
3. Qubbas, whose height varies between 5m and 8m, and with an area between 25m² and 64 m². They grouped in cemetery;
4. Qubbas, whose height varies between 8m and 10m, and with an area between 64m² and 144 m². They isolated in cemetery.
C.S. constructive system.
SC1. An overhanging full arch, the columns are smooth, the technique of connection is based on framings.
SC2. An overhanging full arch, the columns are smooth, the domes are on pendants.
SC3. An overhanging full arch, the columns are octagonal, the domes are on pendants.
SC4. Gothic arch besides past system, the columns are smooth, the domes are on horns.
T.D. Types of Dome.
T1: "Qubbas" with ogival or conical dome .
T2: "Qubbas" with central thin drum .
T3: "Qubbas" with flat roofing.
T.Q. Typologies of Qubbas.

Code	Denomination	T.S.O.C	C.S	T.D	T.Q
Q02	Sîd Hafiyan	1	SC1	T1	A
Q03	Sîd Mûlay Hashmi	1	SC1	T1	A
Q04	Sîd Bûnakhil	1	SC1	T1	A
Q06	Sîd 'Ali Khlifa	2	SC2	T1	B
Q07	Sîd H'med B 'Uda	2	SC2	T2	C
Q08	Sîd B Mukhtar	1	SC1	T1	A
Q09	Sîd B 'Uthman	1	SC1	T1	A
Q10	Sîd Sguir	1	SC1	T1	A
Q11	Sîd Lak'hal	1	SC1	T1	A
Q12	Sîd B Sh'ayb	1	SC1	T1	A
Q13	Sîd 'Abd-l-Hadi	2	SC2	T2	C
Q15	Sîd M'amar	2	SC3	T2	D
Q16	Sîd Brahim	3	SC3	T2	E
Q18	Sîd 'Isa	3	SC3	T2	E
Q20	Sîd 'Ali B.Sa'id	2	SC2	T1	B
Q21	Lalla 'Aysha	2	SC0	T3	O
Q22	Sîd Muhamed B Slayman	2	SC2	T2	C
Q26	Sîd Hadj B 'Amer	4	SC3	T2	G
Q29	Sîd Shaykh	4	SC3	T2	G
Q30	Sîd Hadj Bahûş B Shaykh	3	SC3	T2	E
Q31	Sîd Hadj B Ddin B Hadj Ddin	3	SC3	T2	E
Q32	Sîd Muhamed 'Abd-l-Lah B Shaykh	3	SC3	T2	E
Q33	Sîd Hadj 'Abd-l-Hakem B Shaykh	3	SC3	T2	E
Q34	Sîd 'Abd-Er-Rahman B Shaykh	2	SC3	T2	D
Q35	Sîd Hadj Mkhayti B Shaykh	3	SC3	T2	E
Q36	Sîd Hadj B Shaykh	3	SC3	T2	E
Q37	Sîd Bahûş B Hadj 'Abd-l-Hakem	3	SC3	T2	E
Q38	Sîd Brahim B Muhamed	3	SC3	T2	E
Q39	Sîd Muhamed B Shaykh	3	SC3	T2	E
Q40	Sîd Hadj El Hafid'	3	SC3	T2	F
Q41	Sîd Hmed B Yûsef	1	SC2	T2	F
Q42	Sîd El Bashir	1	SC2	T2	F
Q43	Sîd Lakhdar	1	SC2	T2	F
Q44	Sîd Brahim B Sa'id	1	SC2	T2	F
Q45	Sîd Muhamed B Hmed	1	SC2	T2	F
Q46	Sîd Muhamed Mûl Khalwa	1	SC2	T2	F

***T.S.O.C 1 : D3. OG** : 3,00 ≤ H < 5,00 ; 3,00 ≤ L < 5,00 ; 3,00 ≤ l < 5,00. And grouped occupation
***T.S.O.C 2 : D2 OI :** D2 : 5,00 ≤ H < 8,00 ; 5,00 ≤ L< 8,00 ; 5,00 ≤ l< 8,00. And isolated occupation
***T.S.O.C 3 : D2 OG :** D2 : 5,00 ≤ H < 8,00 ; 5,00 ≤ L< 8,00 ; 5,00 ≤ l< 8,00. And grouped occupation
***T.S.O.C 4 : D1 OI :** 8,00 ≤ H < 10,00 ; 8,00 ≤ L < 12,00 ; 8,00 ≤ l < 12,00. And isolated occupation
H: Height m.
L: Length m
l: Width m

7.2.1 *"Walï"* and *"Silsila"* (Mystical chain)

Each Saint occupies a place in a hierarchy of a *mystical order*, expressed by the *Silsila* (Touati, 1994). The highest rank is that of *Ghaûth*[4]. The second rank is referred to as *Qutb*[5]. In the third rank we find the *Aûtad*[6]. After them, place the *Khiyar*[7]. At the fifth place is the *Abdal*[8]. In the sixth rank, the *Nedji*[9], in the seventh and last rank are the *Naqib*[10]. Each Saint must be able to provide sufficient evidence to justify his rank. His actions *(A'māl)* take precedence over his science *('ilm)* (Brosselard, 1859).

7.2.2. The founding Walï

A *Walï* is in essence the founder of something (Berque, 1982). Each ksar has its founding legend, of which the *Walï* constitutes the centerpiece (Detienne, 1994). We classified the *Walï* according to their performances of foundations.

7.2.3. The *"Walï"* and genealogy

The *Walï* exists and reigns, first and foremost, through his genealogy (Coppolani & Depont, 1897). We distinguish two types of Adamic genealogy.

1. The prophetic genealogy known as *"Shurfa"* [11].

2. The *Khalifite* genealogy derived from the word khalifa which designates replaced[12].

Among the twenty eight *Walï,* eighteen are of prophetic genealogy and ten are of the so-called *khalifite* genealogy.

7.2.4. Summary of the immaterial data

Examination of the profile of the *Awliya* revealed five types.

1. W1: A *Naqib*. From a prophetic genealogy.

2. W2: A *Khiyar*, founders of a *ksar* or lineage. From a prophetic genealogy.

3. W3: *Ghaûth*, founders of a *ksar,* a lineage, and a brotherhood. From a prophetic genealogy.

4. W4: *Qutb*, founders of a *ksar* and a lineage. From a khalifite genealogy

5. W5: *Aûtad*, founders of a *ksar* or a lineage. From a khalifite genealogy

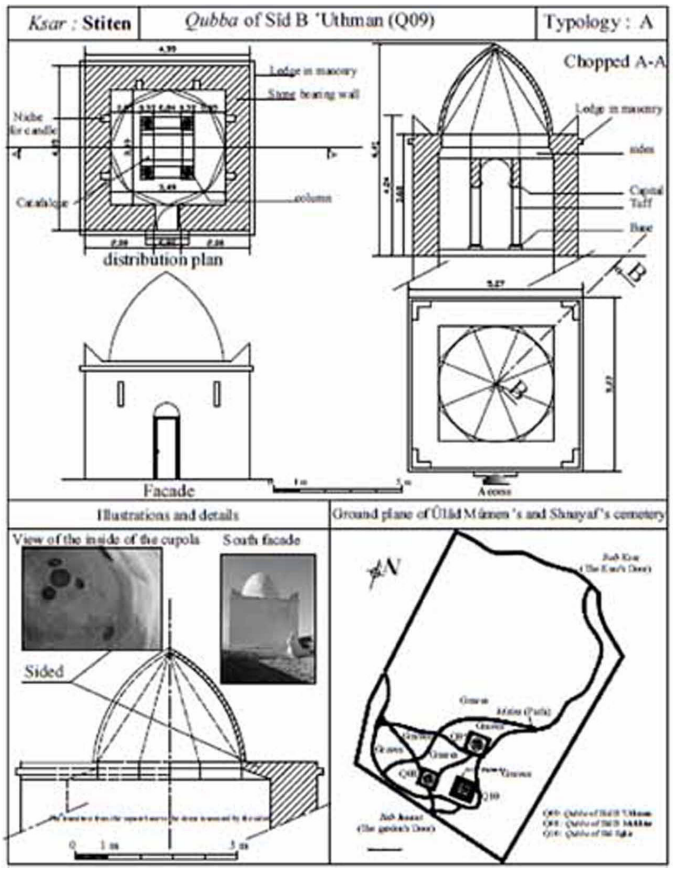


Figure 2. *Qubba specimen of typology F (Source: Djeradi & Lakjaa).*

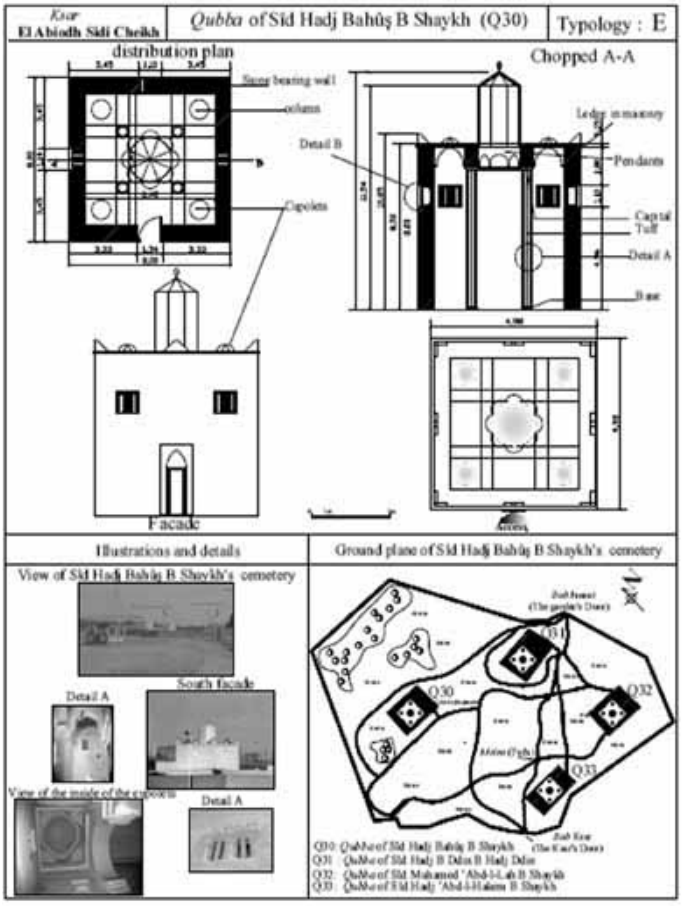


Figure 3. *Qubba specimen of typology E.*

7.3. Cross-referencing material and immaterial data

In order to find the causes of the specificities of the *Qubbas*, we have crossed the material data with the immaterial parameters (Table 4).

We revealed that *Awilya* (W1), live in *Qubbas* of types A and F. Let us try to detect the degree of variability between the two types (A, F). To do this, we decomposed, again, the material criteria. By examining Table. 4, we have detected the constants and the variables. Only the connection technique and the shape of the cupola differ between Qubba A and F. *Awliya* types W2, W4 and W5 inhabit *Qubbas* type E. By examinating the types of Qubba E and F, their differences reside in the dimension and the type of column. We can conclude that the variation of the *Qubbas* resides in the dimension and the columns. The *Ghaûth,* inhabit *Qubbas* type G. This type differs from the others in terms of compensation and type of occupation.

The cross-referencing of *material* and *immaterial* data revealed only partial variations in columns types, connection techniques and dome shapes. We can conclude that the evolution of the shape of the *Qubbas* is due to construction methods. These forms bear witness to architectural habits and local engineer.

The Analysis of the heights revealed a fundamental fact that is directly related to the religious figure concerned. We argue that the more the *Walï* is venerated, the greater the volume and the greater the influence of his cenotaph.

All the *Qubbas*, housing W1, W2, W4 and W5 are grouped together inside the cemetery. As for the *Ghaûth* (W3), their *Qubba* is located alone in the cemetery.

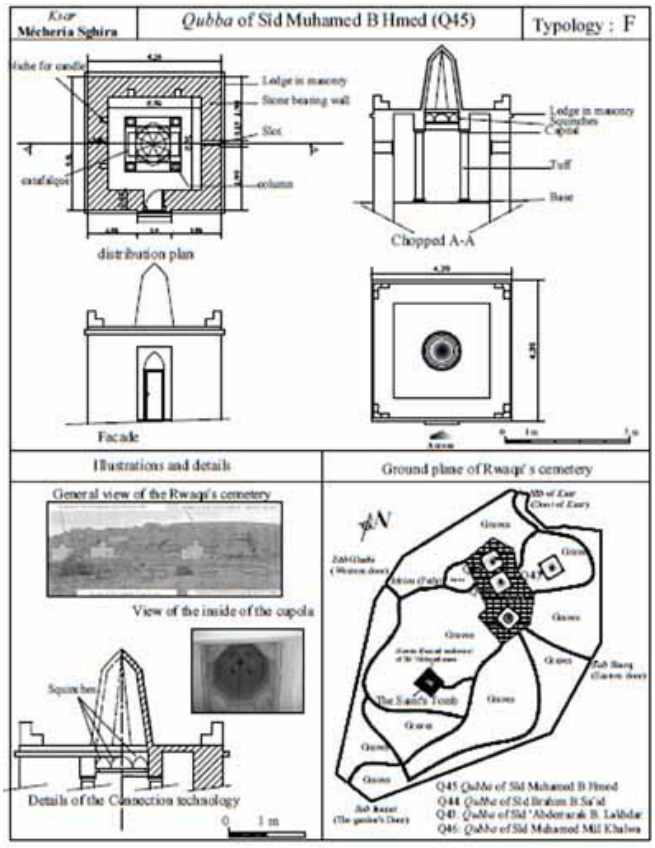


***Figure 4**. Qubba specimen of typology A (Source: Djeradi & Lakjaa).*

***Table 4**. Summary of the intersection of material and immaterial data.*

Typology	Types of Walï	type of occupation and size		construction systems			Types of Dome
	Awliya	Dimension	occupation	arcade System	Column types	techniques of connecting	
E	W2, W4 and W5	D2	OG	**B**	**F**	**B**	**T2**
F	W1	D3	OG	B	A	B	T2
A	W1	D3	OG	B	A	A	T1
G	W3	D1	OI	B	F	B	T2

7.4. Analysis of axiological data

The analysis of the axiological took place in three stages:

1. Counting;
2. Comparison;
3. Interpretation.

7.4.1. Counting

The aim is to bring together the data collected in a summary document. The counting is divided into two stages:

1. Distribution of respondents by family, nationality (national and international) and profile (general public, expert);
2. Statistical processing.

7.4.1.1. Distribution of respondents by family

Respondents are grouped by nationality and by profile. The national respondents number is *(136), (13)* of whom are experts. The international respondents number is *(35), (06)* whom are experts.

7.4.1.2. Statistical data processing

Statistical processing was carried according to the function of the item and according to the types of respondents. "Flat" sorting was applied.

Table 5.*Statistical treatment of items, relating to the normalization function.*
NPR: National public respondents.
NER: national expert respondent.
IPR: International public respondents.
IER: International expert respondents.

Respondents	Function's types	Types of items	Items	coded	YES		NO	
					Absolute values	Relative values	Absolute values	Relative values
NPR	Normalization	closed	Do you have an ancestor buried in a Qubba?	Q1	40	32,50%	83	67,50%
		closed	Have you ever visited a Qubba?	Q2	94	76,40%	29	23,60%
		filter	Do you know other funerary monuments?	Q5	44	35,80%	79	64,20%
NER		closed	Do you have an ancestor buried in a Qubba?	Q1	9	69%	4	31%
		closed	Have you ever visited a Qubba?	Q2	12	92,30%	1	7,70%
		filter	Do you know other funerary monuments?	Q5	12	92,30%	1	7,70%
IPR		closed	Do you have an ancestor buried in a Qubba?	Q1	6	20,70%	23	79,30%
		closed	Have you ever visited a Qubba?	Q2	17	58,60%	12	41,40%
		filter	Do you know other funerary monuments?	Q5	20	69,00%	9	31,00%
IER		closed	Do you have an ancestor buried in a Qubba?	Q1	1	16,67%	5	83,33%
		closed	Have you ever visited a Qubba?	Q2	3	50,00%	3	50,00%
		filter	Do you know other funerary monuments?	Q5	5	83,33%	1	16,67%

1. Quantitative knowledge items;
2. Items expressing values.

We will not dwell on the quantitative data. These are mentioned in the form of Table. 5 (Table 5).

We are interested in data that express value. By definition, works of art are things that we value, that we qualify (Heinich, 2009).

Q3: Do you know the function of a Qubba?

National public respondents (NPR)

- *(72)* claim that they know the function of a *Qubba*.
- *(51)* do not know its function.
- *National expert respondents (NER)*
- *(11)* claim that they know the function of a *Qubba*.
- *(02)* do not know its function.

International public respondents (IPR)

- *(09)* claim that they know the function of a *Qubba*.
- *(20)* do not know its function.

International expert respondents (IER)

- *(02)* claim that they know the function of a *Qubba*.
- *(04)* do not know its function.

Q4: What do the Qubbas, these small funeral constructions, represent to you?

We have given free choice to the respondents to give an answer. For sorting, we take the three most frequent answers.

(NPR)

- *(67)* did not provide answers.
- *(21)* consider it to be a mausoleum.
- *(15)* think it was a memorial.

(NER)

- *(04)* did not provide answers.
- *(03)* consider it to be a sacred space
- (02) think it to be a mausoleum.
- *(02)* of which the *Qubba* represents nothing for them

(IPR)

- *12)* did not provide answers.
- *(07)* of which the *Qubba* represents nothing for them.
- *(05)* think it is a sacred space.
- *(IER)*
- *(04)* consider that the Qubba is a memorial.
- *(02)* did not provide answers.

Q6: What difference (s) do you notice in their external aspects?

We have given the respondents a free choice to give an answer. We proceeded to the classification of the answers (Combessie, 2007).

- No difference: twenty one answers.
- Materials: seven answers.
- Template: three answers.
- Dome shape: twelve answers.
- Shape and template: eleven responses.

Form and location: One hundred and five responses.

- Without answer : twelve answers.

(NPR)

- *(85)* think that the differences between the *Qubbas* reside in form and location.
- *(18)* consider that there are no differences, all *Qubbas* are similar.
- *(06)* see the differences in the shape of the dome.
- *(06)* whose opinions of differentiation are oriented towards the shape of the *Qubba* and its size.

(NER)

- *(07)* experts did not respond.
- *(03)* consider that there are no differences, al*l Qubbas* are similar.
- *(02)* see the differences in the shape of the dome.

(IPR)

- *(20)* think that the differences between the Qubbas are in form and location.
- *(04)* consider that the differences are in the shape of the dome.
- *(03)* see the differences in used construction materials.

(IER)

- *(04)* did not provide answers.
- *(02)* see the differences in the shape of the *Qubba* and its color.

Q7: What do you think will be the cause (s)? (To be classified in order of importance)?

We have given the respondents a free choice to answer it. We have classified the answers into four categories:

- The causes of *material* orders
- The causes of *immaterial* orders
- The causes of *material and immaterial* orders.
- Ignored causes

(NPR)

- *(92)* of the respondents are unaware of the causes of the differences between the *Qubbas.*
- *(16)* think that the causes are *immaterial* in relation to the Saint who resides in the *Qubba.*
- *(08)* consider that the causes are *material*, mainly related to the availability of building materials, the mastery of construction techniques, and cultural interference.
- *(07)* see the differences between *material and immaterial* orders.

(NER)

- *(09)* of the respondents are unaware to the causes of differences between the Qubbas.
- *(02)* think that the causes are immaterial.
- *(01)* respondent considers that the causes to be material.
- *(01)* respondent found that the differences to be material and immaterial.

(IPR)

- *(24)* respondents are unaware of the causes of differences between the *Qubbas*.
- *(03)* think that the causes are *material.*
- *(01)* respondent considers the causes to be *immaterial.*
- *(01)* respondent considered the differences to be *material and immaterial.*

(IER)

- *(04)* respondents do not know the causes of differences between the *Qubbas.*
- *(02)* respondents consider the causes to be *immaterial.*

Q8: You have an idea on the mystical chain (Silsila)?

This item is closed. The answers are as follows:

(NPR)

- *(104)* respondents do not know the mystical chain.
- (19) know the *mystical chain*.

(NER)

- *(10)* respondents do not know the *mystical chain.*
- (03) know the *mystical chain.*

(IPR)

- *(28)* respondents do not know the *mystical chain.*
- *(01)* knows the mystical chain.

(IER)

- *(06)* international experts do not know the *mystical chain.*

Q9: in your opinion, the Qubba is a cult building or cultural building?

It is a question of classifying the qubba according to its vocation. We have given three possible answers:

- *cult building.*
- *cultural building.*
- No idea.

(NPR)

- *(52)* respondents state that the *Qubbas* are *cult buildings.*
- *(49)* think *Qubbas* are *cultural buildings.*
- And finally *(22)* have no idea about the functional character of the *Qubba.*

(NER)

- *(08)* respondents state that the *Qubbas* are *cult buildings.*
- *(05)* experts think that they are *cultural buildings.*

(IPR)

- *(12)* respondents state that the *Qubbas* are *cult buildings.*
- *(15)* think *Qubbas* are *cultural buildings.*
- And *(02)* have no idea about the functional character of the *Qubba.*

(IER)

- *(02)* respondents consider the *Qubbas* to be *cult buildings.*
- *(03)* mention that they are *cultural buildings.*

- And *(1)* expert has no idea on the functional character of the *Qubba*.

Q10: Can it be classified as a national tangible heritage?

This item is closed. The answers are as follows:

(NPR)

- *(85)* respondents think that the *Qubbas* can be classified as *national tangible heritage.*
- *(38)* believe that these buildings do not deserve to be classified as *national tangible heritage.*

(NER)

- *(11)* experts consider that the *Qubbas* can be classified as *national tangible heritage.*
- *(03)* among the experts evokes, that they do not have the merit to be classified.

(IPR)

- *(20)* respondents think that the *Qubbas* can be classified as *national tangible heritage.*
- *(09)* consider that these buildings do not deserve to be classified as *national tangible heritage.*

(IER)

The surveyed experts are split

- *(03)* experts believe that the Qubbas can be classified as *national tangible heritage.*
- *(03)* among the experts mentioned that they do not have the merit of being classified.

Q11: Is its architecture part of the architectural vocabulary?

The purpose is to classify the *Qubba* according to its architectural vocabulary. The *Qubba* expresses architecture of:

- *From below;*
- *Religious;*
- *Sacred;*
- *Funeral;*
- *No idea.*

We take the three most frequent answers for.

(NPR)

- *(52)* respondents state that the architecture of the *Qubba* is a *funerary architecture.*
- *(29)* consider it to be part of the *religious architecture vocabulary.*
- And *(26)* see it as s*acred architecture.*

(NER)

- *(04)* experts consider that the *Qubba* is of *sacred architecture.*
- *(04)* experts consider that the architectural vocabulary of the *Qubbas* is *funerary.*
- And *(03)* experts think that it is an *architectural vocabulary* that belongs to the *religious.*

(IPR)

- *(09)* respondents state that the architecture of the *Qubba* is a fu*nerary architecture.*
- *(09)* respondents consider it to be *sacred.*
- And *(06)* see it as an *architecture from below.*

(IER)

- *(02)* experts consider the *Qubba* to be *sacred architecture.*
- *(02)* state that it falls within the *religious architectural vocabulary.*
- *(01)* expert considers the *Qubba* to be *funerary architecture.*
- Another expert has no idea about the architectural value of the *Qubba.*

Q12: Does it deserve to be restored?

This item is closed. The answers are as follows:

(NPR)

- *(91)* respondents think that the *Qubbas* are worthy of *restoration.*
- *(38)* respondents believe that the buildings were not worthy of *restoration.*

(NER)

- *(11)* experts say the *Qubbas* are worth *restoring.*
- *(02)* experts on the other hand, consider that these buildings do not deserve to be *restored.*

(IPR)

- *(18)* respondents think the *Qubbas* are worthy of *restoration.*
- *(11)* thought the *Qubbas* are not worthy of *restoration.*

(IER)

- *(02)* experts think that the *Qubbas* are worth *restoring.*
- *(04)* experts think that the *Qubbas* are not worthy of *restoration.*

After having sorted the answers, we will devote ourselves to comparing of the answers.

7.4.2. Comparison

During and after the surveys are carried out, the question arises as to how the comparison should be interpreted and how it should be reported (Courtin et al, 2012). Going beyond

the descriptive phase, another phase consists of try to understand the object of study through public thought (Angers, 1996). To do this, a comparative analysis is appropriate (Paugam, 2012).

The national respondents report knowledge of the function of the Qubba, at various levels. On the other hand, for the international respondents, ignorance of the function prevails.

When we wanted to know the representative image of the object of study, we noticed that the refusal rate is high. We note that international experts see the Qubba as a memorial. For the other categories of respondents, the images that come up are the mausoleums and the sacred spaces.

The majority of (NPR and IPR) noticed the difference in the shape of the building and its layout. For the international experts who provided answers, the difference lies in the shape and the size. The national experts consider that the Qubbas are similar.

(75%) of respondents are unaware of the factors that influence the outward appearance of Qubba. For the others, all converge on the immaterial causes. The exception is the foreign public and national experts who consider the causes are material.

The majority of the public questioned (all types) are unaware of this mystical and spiritual phenomenon.

In the *Qubba*'s vocation, the opinions are divided between a religious building or a cultural building. For the general national public the tendency is about (40%) for each vocation. On the other hand, more than (60%) of the national experts are of the opinion that the Qubba is a cultural building. For the foreign respondents half consider it to be a cultural facility.

For the general (NPR and IPR), the majority (69%) consider that *Qubbas* have architectural, cultural, religious and historical values and can be classified as national heritage. This opinion is accentuated by national experts (85%). On the other hand, international experts are divided in their opinions.

Concerning the value and architectural expression of the *Qubba,* the opinions converge on religious, sacred and funerary architecture.

All respondents agreed that *Qubba* is worthy of restoration. With the exception of international experts, (67%) of whom expressed their opposition to the restoration.

7.4.3. Interpretation

The representative mental images are:

- *Mausoleum;*
- *Sacred;*
- *And memorial.*

We were led to reject the signifier: Mausoleum represented by some respondents as the equivalent of *"Qubba"*. The definition of mausoleum seems to us insufficient to express all the semantic, patent and latent charge conveyed by the Qubba. Derived from Mausole, became generic to designate any funerary monument (Roland, 2012). The Maghreb's Qubbas are erected only in homage to holy people.

The sacred is part of the belief system, which distinguishes between sacred and profane by symbolizing the sacred with a totem (Codrington, 1891). The *Qubba* is a *totem.* As a symbol of the mana emanating from the social group. The *Qubba* is not only the symbol of the sacred, it is also the substance of the sacred, the materialized sacred (Hubbert & Mauss, 1968).

The sacred and the memorial come together. In the *ksourian* society, the *sacred* is certainly substantial but above all relational. We see it, when the seat of the sacred (*Qubba* or ancestor), is more or less absent and arises only in significant moments. On this occasion, it is the relational that amplifies the sacredness of the object or being. These moments are discovered through the feasts *(Wa'das)* (Roncayolo, 1990). The *Qubba* by receiving the feast becomes a qualitatively different space (Bachelard, 1957).

In the case of the *Wa'das* the event is either the beginning or the end (the death or birth of the Saint).The *Wa'da,* can only be a return to the constitutive milestones of the memory and the community (Halbwachs, 1968).

The public believe that the *Qubbas* are all the same. We have had to recognize how inaccurate this conception is. The examination with the help of pho-

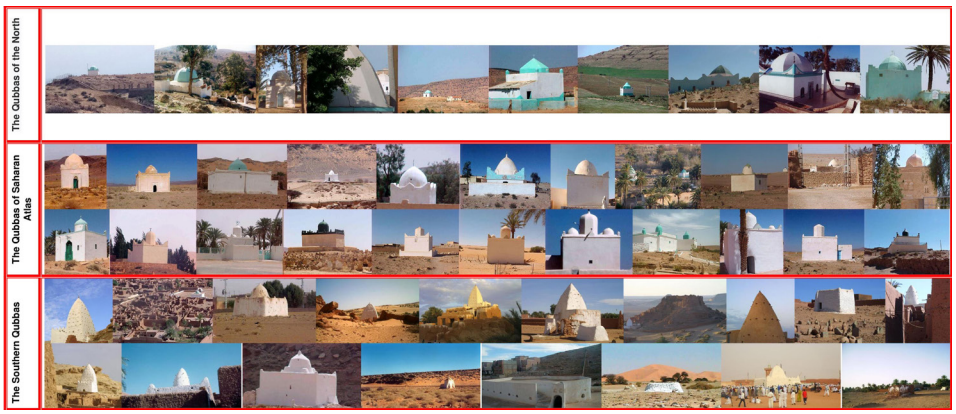


Figure 5. *A Collection of Qubbas forms in the North, in the Saharan Atlas and in the South (Source: Djeradi & Lakjaa).*

tographs of the external appearance of the different *Qubbas* throughout the various regions of the country shows the diversity of forms (Figure 5). These small buildings in the North are built in typical North African architecture (square topped by a hemispherical dome); those in the South are closer to African architecture (Mahrour, 2011).

The differences in the external appearance of the *Qubbas* lie in the immaterial factors. The material logics remain secondary. The technique comes for concretize. Since Heidegger we know that the act of living precedes the act of building (Heidegger, 2012).

In the Qubba's vocation, a confusion reigns among the respondents. They are divided between the religious and cultural vocation. The *Qubba* combines both vocations. Its plan and construction are an art form. The adepts have tried to recreate the universe in a three-dimensional space where they will penetrate both physically and spiritually.

The architectural vocabulary of the *Qubba* expresses the sacred. The sacred architecture strives to reproduce the patterns, structures and alignments of the universe (Humphrey & Vitensky, 1997). To visit the *Qubba* is to present oneself at the centre of the cosmos, at the threshold of the sky (Maffesoli, 2013).

In the *ksour*, the buildings are small and humble. The Horizontality remains the dominant rule. The houses are only the tombs of this world. The verticality is the expression of the sacred. It is reserved for exceptional buildings: *Qubba,* minaret (Djeradi, 2012).

The *Qubba* can be classified as national heritage, because it is a merged image of the sacred and the memorial. It is a combined architecture of the sacred, the religious and the funerary. Its vocation is a hybrid of *worship* and *culture.*

The majority of the *Qubbas* are maintained by the communities attached to them. The *Qubbas* are limed and cleaned episodically and regularly as the Wa'da approaches.

Some *Qubbas* are in ruins despite their architectural values. The hagiography accounts for this phenomenon by the intertribal conflicts around the *Qubbas.* The dilapidated state of the *Qubbas* can be explained by these conflicts. The descendants of a saint, once they have been expelled from a territory, abandon their *Walï* and his abode.

8. Conclusion

Purposefully, our analysis is multidirectional focused on the distinctive look we have given to the object: The material and the immaterial in the *Qubbas.* What would be the part of the immaterial conveyed by the sacred in the construction of the *Qubbas*?

Two forms characterize and identify the *Qubbas:* the square and the vault. Regarding the square, it is marked by pillars arguably representing the four cardinal points. The vault would represent the sky reduced to a scale of architectural element. The arch occupies a prominent place in the architectural vocabulary of the *Qubbas.*

The architecture of the Qubbas is varied and variable over time. Their symbolism has constantly changed and evolved, giving the *Qubbas* differentiated external appearances. As for

the causes of differentiations, they are founded in the *immaterial,* through charges of veneration with respect to sacred characters

The study on the *Qubbas* of the *Ksour* Mountains shows that it is not at the level of a precise architectural form that the sacred is expressed. Rather, it should be sought in the care taken by a group to improve architecture, stemming from its culture and its environment. There are several logics of organization of the *Qubba* space and the most decisive ones, remain those which come from what we have called the immaterial. Technological and material logics remain secondary.

It seems relevant to us to stop seeing in the architecture of the *Qubbas* only a spontaneous architecture without rules or models. Another look is essential, by which tradition does not necessarily rhyme with archaic or backlog.

Endotes

[1] From the root awd: the periodic return

[2] A district fortified in the Ksar

[3] See the links cited in reference to view the questionnaires

[4] The supreme recourse of the afflicted, the refuge, the savior.

[5] Means pole.

[6] Stakes, tent pegs.

[7] The elected, the chosen, the best.

[8] Substitutes

[9] The distinguished, the excellent

[10] Leader of a group of saints

[11] They are the descendants of the Prophet.

[12] We designate all the descendants of Abu-Beker-es-Ṣeddik.

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The influence of traditional Indian architecture in Balkrishna Doshi's IIM Complex at Bangalore: A comparative analysis using fractal dimensions and lacunarity

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Abstract

Initiated in 1977 and completed in 1992, the Indian Institute of Management (IIM) Complex at Bangalore is generally accepted as one of the most significant turning points in the career of the Indian architect Balkrishna Vithaldas Doshi, as well as one of the key works in the history of contemporary Indian architecture. As declared by the architect himself and interpreted by scholars, the complex's design, in particular its sophisticated spatial order, was significantly influenced by and closely resembles some key specimens of the traditional Indian architecture: the Royal Complex of Fatehpur Sikri (a specimen of Mughal architecture), the Meenakshi-Sundereshwara Temple Complex, and possibly the Sri Ranganatha-Swamy Temple Complex (both are examples of Hindu architecture). However, these qualitative claims and commentaries have remained mostly unverified in a quantitatively measurable manner. Thus, the present paper uses comparative fractal dimension and lacunarity analysis to mathematically calculate the visual complexity and spatial heterogeneity of these architectural works, focusing on the site plans as the best device to efficiently and comprehensively represent the spatial orders two-dimensionally. While the lacunarity analysis shows a relatively low heterogeneity of the IIM Complex compared to the traditional counterparts, the fractal dimension analysis indicates a relatively high concurrence between the visual complexities of the spatial orders of the IIM Complex and both the Hindu temple compounds. This finding confirms Doshi's preference for a more unorthodox spatial fabric of Hindu architecture compared to the more straightforward order of Mughal architecture.

Keywords

Balkrishna Vithaldas Doshi, Fractal dimension analysis, IIM Complex at Bangalore, Indian architecture, Lacunarity analysis.

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1. Introduction

Designed from 1977 to 1979 and completed in 1992, the architect Balkrishna Doshi's Indian Institute of Management (IIM) Complex at Bangalore is now considered one of the architect's most acclaimed masterpieces. The IIM Complex marks a transition in Doshi's evolution of architectural approach, at which time his earlier works, which had been heavily influenced by Western Modernism, transformed into a new kind of architecture which was (and still is) more sensitive and responsive to the contemporary Indian context. It was during this time that Doshi re-learned Indian culture and philosophy and took inspirations from the Indian architecture from the past. In this regard, the remarkable influence of traditional Indian architecture in the IIM Complex is undisputable; it is admitted by Doshi himself (Doshi, 2012a) and noted by a number of scholars (Curtis, 1987; Curtis, 1988; Mukerjin & Basu, 2011; Hoof, 2019; Subramanian, 2019) that the design of the complex was inspired by a number of ancient Indian masterpieces, such as the Royal Complex of Fatehpur Sikri, the Meenakshi-Sundereshwara Temple Complex, and possibly the Sri Ranganatha-Swamy Temple Complex.

In particular, these structures share a mutual key characteristic with Doshi's IIM Complex at Bangalore: an advanced, intricate spatial order. Scholars have observed how the IIM Complex resembles those ancient masterpieces: the labyrinthine, fluid sequence of spaces, the interweaving of indoor and outdoor area, the shifting axes forming an unorthodox yet balanced type of symmetries, and the arrangement of hierarchical layers, resulting in ambiguous and mysterious spatial experiences. These are the very traits which characterize the complexity of traditional Indian architecture in particular, and the complexity of Indian culture and life in general; a complexity which Doshi has been continuously attempting to capture through his works. Nevertheless, these commentaries on the IIM Complex's formal properties rely heavily on qualitative strategies, such as poetic description, interpretive analysis, or phenomenology; this implies a need to investigate such claims and observations in a more quantitative, mathematically measurable manner. This study aims to provide such mathematical evidence which may confirm (or disprove) these views on the influence of the traditional Indian architecture in Doshi's IIM Complex at Bangalore by using an alternative method for quantitative formal inquiry in architecture: fractal dimension analysis and lacunarity analysis.

The concept of fractals and fractal dimensions was first coined by Benoit Mandelbrot (1977); in principle, fractal dimension analysis is a method to mathematically quantify the visual *complexity* of an image or an object. This method has been conducted in various areas, such as medical studies (Asvestas, et al., 2000), economy (Andronache, et al., 2016), and geology (Blekinsop & Sanderson, 1999). Since the 1990s, the idea of fractals has been more frequently utilized as both a quantitative technique for analyzing architecture (Rian, et al., 2007; Vaughan & Ostwald, 2008; Ostwald & Ediz, 2015; Qin, et al., 2015) and a generator for computational, algorithm-based architectural designs (Ediz & Çağdaş, 2004; Ediz, 2009; Sakai, et al., 2012; Sedrez & Pereira, 2012).

The notion of lacunarity was initially observed by Mandelbrot as well (1983). In short, lacunarity analysis is a method to mathematically quantify "gap distribution" or the s*patial heterogeneity* of a geometric structure. Researches utilizing lacunarity analysis have been conducted in various areas such as landscape ecology (Malhi & Román-Cuesta, 2008) and biology and medical studies (Gould, et al., 2011). In the field of built environment, lacunarity analysis is proven useful for spatial analysis in urban studies (Barros Filho & Sobreira, 2005; Alves Júnior & Barros Filho, 2005; Kaya & Bölen, 2017). Moreover, lacunarity analysis has also been utilized to produce inputs and feedbacks for computational-generative urban design (Gürbüz, et al., 2010; Swaid, et al., 2016).

This present paper commences with a short biography of Balkrishna Doshi and how his approach in architecture has been (and still is) influenced by both Modernism and Indian context, followed by a description of the IIM Complex at Bangalore in relation to the Indian architectural works from the

past which might influence Doshi in designing the complex. Afterwards, overviews of fractal dimension and lacunarity analysis as well as the applications in architectural researches are presented, followed by brief descriptions of the variables and settings of analysis used in this study. Finally, the results of fractal dimension and lacunarity calculations are presented, followed by mathematical analysis and interpretive discussions of those quantitative results.

Before progressing, there are some issues that must be clarified. First, with no purpose to understate the broader and more abstract significance of the IIM Complex and other architectural works investigated in this study, be it historical, cultural, or philosophical, such aspects are not directly considered in this paper. This study is focused on two of the formal properties of these works; namely, the visual *complexity*, measured in the form of *fractal dimension,* and the *spatial heterogeneity*, measured in the form of *lacunarity.* Second, as described further in following sections, the analysis is focused on the *spatial order* of the architectural works. Consequently, other formal properties, such as the elevational expression or the layout of building masses, are not investigated in this study; nevertheless, such aspects may be evaluated in future researches.

2. Architect Balkrishna Vithaldas Doshi

Born in 1927 in Pune, India, Balkrishna Vithaldas Doshi began his architectural education in Bombay; however, it is the chance for working with two Modern masters, Le Corbusier (from 1951 to 1955, both in Paris and in India) and Louis Isadore Kahn (in 1962, for the design of the Indian Institute of Management in Ahmedabad, together with Indian architect Anant Raje) that might be considered as the real learning experiences for him. Reasonably, the earlier works of Doshi display strong characteristics of Western Modernism, influenced by the two masters.

Nevertheless, the time finally came for Doshi to feel that, up to that point, his works seemed out of place and significantly lacked a much-needed Indian identity. This was a period during which time Doshi looked back upon the past; in addition to observing the traditional Indian architecture, he also studied the literatures, culture, and in general the Indian philosophies. Doshi's continuous learning and searching establishes him as one of the most respected contemporary architects in India, and in 2018, he was awarded the Pritzker Architecture Prize. His mature works embody his idea of architecture as a reflection of the complexity and nuanced aspects of the relationship between human and environment; an idea of architecture as a "celebration of life" (Doshi, 2012b).

3. The Indian Institute of Management (IIM) Complex at Bangalore and the possible influence of traditional Indian architecture

The Indian Institute of Management (IIM) Complex at Bangalore is one of the four national institutes of management envisaged in the early 1960s by the government of India, the others being at Ahmedabad, Calcutta, and Lucknow. The complex at Bangalore was designed from 1977 to 1979 by Doshi in collaboration with James Allen Stein, Jai Rattan Bhalla, and Achyut Kanvinde, and was constructed between 1977 and 1992.

The IIM Complex at Bangalore is one of the key works from the period of a significant transition in Doshi's architectural career, during which time Doshi felt that his previous works "somehow have a foreign look" and "appear not to have their roots in the soil", and that he had to develop a new kind of architecture which is more appropriate to the vision of the new India; a kind of architecture which is more sensitive and responsive to the "people, their tradition, and social customs and the philosophy of life" (Doshi, 1981: 67). Taking inspirations from Indian architecture of the past, the IIM Complex at Bangalore is an appropriate example of such new kind of architecture. The enormous complex was designed in such a manner that resembles a city, a whole "environment" or *vastu*, more than a "free-standing" building (Curtis, 1988: 29), and in this sense, the influence of large ancient Indian palaces and temple complexes is undeniable.

On numerous occasions, Doshi did express his admiration for traditional Indian architecture and urban design in general, and he also explicitly stated that the design of the IIM Complex was inspired specifically by two large ancient Indian complexes: the Royal Complex of Fatehpur Sikri near Agra and the Meenakshi-Sundereshwara Temple Complex at Madurai (Doshi, 2012a: 14); this was also observed by other scholars (Curtis, 1987; Curtis, 1988; Mukerjin & Basu, 2011; Hoof, 2019; Subramanian, 2019). Besides, on an occasion, while describing his opinion on the importance of spatial experience in Hindu temples, he mentioned specifically the Temple City of Srirangam (Doshi, 1989), at which the Sri Ranganatha-Swamy Temple Complex is located. While Doshi did not mention any explicit connection between the temple and the IIM Complex, its spatial resemblance to the Meenakshi Temple makes it a potential, influential comparison worth to investigate.

Constructed between 1571 and 1585, the Royal Complex of Fatehpur Sikri is a superb example of Mughal architecture (Pandya, 2014: 26); meanwhile, both the Meenakshi-Sundereshwara and the Sri Ranganatha-Swamy Temple Complexes (built in 17th century and c.10th CE, respectively) unmistakably display the key features of Indian Hindu architecture (Hari Rao, 1976; Pandya, 2014: 112). On one side, it is evident that Doshi borrowed the idea of numerous interlocking between building masses and courtyards, the ambiguous border between indoor, outdoor, and all the interstitial spaces (Curtis, 1987: 36), as well as the concept of multiple axes and local symmetries which sometimes clash each other, restraining the whole complex from becoming too formal and too monumental and instead feeling surprisingly humane (Curtis, 1988: 29), from the Royal Complex of Fatehpur Sikri, with its multiple nuclei formed by numerous building masses and courtyards surrounded by galleries and colonnades, declaring each own spatial and formal arrangement, yet harmonious as a whole. On the other hand, the IIM Complex's more intricate and complex fabric of spaces and architectural elements (Subramanian, 2019: 37), the hierarchical structure of "layers" and "overlays" (Curtis, 1988: 29), and the experiential sense of rhythm and progression which frequently interrupted and denied by changes and shifts in vistas or axes (Hoof, 2019: 185), also bring to mind the Meenakshi-Sundereshwara and the Sri Ranganatha-Swamy Temple Complexes. In conclusion, those features which mutually characterize Doshi's IIM Complex and these three major structures may be summarized as one common formal property: a sophisticated, if not unorthodox, spatial order.

Thus, it is the *formal relationship between* Doshi's IIM Complex and these three influential Indian architectural complexes from the past which becomes the focus of this study. In particular, this study investigates the visual complexity, i.e., the density of the visual information found in the spatial order of these architectural works, and the spatial heterogeneity, i.e., the distribution of such visual information. To examine this relationship in a quantitative and mathematically measurable manner, this study utilizes alternative two complementary methods for analyzing formal properties in architecture: fractal dimension and lacunarity analysis.

4. Research methods

Researches based on the idea of applying quantitative and mathematically measurable approach to analyze certain architectural properties are being more frequently conducted, complementing the more abstract and occasionally poetic qualitative analyses. The examples of such inquiries are the study by Şener & Görgül (2008), wherein a particular algorithm is proposed to investigate the shape grammar of classical Ottoman mosques, and the research by Ye and Van Nes (2014) in which space syntax, spacematrix, and mixed-use index are utilized to analyze the New and Old Towns of Songjiang in a comparative manner. Similar to the latter study, this present paper proposes a premise of comparatively analyzing new architecture and its traditional counterparts; yet in this case, the quantitative approach is focused to the visu-

al complexity as well as the spatial heterogeneity of these architectural works, using the methods of fractal dimension and lacunarity analysis.

4.1. Fractal dimension analysis

Fractal dimension is a dimension in the form of *fraction* or n*on-integer value* indicating the *visual complexity* of 2-dimensional images and 3-dimensional objects, in a directly proportional relationship. For instance, a value of 1.25 indicates a 2-dimensional image with low visual complexity, whereas a value of 2.75 indicates a 3-dimensional object with high visual complexity. Mandelbrot (1982) proposed box-counting method to calculate fractal dimension, but it is Voss (1986) who is commonly credited with the first use of the method. Afterwards, researches utilizing fractal analysis have been conducted more frequently in various areas, including architecture. The focus of these studies varies from vernacular and traditional architecture (Ediz, 2003) to Modern and contemporary masterpieces (Ostwald, et al., 2008); the scale ranges from building component (Sakai, et al., 2012) to urban form (Qin, et al., 2015); and the strategy differs from analyzing past works (Ediz & Ostwald, 2012) to utilizing fractal analysis for generating future design (Çağdaş, Gözübüyük, & Ediz, 2005; Ediz & Çağdaş, 2007).

Due to the complexity in terms of its formal and visual characteristics, traditional Indian architecture has become a favoured object in a number of fractal-related researches. For example, Dutta & Adane (2014) and Sardar & Kulkarni (2015) separately conducted studies on fractal geometry in Indian Hindu temples, while Rian, et al. (2007) calculated the fractal dimension of the Kandariya Mahadev Temple in Khajuraho. Yet, it is the study by Kitchley (2003), wherein the fractal dimension of Indian architecture was compared to that of Modern piece, that might be considered most similar to this paper, in terms of the main idea of *comparative* fractal dimension calculation. However, this present paper utilizes the comparative fractal analysis in a more focused manner: a comparison between Balkrishna Doshi's IIM Complex at Bangalore and a number of major traditional Indian complexes which possibly influence the design of the IIM Complex, in terms of the intricacy of the spatial order.

4.1.1. Methodological concerns

As previously described, the most prominent mutual formal and visual characteristics and features of Doshi's IIM Complex at Bangalore and the influential Indian architectural works from the past (the Royal Complex of Fatehpur Sikri, the Meenakshi-Sundereshwara Temple Complex, and the Sri Ranganatha-Swamy Temple Complex) can be summarized under the major theme of *spatial order*. Since the fractal analysis in this paper were conducted two-dimensionally, this *spatial order* must be visualized in the form of the best possible two-dimensional drawing: the *site plans*. Compared to the elevation drawings, which give insight on the exterior forms, masses, and visual articulations but generally inform very little or nothing about the interior, the site plan drawing offer a comprehensive reading on a building's spatial network, including both indoor and outdoor spaces, in a most efficient manner. Therefore, while there are indeed possibilities to conduct fractal analysis upon the other formal aspects of the IIM Complex and these influential ancient complexes in the future works, the fractal calculations in this study are focused on the site plans.

For this study, a number of images were digitally retraced by the authors using the Autodesk AutoCAD 2018 software. The site plan of the IIM Complex (Figure 1) was redrawn based on a drawing depicting the main section of the complex, credited to Stein Doshi & Bhalla in association with Kanvinde & Rai and published in Curtis's book (1988: 99). For the Royal Complex of Fatehpur Sikri, the site plan (Figure 2a) was based on a drawing in a book by Herdeg (1990: 51). The site plan of the Meenakshi-Sundereshwara Temple Complex (Figure 2b) was redrawn based on a drawing in a book published by John Murray (1911: 646); and for the Sri Ranganatha-Swamy Temple Complex, the site plan (Figure 2c) was based on a drawing in a book by Fer-

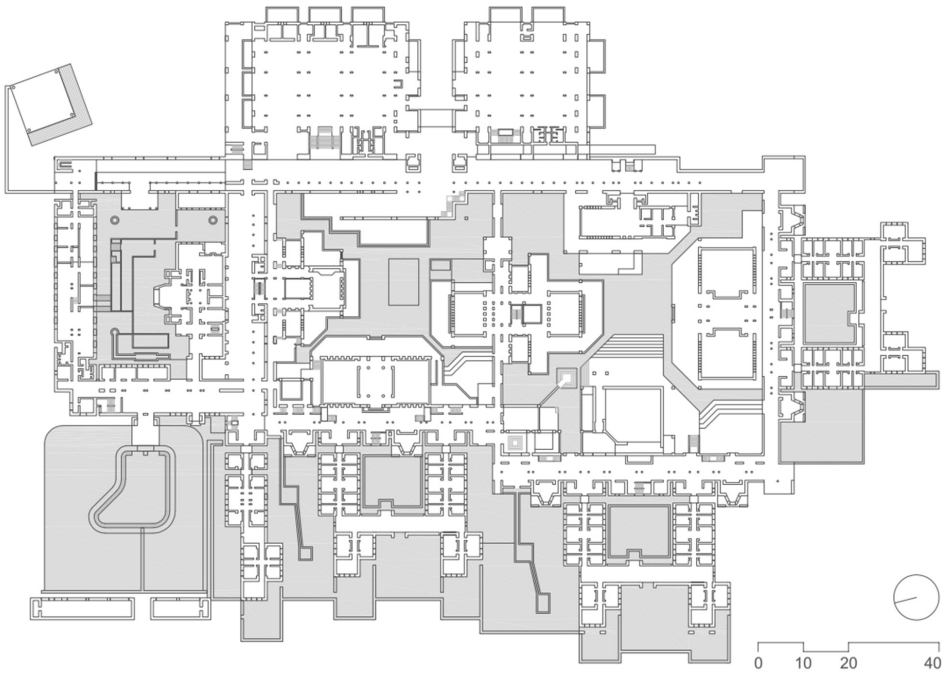


Figure 1. *The site plan of Doshi's IIM Complex at Bangalore (main section).*

gusson, et al. (1910: 368). These three site plans are depicted on the same scale and orientation. It should be noted that, in this paper, the fractal dimension analyses only measure the lines. The gray areas shown in the site plans, depicting the outdoor open spaces, are not measured, and presented here only to illustrate the differentiation between the indoor and outdoor spaces of these complexes.

4.1.2. Image preparations

In principle, architectural fractal dimension analysis requires a strict representation of only the concrete, physical architectural elements of the objects in the form of *line drawings*. Thus, neither shades, colors, non-linear texture, any conventional symbols usually presented in technical drawings, nor any entourage components such as humans, vehicles, or vegetation, may be depicted on the drawings. Furthermore, for the purpose of comparative fractal analysis, all the drawings must be presented in a similar manner of depiction, with an equal level of visual complexity. Thus, in the four site plan drawings used in this study, only a limited set of elements is depicted: the outlines of the wall and columns, and the lines indicating the differences in the floor elevation. The panes, frames, and sills of the doors and windows, as well as the furniture, are not presented. Finally, the images must be produced according to certain standards (Foroutan-Pour, et al., 1999; Ostwald & Vaughan, 2013) summarized in Table 1.

Table 1. *Methodological variables and settings for fractal dimension calculations used in this paper.*

Stage	Variable	Setting	Notes
Image preparations	White space	50/50	The dimension of the field was determined by enlarging the rectangular outline of the image by the scale of √2, or approximately 1.4142; this results in the ratio of 1:1, or 50/50, between the area of the image and the white space around the image
	Image position	Centre-centre	The image was located at the centre of the field before analysis
Fractal dimension calculations	Scaling coefficient (SC)	√2:1	This is the ratio by which successive grids are reduced in size
	Grid disposition (GD)	Centre-growth	Successive grids for comparison were generated from the centre of the image
	Grid comparison	10	The number of grids/iterations
	Starting grid size	0.25 *l*	The first grid was generated by dividing the shortest dimension of the field by four

4.1.3. Fractal dimension calculations

Among a number of methods developed for calculating fractal dimension, the method used in this study, i.e., the *box-counting method*, is considered as the most suitable, useful, reliable, and accurate for most results (Ostwald & Vaughan, 2016: 12). The box-counting

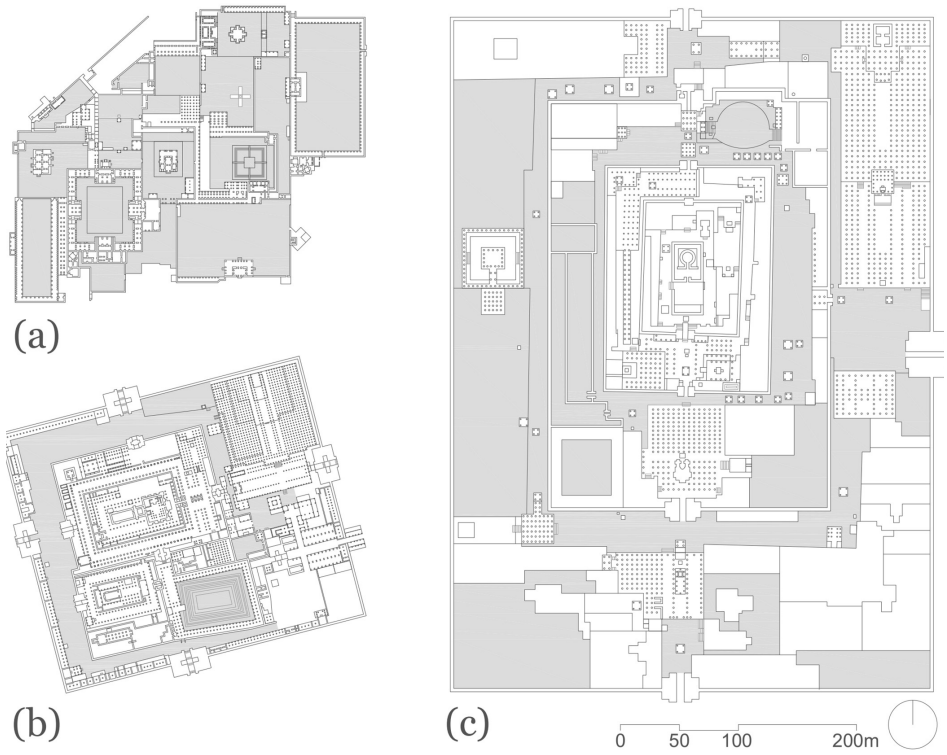


Figure 2. *The site plans of (a) the Royal Complex of Fatehpur Sikri near Agra, (b) the Meenakshi-Sundereshwara Temple Complex at Madurai, and (c) the Sri Ranganatha-Swamy Temple Complex at Srirangam, depicted on the same scale and orientation.*

method states that a number of grids containing boxes of varying numbers and sizes must be super-imposed over the images (Figure 3), and the boxes which intersect with the image must be counted; hence the name "box-counting". Since the sizes of the boxes in each of the successive grids are diminished according to certain *scaling coefficient* (SC)—which, in this case, is √2, or approximately 1.4142—this process results in different *numbers of boxes containing parts of the images* (N#, in which # = the #th iteration) for each grid. In this study, this process was iterated ten times, following the suggestion (Ostwald & Vaughan, 2016: 40–41) about the ideal number of iteration for producing accurate result. Next, *the approximate fractal dimension* (D#) is calculated using Equation 1:

Finally, the *final fractal dimension* (D) is calculated as the mean value of

$$D_{\#} = \frac{[(\log(N\#+1) - \log(N\#)]}{\log(SC)} \qquad (1)$$

a number of D# values; thus, a process consisting of ten iterations produces nine D# values, from which the final D value must be derived as a mean value. The methodological variables and settings for the fractal dimension calculations are resumed in Table 1. These variables and settings are described in a more detailed manner in several publications (Lorenz, 2003; Ostwald & Ediz, 2015; Ostwald & Vaughan, 2016). For this study, a set of four images were analyzed, and a total of 40 grid comparisons were calculated, recording over 26,000 data points.

4.2. Lacunarity analysis

The concept of lacunarity may be considered as a complement to the fractal dimension, in that geometric constructions with similar or even precisely identical fractal dimension values can possess very different lacunarity values. While fractal dimension quantifies the visual complexity of geometric objects, i.e., the density of the objects' visual information, lacunarity quantifies how such visual information are spatially organized; i.e., the distribution of the density. Mandelbrot (1983) originally described lacunarity as distribution of the size/area of the lacuna or gaps (open/empty spaces) in fractal sequences; however, it is possible to calculate the lacunarity from the non-fractal geometries as well (Plotnick, et al., 1996).

Thus, lacunarity can be more precisely defined as the measurement of the spatial heterogeneity (Plotnick, et al., 1993) or the "gappiness" (Gefen, et al., 1983) of geometric structures. Similar to fractal dimension, the value of lacunarity is directly proportional to the spatial heterogeneity. Thus in a way, a higher lacunarity value indicate a more complex arrangement of gaps or spaces among the visual information of certain geometric objects.

Lacunarity analysis has been conducted more frequently in the area of urban studies. For example, lacunarity calculations as part of a comprehensive morphogenetic investigation of the city of Istanbul (Kaya & Bölen, 2017) as well as for other Anatolian cities in Turkey (Kaya & Bölen, 2006), a comparative study of morphological evolution of the Turkish city of Bursa in terms of fractal dimension and lacunarity values (İlhan & Ediz, 2019), and a development of texture-based identification system for urban slum areas in the city of Hyderabad, India (Kit, et al., 2012). Lacunarity analysis has also been utilized in computational-based, generative urban designs as in the cases of the city of Gaziantep, Turkey (Gürbüz, et al., 2010) and the city of Cosenza, Italy (Swaid, et al., 2016).

4.2.1. Methodological concerns

As previously mentioned researches demonstrate, in general, lacunarity analysis for urban studies is focused in the spatial distribution of the *open spaces*; i.e., the spaces between building masses. However, in conducting the lacunarity analysis, this present paper aims to investigate the spatial heterogeneity of these complexes in general; that is, not only the outdoor open spaces but also the indoor spaces (the spaces confined inside building masses); in short, all the spaces in general sense. Thus, while the urban studies typically use figure-ground images (buildings versus outdoor open spaces) for lacunarity analysis, this present paper uses the site plan drawings of the complexes wherein masses or volumes (walls and columns) are solid-hatched (black area), while spaces (both indoor and outdoor) are unhatched (white area). Finally, some other preparations have also been applied to the drawings, as explained in the following section.

4.2.2. Image preparations

One key properties of lacunarity is that it is scale-dependent; geometric structures which seem considerably homogeneous (indicating low lacunarity) at certain scale may seem more heterogeneous (indicating higher lacunarity) at different scale. Thus it becomes conventional to conduct lacunarity analysis at different scales or box sizes, as described in the following section. Furthermore, it is also necessary for

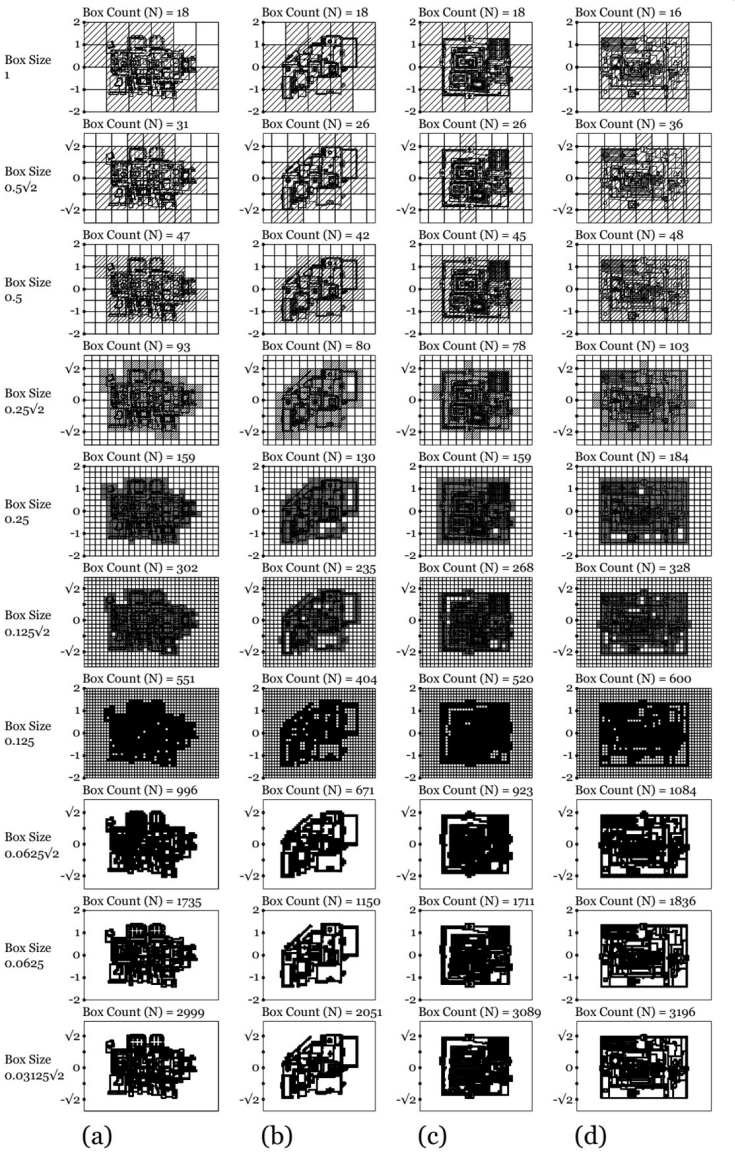


Figure 3. *Box-counting process: (a) the IIM Complex, (b) the Royal Complex of Fatehpur Sikri, (c) the Meenakshi-Sundereshwara Temple Complex, and (d) the Sri Ranganatha-Swamy Temple Complex.*

the drawings to be of identical scale. Since the IIM Complex at Bangalore and the three traditional Indian complexes differ considerably in size, prior to the analysis, each of the site plan drawings was divided into a number of parcels identical in size with the dimension of 50 m x 50 m; this is the optimum largest square unit by which each of the complexes can be divided. This procedure results in the IIM Complex of Bangalore being divided into 12 parcels, the Royal Complex of Fatehpur Sikri into 28 parcels, the Meenakshi-Sundereshwara Temple Complex into 30 parcels, and the Sri Ranganatha-Swamy Temple Complex into 108 parcels (Figure 4). Afterwards, the parcels are converted automatically to binary drawings by the program and the plug-in used for the analysis (ImageJ and FracLac). The size of each of the drawings is 500 x 500 pixels, wherein 10 pixels represent(s) a length of 1 meter. Each of these parcels then was calculated according to the procedure explained in the following section.

4.2.3. Lacunarity calculations

To conduct the lacunarity calculations, this present paper utilizes the conceptually straightforward, computationally simple *gliding-box algorithm* proposed by Allain and Cloitre (1991) and later popularized by Plotnick, et al. (1993). In this algorithm, a box of certain size (b) is placed upon a binary image, resulting in a certain number of open/empty spaces confined inside the box. The box is then shifted or "glided" both along X- and Y-axis, resulting in other number of empty spaces, which may be identical to or different from the previous result. This process of shifting or "gliding" the box is repeated until the whole image is covered completely. As demonstrated in a more detailed manner by Malhi & Román-Cuesta (2008), this procedure results in the *mean value of the numbers of the open/empty unit per box* (μ[b]) and *the standard deviation* (σ[b]). The lacunarity (λ[b]) can be calculated using Equation 2:

$$\lambda[b] = 1 + (\sigma[b]/\mu[b])^2 \qquad (2)$$

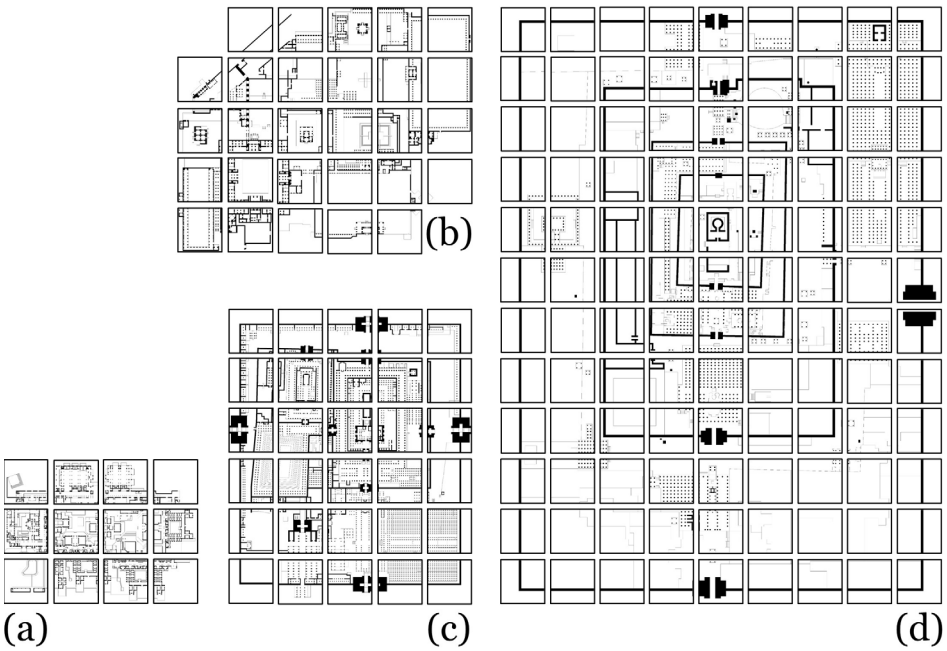


Figure 4. *The divisions of the complexes into parcels identical in size (50 x 50 m): (a) the IIM Complex—12 parcels, (b) the Royal Complex of Fatehpur Sikri—28 parcels, (c) the Meenakshi-Sundereshwara Temple Complex—30 parcels, and (d) the Sri Ranganatha-Swamy Temple Complex—108 parcels.*

This formula produces the lacunarity value resulted from gliding-box algorithm using box with certain size (b); consequently, changing the size of the box may result in different lacunarity value(s). Thus, a series of the algorithm using a certain number of different box sizes may be conducted, resulting in a series of lacunarity values. Finally, the average lacunarity value (λ_μ) may be calculated as a mean of these λ[b] values. This procedure was applied separately to each of the parcels described in the previous section; every parcel thus possesses its own λ_μ value. The final total lacunarity value (Λ) of each of the complexes was calculated as a mean of the λ_μ values of the parcels. For this paper, the ImageJ open source image processing program and the FracLac plug-in were used for the lacunarity analysis using the gliding-box algorithm (also called *sliding lacunarity* or SLac in the FracLac's glossary). The methodological variables and settings for the lacunarity calculations are resumed in Table 2.

5. Results and discussions

5.1. Fractal dimension values, comparisons, and interpretive analysis

Four fractal dimension values (D) of the site plans were produced: Doshi's IIM Complex at Bangalore (D_{IIM}), the Royal Complex of Fatehpur Sikri (D_{FS}), the Meenakshi-Sundereshwara Temple Complex (D_{MS}), and the Sri Ranganatha-Swamy Temple Complex (D_{SRS}). Likewise, the differences (Diff-D)

Table 2. *Methodological variables and settings for lacunarity calculations used in this paper.*

Variable	Setting	Notes
Scaling method	Linear (default sampling method)	Box sizes are increased by a fixed value over a range from the minimum to the maximum box sizes.
Number of box sizes	10	The series/iteration consists of 10 different box sizes.
Minimum box size	10 x 10 pixels	This size represents an area of 1 m².
Maximum box size	200 x 200 pixels	40% of the dimension of the images (500 x 500 pixels).
Slide-X	5 pixels	The boxes are shifted 5 pixels along the horizontal/X-axis.
Slide-Y	5 pixels	The boxes are shifted 5 pixels along the vertical/Y-axis.

Table 3. *Results of fractal dimension calculations.*

Settings		The IIM Complex at Bangalore	The Royal Complex of Fatehpur Sikri	The Meenakshi-Sundereshwara Temple Complex	The Sri Ranganatha-Swamy Temple Complex
Iteration	**Box Size**	**Box Count**	**Box Count**	**Box Count**	**Box Count**
1	1	18	18	18	16
2	0.5√2	31	26	26	36
3	0.5	47	42	45	48
4	0.25√2	93	80	78	103
5	0.25	159	130	159	184
6	0.125√2	302	235	268	328
7	0.125	551	404	520	600
8	0.0625√2	996	671	923	1084
9	0.0625	1735	1150	1711	1836
10	0.03125√2	2999	2051	3089	3196
Fractal Dimension (D)		**D_{IIM} 1.64008**	**D_{FS} 1.51826**	**D_{MS} 1.64956**	**D_{SRS} 1.69823**
Difference/Diff-D (%)			**Diff-$D_{(IIM/FS)}$ 12.18**	**Diff-$D_{(IIM/MS)}$ 0.95**	**Diff-$D_{(IIM/SRS)}$ 5.82**

between the fractal dimensions of Doshi's IIM Complex and the three comparisons—between the IIM Complex and the Royal Complex of Fatehpur Sikri or Diff-$D_{(IIM/FS)}$, between the IIM Complex and the Meenakshi- Sundereshwara Temple Complex or Diff-$D_{(IIM/MS)}$, and between the IIM Complex and the Sri Ranganatha-Swamy Temple Complex or Diff-$D_{(IIM/SRS)}$—were also calculated. The complete results as well as the comparisons between the fractal dimension values are summarized in Table 3.

In terms of fractal dimension analysis with architectural works as the object, it has been suggested that the fractal dimension value of ~1.8 can be considered as the upper limit of visual complexity (Ostwald & Vaughan, 2016: 62), and the value of ~1.1 as the lower limit (Vaughan & Ostwald, 2008); this implies that an average value of ~1.5 can be considered as an indication of moderate visual complexity. In this respect, the spatial order of Doshi's IIM Complex, represented by the site plan, can be considered more than moderately complex, since the fractal dimension (D_{IIM}) is ~1.64. Meanwhile, among the three major Indian complexes, the Meenakshi-Sundereshwara Temple Complex is the closest to the IIM Complex, with a fractal dimension value (D_{MS}) of ~1.65. The other temple, Sri Ranganatha-Swamy Temple Complex, is more intricate visually than the IIM Complex (D_{SRS} ~1.70), while the Royal Complex of Fatehpur Sikri is significantly less intricate (D_{FS} ~1.52).

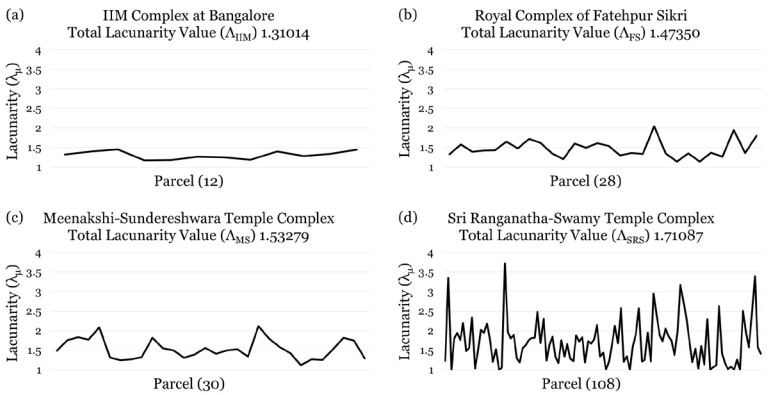
For this paper, the most significant results are the fractal dimension differences (Diff-Ds) between the IIM Complex and the three complexes. This type of difference is inversely proportional to the level of concurrency between the visual complexities of the calculated objects, and it has been suggested that, for a number of objects to be considered highly concurrent in terms of visual complexity, the difference must not exceed 1% (Vaughan & Ostwald, 2009). In this sense, the most interesting result is the difference between Doshi's IIM Complex and the Meenakshi-Sundereshwara Temple Complex (Diff-$D_{(IIM/MS)}$), which is ~0.95%. Slightly less than 1%, this value undoubtedly indicates a high degree of concurrency in terms of visual complexity. In other words, these two complexes are equally intricate in terms of the spatial order. Meanwhile, the difference between the IIM Complex and the Sri Ranganatha-Swamy Temple Complex (Diff-$D_{(IIM/SRS)}$) is ~5.82%, resulted from the fact that the temple's spatial order is more intricate than that of Doshi's IIM Complex. While this number is considerably higher than the Diff-$D_{(IIM/MS)}$ value, this suggests that a similarity in terms of visual complexity is still observable between the IIM Complex and the Sri-Ranganatha Swamy Temple Complex, albeit in a considerably lower degree. Conversely, the difference between the IIM Complex and the Royal Complex of Fatehpur Sikri (Diff-$D_{(IIM/FS)}$ ~12.18%) indicates that the latter's spatial order is undoubtedly and remarkably less intricate than that of Doshi's IIM Complex.

There is also some additional interpretations of these results. It is apparent from the mathematical evidences that, in terms of the fractal dimension values (which represent the visual intricacy of these complexes' spatial order), the resemblance among Doshi's IIM Complex and the two temple complexes is considerably higher than the resemblance between these three complexes (the IIM, the Meenakshi-Sundereshwara Temple, and the Sri Ranganatha-Swamy Temple) and the Royal Complex of Fatehpur Sikri. With fractal dimension values ranging from ~1.64 (D_{IIM}) to ~1.70 (D_{SRS}), and the average value of ~1.66, the IIM Complex and the two temple complexes is significantly more intricate in terms of the spatial order than the royal complex, with the fractal dimension value (D_{FS}) of ~1.52. This phenomenon interestingly concurs with Doshi's opinion about the difference between traditional Indian Hindu and Mughal architecture. He sensed that Mughal architecture is "simple, clear, and pure", with an "explicit" geometry, while Hindu architecture presents "apparent disorder", wherein "things would twist and turn, go up and down" (Doshi, 2012b: 35–36).

In short, in Doshi's opinion at least, Hindu architecture is considerably more intricate visually than Mughal architecture. It should be noted that this differentiation is probably more about the non-spatial aspects than about the spatial properties of both these architecture styles, such as the articulation of surfaces and building elements (Doshi, 2012b: 55). This implies that the results of fractal analysis somehow complement this notion: the contrast between Hindu and Mughal architecture can be observed *not only* in terms of the non-spatial properties, *but also* in the spatial order. However, such deduction is quantitatively reasoned from the measurements of only two specimens of Hindu architecture and one specimen of Mughal architecture (although these structures are arguably among the most impressive and representative specimens). Therefore, although this intuitive and qualitative observation about the contradictory characteristics of Hindu and Mughal architecture is potentially true, it requires more extensive sets of fractal dimension analysis upon a large number of specimens—both of Hindu and Mughal architecture—to prove (or to disprove) such commentaries quantitatively. However, this discussion is already too far beyond the scope of this paper. Nevertheless, in regards to this study, since the Royal Complex of Fatehpur Sikri is one of the masterpieces of Mughal architecture, it is neither unreasonable nor unexpected that the royal complex's fractal dimension value is remarkably lower than those of the Meenakshi-Sundereshwara Temple and the Sri Ranganatha-Swamy Temple Complexes; these two temples are among the most important specimens characterizing Hindu architecture.

While on one hand Doshi depicted this dualism of Mughal architecture's clear order and simplicity versus Hindu architecture's apparent disorder and complexity in a neutral and balanced manner of analysis, on the other hand he also has a clear preference when the times come for him to design himself; namely, the latter. Starting from the period of transition at least, Doshi has been always, and still is, more interested in a more sophisticated and more intricate, even "invisible" order—so invisible that it can also be dubbed as an "apparent *dis*order"—wherein it is possible to introduce contradictions, exceptions, and disruptions every so often, yet still in a general formal idea (Doshi, et al., 2006). Doshi does not take such approach for the sake of formalism only; it is his belief that architecture has an obligation to be more than a mere utilitarian device, even more than a superficially aesthetic object; he believes that architecture has to touch and affect human psyche, sometimes in an undefined and immeasurable manner, through experiences. In this regard, in Doshi's opinion, it is the aspects such as contradiction and ambiguity that characterize a "supreme among architectural experiences" (Doshi, 1989); the aspects found in Hindu temples.

Thus, since Doshi indeed tried to apply this type of advanced order in his design of the IIM Complex, in particular in terms of the spatial order, it is understandable that the fractal dimension of the IIM Complex considerably closely resembles those of the temple complexes, more than it resembles that of the Royal Complex of Fatehpur Sikri. While Doshi did also take inspiration from the royal complex as he himself acclaimed, in the end it is the temple complexes that more strongly influence the intricacy of the spatial order in his design of the



Total Lacunarity (Λ)	**Λ_{IIM} 1.31014**	**Λ_{FS} 1.47350**	**Λ_{MS} 1.53279**	**Λ_{SRS} 1.71087**
Difference (Diff-Λ)		**Diff-$\Lambda_{(IIM/FS)}$ 0.16**	**Diff-$\Lambda_{(IIM/MS)}$ 0.22**	**Diff-$\Lambda_{(IIM/SRS)}$ 0.40**

Figure 5. *Results of lacunarity calculations: (a) the IIM Complex, (b) the Royal Complex of Fatehpur Sikri, (c) the Meenakshi-Sundereshwara Temple Complex, and (d) the Sri Ranganatha-Swamy Temple Complex.*

IIM Complex. The Royal Complex of Fatehpur Sikri might influence Doshi's design of the IIM Complex more significantly in terms of other aspects, such as the vocabulary of the architectural components, or the interplay of building masses and open spaces. While these aspects are beyond the scope of this paper, future studies may be conducted to investigate the importance of such formal properties in a more complete set of Doshi's architectural works.

5.2. Lacunarity values, comparisons, and interpretive analysis

Four total lacunarity values (Λ) of the site plans were produced: Doshi's IIM Complex at Bangalore (Λ_{IIM}), the Royal Complex of Fatehpur Sikri (Λ_{FS}), the Meenakshi-Sundereshwara Temple Complex (Λ_{MS}), and the Sri Ranganatha-Swamy Temple Complex (Λ_{SRS}). Likewise, the differences between the lacunarity values (Diff-Λs)—Diff-$\Lambda_{(IIM/FS)}$, Diff-$\Lambda_{(IIM/MS)}$, and Diff-$\Lambda_{(IIM/SRS)}$—were also calculated. The complete results are summarized in Figure 5, with the graphs illustrating the various λ_μ values of the individual parcels shaping the whole images.

The direct relationship between the real sizes (ground area) and the lacunarity values of the complexes is immediately evident. The IIM Complex, being the smallest in terms of area, possess the lowest mean lacunarity value (Λ_{IIM} ~1.31). The complex with the largest area, the Sri Ranganatha-Swamy Temple Complex, possess the highest lacunarity value (Λ_{SRS} ~1.71). Meanwhile both the Royal Complex of Fatehpur Sikri and the Meenakshi-Sundereshwara Temple Complex, with the relatively similar area fall between the lowest and the highest, have lacunarity values of Λ_{FS} ~1.47 and Λ_{MS} ~1.53, respectively. This gives the difference values of Diff-$\Lambda_{(IIM/FS)}$ ~0.16, Diff-$\Lambda_{(IIM/MS)}$ ~0.22, and Diff-$\Lambda_{(IIM/SRS)}$ ~0.40.

In this case, it is not the size of the area per se that affect the lacunarity of these complexes; instead, it is more logical to interpret that, in the complex with larger ground area, there are *more possibilities to design and organize spaces* in terms of size variations and distribution arrangements. Thus in the Sri Ranganatha-Swamy Temple Complex, there can be found particularly more complex distributions of spaces differ extremely in sizes; this is indicated in the graph (Figure 5d) which shows that ~60.19% of the total parcels forming the whole area possess λ value more than 1.5, and ~21.30% have λ value more than 2. Compare this with the Royal Complex of Fatehpur Sikri (Figure 7b) wherein ~35.71% of the parcels possess λ value more than 1.5 and only ~3.57% have λ value more than 2, and with the Meenakshi-Sundereshwara Temple Complex (Figure 7c) wherein ~50% of the parcels possess λ value more than 1.5 and only ~6.67% have λ value more than 2. This indicates less extreme differences in the sizes and less complex distribution of the spaces. Meanwhile, in the IIM Complex at Bangalore, all the parcels have λ value less than 1.5 (Figure 5a), indicating the least differences in terms of sizes of the spaces as well as the least intricate arrangement of those spaces.

Thus, the relatively low lacunarity (and therefore the lower spatial heterogeneity) of the IIM Complex is less the result of Doshi's philosophical design choice than a pragmatic consequence of the complex's relatively small ground area (compared to the three traditional Indian compounds). Furthermore, due to the relatively stricter and utilitarian functional programs, most of the spaces in the IIM Complex were designed with relatively similar sizes (classrooms), resulting in smaller differences between the sizes of the spaces and less complex arrangement of those spaces. Had Doshi been given a ground area as large the Sri Ranganatha-Swamy Temple Complex, it would not be impossible for him to more freely experiment with spaces extremely contrasting in sizes and more heterogeneously distributed all over the area, giving a significantly higher lacunarity value.

Finally, it is interesting to particularly investigate the Royal Complex of Fatehpur Sikri and the Meenakshi-Sundereshwara Temple Complex. These two compounds have relatively

similar ground area as well as circumferential sizes, and thus it is possible to compare the lacunarity values of both these complexes. It is immediately evident that the Meenakshi-Sundereshwara Temple Complex is spatially more heterogeneous (Λ_{MS} ~1.53) than the Royal Complex of Fatehpur Sikri (Λ_{FS} ~1.47), with the difference of ~0.06. This concurs with Doshi's notion that Hindu architecture is inherently more complex than Mughal architecture; more specifically, in Hindu architecture, spaces are designed and distributed more heterogeneously than in its Mughal counterparts. Indeed, in this particular case, despite the rich differences in terms of the sizes, the spaces in Fatehpur Sikri are organized in a more orderly fashion, in which the large courtyards are placed in a grid-like arrangement surrounded by colonnaded corridors consisting of rows of small spaces relatively identical in sizes. By contrast, in the Meenakshi-Sundereshwara Temple Complex, the spaces do not only differ contrastingly in sizes, but are also organized in a more heterogeneous, less rigid arrangement. Indeed, these characteristics can also be found in the Sri Ranganatha-Swamy Temple Complex; however, it should be noted that the latter is far greater in size than the other complexes, resulting in greater range of possible complex spatial organizations.

5.3. Summary

Figure 6 illustrates the relationship between fractal dimension and lacunarity values of the architectural works being analyzed. For the three traditional Indian complexes, this relationship is straightforwardly proportional: the higher the fractal dimension value, the higher the lacunarity value. However, this is not the case for the IIM Complex, with the considerably high fractal dimension value nearly equal to the Meenakshi-Sundereshwara Temple Complex, yet the lowest lacunarity value. This demonstrates that the measurements of spatial complexity proposed here, i.e. the density and the distribution of visual information, are indeed two different parameters to measure visual complexity. A relatively dense amount of visual information found in a geometric structure is not necessarily distributed in a heterogeneous manner, and vice versa. However, in this particular case of the IIM Complex at Bangalore, it is likely that the seemingly contradictory high density and low heterogeneity are actually complementary results of common causes: certain programmatic requirements and relatively limited site area. The amount of multiple functions and facilities, combined with Doshi's strategy of orchestrating various architectural elements, results in the dense visual information in the IIM Complex's site plan. However, a necessity to accommodate multiple spaces of relatively identical sizes, an inherent orderly spatial pattern of the functional typo-morphology of an educational facility, and the constraint of the site area result in a spatial distribution less heterogeneous than the three traditional Indian complexes.

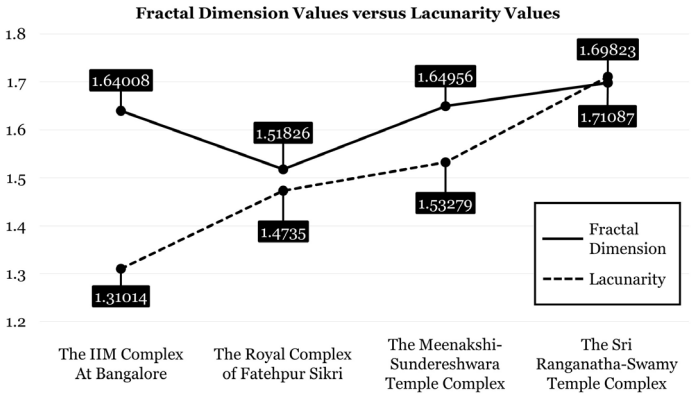


Figure 6. *Comparison between fractal dimension and lacunarity values.*

6. Conclusion

Balkrishna Doshi himself, along with a number of scholars, have acknowledged the significance of the influence of several major traditional Indian architectural works in his design of the IIM Complex at Bangalore. This paper examines this proposition by utilizing fractal dimension and lacunarity analysis to quantify the visual and formal properties of these works. While the lacunarity analysis shows the complex's relatively low spatial heterogeneity compared to the traditional counterparts, the fractal dimension analysis confirms the concurrence between the visual density of the IIM Complex and these traditional Indian structures. In particular, when comparing the fractal dimensions of the architectural works being investigated, it is also evident

that, while Doshi's IIM Complex indeed closely resembles the two major temple compounds—the Meenakshi Sundereshwara Temple Complex and the Sri Ranganatha-Swamy Temple Complex—in terms of the complexity of the spatial order, the IIM Complex is also remarkably more intricate than the Royal Complex of Fatehpur Sikri. This also confirms Doshi's preference for designing a more sophisticated and unorthodox type of formal order generally found in Hindu architecture, compared to the simpler and more straightforward Mughal architecture.

Finally, whether these results may indicate a more general trend in Doshi's body of work, particularly during and after his period of transition, is not yet discovered. It would be interesting and insightful to quantitatively compare the relationship between Doshi's earlier works and, say, the works of Le Corbusier and Louis Kahn, with the relationship between Doshi's later, more mature works and the vernacular Indian houses or ancient cities and villages. Thus, future works may investigate a larger set of Doshi's masterpieces, as well as other architectural works which might be considered influential to him—both traditional and Modern—to understand how his strategy for devising spatial order as well as other formal aspects evolved, both over time and in response to the architecture which might inspire him.

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The dialectic of the instrumental and the aesthetic mind in the philosophy of Theodore Adorno and its representations in contemporary art

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Abstract

The current study aims to identify the controversy dimensions between the instrumental and the aesthetic mind in Theodore Adorno's philosophy and its representations in contemporary composition. The problem of the study is based on Theodore Adorno's readings of the contemporary and cultural scene nature related to the conflict principle between the two concepts of conflict: the instrumental mind that makes technology, machinery; and the aesthetic mind that makes art and beauty. The importance of the study lies in presenting the ideas and thesis of the Frankfurt Critical School, as Adorno was one of its pioneers. The study includes five artworks achieved by artists from the European and American West, as the researcher's selection criteria were based on observing the most famous and influencing artists in the contemporary art and on choosing artworks achieved between 1958 and 2004. The study found that most important of which is celebration of the productions of contemporary fine art in all its marginal, which elevates it to the place of artistic and aesthetic work to cut contemporary human ties with everything that is perfect and Semitic, and elevate human mind, spirit, and general human culture. Furthermore, the study found that the most important of which is the emergence of hybrid artistic genres combining different creative styles and turning a large number of artists to the practice technical specialties away from their original areas in search of innovation and fame.

Keywords
Art philosophy, Art sociology, Art mediation.

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1. Introduction

The two world wars that Europe experienced during the 20th century have had devastating effects on the convictions and principles of the European individual and have led to the shaking of confidence in the mind, which was directly responsible for wars. Art was the first field of culture that foreshadowed the movement of modernity based on the concepts of mind, nihilism, subjectivity, and aspiration to destroy the last strongholds of religious, value, and ethics constants. These cognitive transformations were accompanied by the emergence of modern industries and the growing desire for capital to expand. The post-war arts came in a hybrid and fragmented form of their origins and roots, unable to produce the perfect ideal models that directed the advanced technology obsession that has become involved in all joints of contemporary life and gave the artists opportunities to work with excellence and superior technical and industrial support, but on the other side it took emptying the art of its emotional and aesthetic content.

Theodore Adorno's readings focus on the contemporary cultural scene at the level of human thought, in its comprehensive form, on the possibility of delineating precise boundaries to distinguish between two fundamental approaches that govern the pathways of evolution that follow the contemporary human mind. The first is the aesthetic approach, which related to understanding nature and life and trying to work in harmony in the interest of all human societies, which Theodore Adorno calls "the aesthetic mind that sees its seeds arise with man, and his roots meet the inherent nature of living beings, and the finest are human beings who live and enjoy and know in the light of the aesthetic vision of the universe, and the life is permeated deep in their vital and human nature."

However, man was able to develop within him a vision of a stronger nature less effective and more effective, and utilitarian is the instrumental vision of the universe and life, where this object has also an innate mental faculty, which is the faculty of the search for tools and use of them to achieve near or far goals. Rather, it has the ability to develop, organize, and continually adjust tools to achieve new and more complex goals and objectives.

2. Study plan

2.1. Study objectives

- To identify the dimensions of the controversy between the instrumental mind and the aesthetic mind in the philosophy of Theodore Adorno and its representations in the contemporary fine art.
- To provide the most important ideas and philosophy of Frankfurt Critical School, which contributed to the transformations of contemporary art.
- To clarify the concept of the instrumental and the aesthetic mind in Theodore Adorno's thought and its effect on arts during the post-modern period.
- To study the analytical and critical readings of art works of the most important contemporary artists.

2.2. Study significance

- The present research provides presentation of the ideas of the Frankfurt Critical School.
- The research provides a reading in the concept of instrumental and aesthetic mind in the thought of Theodore Adorno.
- The research includes analytical and critical readings of the work of the products of contemporary fine art.
- The research benefits the preliminary and higher studies students in the areas of technical criticism and contemporary fine art.

2.3. Study problem

Theodore Adorno's reading of the nature of the contemporary cultural scene is based on the principle of conflict between the two concepts of conflict: the instrumental mind that makes technology and machinery and the aesthetic mind that makes art, beauty, and harmony. With the development of human societies, the power of the instrumental mind has increased over the aesthetic mind by industrial revolution, extensive technical development, and scientific and technical knowledge, which was directed to control nature as it was also used to control the human. Adorno

decides that the aesthetic dimension is capable of liberating the contemporary man, who has become an exiled expatriate with one dimension, and thus change aesthetic into a salvation of instrumental rationality, which has tightened its grip on man and dominated his life and mind. The current research problem can be summed up in answering the following questions:

1. What are the dimensions of the current controversy between the instrumental and the aesthetic mind in Theodore Adorno's thinking and its representations in contemporary fine art?

2. How can contemporary art reflect the thoughts of Theodore Adorno in the instrumental and the aesthetic mind?

Study Hypothesis: The study assumes that, in Theodore Adorno's philosophy, the instrumental mind has become dominant in comparison to the aesthetic mind. This is due to the technological developments and the predominance of capital on the expense of man—things that affected the representations of contemporary plastic art.

2.4. Study methodology

This study employed the descriptive analytical approach; an approach cares for an additional, more flexible, and useful function by describing the phenomena in a realistic way through the use of observation and its different methods. This approach also implies what is termed phenomenological analysis and comparison in a more detailed manner. The reasons behind the researcher's employment of this approach were: to get into Theodore Adorno's philosophy, noting its impact on the trends of contemporary arts and the need of this study for the description and analysis.

2.5. Study tools

In this study, the observation tool was used, as it is one of the tools approved in the descriptive analytical approach. By using it, the researchers observed the phenomenon of the study, which is based on examining the controversy dimensions between the instrumental and aesthetic minds in Theodore Adorno's philosophy and its representations in the contemporary plastic art, writing down everything related to them and describing them clearly. In determining the phenomenon's behaviors during the use of observation, the researchers' experiences and skills were relied on. Therefore, the researchers, by using this tool, defined his goal, collected information systematically, recorded it, and defined the activities concerned with the observation.

2.6. Study limits

Given the fact that Theodore Adorno lived in Germany and America and moved between several European countries, the study was limited to spatial limits, by selecting contemporary plastic artists in the European and American West. The researchers confined them to this study by observing the most famous and influencing artists in the contemporary art, namely the British artist Robert "Banksy," the American artists Duane Hanson and Robert Rauschenberg, the French artist Yves Klein, and the Dutch artist Theo Janssen. This study was also limited to time limits by selecting artworks published between 1958 and 2004.

2.7. Study procedures

The researchers applied the study procedures as follows:

1. The researchers have reviewed, in an attempt to answer the study's main question, various previous studies written in Arabic, German, and English and addressed the field of Adorno's philosophy, as well as considering the most prominent contemporary artists who were influenced by his philosophy.

2. Preparing the study's methodology and tools that are appropriate to the study content

3. The researchers took all the notes related to the scope of the study by tracking Adorno's philosophy and the most prominent artists influenced by his philosophy.

4. Determining the criteria for selecting artists and their works, as these criteria include determining the artistic works in which consumerism and its impact on mankind and life appears, considering it the facade of the instrumental mind searching for benefit and profit through the use of all ways and methods

5. Reviewing multiple works by contemporary artists in the European and

American West, and an examining of the extent to which they are compatible with the philosophy of the instrumental and aesthetic mind, which is considered the basis of the study, in preparation for selecting the study sample

6. The artists' works were analyzed after being selected in line with Adorno's philosophy.

7. Determining the study sample represented by the artists mentioned in Study Limits

8. Analyzing the notes related to the selected artists and their artworks, and then recording them

9. The previous notes were audited, classified, and analyzed, and then the results were concluded.

3. The concept of culture industry in Adorno's philosophy and its representations

The failure of the labor movements in Europe and their transformation from class objectives led to the rise of Nazism in Germany. All these transformations led to the symposium on the revival of Marxism, in which the leading philosophers and thinkers participated, and led to the establishment of a social research institute at Goethe University in Frankfurt, which aimed to continue research and debate. The call for establishing critical theory can stand in front of traditional social theories that still dominate the social and philosophical thought of German universities (Buchholz, 2017).

Theodore Adorno's readings of the contemporary cultural scene are based on the level of human thought in its comprehensive form and the possibility to draw precise boundaries to distinguish between two basic approaches governing the pathways of evolution in the modern human mind. The first is the aesthetic approach related to understanding nature and life and working in harmony with them in the interest of all human societies, which Adorno called "the aesthetic mind," as he sees that its seeds grow along with man and that its roots meet the original nature of the living beings, as human beings (who live, learn, and work in light of an aesthetic vision of the universe) are ranking at the highest of them. But at the same time, man was able to develop other natural visions—less influential, but more effective and utilitarian—and this is the instrumental vision of the universe and life (Mohamad, 1998).

3.1. The instrumental mind according to Adorno's philosophy

The most important and dangerous factor in Adorno's view is the ability of man to make tools through purely mental schemes, or through abstract ideas and perceptions arising from his need to achieve different ideas and ends, which Adorno calls the instrumental mind that leads man to harness everything and anything for his direct practical and utilitarian purposes. Theodore Adorno is one of the most prominent philosophers of the Frankfurt School, whose main concern is to deconstruct the concept of the instrumental mind and to take the procedural concept of reason as a direct analysis and thinking faculty. Adorno's thesis deals with criticizing system and relationships produced by the mind, which center on self, and revealing the contradictions of the instrumental mind, which transfers the act of the mind to the act of dominance and control on the man himself. With the development of human societies, the power of the instrumental mind has increased on the aesthetic mind, especially with the industrial revolution and huge technical development that was witnessed in modern times (Jones, 1993). Adorno believes that philosophers of light revolted against the myth of religion and revealed the manipulation of his men, opening doors of hope to the mind that moves us from the kingdom of darkness to the kingdom of lights. But this mind, in the framework of instrumental technology, betrayed enlightenment and fell into a false identity that breathed nothing but blood and accepted only the domination and exploitation of everything to turn the mind into irrationality (Mustafa & Ghareeb, 2016).

Where the instrumental mind dominated the activities and patterns of life, it took the form of the machine or the means capable of giving importance to every act until the human suffered and faced tougher control and unparalleled humanity in history. The instrumental rationality, in Western societies, pro-

duced new forms where it also used to control man, meaning that control was transferred from the field of nature to the humanitarian field (Maazouz, 2011).

This dominance reached its peak in industrially advanced societies, and the philosophers of critical theory worked on the study of the state of alienation in capitalist society. Man suffers from the emergence of the idea of reification, alienation, and automatic repression. Thus, aesthetics became a salvation of the instrumental mind that have tightened their grip on man and dominated his internal and external dimensions (Mustafa & Ghareeb, 2016). The instrumental rationality opened the doors of art on technology, advertising, consumption, and politics. Adorno sees technology as a tool for the dissemination of art and delivery to the largest number of the public, and in a record time, where the controversy and thought of enlightenment extended to overcome the pessimistic character that left behind the atmosphere of the two world wars within the framework of instrumental rationality in which the mind has become a tool of control (Biro, 2011).

The happiness promised by the Enlightenment turned into injustice and misery under the totalitarian systems, so Adorno focused on the controversy of the mind and legend, and he emphasized the need to separate art from politics and the consumer market in the sense that it is not used as a tool to achieve political goals. It affirms the independence of the art work, and not to accept the interpretation of any text from outside, because Adorno's real art is art that is not subject to the laws and rules of reality and it maintains his independence and his ability to criticize. The true independent art of Adorno is the one who can triumph over the question of meaning and the constant criticism, not the preemptory answers and absolute aesthetic realities, nor to closed and rigid patterns. Therefore, he attached particular importance to constantly reviewing the formulation of the meaning of aesthetic truth, the mysteries of technical interpretation, and the questioning of origins and methodologies of aesthetics that are adopted today and are prevailing in the daily and human reality. They market the concepts of domestication and contempt of peoples, the imposition of a false ideology to conceal the facts, and the penetration of control and exploitation and contempt under the pretext of science, enlightenment, and civilization (Abd Al-Jabbar, 2016).

This has led to the influence of the mind and the exploitation of the individual and society under the cloak of science, technology, and urbanization, and how it has made a certain class, category, or official institutions of science and technology an instrument of exploiting the individual and society with the worst exploitation. Therefore, Adorno transmitted human art and thought to cultural industries and commoditization, and he criticized modernity and its implications for postmodernism, which Adorno considered to be the art of negation in the first place, which believes in the cognitive aspect of the disappearance of meaning through fragmentation or fractional method (Cobb & Abromeit, 2014).

On the other hand, Adorno and Max Horkheimer formulated the concept of cultural industry, where the concept was formulated in the light of three major concepts, the first of which revolves around the concept of materialism and the expansion of the Marxist concept to encompass cultural production rather than merely material production. Then, making culture involved in capitalist production as a whole is George Lokac's concept of reification, with the extension of its significance also to include the structure of the capitalist society rather than restricting it to class consciousness alone. The reason for criticizing the concept of cultural industry was to emphasize the concepts of homogeneity and symmetry in the overall products of mass culture in order to establish in society a pattern of dynamic connection between the requirements of production of the cultural text and the nature of its consumer life (Adorno, 1991).

Mostly, it has become possible to address the community only through media cultural products in the framework of the cultural industry, which is guided and directed by the principle of advertising, where the capital marketers and planners have alerted of its impact and seriousness in terms of

forming public awareness that characterizes it. This structure becomes now a product that is manufactured. This led Adorno to put the critique of popular culture within Marx's critique of commodity fascism in his joint article with Horkheimer, titled "The Industry of Culture, Enlightenment and the Deception of the Masses," which was in their joint book "The Dialectic of Enlightenment" (Noeri, Adorno, & Horkheimer, 2002). The goods the culture industry produced are not measured by the value in use, but by the abstract value determined by the market.

All this is in the context of consumption, which assumes ready patterns of masses in the contexts of the dominance of money and goods, especially in the capacity of the industrial society to transform the real culture into a mass consumer culture. If the philosophy of enlightenment calls for the use of the mind in everything, Adorno called for using the mind in a new field, which is the critique of the same mind in its use as a social structure of domination and repression. Adorno considered that the philosophy of Enlightenment in the 18th and 19th centuries, confused by the absolute uses of mind (Moneer, 2010).

Thus, the cultural and artistic production of the advanced industrial and technical society is transformed into a mechanism that absorbs various industrial techniques and expresses the power of industrial capital and anesthesia, which is a popular culture that satisfies collective needs but becomes a means of domination due to the development of technology and communication and its indirect control in the obligatory participation of millions in the process of production and consumption and their consent without resistance. This type of industrial culture pumps today's factories selling cultural goods and is aimed to controlling the taste and the mind of members of the community and turn them into passive recipients unable to criticize through the consumption of fast, tempting pleasures. The media and modern communication displace individuals from their reality and make them run agonizingly behind the bright civil goods, regardless of their living conditions. The danger they cause lies in cultural goods that create psychological needs that can't be satisfied through industrial products (Moneer, 2010).

3.2. Adorno's aesthetic philosophy

In Adorno's aesthetic theory, sports, media, television, fashion, and other means of advertising provided for individuals new and diverse alternatives produced by advanced technology which is rich with technical capabilities that have led to a wide expansion of the arts, especially in the techniques of printing, photography, film, and finally audio and video technologies. But, at the same time, it has led to fragmentation of the arts and the spread of entertainment arts instead of the enjoyment of fine art and deep insight into it (Fawsi, 2014). Adorno's opinion also applies to music, which is supposed to remain faithful in giving credence to telling the truth, because it is the last innocent expression of truth in art (Moneer, 2010).

But, modern music, fine arts, and literature stand today on the verge of what can be called art because it makes a coincidence or incident one of the basic elements of it, and it is a tendency to a new job in modern consumer society after losing its old positions for the power of advertising. Adorno decides that the alienation of the art by the art itself does not mean silence the arts, but that means the art of the manufactured culture becomes an art that is not slender because it is now transformed into goods and CDs, pictures or videos of Beethoven, Mozart, linguistic works and books that can be purchased in the form of a pocket book (Leppert & Adorno, 2002).

In the same mechanical way, provided various other arts such as jazz in America as an example of mass culture that spontaneously evolved by the masses are a problem in themselves because the masses are in fact not composed of independent individuals but by persons supported by their economic subordination and labor conditions in consumer industrial societies and they have to run behind the sweeping mainstream, just as happen with deceptive entertainment music (Markham, 2017).

According to Adorno, the imagination faculty in art connects sensitivity and the world of reason. When art abandons imagination, it also abandons about the aesthetic, which reveals itself in the autonomy of art and finally falls in the capture of reality, which art seeks to understand and overcome it. Conversely the abandonment of aesthetic means to abdicate responsibility in creating the other reality from within the existing reality and this is what Adorno called the industry and falsification of the moral position which is represented of what we call the guilty pleasures (Mahdi, 2018).

On the other hand, Adorno explains his attitude from the relationship between art, function and pragmatism, and asserts that art has always been a commodity but it has never been a mere commodity. In contrast, the culture industry is only a commodity without the need to prove that the manufactured art achievements becomes covered all aspects of contemporary individual life, and it is an art that repeats itself in a tired and tedious manner, but contains moments or few scenes that are rare or valuable (Hao, 2010).

The aim of Adorno's aesthetic experience is making it shocking to reject reality which steeped in negative dialectics. This is what makes art a revolutionary function in Adorno because the arts must provide a critique of the rigid rationality that modernist societies give in. The artistic work must not be subject to the domination exercised by those regimes that have produced many works that call themselves artistic, but they are not art, but rather a culture manufactured to suit the hierarchical order of consumer society. Therefore, the task of art is the creation of a magical and critical aesthetic world that stands in the face of the turbulent reality and works to revolutionize it, in which the modern capitalist industrial societies will not succeed in suppressing man to the point of rot (Lechte, 2008).

Adorno's aesthetic theory tries to preserve the unique essence of things, liberating it from any manufactured holistic culture dominating on the human, where the work of art transmits us to the world that philosophy aspires to and can't reach. This imaginary world is not an illusion or a metaphor; it is a simulation of reality. Of course it's not the reality of modernity and postmodernity, but the reality that should have existed (Abd Al-Jabbar, 2016). And other works that consider an extension of the manufactured culture, where it is a way to remove the essence of real art which is the imagination of art or what Adorno later called, removing art from art. Therefore, Adorno's negative aesthetics and dialectical theory is not aimed to creating a different world as imaginary Utopia can't be achieved on the ground, but aspire to elastic Utopia, and the art has his own way of doing so. Aesthetics can imagine a better world. It may not be created in front of our eyes, but at least it is unraveling the current world of lies and contradictions, which appear strongly in the public suffering of all by the regimes which are taken from of liberalism and rationality disguised by them; irrational and brutal. He highlights the role of art where it has to tell us that things should be different, the world should be fair, and that man is free from the values of oppression, injustice, and slavery, which calls itself false enlightenment.

This is the value of art and the responsibility of the artist is not to accomplish as much of the beautiful scenes through photography, painting, or other creative means, but at least to persist, and even criticism of the values of the world system with its control and suppress; and seeking to free humans from it. A society in which a human being lives freely is not impossible. What we suffer from daily is impossible and illogical, and art, as aspiring to this new world, is not about naivety or fantasy, but it is the ultimate rationality (Cobb & Abromeit, 2014).

4. Analytical framework of the study

4.1. Implications of Theodore's philosophy in contemporary art

In this context, we will address the most important artists who were influenced by Adorno's philosophy with an analysis and critique of their art works, linking them to the concept of instrumental and aesthetic mind in contemporary art.

4.1.1. The artist: Robert Banksy

Banksy is a famous and English graphite artist, and unknown in the same time, where he believed his name Robert Banksy, born in 1974 and his origin from the town of Yet, near Bristol. However, there is no confirmation of the true Banksy identity and his autobiography remains unknown. His paintings appeared in many locations in England, especially in Bristol and London city (Dickens, 2019). In this work (Figure 1), the artist depicts the famous iconic figure of Jesus in the poignant steel scene where he was suspended between the sky and the earth, his arms stretched to the sides, his head resting on his left shoulder, while the artist depicts the legs of Christ to the limits of his knees where the colors flowed down to the bottom of the painting in a way that simulates the scene of blood flowing from the amputee. Liquid blood droplets also appear along the arms and down the neck, and the head of Christ is surrounded by a round halo with droplets of color hanging in a vacuum without a cross, tried from his hands shopping bags that are popular in the stores and appear from it gifts, candy and drinking bottles, while appearing on the other side of Mickey Mouse's famous cartoon character. The idea of art work based on the famous image of crucified Christ, he appeared with shopping bags in his hands instead of nails, suggesting consumerism, which killed him. It is a very powerful message, since Christmas is the celebration of the birth of Jesus, and there are the signs of Christmas, in the cane of candy, in the shopping bag, while Jesus criticized several times in the Bible, the emphasis on material things at the expense of the soul, and he also expel sellers and bankers from the temples. This philosophical paradox shows disgust at the consumer-based brands and traditions during Christmas, which appear through the candy stick and Mickey Mouse logo that appears in the shopping bags and candy sold at birth. They are shaped like a Jesus stick to represent the shepherds in the Christmas story and justify their sale in the Church.

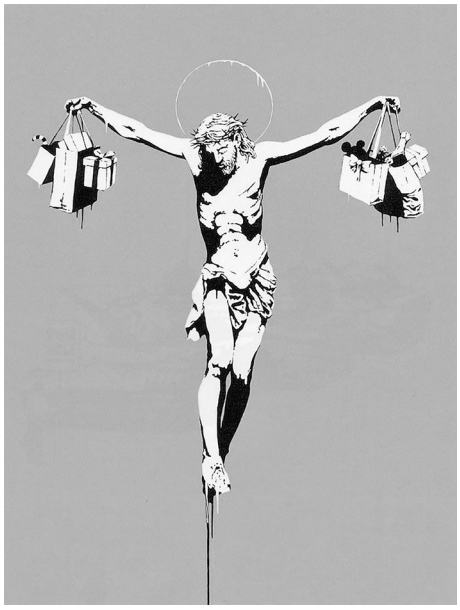

Figure 1. *Consumption Christ, The artist: Robert Banksy, dimensions, 50x70 cm, The materials: Silk cloth on paper, Date: 2004, Tate Gallery / London.*
Available at: http://www.blogs.buprojects.uk/2015-2016/rachelrichardson/wp-content/uploads/sites/83/2015/11/Screen-Shot-2015-11-08-at-22.23.17.png 20.05.2019

This is the main example of early consumerism and by using of religious events for profit. The existence of Mickey Mouse doll indicates to represent of big brands, corruption, and manipulation of public profit by big companies. Banksy uses Disneyland symbol to prove that they are selling people a happy dream, his work indicates that consumption is christened by major consumer symbols such as Mickey Mouse and the candy industry, which represents the greatest beneficiary of religious events and the obsessive consumption in contemporary human life.

4.1.2. The artist: Duane Hanson

Duane Hanson created a statue (A shopper) at the end of the post-war economic boom. In the late 1960s, the first supermarkets appeared, and people were able to buy many things in the same place. People no longer had to cook, because they could buy ready-made meals. Processed food became very popular and soon took over freshly handmade meals. Hanson's sculpture is made of polyester resins, fiber glass, oil paints, clothes, and a real shopping cart (Figure 2). It represents a middle-aged obese woman wearing a short blue skirt that reveals her legs, a pink blouse, a small headband to keep her short blond hair in check, and a cheap necklace made of artificial

Figure 2. *A shopper, the artist: Duane Hanson, Dimensions: 166x55 cm, the materials: Industrial plastic, shopping cart and accessories. Date: 1970, Cultural Centre / Washington: Available at: http://art-and-you.over-blog.com/article-30506063.html 20.05.2019*

beads. Hanson focused his attention on two important positions. Firstly, the shopping cart, which is burdened by the purchases it contains, bursting with mostly ready-made canned foods from famous brands; secondly, the woman's body - fat and greasy, she's wearing light blue canvas shoes and has a cigarette in her mouth as she leads the vehicle languidly. The scene is generally designed to evoke feelings of distaste, because this woman is overweight and her figure is compared to the food boxes overflowing from the cart, and her tight clothes highlight accurately all her body details. She looks like a machine that buys a lot and eats too much but will still probably buy more food (Buchsteiner and Letze, 2007).

Hanson focused his extraordinary creativity on showing small details that represent the true content of the message which he wants to convey through his statue by exposing the woman's skin, covered in small bruises and varicose veins. On her right arm, she has a small medical patch to treat and conceal those bruises; she looks ugly and tired, and her eyes express the misery suffered by contemporary man, caught up in the spiral of consumerism, a mechanism which crushes individuals and transforms them into mere numbers in a mathematical matrix which is calculated and adjusted according to the great equation, where the result needs to be more profit in the pockets of the companies' owners who dominate the economy and everything that is related to it. It is the interface of the instrumental mind which seeking benefits and profit in all ways and methods, even at the expense of man. At a closer look, we realise that the artist only used canned food - there are no fruits or fresh vegetables in the cart. The lady doesn't need to cook, only reheat precooked meals. However, she does not seem satisfied with this boisterous attitude, because she looks sad and a bit tired, and the artist can confirm that this lady behaves like a robot, subject to the social status and the ideals of the mass, whose authority is represented by the instrumental mind which controls the individuals' and society's fate.

4.1.3. The artist: Robert Rauschenberg

Robert Rauschenberg's first works were the first steps of aggregation art, which later developed and became an independent art movement within the various postmodernist currents, trends, ideas, and techniques (Figure 3). Through his unconventional use of materials, the artist aims to assert his bizarre criticism and strike a bold blow

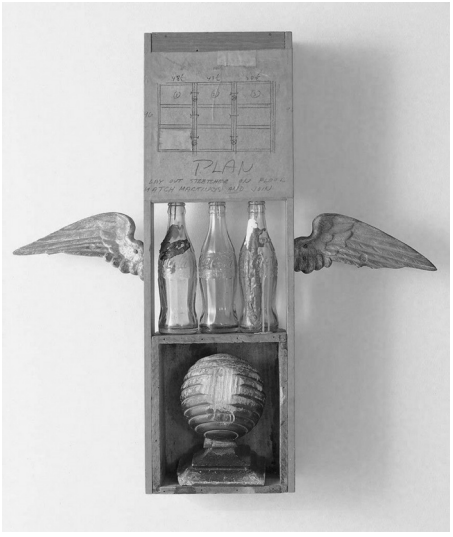

Figure 3. *The fine work: Coca Cola Scheme, The artist: Robert Rauschenberg, Dimensions: 26.5x25.5x5.5 inch, the materials: Wooden shelves, Coca Cola bottles, wooden statue, metal wings, paper and colors. Date: 1958, Contemporary Art Museum / Los Angeles. Available at https://www.pinterest.com/pin/484418503649872470/?lp=true 20.05.201920.05.2019*

against the artistic traditions inherited from the past. He believed that there is always something hidden behind the glamorous sheen of things, industrial signs, and symbols. In this work, the shelves of an old cupboard are lined with three bottles of Coca-Cola - one is red and yellow, another is green and brown, and the bottle in the middle looks clean, without smudging colors. Above this row of bottles, the artist sketched an engineering scheme of nine adjacent rectangles representing a modern house or a large building with adjacent rooms separated by thick walls; this sketch is closed tightly on all four sides, indicating that getting out of it is not possible (Rauschenberg and Joseph, 2003).

The artist used a pencil to write under the word (Plan), which of course refers to the Coca-Cola scheme of placing the man in a closed space he can't escape from. This explanation is completed by the lower part of the work, where is a dark brown wooden shape that resembles a human head cut off to look distorted and without features, and which is a reference to contemporary man - stylized, without eyes or a mouth, just a tool for consumption, a rigid structure with no decision-making skills, thoughts, or willpower. On the sides of this work, the artist added metal wings in a rising movement, which is another symbolic reference to the fact that this scheme has wings, so it is capable of being carried away to any place in the world without barriers. This evokes transnational companies such as the Coca-Cola brand, which is present all over the world, through the arms and claws of the hidden mind behind it, which moves the strings from behind the curtains.

Rauschenberg's work features different materials put together in innovative artistic structures that promise the birth of a collective and hybrid art pattern lacking the existence of a clear central creative mind or technical style, as it is based on the idea of grabbing the attention and alienating the spectator, who remains puzzled by the details of the artwork, which may or may not have a specific meaning. The artist tries to collect things and write experiences gathered from the most vulgar activities of daily life, described best as remnants of the consumerism era by the likes of empty bottles and crushed wooden shelves left behind, neglected and marginalized.

4.1.4. The artist: Yves Klein

Yves Klein's work (Figure 4) personifies female bodies through dark blue prints on white canvas in a very unmistakable way by clearly displaying the distinguishing traits of a woman, as it focuses on features such as prominent breasts, abdomen, and legs. The fine works of Yves Klein depend on the real human body as a materialistic source of inspiration, and a representative act that gives the ability to sense the rhythm of the vital soul that inherently lives within us, which represents the meaning of the movement and imitates reality by reducing the traditional language of the artistic work in exchange for active participation among a group of elements within the substratum of the art show. The body, in its present and expressive entirety, shows that the psychological and the intellectual are on the same axis, which is depicted by the artist without any exaggeration, either as a direct display through interactive performances or implicitly through the photographs that the artist takes during each production stage, or even through the works that result from the movement of bare, colored bodies on drawing canvas. Body art may appear as a renewed style reminiscent of the

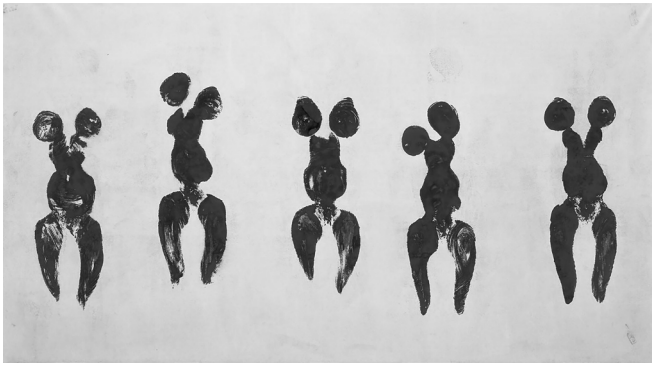

Figure 4. *The fine work: Women in Blue, The Artist: Yves Klein, Dimensions: 5.165x5.282 cm, the materials: Bodies colored by blue on canvas, Date: 1960, Museum of Modern Art, George Pompidou Centre / Paris. Available at: http://www.yvesklein.com/en/oeuvres/view/595/anthropometrie-de-l-epoque-bleue-anthropometry-of-the-blue-period/ 20.05.2019Screen-Shot-2015-11-08-at-22.23.17.png 20.05.2019*

ancient tradition of painting faces or naked bodies found in Greek or Renaissance art; it creates artworks in which the beauty of the body, its vitality, and its motor functions are the focus (Banai, 2014).

Yves Klein avoided using any traditional materials or painting methods for his fine works. Instead of using the brush to draw the models, he used the models' bodies, which he called living butterflies. He dyed the women's bodies, which - by applying pressure on the canvasses - transformed their figures into prints. Klein believed that the body is a natural center and a source of bioenergy; he applied this principle to this work, and through these paintings he reduced the human body and its surface to a symbol. The human body has an important role in consumer society, which seeks to exploit man. The human body is used to advertise products, and is also something that gives sensual pleasure; man has become a thing or a purpose, and this hints at its decrease in value. The art of the flesh has emerged in plenty of forms and manifestations, where through the human body the artist expresses the thoughts, culture, and philosophy peculiar to the era of consumerism, which exploits man for advertising and commercial purposes. The body is transformed into a commodity that is marketed, sold, or leased for the monetary revenues it can yield; there is no regard for human values, feelings and ideas anymore. Contemporary man's physicality and spirituality are entirely subject to the control of the instrumental utilitarian mind, which seeks to reduce the human body to a thing that has superficial needs and desires.

4.1.5. The artist: Theo Janssen

The fine works of the Dutch artist Theo Janssen are classified within the dynamic are stream. He constructs giant structures of bamboo chopsticks, linked together by rollers and springs, covered by layers of cloth or transparent plastic and designed to form giant fairy animals that combine the bodies of dinosaurs and marine creatures on the one hand, and have many legs, mimicking creeping insects. The movements of Janssen's creations have many varieties. Some movements are propelled by small motors, and others move by the force of the air, wherein the artist includes some shapes that resemble sails that are pushed by the air causing the movement of light structures that appear to the viewer as

Figure 5. *The fine work, Beach Monster, the artist: Theo Janssen, Dimensions: 37x11x22 meter, the materials: Bamboo, paper and cloth, Date: 1999, The artist's private collections. Available at: https://www.wbur.org/artery/2015/08/19/strandbeests 20.05.2019 anthropometrie-de-l-epoque-bleue-anthropometry-of-the-blue-period/ 20.05.2019Screen-Shot-2015-11-08-at-22.23.17.png 20.05.2019*

if it is moving on its own, like it longs live again when the air moves. This fine work, entitled 'beach monster' has strange, ugly piles of bending pipes up to the top that create a strange visual effect. When it is sitting, motionless on the sand, the observer does not know the specific goal of this huge engineering architecture, but when the air blows on the beach, it comes to life in an astounding way, walking across the beach as if it were moving of its own accord (Rees, 2011).

The art of Janssen represents an anachronism (Figure 5). It is a remnant of a time before modern civilization, electricity, motors and fuel became a way of life in contemporary societies. This mythic beast has many opposite legs on both sides of its huge body. It moves in the same way that insects and reptiles move. It is terrifying when it walks alone with the force of the air pushing it along the coast. The artist Janssen believes his work to be a superior engineering achievement more than a beautiful work of art. It is subject to measurements and engineering calculations and very complex mathematical processes in order to control its movement, balance and center of gravity, air pushing angles in the moving art and the simple mechanisms that camouflage it deliberately so as not to reveal to the public the energy source and the movement driving these objects forward. The artist acknowledges that his mind for these frightening movements originally looks at the possibilities of constructing geometric structures capable of generating self-movement or with the simple help of natural forces, or small mechanical engines. For him, this is a practical and technical issue. First of all, he doesn't care about the aesthetic structure except in its final stages. Whereas the outer structure that covers the surfaces of these large vehicles is often not beautiful, it is no longer a source of horror or surprise for people (Rees, 2011).

5. Results

5.1. Summary of results

The products of fine art reflect the manifestations of industrial development and the tremendous technological progress witnessed by the contemporary world, which, in turn, produce different artistic styles and trends resulting in innovative techniques in the fields of industry, media and communications.

1. The emergence of hybrid artistic genres that combine a number of different creative techniques and styles and transform a large number of artists into practicing technical specialties, away from their original fields of specialization in search of innovation, development and fame. The researchers concluded with this result by analyzing many artworks that have become like a fashion or a new and strange form of art, promoting the value of the artist at the expense of the value of the artwork itself. Therefore, we find that many contemporary artists use different techniques and engage in political or media trends in search of personal fame and away from the requirement of the aesthetic mind that cares about promoting the value of mankind, rather than the artist's fame and benefit. This is due to the development of the machine and its tools' exclusion of human beings and replacement of them; thus, becoming a machine (inhuman) production.

2. The logic of the instrumental mind is associated with the principles of interest and benefit, industry, marketing and large scale production to meet the wide variety of needs of the largest number of recipients in various fields. This led to the emergence of technical names quickly becoming shining stars and then disappearing after a short period. The researchers concluded that this resulted in the domination of material on all art products, as art's primary goal became material profit at the expense of humankind itself. The instrumental mind, that Adorno's philosophy believed in, praised, promoted and considered as a way to the salvation of humanity and the achievement of luxury and happiness, has become out of control due to the development of science and technology into an instrumental, all-encompassing nature. Thus, humankind became a thing, like the rest of material things, as many philosophers, such as Jean-Marie and Guy-

an, who declare that human industry will become more incompatible with art (Abul-Enein, 1995). This is due to the development of the machine and its tools excluding the human beings and replacing them, becoming solely a product of (inhuman) machinery.

3. The products of contemporary fine art focus on the effect of trauma to the recipient and sensory experience. Emptied of the goal and adopting visual effects methods to activate the senses and disrupt the aesthetic mind to seek the meaning and real aesthetic value. Since the beginning of Modernism, the artist has become focused on the form of the artistic work, rather than its aesthetic and human content, as it became the form that merely attracted the person visually, without having any deeper meaning. Furthermore, as mentioned in the first point, art has become interested in fashion and form to create an effect, apparently without having any goal except the artist's fame and material benefit.

5.2. Discussion

The production of contemporary fine art celebrates everything that is marginal and banal, raising it to a place of artistic and aesthetic work in order to cut the ties of contemporary humans with everything that is ideal and supreme that elevates the mind of humankind's spirit and overall human culture. The researchers have concluded this result from the fact that consumerism is the dominant feature of our contemporary society and it seems to be an increasing cultural feature, as the interest in selling, or simply displaying, images, sounds and words, has become an instrumental act and not borne of the aesthetic mind, which considers art as unrelated to the dominance of the instrumental mind; as envisioned by Adorno.

The dominance of the instrumental mind is clarified in the contemporary artists' methods of choice in his/her subjects and artistic instruments, which provide superficial ideas that work within the limits of external form, without incorporating any significant or important, meaningful content. The researchers have concluded with this results through reviewing many contemporary artistic works related to material employment and making art as a commodity. Thus, art has become an automatic production and instrument for industry and marketing. In other words, it became an ephemeral recreational aesthetic.

The authority of the instrumental mind seeks to transform the human body into a mere commodity of aesthetic or utilitarian use. It is presented to justify the sale of any large or small commercial commodity, until the body itself becomes a mere tool for drawing or copying symbols and signs of sex, lust and human life from its surfaces to the depth of conscience and feelings, and the human thought beneath it. This has been observed within many international companies that seek to market their products using the body as an active, artistic product via linking it to the subject of the product itself, in order to achieve a certain impact on the viewer and attract him/her as a consumer with the aim of increasing their financial profit.

The philosophy of the instrumental mind brings down the prestige of the religious, spiritual and culturally sacred in the contemporary individual and the installation of industry, trade and consumption symbols are elevated and respected as holy idols, revered and perpetuated at the level of contemporary plastic production. Therefore, many artworks bearing religious symbols and texts from the holy books have emerged for marketing, as we find, for example, that Communist China, which does not have a specific state religion, has made machines to produce sacred paintings for Muslims and Christians alike, only to support its economy.

The innovated technical techniques play the most important role in the formulation of contemporary art works, where the work of casting, plumbing, engineering and electric motors, mechanical and pneumatic parts participate in the art industry and methods of installation, coloring and reproduction. As mentioned in the previous conclusion, industrialized countries have intentionally produced machines for the production of artistic paintings and replicating them to strongly match their original copies in order to in-

crease their sales. The dialectic of the instrumental and the aesthetic mind is subject to a difficult equation that produces the truth of the instrumental mind's control, which is supported by the strength of authority, money and power, and its need to harness the aesthetic mind to achieve its utilitarian and commercial purposes and to benefit from the aesthetic mind's ability to address the human senses and motivate it to experience beauty and art. Thus, these consumer products are now interfering with daily life, using their aesthetic form. Furthermore, they rather became a cultural commodity, causing a shift in life experience, from experiencing aesthetic and mental perception; therefore, becoming a part of consumer context.

5.3. Recommendations

1. The researchers recommend the necessity of providing modern sources and books of contemporary art because the Arabic library lacks these.

2. There is a need to hold academic seminars and research conferences on the latest developments in contemporary fine art.

3. Translation of books and special articles for schools on trends of modern criticism and its close association with the concepts of contemporary art and its transformations and philosophical references.

5.4. Suggestions and implications: Researchers suggest the following studies

1. The impact of critical theory in the philosophy of Theodore Adorno on the trends of contemporary Arab composition.

2. The theory of manufacturing culture between Western and contemporary Arabian art.

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